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Draft Programmatic Environmental Impact Statement for

Solar Energy Development in Six Southwestern States



Volume 8
Appendices

U.S. DEPARTMENT OF ENERGY

NATIONAL SYSTEM OF PUBLIC LANDS

On the cover:
Typical Solar Fields for Various Technology Types (clockwise from upper left):
Solar Parabolic Trough (Source: Hosoya et al. 2008),
Solar Power Tower (Credit: Sandia National Laboratories. Source: NREL 2010a),
Photovoltaic (Credit: Arizona Public Service. Source: NREL 2010b), and
Dish Engine (Credit: R. Montoya. Source: Sandia National Laboratories 2008).
Reference citations are available in Chapter 1.

Background photo: Parabolic trough facility from an elevated viewpoint
(Credit: Argonne National Laboratory)

Draft Programmatic Environmental Impact Statement (PEIS) for Solar Energy Development in Six Southwestern States (DES 10-59; DOE/EIS-0403)

Responsible Agencies: The U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) and the U.S. Department of Energy (DOE) are co-lead agencies. Nineteen cooperating agencies participated in the preparation of this PEIS: U.S. Department of Defense; U.S. Bureau of Reclamation; U.S. Fish and Wildlife Service; U.S. National Park Service; U.S. Environmental Protection Agency, Region 9; U.S. Army Corps of Engineers, South Pacific Division; Arizona Game and Fish Department; California Energy Commission; California Public Utilities Commission; Nevada Department of Wildlife; N-4 Grazing Board, Nevada; Utah Public Lands Policy Coordination Office; Clark County, Nevada, including Clark County Department of Aviation; Dona Ana County, New Mexico; Esmeralda County, Nevada; Eureka County, Nevada; Lincoln County, Nevada; Nye County, Nevada; and Saguache County, Colorado.

Locations: Arizona, California, Colorado, Nevada, New Mexico, and Utah.

Contacts: *For further information about this PEIS, contact:* Linda Resseguie, BLM Washington Office, e-mail: linda_resseguie@blm.gov, phone: (202) 912-7337; or Jane Summerson, DOE Solar PEIS Document Manager, e-mail: jane.summerson@ee.doe.gov, phone: (202) 287-6188; or visit the PEIS Web site at http://solareis.anl.gov.

Abstract: The BLM and DOE are considering taking actions to facilitate solar energy development in compliance with various orders, mandates, and agency policies. For the BLM, these actions include the evaluation of a new BLM Solar Energy Program applicable to all utility-scale solar energy development on BLM-administered lands in six southwestern states (Arizona, California, Colorado, Nevada, New Mexico, and Utah). For DOE, they include the evaluation of developing new program guidance relevant to DOE-supported solar projects. The Draft PEIS assesses the environmental, social, and economic effects of the agencies' proposed actions and alternatives.

For the BLM, the Draft PEIS analyzes a no action alternative, under which solar energy development would continue on BLM-administered lands in accordance with the terms and conditions of the BLM's existing solar energy policies, and two action alternatives for implementing a new BLM Solar Energy Program. Under the solar energy development program alternative (BLM's preferred alternative), the BLM would establish a new Solar Energy Program of administration and authorization policies and required design features and would exclude solar energy development from certain BLM-administered lands. Under this alternative, approximately 22 million acres of BLM-administered lands would be available for right-of-way (ROW) application. A subset of these lands, about 677,400 acres, would be identified as solar energy zones (SEZs), or areas where the BLM would prioritize solar energy and associated transmission infrastructure development. Under the SEZ program alternative, the same policies and design features would be adopted, but development would be excluded from all BLM-administered lands except those located within the SEZs.

For DOE, the Draft PEIS analyzes a no action alternative, under which DOE would continue to conduct environmental reviews of DOE-funded solar projects on a case-by-case basis, and one action alternative, under which DOE would develop programmatic guidance to further integrate environmental considerations into its analysis and selection of solar projects that it will support.

The EPA Notice of Availability (NOA) of the Draft PEIS was published in the *Federal Register* on December 17, 2010. Comments on the Draft PEIS are due by March 17, 2011.

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NOTATION

The following is a list of acronyms and abbreviations, chemical names, and units of measure used in this document. Some acronyms used only in tables may be defined only in those tables.

GENERAL ACRONYMS AND ABBREVIATIONS

AADT	annual average daily traffic
AASHTO	American Association of State Highway and Transportation Officials
AC	alternating current
ACC	air-cooled condenser
ACEC	Area of Critical Environmental Concern
ADEQ	Arizona Department of Environmental Quality
ADOT	Arizona Department of Transportation
ADWR	Arizona Department of Water Resources
AERMOD	AMS/EPA Regulatory Model
AFC	Application for Certification
AGL	above ground level
AIRFA	American Indian Religious Freedom Act
AMA	active management area
AML	animal management level
ANHP	Arizona National Heritage Program
APE	area of potential effect
APLIC	Avian Power Line Interaction Committee
APP	Avian Protection Plan
AQCR	Air Quality Control Region
AQRV	air quality-related value
ARB	Air Resources Board
ARRA	American Recovery and Reinvestment Act of 2009
ARRTIS	Arizona Renewable Resource and Transmission Identification Subcommittee
ARS	Agricultural Research Service
ARZC	Arizona and California
ATSDR	Agency for Toxic Substances and Disease Registry
AUM	animal unit month
AVWS	Audio Visual Warning System
AWBA	Arizona Water Banking Authority
AWEA	American Wind Energy Association
AWRM	Active Water Resource Management
AZ DOT	Arizona Department of Transportation
AZDA	Arizona Department of Agriculture
AZGFD	Arizona Game and Fish Department
AZGS	Arizona Geological Survey

BA	biological assessment
BAP	base annual production
BEA	Bureau of Economic Analysis
BISON-M	Biota Information System of New Mexico
BLM	Bureau of Land Management
BMP	best management practice
BNSF	Burlington Northern Santa Fe
BO	biological opinion
BOR	U.S. Bureau of Reclamation
BPA	Bonneville Power Administration
BRAC	Blue Ribbon Advisory Council on Climate Change
BSE	Beacon Solar Energy
BSEP	Beacon Solar Energy Project
BTS	Bureau of Transportation Statistics
CAA	Clean Air Act
CAAQS	California Air Quality Standards
Caltrans	California Department of Transportation
C-AMA	California-Arizona Maneuver Area
CAP	Central Arizona Project
CARB	California Air Resources Board
CAReGAP	California Regional Gap Analysis Project
CASQA	California Stormwater Quality Association
CASTNET	Clean Air Status and Trends NETwork
CAWA	Colorado Agricultural Water Alliance
CCC	Civilian Conservation Corps
CDC	Centers for Disease Control and Prevention
CDCA	California Desert Conservation Area
CDFG	California Department of Fish and Game
CDOT	Colorado Department of Transportation
CDOW	Colorado Division of Wildlife
CDPHE	Colorado Department of Public Health and Environment
CDWR	California Department of Water Resources
CEC	California Energy Commission
CEQ	Council on Environmental Quality
CES	constant elasticity of substitution
CESA	California Endangered Species Act
CESF	Carrizo Energy Solar Farm
CFR	*Code of Federal Regulations*
CGE	computable general equilibrium
CIRA	Cooperative Institute for Research in the Atmosphere
CLFR	compact linear Fresnel collector
CPC	Center for Plant Conservation
CNDDB	California Natural Diversity Database
CNEL	community noise equivalent level
CNHP	Colorado National Heritage Program

Colorado DWR	Colorado Department of Water Resources
CPUC	California Public Utilities Commission
CPV	concentrating photovoltaic
CRBSCF	Colorado River Basin Salinity Control Forum
CREZ	competitive renewable energy zone
CRSCP	Colorado River Salinity Control Program
CSA	Candidate Study Area
CSC	Coastal Services Center
CSFG	carbon-sequestration fossil generation
CSP	concentrating solar power
CSQA	California Stormwater Quality Association
CSRI	Cultural Systems Research, Incorporated
CTG	combustion turbine generator
CTPG	California Transmission Planning Group
CTSR	Cumbres & Toltec Scenic Railroad
CUP	Conditional Use Permit
CVP	Central Valley Project
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
CWHRS	California Wildlife Habitat Relationship System
DC	direct current
DHS	U.S. Department of Homeland Security
DNA	Determination of NEPA Adequacy
DNI	direct normal insulation
DNL	day-night average sound level
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
DRECP	California Desert Renewable Energy Conservation Plan
DSM	demand side management
DTC/C-AMA	Desert Training Center/California–Arizona Maneuver Area
DWMA	Desert Wildlife Management Area
EA	environmental assessment
ECAR	East Central Area Reliability Coordination Agreement
ECOS	Environmental Conservation Online System (USFWS)
EERE	Energy Efficiency and Renewable Energy (DOE)
Eg	band gap energy
EIA	Energy Information Administration
EIS	environmental impact statement
EISA	Energy Independence and Security Act of 2007
EMF	electromagnetic field
E.O.	Executive Order

EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EQIP	Environmental Quality Incentives Program
ERCOT	Electric Reliability Council of Texas
ERO	Electric Reliability Organization
ERS	Economic Research Service
ESA	Endangered Species Act of 1973
ESRI	Environmental Systems Research Institute
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FLPMA	Federal Land Policy and Management Act of 1976
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FRCC	Florida Reliability Coordinating Council
FSA	Final Staff Assessment
FTE	full-time equivalent
FY	fiscal year
G&TM	Generation and Transmission Modeling
GCRP	U.S. Global Climate Research Program
GDA	generation development area
GHG	greenhouse gas
GIS	geographic information system
GPS	global positioning system
GTM	Generation and Transmission Model
GUAC	Groundwater Users Advisory Council
GWP	global warming potential
HA	herd area
HAP	hazardous air pollutant
HAZCOM	hazard communication
HCE	heat collection element
HCP	Habitat Conservation Plan
HMA	Herd Management Area
HMMH	Harris Miller Miller & Hanson, Inc.
HRSG	heat recovery steam generator
HSPD	Homeland Security Presidential Directive
HTF	heat transfer fluid
HVAC	heating, ventilation, and air-conditioning

I	Interstate
IARC	International Agency for Research on Cancer
IBA	important bird area
ICE	internal combustion engine
ICWMA	Imperial County Weed Management Area
IEC	International Electrochemical Commission
IFR	instrument flight rule
IID	Imperial Irrigation District
IM	Instruction Memorandum
IMPS	Iron Mountain Pumping Station
IMS	interim mitigation strategy
INA	Irrigation Non-Expansion Area
IOP	Interagency Operating Procedure
IOU	investor-owned utility
IPPC	Intergovernmental Panel on Climate Change
ISA	Independent Science Advisor; Instant Study Area
ISB	Intermontane Seismic Belt
ISCC	integrated solar combined cycle
ISDRA	Imperial Sand Dunes Recreation Area
ISEGS	Ivanpah Solar Energy Generating System
ITP	incidental take permit
IUCNNR	International Union for Conservation of Nature and Natural Resources
IUCNP	International Union for Conservation of Nature Pakistan
KGA	known geothermal resources area
KML	keyhole markup language
KOP	key observation point
KSLA	known sodium leasing area
LCC	Landscape Conservation Cooperative
LCOE	levelized cost of energy
L_{dn}	day-night average sound level
LDWMA	Low Desert Weed Management Area
L_{eq}	equivalent sound pressure level
LLA	limited land available
LLRW	low-level radioactive waste (waste classification)
LRG	Lower Rio Grande
LSA	lake and streambed alteration
LSE	load-serving entity
LTVA	long-term visitor area
MAAC	Mid-Atlantic Area Council
MAIN	Mid-Atlantic Interconnected Network
MAPP	methyl acetylene propadiene stabilizer; Mid-Continent Area Power Pool
MCAS	Marine Corps Air Station
MCL	maximum contaminant level

MFP	Management Framework Plan
MIG	Minnesota IMPLAN Group
MLA	maximum land available
MOA	military operating area
MOU	Memorandum of Understanding
MPDS	maximum potential development scenario
MRA	Multiple Resource Area
MRI	Midwest Research Institute
MRO	Midwest Reliability Organization
MSDS	Material Safety Data Sheet
MSL	mean sea level
MTR	military training route
MWA	Mojave Water Agency
MWD	Metropolitan Water District
MWMA	Mojave Weed Management Area
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NAGPRA	Native American Graves Protection and Repatriation Act
NAHC	Native American Heritage Commission (California)
NAIC	North American Industrial Classification System
NASA	National Aeronautics and Space Administration
NCA	National Conservation Area
NCCAC	Nevada Climate Change Advisory Committee
NCDC	National Climatic Data Center
NCES	National Center for Education Statistics
NDCNR	Nevada Department of Conservation and Natural Resources
NDEP	Nevada Division of Environmental Protection
NDOT	Nevada Department of Transportation
NDOW	Nevada Department of Wildlife
NDWP	Nevada Division of Water Planning
NDWR	Nevada Division of Water Resources
NEAP	Natural Events Action Plan
NEC	National Electric Code
NED	National Elevation Database
NEP	Natural Events Policy
NEPA	National Environmental Policy Act of 1969
NERC	North American Electricity Reliability Corporation
NHA	National Heritage Area
NHNM	National Heritage New Mexico
NHPA	National Historic Preservation Act of 1966
NID	National Inventory of Dams
NM DOT	New Mexico Department of Transportation
NLCS	National Landscape Conservation System
NMAC	*New Mexico Administrative Code*
NMBGMR	New Mexico Bureau of Geology and Mineral Resources

NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NMED-AQB	New Mexico Environment Department-Air Quality Board
NMFS	National Marine Fisheries Service
NMOSE	New Mexico Office of the State Engineer
NMSU	New Mexico State University
NNHP	Nevada Natural Heritage Program
NNL	National Natural Landmark
NNSA	National Nuclear Security Administration
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NP	National Park
NPL	National Priorities List
NPS	National Park Service
NRA	National Recreation Area
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
NRHP	*National Register of Historic Places*
NRS	*Nevada Revised Statutes*
NSC	National Safety Council
NSO	no surface occupancy
NSTC	National Science and Technology Council
NTS	Nevada Test Site
NTTR	Nevada Test and Training Range
NVCRS	Nevada Cultural Resources Inventory System
NV DOT	Nevada Department of Transportation
NWCC	National Wind Coordinating Committee
NWI	National Wetlands Inventory
NWPP	Northwest Power Pool
NWR	National Wildlife Refuge
NWSRS	National Scenic River System
O&M	operation and maintenance
ODFW	Oregon Department of Fish and Wildlife
OHV	off-highway vehicle
ONA	Outstanding Natural Area
ORC	organic Rankine cycle
OSE/ISC	Office of the State Engineer/Interstate Stream Commission
OSHA	Occupational Safety and Health Administration
OTA	Office of Technology Assessment
PA	Programmatic Agreement
PAD	Preliminary Application Document
PAH	polycyclic aromatic hydrocarbon

PAT	peer analysis tool
PCB	polychlorinated biphenyl
PCM	purchase change material
PCS	power conditioning system
PCU	power converting unit
PEIS	programmatic environmental impact statement
PFYC	potential fossil yield classification
PIER	Public Interest Energy Research
P.L.	Public Law
PLSS	Public Land Survey System
PM	particulate matter
$PM_{2.5}$	particulate matter with a mean aerodynamic diameter of 2.5 μm or less
PM_{10}	particulate matter with a mean aerodynamic diameter of 10 μm or less
POD	plan of development
POU	publicly owned utility
PPA	Power Purchase Agreement
PPE	personal protective equipment
PSD	Prevention of Significant Deterioration
PURPA	Public Utility Regulatory Policy Act
PV	photovoltaic
PVID	Palo Verde Irrigation District
PWR	public water reserve
QRA	qualified resource area
R&I	relevance and importance
RCI	residential, commercial, and industrial (sector)
RCRA	Resource Conservation and Recovery Act of 1976
RD&D	research, development, and demonstration; research, development, and deployment
RDBMS	Relational Database Management System
RDEP	Restoration Design Energy Project
REA	Rapid Ecoregional Assessment
REAT	Renewable Energy Action Team
REDI	Renewable Energy Development Infrastructure
ReEDS	Regional Energy Deployment System
REPG	Renewable Energy Policy Group
RETA	Renewable Energy Transmission Authority
RETAAC	Renewable Energy Transmission Access Advisory Committee
RETI	Renewable Energy Transmission Initiative
REZ	renewable energy zone
RF	radio frequency
RFC	Reliability First Corporation
RFDS	reasonably foreseeable development scenario
RGP	Rio Grande Project
RGWCD	Rio Grande Water Conservation District

RMP	Resource Management Plan
RMPA	Rocky Mountain Power Area
RMZ	Resource Management Zone
ROD	Record of Decision
ROI	region of influence
ROS	recreation opportunity spectrum
ROW	right-of-way
RPG	renewable portfolio goal
RPS	Renewable Portfolio Standard
RRC	Regional Reliability Council
RSEP	Rice Solar Energy Project
RSI	Renewable Systems Interconnection
RTTF	Renewable Transmission Task Force
RV	recreational vehicle
SAAQS	State Ambient Air Quality Standards
SAMHSA	Substance Abuse and Mental Health Services Administration
SCADA	supervisory control and data acquisition
SCE	Southern California Edison
SCRMA	Special Cultural Resource Management Area
SDRREG	San Diego Regional Renewable Energy Group
SDWA	Safe Drinking Water Act of 1974
SEGIS	Solar Energy Grid Integration System
SEGS	Solar Energy Generating System
SEI	Sustainable Energy Ireland
SEIA	Solar Energy Industrial Association
SES	Stirling Energy Systems
SETP	Solar Energy Technologies Program (DOE)
SEZ	solar energy zone
SHPO	State Historic Preservation Office(r)
SIP	State Implementation Plan
SLRG	San Luis & Rio Grande
SMA	Special Management Area
SMP	suggested management practice
SNWA	Southern Nevada Water Authority
SPP	Southwest Power Pool
SRMA	Special Recreation Management Area
SSA	Socorro Seismic Anomaly
SSI	self-supplied industry
ST	solar thermal
STG	steam turbine generator
SUA	special use airspace
SWAT	Southwest Area Transmission
SWIP	Southwest Intertie Project
SWPPP	Stormwater Pollution Prevention Plan
SWReGAP	Southwest Regional Gap Analysis Project

TAP	toxic air pollutant
TCC	Transmission Corridor Committee
TDS	total dissolved solids
TEPPC	Transmission Expansion Planning Policy Committee
TES	thermal energy storage
TSA	Transportation Security Administration
TSCA	Toxic Substances Control Act of 1976
TSDF	treatment, storage, and disposal facility
TSP	total suspended particulates
UACD	Utah Association of Conservation Districts
UBWR	Utah Board of Water Resources
UDA	Utah Department of Agriculture
UDEQ	Utah Department of Environmental Quality
UDNR	Utah Department of Natural Resources
UDOT	Utah Department of Transportation
UDWQ	Utah Division of Water Quality
UDWR	Utah Division of Wildlife Resources
UGS	Utah Geological Survey
UNEP	United Nations Environmental Programme
UNPS	Utah Native Plant Society
UP	Union Pacific
UREZ	Utah Renewable Energy Zone
USACE	U.S. Army Corps of Engineers
USC	*United States Code*
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
Utah DWR	Utah Division of Water Rights
UTTR	Utah Test and Training Range
UWS	Underground Water Storage, Savings and Replenishment Act
VACAR	Virginia-Carolinas Subregion
VCRS	Visual Contrast Rating System
VFR	visual flight rule
VOC	volatile organic compound
VRI	Visual Resource Inventory
VRM	Visual Resource Management
WA	Wilderness Area
WAPA	Western Area Power Administration
WECC	Western Electricity Coordinating Council
WECC CAN	Western Electricity Coordinating Council – Canada
WEG	wind erodibility group
WGA	Western Governors' Association

WGFD	Wyoming Game and Fish Department
WHA	wildlife habitat area
WHO	World Health Organization
WRAP	Water Resources Allocation Program; Western Regional Air Partnership
WRCC	Western Regional Climate Center
WREZ	Western Renewable Energy Zones
WRRI	Water Resources Research Institute
WSA	Wilderness Study Area
WSC	wildlife species of special concern
WSMR	White Sands Missile Range
WSR	Wild and Scenic River
WSRA	Wild and Scenic Rivers Act of 1968
WWII	World War II
YPG	Yuma Proving Ground
ZITA	zone identification and technical analysis
ZLD	zero liquid discharge

CHEMICALS

CH_4	methane	NO_2	nitrogen dioxide
CO	carbon monoxide	NO_x	nitrogen oxides
CO_2	carbon dioxide		
CO_2e	carbon dioxide equivalent	O_3	ozone
H_2S	hydrogen sulfide	Pb	lead
Hg	mercury		
		SF_6	sulfur hexafluoride
N_2O	nitrous oxide	SO_2	sulfur dioxide
NH_3	ammonia	SO_x	sulfur oxides

UNITS OF MEASURE

ac-ft	acre-foot (feet)	°F	degree(s) Fahrenheit
bhp	brake horsepower	ft	foot (feet)
		ft^2	square foot (feet)
°C	degree(s) Celsius	ft^3	cubic foot (feet)
cf	cubic foot (feet)		
cfs	cubic foot (feet) per second	g	gram(s)
cm	centimeter(s)	gal	gallon(s)
		GJ	gigajoule(s)
dB	decibel(s)	gpcd	gallon per capita per day
dBA	A-weighted decibel(s)	gpd	gallon(s) per day

gpm	gallon(s) per minute
GW	gigawatt(s)
GWh	gigawatt hour(s)
GWh/yr	gigawatt hour(s) per year
h	hour(s)
ha	hectare(s)
Hz	hertz
in.	inch(es)
J	joule(s)
K	degree(s) Kelvin
kcal	kilocalorie(s)
kg	kilogram(s)
kHz	kilohertz
km	kilometer(s)
km^2	square kilometer(s)
kPa	kilopascal(s)
kV	kilovolt(s)
kVA	kilovolt-ampere(s)
kW	kilowatt(s)
kWh	kilowatt-hour(s)
kWp	kilowatt peak
L	liter(s)
lb	pound(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mg	milligram(s)
Mgal	million gallons
mi	mile(s)
mi^2	square mile(s)
min	minute(s)
mm	millimeter(s)
MMt	million metric ton(s)
MPa	megapascal(s)
mph	mile(s) per hour
MW	megawatt(s)
MWe	megawatt(s) electric
MWh	megawatt-hour(s)
ppm	part(s) per million
psi	pound(s) per square inch
psia	pound(s) per square inch absolute
rpm	rotation(s) per minute
s	second(s)
scf	standard cubic foot (feet)
TWh	terawatt hours
VdB	vibration velocity decibel(s)
W	watt(s)
yd^2	square yard(s)
yd^3	cubic yard(s)
yr	year(s)
µg	microgram(s)
µm	micrometer(s)

ENGLISH/METRIC AND METRIC/ENGLISH EQUIVALENTS

The following table lists the appropriate equivalents for English and metric units.

Multiply	By	To Obtain
English/Metric Equivalents		
acres	0.004047	square kilometers (km^2)
acre-feet (ac-ft)	1,234	cubic meters (m^3)
cubic feet (ft^3)	0.02832	cubic meters (m^3)
cubic yards (yd^3)	0.7646	cubic meters (m^3)
degrees Fahrenheit (ºF) –32	0.5555	degrees Celsius (ºC)
feet (ft)	0.3048	meters (m)
gallons (gal)	3.785	liters (L)
gallons (gal)	0.003785	cubic meters (m^3)
inches (in.)	2.540	centimeters (cm)
miles (mi)	1.609	kilometers (km)
miles per hour (mph)	1.609	kilometers per hour (kph)
pounds (lb)	0.4536	kilograms (kg)
short tons (tons)	907.2	kilograms (kg)
short tons (tons)	0.9072	metric tons (t)
square feet (ft^2)	0.09290	square meters (m^2)
square yards (yd^2)	0.8361	square meters (m^2)
square miles (mi^2)	2.590	square kilometers (km^2)
yards (yd)	0.9144	meters (m)
Metric/English Equivalents		
centimeters (cm)	0.3937	inches (in.)
cubic meters (m^3)	0.00081	acre-feet (ac-ft)
cubic meters (m^3)	35.31	cubic feet (ft^3)
cubic meters (m^3)	1.308	cubic yards (yd^3)
cubic meters (m^3)	264.2	gallons (gal)
degrees Celsius (ºC) +17.78	1.8	degrees Fahrenheit (ºF)
hectares (ha)	2.471	acres
kilograms (kg)	2.205	pounds (lb)
kilograms (kg)	0.001102	short tons (tons)
kilometers (km)	0.6214	miles (mi)
kilometers per hour (kph)	0.6214	miles per hour (mph)
liters (L)	0.2642	gallons (gal)
meters (m)	3.281	feet (ft)
meters (m)	1.094	yards (yd)
metric tons (t)	1.102	short tons (tons)
square kilometers (km^2)	247.1	acres
square kilometers (km^2)	0.3861	square miles (mi^2)
square meters (m^2)	10.76	square feet (ft^2)
square meters (m^2)	1.196	square yards (yd^2)

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APPENDIX A:

CURRENT AND PROPOSED BUREAU OF LAND MANAGEMENT SOLAR ENERGY DEVELOPMENT POLICIES AND DESIGN FEATURES

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APPENDIX A:

CURRENT AND PROPOSED BUREAU OF LAND MANAGEMENT SOLAR ENERGY DEVELOPMENT POLICIES AND DESIGN FEATURES

A.1 CURRENT BLM SOLAR ENERGY DEVELOPMENT POLICIES

As of December 1, 2010, three solar energy development policies were being used by the U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) to process solar right-of-way (ROW) applications. These policies are presented in Sections A.1.1 through A.1.3.

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A.1.1 Instruction Memorandum 2007-097, Solar Energy Development Policy

UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Land Management
Washington, D.C. 20240
http://www.blm.gov

April 4, 2007

In Reply Refer To:
2800 (350) P

EMS TRANSMISSION 04/11/2007
Instruction Memorandum No. 2007-097
Expires: 09/30/2009

To: All Field Officials

From: Director

Subject: Solar Energy Development Policy

Program Area: Rights-of-Way Management, Solar Energy
Facilities Management, Solar Energy

Purpose: This Instruction Memorandum (IM) establishes policy for the processing of right-of-way applications for solar energy development projects on public lands administered by the Bureau of Land Management (BLM) and evaluating the feasibility of installing solar energy systems on BLM administrative facilities and projects.

Policy/Action: This IM replaces the Solar Energy Development Policy (IM No. 2005-006), issued October 20, 2004. The BLM's general policy is to facilitate environmentally responsible commercial development of solar energy projects on public lands and to use solar energy systems on BLM facilities where feasible. Applications for commercial solar energy facilities will be processed as right-of-way authorizations under Title V of the Federal Land Policy and Management Act (FLPMA) and Title 43, Part 2804 of the Code of Federal Regulations (CFR). Commercial concentrating solar power (CSP) or photovoltaic (PV) electric generating facilities must comply with the BLM's planning, environmental and right-of-way application requirements, as do other similar commercial uses.

The BLM will evaluate the feasibility of installing PV systems on administrative facilities and on range improvement, resource monitoring, public safety, and recreation projects. Project planning and design should incorporate an appropriate analysis to determine the feasibility, cost and benefits of using PV systems. In June 2006, an Energy Savings Performance Contract was awarded to Johnson Controls, Inc. for the installation of energy efficiency technologies into BLM facilities. Phase II of the contract, expected to be awarded in May 2007, will include the installation of solar and other renewable energy technologies. Trent Duncan, BLM Utah State Office, at 801-539-4090 or Pat Fleming, BLM National Science and Technology Center, at 303-

987-6856 can provide additional information on installing PV systems on BLM administrative facilities or for other project uses.

Inventory and Planning

The Department of Energy's National Renewable Energy Laboratory (NREL) has prepared solar insolation potential maps at the request of the BLM for Arizona, California, Nevada, and New Mexico. The maps identify areas with one percent or less slope with high levels of solar insolation that have potential for commercial solar energy development. Solar maps from NREL are available at http://www.nrel.gov/csp/maps.html.

New or updated BLM land use plans are required to consider NREL maps showing areas having commercial solar energy development potential. The land use plans or revisions should address potential impacts of solar energy development and related environment and local community issues. The land use plans should sufficiently analyze and consider the potential for solar energy development and the local environmental or community issues related to making lands available (or not available) for commercial solar energy development. When necessary, the land use plan amendment and the environmental analysis for the solar energy development proposal can be prepared and processed concurrently. This policy does not require updates for recently completed plans to include an analysis of solar energy development.

Right-of-Way Applications

Applications for commercial solar energy facilities, both PV and CSP, will be processed as right-of-way authorizations under Title V of the FLPMA and Title 43, Part 2804 of the CFR. Applications submitted to the BLM for commercial solar energy development projects will use Form SF-299, Application for Transportation and Utility Systems and Facilities on Federal Land, consistent with the requirements of 43 CFR 2804. No separate authorization is necessary if the installation of a PV system is part of another authorized facility or use. As an example, oil and gas operators may install PV facilities for operating metering equipment and lighting systems on their lease area as part of an approved oil and gas lease operation. In addition, oil and gas pipeline right-of-way authorizations would allow for the use of PV facilities at pump station locations. Those are valid uses that the BLM can encourage and allow.

Right-of-way applications for solar energy development projects will be identified as a high priority Field Office workload and will be processed in a timely manner. This priority is consistent with the President's National Energy Policy of 2001 and the Energy Policy Act of 2005. Adequate resources should be provided to review and process the application. The applicant must submit a complete and acceptable application and provide a cost recovery payment before the BLM will initiate processing of a right-of-way application. It is anticipated that most right-of-way applications for solar energy development will be Category 6, full cost recovery applications. The BLM will apply sound business practices in expediting the application process. For further information regarding the BLM ROW application process, please refer to the following BLM web site:
http://www.blm.gov/wo/st/en/prog/energy/cost_recovery_regulations.html.

1
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The BLM authorized officer should schedule pre-application meetings with applicants (43 CFR 2804.10). This facilitates preparation and processing of applications that identifies potential issues and land use conflicts impacting the authorized officer's decision to grant or not grant the right-of-way authorization. The pre-application process will identify any environmental or cultural resource studies that may be needed, assess public interest and concerns, identify other authorized uses within or near the area, allow consideration of potential alternative site locations, and outline arrangements for paying the costs associated with processing a right-of-way grant.

Early public notification and involvement of local communities and other interests is also important in increasing public acceptance and avoiding potential conflicts, especially in areas where other uses exist on the public lands. The application process is pre-decisional and may or may not result in the BLM granting a right-of-way authorization.

A BLM State or Field Office right-of-way project manager will be assigned to process the application; ensure appropriate cost recovery; and monitor construction and use of the land for the authorized purpose. As an option, the BLM State Director may request assistance of a National Right-of-Way Project Manager from the BLM Washington Office (WO-350).

Solar energy right-of-way applications and authorizations are subject to appropriate cost recovery and rental payments required by 43 CFR 2804.14, 43 CFR 2805.16, and 43 CFR 2806.10, and the bonding requirements of 43 CFR 2805.12(g).

Right-of-Way Authorizations

A right-of-way grant (Form 2800-14) will be used to authorize all facilities held by the holder of the grant on the public lands related to a commercial solar energy development project. This authorization will include the solar collectors, tower, turbine generator, fossil fired generator for hybrid systems, thermal storage, access roads, electrical and transmission facilities, and other testing and support facilities. The lands involved in the right-of-way grant will be defined by aliquot legal land descriptions and be configured to minimize the amount of land involved.

The right-of-way authorization will contain appropriate stipulations relating to all aspects of project development including, but not limited to, road construction and maintenance, vegetation removal, natural, cultural and biological resources mitigation and monitoring, and site reclamation. In addition, an approved Plan of Development (POD) for construction and operation of the solar facility must be completed prior to beginning construction. When possible, the right-of-way authorization and POD can be processed simultaneously.

The right-of-way holder should be encouraged, through terms and conditions of the right-of-way authorization, to work with the BLM to increase public acceptance and awareness of the benefits of solar energy development by providing information and public viewing areas at safe locations near the development. The BLM and right-of-way holder can provide a positive message on the responsible use of renewable resources and the multiple resource use on public lands.

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A bond will be required for solar energy development right-of-way grants to ensure compliance with the terms and conditions of the authorization and the requirements of the regulations, including reclamation. The reclamation provisions within the POD should include not only removal of solar collectors and other structures, but also the reclamation of access roads and disturbed areas. The amount of the bond will consider potential reclamation and administrative costs to the BLM.

The term length of the authorization is not limited by regulation; however, it should recognize the overall costs and useful life of solar energy facilities (43 CFR 2805.10(a)(3)). The term of the solar energy authorization for a commercial facility should not exceed the design life of the project, typically 30 years. The authorization may be renewed consistent with the provisions of the regulations (43 CFR 2807.22(a)). Other compatible uses may be authorized, but are unlikely due to the intensive use of the site for PV or CSP facility equipment.

The right-of-way grant may be assigned consistent with the provisions of the regulations (43 CFR 2807.21(b)). However, all assignments shall be approved by the BLM authorized officer and the qualifications of all assignees must comply with 43 CFR 2803.10 and the Due Diligence section of this IM and the requirements of the regulations (43 CFR 2807.21(c)(1) and 43 CFR 2807.21(d)). The assignment shall not interfere with the BLM's enforcement of the terms and conditions of the authorization or management of the associated public lands.

All final decisions issued by the authorized officer in connection to the authorization of solar energy projects can be appealed under 43 CFR part 4 and 43 CFR 2801.10. It should also be noted that right-of-way grants are issued as full force and effect decisions (43 CFR 2801.10(b)) and will remain effective during any appeal period.

Rental

All solar energy right-of-way authorizations are subject to rent in accordance with this IM, unless they are specifically exempt from rent by statute or regulation. Some holders or facilities may be exempt from rent pursuant to the Rural Electrification Act of 1936, as amended (43 CFR 2806.14(d)).

The holder of a right-of-way authorization shall pay an annual rent established by the BLM using real estate appraisals and reviews procured from the Department of the Interior, Appraisal Services Directorate. The rents paid will be in conformance with 43 CFR 2806.10(a). The appraisal should consider the value of the rights to be conveyed and the lease of comparable lands in an early or similar stage of potential development, e.g., commercial land or industrial land, as of the date of the appraisal. The procured appraisal and review report will be prepared on a site-specific basis and reflect market conditions for setting rental payments. Since the rental payment reflects the full use of the public land for solar facilities, similar to a lease for industrial purposes, there are no additional royalty payments for electric generation.

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The appraisal assignment to estimate annual rental should also include a request to identify an appropriate rental index for updating the rental payment. The justification for the index should reflect normal market conditions for updating rental payments on similarly used land.

The rental payment will be phased in over a 3-year period to permit additional data collection that may be required after the approval of the grant, preparation and approval of a POD, and construction of the facility. The rent for the first year will be 25 percent of the BLM approved rent, 50 percent the second year, and 100 percent the third year.

Competitive Interest

Right-of-way applications for solar energy development will generally be accepted and processed on a first-come, first-serve basis. The right-of-way regulations (43 CFR 2804.23(c)) provide authority for offering public lands under competitive bidding procedures for solar energy right-of-way authorizations. The BLM will initiate a competitive process if a land use planning decision has specifically identified an area for competitive leasing. The BLM may also consider other public interest and technical factors in determining whether to offer lands for competitive leasing. Competitive bidding will follow the procedures required by 43 CFR 2804.23(c).

Due Diligence

The BLM will discourage applicants from holding right-of-way authorizations for purposes of speculating, controlling, or hindering development of solar energy on public lands. Speculative interest can be mitigated by ensuring the applicant meets qualification requirements of the regulations (43 CFR 2803.10(a-c)), and requiring certain due diligence provisions in the right-of-way authorization for solar energy development.

The regulations clearly provide authority to require that the application include information on the applicant's technical and financial capability to construct, operate, maintain and terminate the solar energy facilities (43 CFR 2803.10(b)). This technical capability can be demonstrated by obtaining the funding, designing, constructing or successfully operating an energy generating project. Actual ownership, development, or successful management of similar-sized electric energy-related facilities within the last 5 years by the applicant would generally constitute evidence of financial capability. The regulations provide the authority to deny the application if the applicant cannot demonstrate adequate technical ability to construct, operate, and maintain the solar energy facilities (43 CFR 2804.26(a)(5)). The BLM may also deny an application if the applicant does not provide, in a timely manner, additional information requested by BLM to process an application or the cost recovery funds required by 43 CFR 2804.14.

In addition, the solar energy development right-of-way grant shall include a due diligence requirement for installation of facilities consistent with an approved POD. If construction of solar energy facilities has not commenced within 3 years after the effective date of the grant, the right-of-way holder shall provide the BLM good cause as to the nature of any delay, evidence of progress toward beginning construction, and the anticipated date of start-up operations. Failure

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of the holder to comply with the due diligence provisions of the solar energy development right-of-way grant provides the authorized officer the authority to terminate the authorization (43 CFR 2807.17).

Environmental Review

The scope of the environmental analysis required by the National Environmental Policy Act (NEPA) for a solar energy development project should address all aspects of the solar project, including direct, indirect, and cumulative effects of the proposed action.

The scope of the NEPA analysis and the compliance requirements with the Endangered Species Act, the Migratory Bird Treaty Act, the National Historic Preservation Act, and other laws for a solar energy development right-of-way application should address the installation and maintenance of solar collectors, water for steam generation and cooling purposes, oil or gas used by backup generators, thermal or electrical storage, turbines or engines, access roads and electrical inverters and transmission facilities. The scope and level of site clearance should include the areas of proposed surface disturbance and areas potentially affected by the project.

The level of NEPA analysis will be determined by project scoping and the anticipated potential impacts on the environment. The level of analysis will reflect the amount of land needed for the solar energy collection and associated support facilities, the amount of surface to be disturbed, water requirements, and potential impacts on wildlife and other resources. It may be possible to combine the required environmental review process for a solar energy development project with other required State or local environmental requirements. This would streamline the process and be consistent with Departmental policy on intergovernmental cooperation.

LR 2000 Data Entry

Commodity code 975 will be used to identify solar energy applications and authorizations in LR 2000, the BLM case recordation system. In addition, the data entry will also identify under the comment section whether the authorization is for a PV or CSP facility. This will allow the BLM to track and report solar energy activities on public land within LR 2000.

Timeframe: This policy is effective immediately.

Background: As part of an overall strategy to develop a diverse portfolio of domestic energy supplies for our future, the National Energy Policy of 2001 and the Energy Policy Act of 2005 (Public Law 109-58, August 8, 2005) encourage the development of renewable energy resources, which includes solar energy. Section 211 of the Energy Policy Act of 2005 encourages the approval of at least 10,000 megawatts (MW) of non-hydropower renewable energy projects on the public lands within the next 10 years.

Solar energy has significant potential in the western United States for converting the sun's light into electricity using technology that is rapidly improving. Solar energy currently accounts for

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less than one percent of total U.S. electricity supply. As the cost of producing solar energy declines, there will be a greater interest in locating large solar power systems on public lands. Please refer to the attachment for additional information regarding PV and CSP solar systems.

Budget Impact: The application of this policy will have a minimal budget impact. Any land use planning associated with this policy will be part of existing planning efforts. Land use plans will take into account the solar mapping data described under the Inventory and Planning section of this IM. It is assumed that any solar energy commercial development will probably meet the criteria for full cost recovery. In addition, the BLM post authorization monitoring activities are subject to the cost recovery provisions of the regulations. These procedures will minimize any unnecessary budget and workload impacts.

Manual/Handbook Sections Affected: Manual 2801, Right-of-Way Management and Handbook H-2801-1. Land Use Planning Handbook H-1601-1.

Coordination: The Washington Office Planning, Assessment and Community Support Division (WO-210), the Property, Acquisition and Headquarters Services Division (WO-850), and the BLM State Offices were contacted to provide input on this policy prior to finalization.

Contact: Please direct any questions concerning the content of this IM to the Washington Office Division of Lands, Realty and Cadastral Survey, attention: Rick Stamm, at 202- 452-5185; or rick_stamm@blm.gov.

Signed by:
James M. Hughes
Acting, Director

Authenticated by:
Robert M. Williams
Division of IRM Governance,WO-560

1 Attachment
1-Solar Energy Systems (2 pp)

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A.1.2 Instruction Memorandum 2010-141, Solar Energy Interim Rental Policy

United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Washington, D.C. 20240
http://www.blm.gov

TAKE PRIDE IN AMERICA

June 10, 2010

In Reply Refer To:
2800 (350) P

EMS TRANSMISSION 06/10/2010
Instruction Memorandum No. 2010-141
Expires: 09/30/2011

To: All Field Officials

From: Director

Subject: Solar Energy Interim Rental Policy

Program Area: Right-of-Way Management, Solar Energy

Purpose: This Instruction Memorandum (IM) provides updated guidance on the rental provisions of right-of-way authorizations for solar energy projects on public lands administered by the Bureau of Land Management (BLM).

Policy/Action: Applications for solar energy projects are processed as right-of-way authorizations under Title V of the Federal Land Policy and Management Act (FLPMA) and require the payment of rent in accordance with the requirements of Section 504(g) of FLPMA and the provisions of 43 CFR 2806. This IM establishes an Interim Policy for a solar energy rental schedule for solar energy right-of-way authorizations and replaces the rental provisions of the Solar Energy Development Policy (IM 2007-097) issued April 4, 2007. This Interim Policy will remain in effect until updated by further guidance. Issuance of this IM ensures BLM-wide consistency for solar energy right-of-way rental fees.

Rental Fees

The BLM will calculate rents on all solar energy right-of-way authorizations in accordance with this IM and the provisions of 43 CFR 2806. Some holders or facilities may be exempt from rent pursuant to the Rural Electrification Act of 1936 (REA), as amended (43 CFR 2806.14(d)). Electric facilities that are financed or are eligible for REA financing, qualify for a rent exemption under the provisions of the Act.

The holder of a solar energy right-of-way authorization must pay an annual rent in conformance with the regulations (43 CFR 2806.10(a)). Consistent with 43 CFR 2806.50, the BLM has developed a schedule to calculate rental fees for solar energy right-of-way authorizations. This rental schedule includes a base rent for the acreage of public land included within the solar

energy right-of-way authorization and an additional megawatt (MW) capacity fee based on the total authorized MW capacity for the approved solar energy project on the public land administrated by the BLM.

As set forth below, the rental schedule for solar right-of-way authorizations will consist of two components: (1) a base rent to be paid upon issuance of the authorization, and (2) a MW capacity fee that will be implemented over a 5-year period once the facility begins generating electricity.

Base Rent

The BLM will calculate and bill the applicant a base rent to be paid upon the date of issuance of the right-of-way authorization consistent with the provisions of 43 CFR 2806.11. As calculated in conformance with the county rates set forth below, the base rent is a per-acre fee that will be charged, regardless of the stage of development or operations, on the entire public land acreage described in the right-of-way authorization.

The base rent will be paid on an annual basis, with no phase-in period. However, the BLM State Director may approve a rental payment plan for the first annual payment, consistent with the provisions of 43 CFR 2806.15(c). This payment plan for the first base rent payment is in response to the unique financing arrangements for some solar projects.

The BLM published regulations in 2008 that used land values published by the National Agricultural Statistics Service (NASS) to establish rental fees for linear right-of-way facilities on the public lands. Per-acre rental fees were established for every county in the U.S. based on the published NASS land values. The per-acre rental fees vary from county to county based on the different rural/agricultural land values in each county. The BLM used a 50 percent encumbrance factor of the land for linear types of rights-of-way to determine the annual rental fee. The BLM will use the same NASS data to establish the base rent for solar energy right-of-way authorizations; however, a 100 percent encumbrance factor will be used to reflect the high density land use common to solar energy projects. The encumbrance factor is a measure of the degree that a particular type of facility encumbers a right-of-way area or excludes other types of land uses. The 100 percent encumbrance factor for solar energy projects reflects the fact that a solar energy project is encumbering the entire right-of-way area to the exclusion of all other uses.

The BLM will adjust base rents for states and counties that are used for solar energy authorizations each year, based on the Implicit Price Deflator-Gross Domestic Product (IPD-GDP) index. The IPD-GDP index is also used to adjust the linear right-of-way rental fee each year (43 CFR 2806.22(a)). The BLM also periodically updates the schedule of county land values as new NASS data is published. The following is a list of the current calendar year (CY) 2010 solar energy base rental fee rates by state and county:

Arizona	CY 2010 Base Rent Fees
La Paz County	$ 62.78 per acre
Maricopa County	$188.34 per acre
Mohave County	$ 31.38 per acre
Pima County	$ 15.70 per acre

Yuma County	$313.88 per acre
Other counties	Double the linear right-of-way rental fee
California	CY 2010 Base Rent Fees
Imperial County	$188.34 per acre
Kern County	$ 94.16 per acre
Riverside County	$313.88 per acre
San Bernardino County	$125.56 per acre
Other counties	Double the linear right-of-way rental fee
Colorado	CY 2010 Base Rent Fees
Alamosa County	$ 62.78 per acre
Conejos County	$ 62.78 per acre
Saguache County	$ 62.78 per acre
Other counties	Double the linear right-of-way rental fee
Nevada	CY 2010 Base Rent Fees
Clark County	$188.34 per acre
Esmeralda County	$ 62.78 per acre
Lincoln County	$ 62.78 per acre
Mineral County	$ 15.70 per acre
Nye County	$ 62.78 per acre
Other counties	Double the linear right-of-way rental fee
New Mexico	CY 2010 Base Rent Fees
Dona Ana County	$ 94.16 per acre
Hidalgo County	$ 15.70 per acre
Luna County	$ 15.70 per acre
Other counties	Double the linear right-of-way rental fee
Utah	CY 2010 Base Rent Fees
Beaver County	$125.56 per acre
Iron County	$ 62.78 per acre
Millard County	$ 62.78 per acre
Other counties	Double the linear right-of-way rental fee

As an example, the base rent for a 4,000 acre solar energy right-of-way authorization in Clark County, Nevada, would be $753,360 per year (4,000 acres x $188.34 per acre).

Megawatt Capacity Fee

The BLM will charge a MW capacity fee in addition to the base rent for each solar energy right-of-way authorization. The MW capacity fee captures the increased industrial use value of the authorization, above the limited rural/agricultural land value captured by the base rent. The MW capacity fee will be calculated based on the total authorized MW capacity approved by the BLM

authorized officer for the project, or an approved phase of development. This capacity fee will be charged on an annual basis upon the start of generation of electricity from the facility.

To allow for a reasonable and diligent testing and operational period, the BLM will provide for a 5-year implementation of the MW capacity fee after the start of generation operations (at the rates of 20 percent the first year, 40 percent the second year, 60 percent the third year, 80 percent the fourth year, and 100 percent the fifth and subsequent years of operations). If generation of electricity starts from Phase 1 of a project, the MW capacity fee will be charged for the authorized MW capacity approved for Phase 1 only. The MW capacity fee for subsequent phases of development will start at the time that generation of electricity begins for the subsequent phases of development. The 5-year implementation of the MW capacity fee will apply to each phase of development after the start of generation operations from each phase. In moving from one phase of a project to the next phase, only incremental (newly added) capacity will be subject to the phase-in of the capacity fee. The phase-in does not apply to capacity previously installed.

Some solar energy development projects may include separate right-of-way authorizations issued for support facilities only (administration building, groundwater wells, construction lay down and staging areas, surface water management and control structures, etc.). The rental fee for these right-of-way authorizations would only use the base rent and not a MW capacity fee. Any separate right-of-way authorizations issued for linear right-of-way facilities (pipelines, roads, power lines, etc.) would use the rental fees established for linear rights-of-way (43 CFR 2806.20).

The MW capacity fee established by this IM is: $5,256 per MW for photovoltaic (PV) solar projects; $6,570 per MW for concentrated PV and concentrated solar power (parabolic trough, power tower and solar dish/engine) projects without storage capacity; and $7,884 per MW for concentrated solar power projects with storage capacity of 3 hours or more. The difference in the MW capacity fee for PV solar projects, concentrated PV, and concentrated solar power projects is dependent on the differences in the efficiency or capacity factor of each technology. These technologies include PV technologies (20 percent efficiency factor), concentrated PV and concentrated solar power without storage capacity (25 percent efficiency factor), and concentrated solar power technologies with storage capacity of 3 hours or more (30 percent efficiency factor). The BLM will periodically review the efficiency factors for the various solar technologies and update the MW capacity fee to reflect improvements in technology.

The MW capacity fee is calculated using a formula that includes an average electricity price of $0.06 per kilowatt hour and an average Federal bond yield of 5.0 percent. The Federal bond yield reflects the rate of return the public would expect for the use of Federal resources. The Federal bond yield is based on the 10-year average of the 20-year Treasury bond yield (as of March 2010). The formula for the MW capacity fee is as follows:

> Photovoltaic: The MW capacity fee is $5,256 per year, calculated as (authorized capacity on public land in MWs) x (8,760 hours per year) x (20 percent capacity factor) x (5.0 percent Federal bond yield) x ($0.06 average price per kilowatt hour) x (1,000 kilowatts per MW) = $5,256 per year for each MW of capacity.

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Concentrated PV and concentrated solar power without storage: The MW capacity fee is $6,570 per year, calculated as (authorized capacity on public land in MWs) x (8,760 hours per year) x (25 percent capacity factor) x (5.0 percent Federal bond yield) x ($0.06 average price per kilowatt hour) x (1,000 kilowatts per MW) = $6,570 per year for each MW of capacity.

Concentrated solar power with storage capacity of 3 hours or more: The MW capacity fee is $7,884 per year, calculated as (authorized capacity on public land in MWs) x (8,760 hours per year) x (30 percent capacity factor) x (5.0 percent Federal bond yield) x ($0.06 average price per kilowatt hour) x (1,000 kilowatts per MW) = $7,884 per year for each MW of capacity.

As an example, the MW capacity fee for a 400-MW photovoltaic solar energy right-of-way authorization would be $2,102,400 per year (400 MW x $5,256 per MW), implemented over a 5-year period after start of generation. The MW capacity fee for a 400-MW concentrated PV or concentrated solar power right-of-way authorization without storage capacity would be $2,628,000 per year (400 MW x $6,570 per MW), implemented over a 5-year period after start of generation. The MW capacity fee for a 400-MW concentrated solar power right-of-way authorization with storage capacity of 3 hours would be $3,153,600 per year (400 MW x $7,884 per MW), implemented over a 5-year period after start of generation.

The payment of the MW capacity fee is in addition to the annual base rent for the acreage of the right-of-way authorization. The full base rent would be paid upon the date of issuance of the right-of-way authorization, and the MW capacity fee would be implemented over a 5-year period after the start of electricity generation from the facility.

Rent Language in Authorization

The BLM has included standard terms in right-of-way grants to provide for adjustments to both the base rent and the MW capacity fee when necessary to reflect changes in the fair market value of right-of-way authorizations. The following revised standard language will be included in all solar energy right-of-way authorizations to additionally provide for rent adjustments consistent with regulatory changes or provisions of new or revised statutory authorities:

"For and in consideration of the rights granted, the holder agrees to pay the Bureau of Land Management fair market value rental, which includes both base rent and a megawatt capacity fee, as determined by the authorized officer unless specifically exempted from such payment by regulation. Provided, however, that the rental may be adjusted by the authorized officer, whenever necessary, to reflect changes in the fair market rental value as determined by the application of sound business management principles, and as far as practicable and feasible, in accordance with comparable commercial practices. The rental provisions of this authorization may also be modified consistent with the provisions of any regulatory changes or pursuant to the provisions of any new or revised statutory authorities."

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consistent with the provisions of any regulatory changes or pursuant to the provisions of any new or revised statutory authorities."

Timeframe: This policy is effective immediately. Pending solar energy right-of-way applications will be processed consistent with the provisions of this IM. The rental policy will periodically be reviewed to ensure that the base rent and MW capacity fee represent a fair return to the public.

Budget Impact: The application of this policy will have minimal budget impact. The processing of solar energy right-of-way applications are subject to the cost recovery provisions of the regulations (43 CFR 2804.14).

Background: As part of an overall strategy to develop a diverse portfolio of domestic energy supplies for our future, the Energy Policy Act of 2005 (Public Law 109-58, August 8, 2005) encourages the development of renewable energy resources on the public lands, including solar energy. Section 211 of the Energy Policy Act encourages the approval of at least 10,000 MW of non-hydropower renewable energy projects on the public lands by 2015. Secretarial Order 3285, signed by the Secretary on March 11, 2009, established the development of renewable energy as a priority of the Department of the Interior.

There is significant potential for the development of solar energy on the public lands in the southwestern states. The BLM has identified some 23 million acres of public lands with utility-scale solar energy potential and over 200 right-of-way applications have been submitted to the BLM for processing. As the cost of producing solar energy declines and as additional transmission capacity is developed, there will be an even greater interest in locating utility-scale solar energy projects on the public lands. This policy IM is necessary to ensure BLM-wide consistency in calculating rental fees for solar energy right-of-way authorizations on the public lands.

Manual/Handbook Sections Affected: This IM transmits interim policy that will be incorporated into BLM Manual 2801, Right-of-Way Management, and Handbook H-2801-1 during the next revision.

Coordination: The BLM State Offices reviewed and provided input to this policy prior to its finalization.

Contact: Please direct any questions concerning the content of this IM to Mike Nedd or your staff may contact Ray Brady, Renewable Energy Policy Team, at 202-912-7312, or ray_brady@blm.gov.

Robert V. Abbey
Director

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A.1.3 Instruction Memorandum 2011-003, Solar Energy Development Policy

United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Washington, D.C. 20240
http://www.blm.gov

TAKE PRIDE IN AMERICA

In Reply Refer To:
2800 (350) P

OCT 0 7 2010

Instruction Memorandum No.
Expires: 09/30/2011

To: All Field Officials

From: Director

Subject: Solar Energy Development Policy

Program Area: Right-of-Way Management, Solar Energy.

Purpose: This Instruction Memorandum (IM) provides updated guidance on the processing of right-of-way applications and the administration of right-of-way authorizations for solar energy projects on public lands administered by the Bureau of Land Management (BLM).

Policy/Action: This IM updates the Solar Energy Development Policy (IM 2007-097) issued April 4, 2007. The BLM's policy is to facilitate environmentally responsible development of solar energy projects on the public lands, consistent with the provisions of Secretarial Order 3285A1 dated March 11, 2009, as amended February 22, 2010.

Applications for solar energy projects will be processed and authorized as rights-of-way under Title V of the Federal Land Policy and Management Act (FLPMA) and Title 43, Part 2800, of the Code of Federal Regulations (CFR). Utility-scale concentrating solar power or photovoltaic electric generating facilities must comply with the BLM's planning, environmental, and right-of-way application requirements.

This IM provides policy guidance on early coordination with Federal land managers and stakeholders, the term of solar energy right-of-way authorizations, diligent development requirements, bond coverage, Best Management Practices (BMPs), and BLM access to records. Issuance of this IM ensures effective BLM-wide consistency in the processing of right-of-way applications and the management of authorizations for solar energy development on the public lands.

Early Coordination with Land Managers and Stakeholders

In order to enhance the consideration and protection of the resources and values associated with shared landscapes (including nearby county, state, tribal, or other Federal agency lands), state and field offices will coordinate and/or consult, as appropriate, with land managers and stakeholders that may be affected by the BLM's decision to grant a right-of-way authorization for a solar energy development project. Land managers and stakeholders include parties such as:

- Federal agencies (e.g., Bureau of Reclamation, Department of Defense, Fish and Wildlife Service, Forest Service, and National Park Service).
- Managers of adjacent or proximate BLM field offices and National Landscape Conservation System units.
- Tribal governments.
- State agencies (e.g., State Land Commission, State Parks, and State Fish and Game).
- County and local community stakeholders (e.g., county jurisdictions, managers of municipal watersheds and local parks).

Potentially affected Federal and state land managers will be provided the opportunity to participate in pre-application meetings with prospective project applicants.

Term of Authorization

In accordance with Title V of FLPMA and the BLM's right-of-way regulations, the term or length of a solar energy right-of-way authorization is limited to a reasonable term (43 U.S.C. 1764(b); 43 CFR 2805.11(b)). The regulations further articulate a number of factors the BLM considers in determining a reasonable term, including the overall costs and useful life of the projects. Most major right-of-way authorizations also include provisions for renewal of the authorization consistent with the provisions of the regulations (43 CFR 2805.15(d) and 2807.22).

Due to the substantial investments required for typical solar energy projects and the projected life of these facilities, it is prudent and in the public interest to provide for a term of solar energy right-of-way authorizations that will provide a reasonable period of time for construction, development, and continued operations. In addition, many Power Purchase Agreements (PPAs) for the purchase of electricity generated from a solar energy facility are for terms of 20 years or longer. The BLM will therefore issue all solar energy right-of-way authorizations for a term not to exceed 30 years. Thirty years provides a reasonable period consistent with the expected needs of a solar energy facility; it also provides for operation periods that are consistent with typical PPAs. The BLM will also include in each solar energy right-of-way authorization a specific provision allowing for renewal, consistent with the regulations at 43 CFR 2807.22.

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Diligent Development

The right-of-way regulations set forth the qualifications that an individual, business, or government entity must possess in order to hold a right-of-way grant, including the requirement that the potential grantee be technically and financially able to construct, operate, maintain, and terminate the use of the public lands covered by the grant (43 CFR 2803.10(b) and 2804.12(a)(5)). In carrying out its obligation to limit right-of-way authorizations to qualified individuals or entities and to prevent such individuals or entities from holding right-of-way authorizations merely for purposes of speculating, controlling, or hindering development on the public lands, the BLM will focus on ensuring the applicant meets the qualification requirements in the regulations. In addition, the BLM will include provisions requiring diligent development in each solar energy right-of-way authorization.

In ensuring that an applicant meets the regulatory requirement to demonstrate its technical and financial capability to construct, operate, maintain, and terminate the proposed solar energy facility (43 CFR 2803.10(b) and 43 CFR 2804.12(a)(5)), the BLM will consider whether the applicant has a history of successfully designing, constructing, or obtaining the funding for a project generating electrical energy. Actual ownership, development, or management of a successful similarly-sized project generating electrical energy within the last 5 years by the applicant would generally constitute evidence of financial capability. Absent such showing, the BLM will ask the applicant to estimate the capital investment necessary to bring the facility on-line and explain how the applicant intends to finance the project. The BLM may confer with the Department of Energy to determine whether the applicant's estimates and business plan appear viable. If the applicant cannot demonstrate adequate technical or financial ability to construct, operate, maintain, and terminate the specific solar energy facility, the BLM is authorized to deny the application (43 CFR 2804.26(a)(3) and (5)). The BLM may also deny an application if the applicant does not provide in a timely manner additional information requested by the BLM authorized officer to process an application (43 CFR 2804.26(a)(6)) or the processing fees required by 43 CFR 2804.14.

The right-of-way regulations specify that a right-of-way grant conveys to the holder only the rights that the grant expressly contains (43 CFR 2805.14) and that the holder must comply with all terms and conditions included in the grant (43 CFR 2805.12). All solar energy right-of-way grants will include a provision that specifies that ground disturbing activities cannot begin until the BLM authorized officer issues a Notice to Proceed (43 CFR 2807.10). In order to facilitate efficient development of solar energy on the public lands, the BLM will also include a requirement in each right-of-way grant that the holder begin construction of the initial phase of development within 12 months after issuance of the Notice to Proceed, but no later than 24 months after the effective date of the right-of-way authorization. Each grant will also specify that construction must be completed within the timeframes in the approved Plan of Development, but no later than 24 months after start of construction unless the project has been approved for phased development as described below. A Notice to Proceed will be issued for each phase of development.

The BLM will not authorize more than three development phases for any solar energy right-of-way authorization. If an approved Plan of Development provides for phased development, the right-of-way grant will include provisions specifying that construction of each phase (following the first) must begin within 3 years of the start of construction of the previous phase.

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The BLM authorized officer may suspend or terminate the authorization when the holder fails to comply with the diligent development terms and conditions of the authorization (43 CFR 2807.17). The regulations provide that before suspending or terminating the authorization, the BLM will send the holder a written notice that gives the holder a reasonable opportunity to correct any noncompliance or to start or resume use of the right-of-way (43 CFR 2807.18). This notice may be satisfied by the BLM sending a Notice of Failure to Ensure Diligent Development.

To address a failure to comply with a grant's diligent development provisions, the holder must show good cause for any delays in construction, provide the anticipated date of completion of construction and evidence of progress toward the start or resumption of construction, and submit a written request for extension of the timelines in the approved Plan of Development. Good cause may be shown, for example, by delays in equipment delivery, legal challenges, and acts of God. This procedure will apply whether a project has multiple development phases or a single phase.

If, following receipt of a Notice of Failure to Ensure Diligent Development, the holder has satisfactorily complied with each of the requirements of the procedure described above, the authorized officer may grant the holder's request for an extension of the timelines in the approved Plan of Development. If, following receipt of such Notice, the holder does not satisfactorily comply with each of the requirements of this procedure, the authorized officer may elect to suspend or terminate the right-of-way grant pursuant to 43 CFR 2807.17 where such action is justified.

Each right-of-way grant authorizing solar energy development will include terms and conditions requiring the holder to maintain all onsite electrical generation equipment and facilities in accordance with the design standards in the approved Plan of Development. In addition, the grant will specify that any idle, improperly functioning, or abandoned equipment or facilities that have been inoperative for any continuous period of 3 months must be repaired, placed into service, or removed from the site within 30 days from receipt of a written Notice of Failure to Ensure Diligent Development, unless the holder is provided an extension of time by the BLM authorized officer. Upon receipt of such Notice from the BLM authorized officer, the holder must timely repair, place into service, or remove the equipment or facilities described in the Notice. Alternatively, the holder must show good cause for any delays in repairs, use, or removal, estimate when corrective action will be completed, provide evidence of diligent operation of the equipment and/or facilities, and submit a written request for an extension of the 30-day deadline. If the holder satisfies neither approach, the BLM authorized officer may elect to suspend or terminate the authorization in accordance with 43 CFR 2807.17 – 2807.19 where such action is justified. In addition, the BLM may use the posted Performance and Reclamation bond to cover the costs for removal of any idle or abandoned equipment and/or facilities.

All solar energy right-of-way authorizations must include the diligent development provisions of this IM in the terms and conditions of the authorization, consistent with the requirements of 43 U.S.C. 1765(b) and the right-of-way regulations at 43 CFR 2801.2.

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Performance and Reclamation Bond

Title V of FLPMA and the right-of-way regulations authorize the BLM to require a right-of-way holder to provide a bond to secure the obligations imposed by the right-of-way grant (43 U.S.C. 1764(i) and 43 CFR 2805.12(g)). The BLM will require a Performance and Reclamation bond for all solar energy projects to ensure compliance with the terms and conditions of the right-of-way authorization.

Acceptable bond instruments include cash, cashier's or certified check, certificate or book entry deposits, negotiable U.S. Treasury securities equal in value to the bond amount, surety bonds from the approved list of sureties (U.S. Treasury Circular 570) payable to the BLM, irrevocable letters of credit payable to the BLM issued by financial institutions that have the authority to issue letters of credit and whose operations are regulated and examined by a federal agency, or a policy of insurance that provides BLM with acceptable rights as a beneficiary and is issued by an insurance carrier that has the authority to issue insurance policies in the applicable jurisdiction and whose insurance operations are regulated and examined by a federal or state agency. The BLM will not accept a corporate guarantee as an acceptable form of bond. If a state regulatory authority requires a bond to cover some portion of environmental liabilities, such as hazardous material damages or releases, reclamation, or other requirements for the project, the BLM must be listed as an additionally named insured on the bond instrument. This inclusion would suffice to cover the BLM's exposure should a holder default in any environmental liability listed in the respective state bond. Each bond instrument will be reviewed by the appropriate Regional Solicitor for the Department of the Interior prior to its acceptance by the BLM.

The BLM authorized officer will review all bonds on an annual basis to ensure adequacy of the bond amount. The bond will also be reviewed at the time of any right-of-way assignment, amendment, or renewal. The BLM authorized officer may increase or decrease the bond amount at any time during the term of the right-of-way authorization, consistent with the regulations (43 CFR 2805.12(g)).

The BLM authorized officer will identify the total amount of the Performance and Reclamation bond in the decision that supports the issuance of the right-of-way authorization. The BLM will require the holder to post the portion of the bond associated with the activities to be approved by the Notice to Proceed prior to the issuance of that Notice. For example, if the Notice to Proceed is limited to an initial phase of development, the bond amount required to be posted before issuance of the Notice to Proceed will be limited to that phase. The bond amount required to be posted would increase with the issuance of a Notice to Proceed for future phases of the project.

The Performance and Reclamation bond will consist of three components for purposes of determining its amount. The first component will address environmental liabilities including hazardous materials liabilities, such as risks associated with hazardous waste and hazardous substances. This component may also account for herbicide use, petroleum-based fluids, and dust control or soil stabilization materials. If a holder uses herbicides extensively, this component of the bond amount may be significant. The second component will address the decommissioning, removal, and proper disposal, as appropriate, of improvements and facilities. All solar projects involve the construction of substantial surface facilities and the bond amount for this component could be substantial. The third component will address reclamation, revegetation, restoration, and

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soil stabilization. This component will be determined based on the amount of vegetation retained onsite and the potential for flood events and downstream sedimentation from the site that may result in offsite impacts, including Clean Water Act violations or other violations of law. The holder of the right-of-way authorization can potentially reduce the bond amount for this component by limiting the amount of vegetation removal as part of the project design and limiting the amount of grading required for project construction.

Ultimately, the Performance and Reclamation bond will be a single instrument to cover all potential liabilities. The entire bond amount could be used to address a single risk event such as hazardous materials release or groundwater contamination regardless of the fact that in calculating the total bond amount other risks were also considered. If the bond is used to address a particular risk, the holder would then be required to increase the bond amount to compensate for this use. This approach to establishing a bond is preferable to one allowing holders to maintain separate bonds for each contingency. If separate bonds are held, an underestimation of one type of liability may leave the BLM responsible for making up the difference, as the funds associated with one bond may not be applicable for the purposes of another. Requiring a single, larger bond will ensure that the holders are bonded with a surety that has the capacity to underwrite the entire amount associated with the grant.

The regulations authorize the BLM to require that applicants submit a Decommissioning and Site Reclamation Plan (DSRP) that defines the reclamation, revegetation, restoration, and soil stabilization requirements for the project area as a component of their Plan of Development (43 CFR 2804.25(b)). The DSRP shall require expeditious reclamation of construction areas and the revegetation of disturbed areas to reduce invasive weed infestation and erosion and must be approved by the BLM authorized officer prior to the grant of the right-of-way. The approved DSRP will be used as the basis for determining the standard for reclamation, revegetation, restoration, and soil stabilization of the project area and, ultimately, in determining the full bond amount.

The BLM has issued policy guidance for determining bonding requirements for 43 CFR 3809 mining operations on the public lands (IM 2009-153, dated June 19, 2009) that provides detailed information about the process for determining the appropriate financial guarantees for intensive land uses on the public lands. This guidance can also be used to assist in calculating the bond amount for utility-scale solar energy development projects on public lands. The guidance requires that mining operators submit a Reclamation Cost Estimate (RCE) to the BLM authorized officer for review to assist in determining the bond amount. Although the right-of-way regulations do not specifically require that a holder of a right-of-way submit a RCE to the BLM, the BLM can require a right-of-way applicant to submit a Plan of Development in accordance with 43 CFR 2804.25(b). Because a RCE is key to determining the bond amount, a figure that is set forth in any decision authorizing a solar energy project on the public lands, BLM policy will be to require all solar energy right-of-way applicants to submit a RCE as part of the DSRP and the overall Plan of Development for a solar energy project. Attachment 1 to IM 2009-153 provides Guidelines for Reviewing Reclamation Cost Estimates and can be used as a guideline to assist in reviewing RCEs submitted for solar energy projects.

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To assist in the consistent review of RCEs for solar energy projects and the establishment of bonding amounts for individual projects, the BLM will form a Solar Energy Bond Review Team to provide support to the BLM state and field offices. The Solar Energy Bond Review Team will consist of one representative each from California, Nevada, and Arizona and a BLM Washington Office Right-of-Way Project Manager. This Solar Energy Bond Review Team will assist the BLM state and field offices in the review of RCEs for solar energy projects and provide recommendations to the BLM authorized officer on the Performance and Reclamation bond for a solar energy project.

Best Management Practices

The BLM is currently preparing a Solar Energy Development Programmatic Environmental Impact Statement (PEIS) that will identify the impacts of solar energy development and potential BMPs that could mitigate or reduce adverse impacts from solar energy development on the public lands. A preliminary set of potential BMPs has been developed as part of the preparation of the PEIS and posted at http://teamspace/sites/rmpnepadocs for consideration by BLM field offices as they analyze individual projects. These potential BMPs are set forth in a document entitled BLM Draft Mitigation Measures (October 2009), which can be found at the above website under the Solar PEIS folder, BLM BMPs folder, and BLM Draft Mitigation Measures folder. This set of potential BMPs is not complete and will continue to be modified as comments are received and as relevant information is collected from the processing of site-specific solar energy projects. This collection of potential BMPs is intended to serve as an interim resource to BLM field offices until the PEIS is completed and a Record of Decision has been issued.

The BLM Draft Mitigation Measures (October 2009) document also identifies a preliminary list of project-specific plans that will be required for each solar energy project and provides a brief description of the components of each plan. Many of the mitigation measures required for a project would be addressed within these project-specific plans. Examples of some of these plans include the Decommissioning and Site Reclamation Plan; Grading, Drainage, Erosion and Sedimentation Control Plan; Vegetation Management Plan; Habitat Restoration and Management Plan; Hazardous Materials Management Plan; Cultural Resources Management and Mitigation Plan; and Visual Restoration Monitoring and Compliance Plan. These plans are an essential part of a Plan of Development, which the BLM will require of an applicant (43 CFR 2804.25(b)). The terms and conditions of each right-of-way grant shall require that these plans be included in a Plan of Development and that the holder will fully comply with the terms of the plans. It is anticipated that additional plans will be identified as comments are received and as information is collected from the processing of individual solar energy projects.

BLM Access to Records

The BLM may require the holder of a solar energy development right-of-way authorization to provide any pertinent environmental, technical, and financial records, reports, and other information, including Power Purchase and Interconnection Agreements, related to project construction, operation, maintenance, and decommissioning, including the production and sale of electricity generated from the approved facilities on public land (43 CFR 2805.12(p); 43 U.S.C. 1765(b); 43 U.S.C. 1764(g); 43 U.S.C. 1761(b)). The BLM may use this information for the

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purpose of monitoring the authorization and for periodic evaluation and adjustment of rental fees or other financial obligations under the authorization.

Upon the request of the BLM authorized officer, the appropriate records, reports, or information shall be made available for inspection and duplication by such officer. Any information marked confidential or proprietary will be kept confidential to the extent allowed by law. Failure to cooperate with such request, provide data, or grant access to information or records, may, at the discretion of the BLM authorized officer, result in suspension or termination of the right-of-way authorization. All solar energy right-of-way authorizations must include such disclosure provisions in the terms and conditions of the authorization in accordance with the regulations (43 CFR 2807.17).

Timeframe: This policy is effective immediately. Pending applications will be processed consistent with the provisions of this IM.

Budget Impact: The application of this policy will have minimal budget impact. The processing of solar energy right-of-way applications are subject to the processing fee provisions of the regulations (43 CFR 2804.14).

Background: As part of an overall strategy to develop a diverse portfolio of domestic energy supplies for our future, the Energy Policy Act of 2005 (Public Law 109-58, August 8, 2005) encourages the development of renewable energy resources on the public lands, including solar energy. Section 211 of the Energy Policy Act encourages approval of non-hydropower renewable energy projects of at least 10,000 megawatts on the public lands by 2015. Secretarial Order 3285A1, signed on March 11, 2009, and amended on February 22, 2010, established the development of renewable energy as a priority of the Department of the Interior.

There is significant potential for the development of solar energy on the public lands in the southwestern states. The BLM has identified some 23 million acres of the public lands with utility-scale solar energy potential, and over 200 right-of-way applications have been submitted to the BLM for processing. As the cost of producing solar energy declines in future years, and as additional transmission capacity is developed, there will be an even greater interest in locating utility-scale solar energy projects on the public lands. This policy IM helps ensure environmentally-responsible development of solar projects on public lands and provides for effective processing of the right-of-way applications.

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Manual/Handbook Sections Affected: This IM transmits interim policy that will be incorporated into BLM Manual 2801, Right-of-Way Management, and Handbook H-2801-1 during the next revision.

Coordination: The BLM state offices reviewed and provided input to this policy prior to its finalization.

Contact: If you have questions, please contact Michael Nedd, Assistant Director for Minerals and Realty Management, at 202-208-4201, or your staff may contact Ray Brady, Renewable Energy Policy Team, at 202-912-7312, or ray_brady@blm.gov.



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A.2 BLM PROPOSED SOLAR ENERGY PROGRAM

A.2.1 Proposed Solar Energy Development Policies

A.2.1.1 Proposed Administration Policies

The BLM is directed to facilitate environmentally responsible development of solar energy projects on the public lands, consistent with the provisions of Secretarial Order 3285A1 dated March 11, 2009, as amended February 22, 2010. Applications for solar energy projects will be processed and authorized as ROWs under Title V of the Federal Land Policy and Management Act (FLPMA) and Title 43, Part 2800, of the *Code of Federal Regulations* (43 CFR Part 2800). Utility-scale concentrating solar power facilities or photovoltaic electric generating facilities must comply with the BLM's Solar Energy Program, including all planning, environmental, and ROW application requirements.

- As a land management agency with a multiple-use mission, the BLM will make land use decisions that sustain the health and productivity of public lands for the use and enjoyment of present and future generations. While solar energy development can provide many environmental and economic benefits, the BLM recognizes that such development must also be consistent with protection of other important resources and values, including units of the National Park System (NPS); national wildlife refuges; other specially designated areas; wildlife; and cultural, historic, and paleontological values. In making its decisions, the BLM will implement sound environmental policies, procedures, and siting and mitigation strategies that include coordination and consultation, as appropriate, with other potentially affected land and natural resource managers (both federal and non-federal) aimed at protecting our natural and cultural heritage, including the values and resources of specially designated areas.

- BLM authorized officers are encouraged to meet with their U.S. Fish and Wildlife Service (USFWS), NPS, and other local land and natural resource managing agency counterparts to develop an effective, streamlined coordination protocol that addresses local issues and conditions. The agreed-upon protocol may be incorporated into a Memorandum of Understanding.

- The BLM, recognizing that data regarding the actual impacts of solar energy development on various resources are still limited, will require the development and implementation of an adaptive management plan to ensure that new data and lessons learned about the impacts of solar energy projects will be reviewed and, as appropriate, incorporated into the Solar Energy Program. The adaptive management plan, to be coordinated with potentially-affected natural resource management agencies, will identify how the impacts of the Solar Energy Program will be evaluated; types of monitoring that would

be responsive to the data needs for program evaluation; science-based thresholds for modification to policy or individual project management based upon monitoring results; and a description of the process by which changes will be incorporated into the Solar Energy Program, including revisions to policies and design features. Sources of information to be considered in the context of adaptive management include data from specific project evaluations (for which monitoring would be required) as well as from project-specific and regional long-term monitoring programs. Changes to the BLM's Solar Energy Program will be subject to appropriate environmental analysis and land use planning.

- The BLM may offer lands within solar energy zones (SEZs) for competitive ROW authorizations on its own motion or as a result of nominations by the public.

- If lands within SEZs are not offered competitively, solar energy development applications for such lands will receive priority processing over other solar energy development applications.

- The BLM will discourage applicants from filing ROW applications for the purpose of speculating, controlling, or hindering development of solar energy on public lands.

- The BLM will assign all utility-scale solar energy development applications to Processing Category 6.

- The BLM will assign all utility-scale solar energy development authorizations to Monitoring Category 6.

A.2.1.2 Proposed Authorization Policies

The BLM proposes to adopt the following authorization policies, to be applicable to all future and existing ROW applications, as part of its proposed Solar Energy Program:

A.2.1.2.1 Pre-application Meeting

- The BLM authorized officer will schedule a pre-application meeting with developers to explain BLM's Solar Energy Program and to identify potential issues and land use conflicts (43 CFR 2804.10). The BLM will include potentially affected federal and state land managers, including USFWS and NPS representatives, to participate in such pre-application meetings with prospective project applicants. On the basis of these preliminary discussions and the recommendations of affected federal and state land managers, the BLM authorized officer may recommend that an application not be filed for a

given action or that a proposed project be modified from its original form prior to submission of an application. Proposals that avoid impacts to resources and values that are the basis for special designations or protections will be given strong consideration.

A.2.1.2.2 Application Analysis and Sufficiency

- The BLM will review applications for land use plan conformance (43 CFR 1610.5-3). To be considered further, applications must conform to the existing land use plan as amended by the Solar Programmatic Environmental Impact Statement (PEIS), including all solar ROW exclusions identified in Table 2.2-2.

- Entities seeking to develop a solar energy project on BLM-administered lands shall coordinate with potentially affected/appropriate federal agencies (e.g., USFWS, NPS), in conjunction with BLM staff, regarding specific projects as early in the project development process as appropriate to ensure that all issues and concerns (e.g., Migratory Bird Treaty Act [MBTA], Bald and Golden Eagle Protection Act [BGEPA], potential impacts on National Park resources) are identified and to ensure that there is potential for those issues to be adequately addressed.

- Entities seeking to develop a solar energy project on BLM-administered lands shall also coordinate with the U.S. Department of Defense (DoD), in conjunction with BLM staff, regarding the location of solar power tower projects early in the application process. This coordination shall occur concurrently at both the installation/field level and the Pentagon/BLM Washington Office level. An interagency protocol will be developed to establish a coordination process and the scope of issues to be addressed by such coordination.

- Entities seeking to develop a solar energy project on BLM-administered lands shall coordinate with appropriate state agencies and local land managers, in conjunction with BLM staff, regarding specific projects as early in the project development process as appropriate to ensure that all issues and concerns are identified and that there is potential for those issues to be adequately addressed.

- Entities seeking to develop a solar energy project on BLM-administered lands shall contact any potentially affected grazing permittee/lessee, in conjunction with BLM staff, to discuss potential impacts of the proposal, possible alternatives that could be addressed in scoping for the National Environmental Policy Act (NEPA), and potential mitigation and compensation strategies.

- Entities seeking to develop a solar energy project on BLM-administered lands shall contact the owner of any federal mining claim located with the boundaries of the proposed solar energy project, in conjunction with BLM staff, to ensure that there is a potential for resolving any conflicts with federal mining claims.

- The BLM will determine whether the lands included in the proposed solar energy project should be segregated from appropriation under the public land laws, including the mining laws, while the solar energy application is being considered by the BLM for authorization.

- On the basis of the analysis of the application and the necessary coordination described above, the BLM can exercise its discretion to deny an application that it finds to be inappropriate for solar ROW uses (43 CFR 2802.10(3)) or to be insufficient under any section of the ROW regulations. Projects that will cause unacceptable impacts to important resources and values will be denied. The denial of an application is an appealable decision. Offices must develop a rationale and record to support their decision to deny an application. Although they do not form a comprehensive list of items for consideration, the following items must be considered in the analysis of applications:

  – At the time a ROW application is submitted, the BLM will review the best available landscape-scale information (including information developed through complete or ongoing landscape conservation cooperatives [LCCs], partnerships, and rapid ecological assessments [REAs]) and will determine whether areas proposed for solar ROW uses and/or associated transmission facilities are inconsistent with other high-priority conservation, restoration, and/or adaptation objectives.

  – The extent to which the proposal will result in impacts to open space, particularly large and/or regionally important, undisturbed tracts. In general, proposals that utilize previously disturbed areas or areas that otherwise lack important open-space values will be given strong consideration.

  – The extent to which the proposal will result in impacts on areas of critical environmental concern (ACECs) and other special areas or sensitive cultural, recreational, wildlife, or visual resources, including special areas and resources administered by other agencies or organizations. In general, proposals that avoid impacts on resources that are the basis for special designations (e.g., National Parks and Monuments) will be given strong consideration.

  – The extent to which the proposal will result in impacts to high priority landscape features or focal areas important for conservation, restoration,

and/or adaptation to climate change, including core areas, corridors, and buffers for vulnerable species.

  - The extent to which the proposal will result in impacts on mitigation lands identified in previously approved projects, including those lands onto which plants or wildlife are translocated and any lands that are restored or managed more intensively to mitigate project impacts.

  - The extent to which the proposal will result in impacts to lands donated or acquired for conservation purposes. Applicants will be advised to avoid these lands or provide details on how they would plan to operate or mitigate their project in a manner consistent with the values of the lands donated or acquired for conservation purposes

- The BLM may consider proposed solar energy projects in areas with potential wilderness characteristics or in areas of citizen-proposed wilderness. Where these lands have not previously been inventoried, or where the BLM determines that the inventory should be updated, then, as part of the environmental review for proposed solar energy projects, these lands will be inventoried for wilderness characteristics. If an inventory determines that the lands have wilderness characteristics, then, consistent with applicable policy, the BLM shall consider whether to initiate a land use plan amendment process to determine how these lands should be managed. After completing the inventory process, if the BLM determines that wilderness characteristics are not present, it may proceed to process the proposed solar energy project consistent with applicable policy.

- The BLM will review the lands for sensitive resources and resource uses (e.g., paleontological, Endangered Species Act [ESA] listed, and BLM sensitive status species) and for potentially affected resources and values under the administration of other agencies (NPS, etc.). Assessment of the resources will include coordinating with appropriate federal, state, and local agencies that have regulatory authority for such resources. Coordination with the NPS may include a determination by the NPS as to whether a proposed project has the potential to cause unacceptable impacts to the resources and values of NPS-administered areas. (See recommendation to establish a local coordination protocol in Administration Policies above.)

- The BLM will consider the visual resource values of the public lands that could be affected by proposed solar energy development projects, consistent with BLM visual resource management (VRM) policies and guidance. The BLM will also coordinate with other potentially affected land managing agencies (including the NPS) regarding potential impacts to visual resources within shared viewsheds.

- To enhance the consideration and protection of the resources and values associated with shared landscapes (including nearby county, state, Tribal, or other federal agency lands, such as NPS lands), the BLM will coordinate and/or consult, as appropriate, with stakeholders who may be adversely affected by the BLM's decision to issue a ROW authorization for a solar energy development project. Potentially affected federal and state land managers will be provided the opportunity to participate in pre-application meetings with prospective project applicants (see Pre-application Meeting section above).

- The BLM will review applications to determine if the applicant can demonstrate adequate financial and technical capability to construct, operate, and maintain the solar energy facilities.

- The BLM will review applications to determine completeness. If necessary, the applicant will provide, in a timely manner, additional information requested by the BLM to process an application.

- Applicants will be required to submit an initial processing fee deposit and enter into a formal cost recovery agreement with the BLM for each solar energy ROW application filed. The applicant will provide, in a timely manner, the required processing fees.

A.2.1.2.3 NEPA Analysis and Compliance with Other Laws and Regulations for Proposed Projects

- Applicants for solar energy development on BLM-administered lands shall develop a BLM-approved plan of development (POD) that incorporates the required programmatic design features and SEZ-specific design features established in the BLM's Solar Energy Program and, as appropriate, the requirements of other existing and relevant BLM mitigation guidance, approved land use plans, and current policies. The POD must address all components of a solar energy generation facility, including the installation and maintenance of solar collectors, water for steam generation and cooling purposes, oil or gas used by backup generators, thermal or electrical storage, turbines or engines, access roads, and electrical inverters and transmission facilities.

- Management goals and objectives for special status species (such as the sage-grouse and desert tortoise) that the BLM has identified in land use plans or goals and objectives substantiated by best available information or science shall be incorporated into the POD for proposed solar energy projects.

- Individual projects will incorporate adaptive management strategies to ensure that potential adverse impacts of solar energy development are avoided,

minimized, or mitigated to acceptable levels. Operators will be required to develop monitoring programs in coordination with the BLM, to establish metrics against which monitoring observations can be measured, to identify additional potential mitigation measures, and to establish protocols for incorporating monitoring observations and additional mitigation measures into standard operating procedures and project-specific stipulations.

- The BLM must complete an environmental review of solar energy ROW applications in accordance with NEPA prior to issuing a ROW authorization. The coordination and considerations discussed above will also be an integral part of the necessary NEPA analysis. The level of environmental analysis to be required under NEPA will be determined at the field office level on an individual project basis. To the extent that land use plans and/or this PEIS anticipate issues and concerns associated with individual projects, including potential cumulative impacts, the BLM will tier from land use plans and/or the PEIS analysis, thereby limiting the required scope and effort of additional project-specific NEPA analysis. For projects that are proposed in SEZs, only limited additional NEPA analysis may be necessary because of the depth of the analysis contained in the PEIS. Potentially affected federal, state, local, and Tribal land managers and government agencies should be invited to participate as cooperating agencies in BLM's site-specific NEPA processes for solar ROW applications.

- The BLM will conduct project-specific public involvement prior to issuing a ROW authorization for solar energy development to ensure that all concerns and issues are identified and adequately addressed. Public involvement may occur as part of the NEPA process or separately, depending on the type of NEPA analysis undertaken. Opportunities for public involvement include, but are not limited to, scoping, public meetings, and public review and comment on completed NEPA documentation.

- The BLM will initiate government-to-government consultation with Indian Tribal governments whose interests might be directly and substantially affected by activities on BLM-administered lands and as required under Section 106 of the National Historic Preservation Act of 1966 (NHPA) as early in the project development process as appropriate to ensure that construction, operation, and decommissioning issues and concerns are identified and adequately addressed.

- The BLM will consult with the appropriate State Historic Preservation Officer(s) (SHPOs) and the Advisory Council of Historic Preservation, as required by Section 106 of NHPA.

- When lands are identified for project mitigation, the BLM will consider amending the applicable land use plan to identify those lands as ROW exclusion areas. Examples of project mitigation lands may include, but are not

limited to, lands onto which plants or wildlife are translocated and any lands that are restored or managed more intensively to mitigate project impacts.

- The BLM will determine if the proposed action may affect any listed or proposed threatened or endangered species or critical habitat. If so, the authorized officer would comply with Section 7 of the ESA.

- On the basis of the required NEPA analysis and public process, the BLM may decide to deny an application for a solar ROW authorization.

A.2.1.2.4 ROW Authorization

- Utility-scale solar energy projects will be authorized as ROW authorizations under Title V of the Federal Land Policy and Management Act and 43 CFR Part 2800.

- The BLM will issue all solar energy ROW authorizations for a term not to exceed 30 years; shorter terms may be justified in some cases. Each solar energy ROW authorization will contain a specific provision allowing for renewal, consistent with the regulations.

- All solar energy ROW authorizations will be issued subject to valid existing rights.

- The BLM will require payment of annual rent for use of the public lands on the basis of a rental schedule. The rental schedule will include a base rent for the acreage of public land included within the solar energy ROW authorization and an additional megawatt capacity fee based on the total authorized megawatt capacity for the approved solar energy project on public lands administered by the BLM. The BLM may adjust the rental whenever necessary, to reflect changes in fair market value as determined by the application of sound business management principles, and so far as practicable and feasible, in accordance with comparable commercial practices. The rental provisions of the authorization may also be modified consistent with the provisions of any regulatory changes or pursuant to the provisions of new or revised statutory authorities.

- The BLM will require a Performance and Reclamation Bond, in an amount determined by the authorized officer, for all solar energy development projects on BLM-administered lands to ensure compliance with the terms and conditions of the ROW authorization and to address environmental liabilities associated with hazardous waste and hazardous substances; decommissioning, removal, and proper disposal of improvements and facilities; and reclamation, revegetation, restoration, and soil stabilization. The authorized officer will require that the holder submit a Reclamation Cost Estimate for review and to

assist the authorized officer in determining the bond amount. The authorized officer will review the bond on an annual basis to ensure the adequacy of the bond amount. The authorized officer may increase or decrease the bond amount at any time during the term of the ROW authorization, consistent with the regulations.

- All solar energy ROW authorizations will include a provision that specifies that ground-disturbing activities cannot begin until the BLM authorized officer issues a Notice to Proceed (Form 2800-15). Each Notice to Proceed will authorize construction or use and occupancy only as therein expressly stated and only for the particular location or use and occupancy therein described (i.e., a construction phase or site location). The holder will not initiate any construction or other surface disturbing-activities on the ROW without such prior written authorization of the BLM authorized officer.

- Upon issuance of a ROW authorization that precludes livestock grazing, the BLM authorized officer will issue a separate proposed grazing decision to the grazing permittee/lessee that includes a copy of the ROW authorization. The proposed grazing decision will (a) state that the effective date of the permit/lease cancellation, and issuance of a new permit/lease for any remaining permitted use, will be 2 years from the permittee's/lessee's receipt of the certified letter; (b) address compensation for range improvements; (c) inform the permittee/lessee of his/her ability to unconditionally waive the 2-year notification requirement; and (d) address grazing management changes as required by the ROW issuance decision. The proposed grazing decision will become final unless protested.

- Upon issuance of a ROW authorization that includes meteorological or power towers or other tall structures that could pose a hazard to air navigation, the BLM will ensure the locations of such facilities are noted on aerial navigation hazard maps for low-level flight operations that may be undertaken by the BLM and other federal or state agencies for fire operations, wild horse and burro censuses and gathers, wildlife inventories, facility maintenance, or other activities.

- Failure of the holder to comply with any diligent development provision of the authorization may cause the authorized officer to suspend or terminate the authorization in accordance with 43 CFR 2807.17–2807.19 and use the posted Performance and Reclamation Bond to cover the costs for removal of any idle or abandoned equipment and/or facilities.

- The holder shall perform all operations in a good and workmanlike manner, consistent with the approved POD, so as to ensure protection of the environment and the health and safety of the public. The authorized officer may order an immediate temporary suspension of operations, orally or in

writing, in accordance with 43 CFR 2807.16 to protect public health or safety or the environment.

- Upon the request of the BLM authorized officer, the holder shall provide access to environmental, technical, and financial records, reports, and information related to construction, operation, maintenance, and decommissioning of the ROW authorization.

- The BLM authorized officer may change the terms and conditions of the authorization as a result of changes in legislation, regulations, or as otherwise necessary to protect public health or safety or the environment in accordance with 43 CFR 2801.15(e).

- Operators of solar power facilities on BLM-administered lands shall coordinate with the BLM and other appropriate federal, state, and local agencies regarding any planned upgrades or changes to the solar facility design or operation. Proposed changes of this nature may require additional environmental analysis and/or revision of the POD.

- The solar ROW authorization, shall, at a minimum, be reviewed by the BLM authorized officer at the end of the 10th year and at regular intervals thereafter not to exceed 10 years.

- The solar ROW authorization may be assigned consistent with the regulations, but all assignments are subject to approval by the BLM authorized officer.

- An application for renewal must be submitted at least 120 days prior to the expiration of the existing authorization. The BLM authorized officer will review the application for renewal to ensure the holder is complying with the terms, conditions, and stipulations of the existing authorization instrument and applicable laws and regulations. If renewed, the ROW authorization shall be subject to the regulations existing at the time of renewal and any other terms and conditions that the authorized officer deems necessary to protect the public interest.

A.2.2 Proposed Design Features

When incorporated into BLM's program in the Record of Decision (ROD), the following proposed design features will be required to be applied to all solar energy applications submitted to the BLM for consideration. Because of site-specific circumstances, some features may not apply to some projects (e.g., a resource is not present on a given site) and/or may require slight variations from what is described in the PEIS (e.g., a larger or smaller protective area). Applicants will be required to discuss any proposed variations with BLM staff. All variations in design features will require appropriate analysis and disclosure as part of future project authorizations. It is anticipated that variations in the design features presented will be approved in very limited circumstances. Those design features that do not apply to a given project will

need to be described as part of the project file along with an appropriate rationale. Additional mitigation measures may be identified and required during individual project development and environmental review.

The proposed design features are presented by resource area and also by project phase (e.g., siting and design, site characterization, construction, operations, and decommissioning). These design features were based on the potentially applicable mitigation measures given by resource area in Chapter 5. All Chapter 5 potentially applicable mitigation measures have been carried forward as proposed design features [Note: Citations for applicable agency guidance documents are given in Chapter 5].

Many of the proposed design features indicate the need for project-specific mitigation plans (see Table A.2-1). The content of these plans will depend on specific project requirements and locations, and their applicability and effectiveness also needs to be evaluated at the project-specific level. The BLM would need to determine the adequacy of such plans at the time of permitting for specific projects.

TABLE A.2-1 Mitigation Plans Specified as Elements of the Proposed Design Features[a]

Access Road Siting and Management Plan
Compensatory Mitigation and Monitoring Plan
Construction and Operation Waste Management Plan
Cultural Resources Management and Mitigation Plan
Decommissioning and Site Reclamation Plan
Drainage, Erosion, and Sedimentation Control Plan
Dust Abatement Plan
Ecological Resource Mitigation and Monitoring Plan
Fire Management and Protection Plan
Glint and Glare Assessment, Mitigation, and Monitoring Plan
Habitat Restoration and Management Plan
Hazardous Materials and Waste Management Plan
Heliostat Positioning Plan
Historic Treatment Plan
Integrated Vegetation Management Plan
Lighting Plan
Nuisance Animal and Pest Control Plan
Paleontological Resources Management Plan
Spill Prevention and Emergency Response Plan
Stormwater Management Plan
Traffic Management Plan
Trash Abatement Plan
Unanticipated Burial Contingency Plan
Water Resources Monitoring and Mitigation Plan
Wind Erosion Management Plan

[a] The need for each plan will need to be determined for specific projects.

In the very early stages of the development of siting and design plans, project developers shall coordinate with appropriate federal, state, and local agencies that regulate activities that affect land and water resources both appurtenant and adjacent to the proposed development to determine what permits or approvals may be needed for construction and operation of a solar facility.

A.2.2.1 Design Features for Lands and Realty

- Where there are existing BLM ROW authorizations within solar energy development areas, pursuant to Title 43, Part 2807.14 of the *Code of Federal Regulations* (43 CFR 2807.14), the BLM will notify ROW holders that an application that might affect their existing ROW has been filed and request their comments. Early discussion will occur with existing ROW holders to insure their rights are protected and that any issues are resolved.

- Where a designated transmission corridor is located within the area of proposed solar energy development project, the need for future transmission capacity in the corridor will be reviewed to determine whether the corridor should be excluded from solar development or whether the capacity of the designated transmission corridor can be reduced. Partially relocating the corridor to retain the current planned capacity will also be an option to be considered, as will relocating the solar project outside the designated corridor.

- Legal access to private, state, and public lands surrounding the solar facilities shall be retained to avoid creating areas that are inaccessible to the public and/or that would be difficult to manage. The effect on the manageability and uses of public lands remaining around boundaries of solar energy facilities shall be considered during the environmental analysis of project applications.

- Coordination with federal, state, and county agencies; Tribes; property owners; and other stakeholders shall be accomplished as early as possible in the planning process to identify potentially significant land use conflicts and issues and state and local rules that govern solar energy development. Significant issues that are raised, and potential modifications to proposed projects to eliminate or mitigate these issues, shall be considered in the environmental analysis of the project application.

- Consolidation of access and other supporting infrastructure shall be required for single projects and for cases in which there is more than one project in close proximity to another in order to maximize the efficient use of public land.

- The protection and preservation of evidence of Public Land Survey System (PLSS) and related federal property boundaries are required of project developers. Prior to commencing any action, evidence of the PLSS and related

property boundaries will be marked for protection. Coordination with BLM cadastral survey staff shall be accomplished to help provide data, search for and evaluate evidence, locate monuments of the PLSS and related property boundaries, and protect them from destruction. If a proposed action is within one-quarter mile of any project boundary, a Chain of Survey Certificate, conformal to the Departmental standard, must be issued. In some cases, Land Description Reviews, Certificates of Inspection and Possession, Boundary Assurance Certificates, resurveys, re-monumentation, and/or referencing of PLSS corners may be required before the start of any action.

- If a proposed action might have an adverse effect on prime and unique farmland, this possibility must be discussed in the associated environmental analysis, along with a consideration of alternatives or appropriate mitigation measures.

- For solar energy and related transmission facilities, the hazards associated with the heights of facilities and the glare from reflective surfaces shall be evaluated through coordination with local airport operators. Proposed construction of any facility that is taller than 200 ft (61 m) must be submitted to the Federal Aviation Administration (FAA) for evaluation of safety hazards.

A.2.2.2 Design Features for Specially Designated Areas and Lands with Wilderness Characteristics

- Solar facilities shall be located and designed to minimize impacts on specially designated areas and lands with wilderness characteristics[1].

- Protection of existing values of specially designated areas and lands with wilderness characteristics shall be evaluated during the environmental analysis of solar energy project applications, and the results shall be incorporated into the project planning and design to minimize off-site impacts.

- Any lands that have not been recently inventoried for wilderness characteristics or any lands that have been identified in any citizen's wilderness proposal shall be inventoried for wilderness characteristics prior to any solar development action being approved within these areas.

A.2.2.3 Design Features for Rangeland Resources—Grazing

- Contact with grazing permittees shall be initiated at the earliest possible time to explore whether modifications could be made to a solar development

[1] See Section 4.3 for details on areas included in these categories.

proposal to minimize impacts on grazing use, especially impacts related to water availability, livestock improvements, access road location, and movement of livestock between pastures. Compensation for or relocation of range improvements shall also be discussed. The ROW applicant and permittee/lessee shall be strongly encouraged to enter into an agreement that addresses mitigation and compensation for range improvements.

- Access roads shall be constructed, improved, and maintained to minimize their impact on grazing operations. Road design shall include fencing, cattle guards, and signs.

- Wherever there are reductions in grazing use, opportunities for mitigating this loss through changes in livestock management or the installation of range improvements shall be considered.

A.2.2.4 Design Features for Wild Horses and Burros

- Activities of project developers shall be coordinated with the BLM and other stakeholders to ensure that impacts on wild horses and burros and their management areas are minimized. Issues to be addressed could include the installation of fencing and access control, provision for movement corridors, delineation of open range, traffic management (e.g., vehicle speeds), and access to water sources.

- Access roads shall be appropriately constructed, improved, and maintained and employ signs to minimize potential horse and burro collisions. Fences shall be built to exclude wild horses and burros from all project facilities, including all water sites built for the development of facilities and roadways.

A.2.2.5 Design Features for Wildland Fire

- In areas susceptible to wildland fire, coordination with the BLM and local fire organizations shall be required early in the project planning process to determine design features to be incorporated into the design of the project to prevent an increase in wildland fire frequency.

- A vegetation plan designed to prevent the establishment of non-native, invasive species on the solar energy facility and along transmission line ROWs and roads shall be developed and implemented to minimize the potential for increasing the frequency of wildland fires.

- The ROWs for solar facilities shall be large enough to ensure there is a sufficient fire break inside the ROW so there would be no threat to facilities from either a wildland fire approaching from outside the ROW or a fire

moving from inside to outside the ROW. This distance shall be determined through coordination with fire management staff, and actions, both active and passive (e.g., vegetation manipulation), shall be undertaken specifically to remove the need for protective responses by the BLM, state, and local fire organizations.

- The effectiveness of developing and adhering to a fire safety plan and providing worker training to reduce fire risks shall be evaluated.

A.2.2.6 Design Features for Recreation Impacts

- Public access through or around solar facilities shall be retained to permit continued use of public lands and non-BLM administered lands.

- Solar facilities shall not be placed in areas of unique or important recreation resources.

- Replacement of acreage lost for off-highway vehicle use shall be considered as part of the analysis of project-specific impacts. Any process for designating a replacement route would include the consideration of the designation criteria for routes as specified in 43 CFR 8342.1 and would be consistent with existing land use plans.

A.2.2.7 Design Features for Military and Civilian Aviation

- Decisions regarding the location of solar facilities and transmission facilities near or within military training routes or adjacent to military or civilian airports shall be coordinated with military and civilian airspace managers very early in the processing of solar project applications, in order to identify and mitigate potential impacts on military and civilian airport and airspace use.

- The FAA shall be contacted early in the process of considering a solar energy project application to determine if there might be any potential impacts on aviation and if any mitigation might be required to protect military or civilian aviation use.

- As part of the evaluation of impacts from the development of solar energy facilities, their potential for impacting the operation of existing military installations, either because they displace species onto an installation or because they increase the significance of special status species populations on the installation, shall be included as part of the environmental impact analysis of the solar energy project.

A.2.2.8 Design Features for Soil Resources and Geologic Hazards

Erosion-control measures shall be based on an assessment of site-specific conditions and include minimizing the extent of disturbed areas, stabilizing disturbed areas, and protecting slopes and channels in the project area. Measures to control sedimentation shall focus on retaining sediment on-site and implementing controls along the project site perimeter.

Developers shall conduct (as necessary) geotechnical engineering and hydrology studies to characterize site conditions related to drainage patterns, soils, vegetation, surface water bodies, land subsidence, and steep or unstable slopes. The results of such studies shall be compiled into reports to aid in the permitting, design, and construction of a proposed solar project. In the geotechnical engineering report, factors such as soil properties, engineering constraints, the corrosive potential of construction materials, stability, and facility design criteria shall be identified. The hydrology report shall present data on local water bodies, surface water drainage patterns, floodplains, rainfall, and expected runon and runoff volumes and flow rates. Many of the design features listed below shall be components of the various plans required to mitigate the impacts of solar energy facilities, particularly the Drainage, Erosion, and Sedimentation Control Plan, Wind Erosion Management Plan, Access Road Siting and Management Plan, Dust Abatement Plan, Integrated Vegetation Management Plan, Ecological Resource Mitigation and Monitoring Plan, Habitat Restoration and Management Plan, Spill Prevention and Emergency Response Plan, and Stormwater Management Plan. Plans shall be revised or amended as necessary to account for changes in site conditions as a project proceeds from construction through the decommissioning phases. Applicants must obtain and meet the requirements of all applicable federal, state, and county permits and building codes.

Studies may also be needed to determine whether construction and operation of a solar facility within a proposed SEZ would affect the eolian processes that maintain nearby sand dunes (e.g., Big Dune in Amargosa Valley). The need for such studies would be evaluated on a case-by-case basis.

Project developers shall implement the design features for soil resources given below and develop others that address unique site conditions not anticipated here. Routine site inspections shall be conducted to identify and correct improperly installed, damaged, or ineffective design features. Inspections shall be made more frequently during the rainy season and during and following intense rainfall events to ensure the timeliness of corrective actions.

A.2.2.8.1 Siting and Design

- The footprint of disturbed areas—including the number and size/length of roads, fences, borrow areas, and laydown and staging areas—shall be minimized. The boundaries of disturbed area footprints shall be clearly delineated on the ground (e.g., through the use of construction fencing).

- Project structures and facilities should be sited to avoid disturbance in areas with existing biological soil crusts to the extent possible.

- Project areas shall be replanted with native vegetation at spaced intervals to the extent possible to break up areas of exposed soil and reduce soil loss by wind erosion.

- Land disturbance (including crossings) in natural drainage systems and groundwater recharge zones, specifically ephemeral washes and dry lake beds, are to be avoided. Any structures crossing drainages must be located and constructed so that they do not decrease channel stability or increase water volume or velocity. Developers shall obtain all applicable federal and state permits.

- Solar facilities or components (e.g., heliostats, panels, dishes, and troughs) shall not be placed in natural drainage ways.

- Adequate space (i.e., setbacks) between solar facilities and natural washes is to be maintained to preserve their hydrological function and provide a buffer for flood control.

- Existing roads, disturbed areas, and borrow pits shall be used. In addition, all borrow pits shall be identified beforehand and included in the NEPA direct and indirect analyses. If new roads are necessary, they shall be designed and constructed to the appropriate road design standards, such as those described in BLM Manual 9113. The specifications and codes developed by the U.S. Department of Transportation (DOT) are also to be taken into account.

- New roads shall be designed to follow natural land contours and avoid or minimize hill cuts in the project area and avoid existing desert washes. Siting of new roads and walking trails (if any) is to be consistent with the designation criteria specified by the BLM in 43 CFR 8342.1.

- Ground-disturbing geotechnical studies (e.g., geotechnical drilling) shall adhere to the permitting requirements specified by the BLM in 43 CFR Part 2920.

- Roads shall be designed on the basis of local meteorological conditions, soil moisture, and erosion potential in order to avoid erosion and changes in surface water runoff .

- Temporary roads shall be designed with eventual reclamation in mind.

- Areas with unstable slopes shall be avoided, and local factors that can cause slope instability (e.g., groundwater conditions, precipitation, earthquake activity, slope angles, and the dip angles of geologic strata) shall be identified.

- Excessive grades shall be avoided on roads, road embankments, ditches, and drainages, especially in areas with erodible soils.

- The creation of excessive slopes shall be avoided during site preparation and construction. Special construction techniques are to be used in areas of steep slopes, erodible soil, and drainage ways.

- Construction shall be conducted in stages to limit the areas of exposed soil at any given time. For example, only land that will be actively under construction in the near term (e.g., within the next 6 to 12 months) should be cleared of vegetation.

A.2.2.8.2 General Multiphase Measures

- Potential soil erosion shall be controlled at culvert outlets with appropriate structures.

- Catch basins, roadway ditches, and culverts shall be cleaned and maintained regularly.

- Abandoned roads and roads no longer needed shall be subsoiled to increase infiltration and reduce soil compaction, then recontoured and revegetated.

- Ground-disturbing activities shall be minimized, especially during the rainy season.

- Originally excavated materials shall be used for backfill.

- The speed of vehicles and equipment on unpaved surfaces shall be controlled to reduce dust emissions.

- Runoff from slope tops shall be controlled and directed to settling or rapid infiltration basins (temporarily) until disturbed slopes are stabilized. Disturbed slopes shall be stabilized as quickly as possible.

- Drainage crossings shall be stabilized as quickly as possible, and channel erosion from runoff caused by the project shall be prevented.

- Sediment-laden waters from disturbed, active areas within the project site shall be retained through the use of barriers and sedimentation devices (e.g., berms, straw bales, sandbags, jute netting, or silt fences). Such barriers and devices should not be installed in wildlife crossing areas.

- Barriers and sedimentation devices shall be placed around drainages and wetlands to prevent contamination by sediment-laden water.

- Sediment from barriers and sedimentation devices shall be removed to restore sediment-control capacity.

- Routine site inspections shall be conducted to assess the effectiveness and maintenance requirements for erosion and sediment control systems.

- Barriers and sedimentation devices shall be maintained, repaired, or replaced as necessary to ensure optimum control.

- A spill prevention plan to identify sources, locations, and quantities of potential chemical releases (through spills, leaks, or fires) and define response measures and notification requirements shall be developed and followed to reduce the potential for soil contamination. The plan shall also identify individuals and their responsibilities for implementing the plan.

A.2.2.8.3 Site Characterization and Construction

- Construction activities shall take place over as short a timeframe as possible once ground disturbance has occurred. If an activity requires an extended schedule, measures to limit wind and water erosion shall be employed during the activity (rather than after the activity) to the extent possible.

- Construction traffic shall avoid unpaved surfaces (to reduce the risk of compaction) and reduce speed to lessen fugitive dust emissions.

- The clearing and disturbing of sensitive areas (e.g., steep slopes and natural drainages) and other areas shall be avoided outside the construction zone. The construction zone boundaries shall be clearly delineated on the ground (e.g., through the use of construction fencing).

- Ground disturbance from construction-related activities, such as vehicle and foot traffic, shall avoid areas with intact biological soil crusts to the extent possible. For cases in which impacts cannot be avoided, soil crusts will be salvaged and restored on the basis of recommendations by BLM once construction has been completed.

- The creation of excessive slopes shall be avoided during site preparation and construction (e.g., during excavation). Special construction techniques shall be used, where applicable, in areas of steep slopes, erodible soil, and stream channel crossings.

- Electrical lines from solar collectors shall be buried along existing features (e.g., roads or other paths of disturbance) to minimize the overall area of surface disturbance whenever possible.

- Borrow materials shall be obtained only from authorized and permitted sites.

- Construction grading shall be conducted in compliance with good industry practice (e.g., the American Society for Testing and Materials [ASTM] international standard methods) and other requirements (e.g., BLM and/or local grading and construction permits), as they apply.

- Erosion-control structures (e.g., rock lining or apron) shall be added at culvert outlets to reduce flow velocity and minimize the potential for scouring.

- Temporary stabilization of disturbed areas that are not actively under construction shall occur throughout the construction phase. Soil stabilization methods, such as erosion matting (organic or synthetic mats or blankets) or soil aggregation (binding), are examples of measures that should be used to limit wind erosion and dust emissions, as site conditions warrant.

- Permanent stabilization of disturbed areas shall occur during final grading and landscaping of the site.

- Water or other stabilizing agents shall be used to wet roads in active construction areas and laydown areas in order to minimize the windblown erosion of soil.

- Topsoil from all excavation and construction activities shall be salvaged so it can be reapplied to the disturbed area once construction is completed.

- Native plant communities in disturbed areas shall be restored by natural revegetation or by seeding and transplanting (using weed-free native grasses, forbs, and shrubs), on the basis of BLM recommendations, as early as possible once construction is completed.

- Construction on wet soils shall be avoided.

A.2.2.8.4 Operations

- All design features developed for the construction phase shall be applied to similar activities during the operations phase.

- The area disturbed by operation of a solar energy project shall be minimized (e.g., by using existing roads).

A.2.2.8.5 Decommissioning/Reclamation

- All design features developed for the construction phase shall be applied to similar activities during the decommissioning/reclamation phase.

- The original grade and drainage pattern shall be re-established.

- Native plant communities in disturbed areas shall be restored by natural revegetation or by seeding and transplanting (using weed-free native grasses, forbs, and shrubs), on the basis of BLM recommendations, as early as possible once decommissioning is completed.

A.2.2.8.6 Geologic Hazards

The potential geologic hazards that could be significant at solar project sites in the six-state study area include seismic ground shaking, ground rupture, liquefaction, slope instability, subsidence (collapse) and settlement, expansive soils, and flooding and debris flows. Solar project developers shall conduct geotechnical studies (as needed) to identify and assess these hazards and to propose facility design criteria and site-specific design features. The design feature to address geologic hazards would therefore be to build project structures in accordance with the design-basis recommendations specified in the project-specific geotechnical investigation report. Structure designs must meet the requirements of all applicable federal, state, and county permits and building codes.

In areas of high seismic activity (especially those having soils with a high liquefaction potential) or in areas that encompass 100-year floodplains, the most effective design feature is to alter the location or scope of the proposed project.

A.2.2.9 Design Features for Mineral Resources

- Where valid mining claims or leases exist, early consultation with claim or lease holders shall be initiated to determine whether it would be possible to locate solar facilities in or near these areas in such a way as to avoid future adverse effects on mineral development activities.

- All solar energy development ROWs will contain the stipulation that BLM retains the right to issue oil and gas or geothermal leases with a stipulation of no surface occupancy within the ROW area. Upon designation, SEZs will be classified as no surface occupancy areas for oil and gas and geothermal leasing.

- Transmission lines shall be located to avoid conflicts with mining activities in areas with active mineral development.

A.2.2.10 Design Features for Water Resources

The main objectives of the design features for water resources are to (1) promote the sustainable use of water resources through appropriate technology selection and conservation

practices and (2) protect the quality of natural water bodies (including streams, wetlands, ephemeral washes, and floodplains, as well as groundwater aquifers) in and around solar energy facilities. An important aspect of implementing these measures is coordinating with federal, state, and local agencies that regulate the use of water resources to meet the requirements of permits and approvals needed to (1) obtain water for development and (2) alter the land surface. In the following subsections, design features for solar energy facilities are given, grouped by phase of development.

A.2.2.10.1 Siting and Design

In the very early stages of the development of siting and design plans, project developers shall coordinate with appropriate federal, state, and local agencies that regulate activities that affect land and water resources to determine what permits or approvals may be needed for construction and operation of a solar facility. This coordination would facilitate the following activities and objectives:

- All structures related to the solar energy facility shall be sited in locations that minimize impacts on surface water bodies, ephemeral washes, playas, and natural drainage areas (including groundwater recharge areas).

- Project developers shall plan to implement water conservation measures related to solar energy technology water needs in order to reduce project water requirements. Developers shall minimize the consumptive use of fresh water for power plant cooling by, for example, using dry cooling, using recycled or impaired water, or selecting solar energy technologies that do not require cooling water.

- Project developers shall conduct a preliminary hydrologic study demonstrating a clear understanding of the local surface water and groundwater hydrology. The primary purpose of this preliminary hydrologic study is to identify surface watersheds and groundwater basins directly affected and connected to the location of the project site, and the study will include the following information:

  – The relationship of the project site hydrologic basin to the basins in the region;

  – Identification of all surface water bodies (including rivers, streams, ephemeral washes/drainages, lakes, wetlands, playas, and floodplains);

  – Identification of all applicable groundwater aquifers; and

  – Preliminary estimates of the physical characteristics of surface water features and groundwater aquifers, the connectivity of surface water and groundwater, and the regional climate (seasonal and long term).

- Project developers shall plan to avoid impacts on existing surface water features, including streams, lakes, wetlands, floodplains, intermittent streams, playas, and ephemeral washes/drainages (any unavoidable impacts would be minimized) of the development and in nearby regions according to:

  – All sections of the Clean Water Act (CWA), including Sections 401, 402, and 404 addressing licensing and permitting issues;

  – Executive Orders (E.O.s) 11988 and 11990 of May 24, 1977, regarding floodplain and wetland management: E.O. 11988, "Floodplain Management" (*Federal Register*, Volume 42, page 26951 [42 FR 26951]), and E.O. 11990, "Protection of Wetlands" (42 FR 26961);

  – U.S. Environmental Protection Agency (EPA) stormwater management guidelines and applicable state and local guidelines;

  – National Wild and Scenic Rivers System (Public Law 90-542; 16 *United States Code* [U.S.C.] 1271 et seq.); and

  – Identification of impaired surface water bodies in accordance with Section 303(d) of the CWA.

- Project developers shall plan to minimize impacts to groundwater aquifers.

  – Impacts on sole source aquifers shall be avoided according to EPA guidelines.

- Project developers should avoid impacts on local surface water and groundwater drinking water supplies (amounts and water quality) and develop mitigation plans in the event that local drinking water sources are contaminated or depleted by project activities.

As project developers formulate final siting and design plans for solar energy facilities, the following activities and objectives shall occur or be considered in order to minimize impacts on water resources, They are to be done in coordination with the appropriate local, state, and federal regulating agencies. The following items relate to quantification and characterization of the existing hydrology, land alteration issues, water rights, and water quality.

- Mitigation plans shall be developed as described in Section 5.1.

- A Drainage, Erosion, and Sedimentation Control Plan shall be developed that ensures protection of water quality and soil resources, demonstrates no increase in off-site flooding potential, and includes provisions for stormwater and sediment retention on the project site. The plan shall identify site surface water runoff patterns and develop mitigation measures that prevent excessive and unnatural soil deposition and erosion throughout and downslope of the

project site and project-related construction areas. The plan shall achieve the following:

  - Runoff from parking lots, roofs, or other impervious surfaces shall be directed to retention basins prior to being released downgradient of the site;

  - Any landscaping used for stormwater treatment shall require little or no irrigation and would be recessed to create retention basins/areas used to capture runoff;

  - The amount of area covered by impervious surfaces shall be reduced through the use of permeable pavement or other pervious surfaces; and

  - Natural drainages and a pre-project hydrograph shall be maintained for the area.

- A Stormwater Management Plan shall be developed for the site to ensure compliance with applicable regulations and prevent off-site migration of contaminated stormwater, changes in pre-project storm hydrographs, or increased soil erosion.

  - Siting in identified 100-year floodplains shall not be allowed within the development.

  - Project developers shall be required to maintain the pre-development flood hydrograph for all storms up to and including the 100-year rainfall event. All stormwater retention and/or infiltration and treatment systems shall also be designed for all storms up to and including the 100-year storm event.

- As part of a Spill Prevention and Emergency Response Plan, measures to prevent potential groundwater and surface water contamination shall be identified.

- Developers shall be required to conduct a detailed hydrologic study that demonstrates their clear understanding of the local surface water and groundwater hydrology. At a minimum, this hydrologic study shall include:

  - Quantification of physical characteristics describing surface water features, such as streamflow rates, stream cross sections, channel routings, seasonal flow rates (intermittent streams), peak flow rates (ephemeral washes/drainages), sediment characteristics and transport rates, lake depths, and surface areas of lakes, wetlands, and floodplains;

  - Hydrologic analysis and modeling to define the 100-year, 24-hour rainfall for the project area and calculate projected runoff from this storm at the site;

  - Hydrologic analysis and modeling to identify 100-year floodplain boundaries of any surface water feature on the site;

  - Quantification of physical characteristics describing the groundwater aquifer, such as physical dimensions of the aquifer, sediment characteristics, confined/unconfined conditions, hydraulic conductivity and transmissivity distribution of the aquifer, groundwater surface elevations, and groundwater flow processes (direction, recharge/discharge, current basin extractions, surface water/groundwater connectivity), and lag times between groundwater withdrawals and surface water depletions);

  - Quantification of the regional climate, including seasonal and long-term information on temperatures, precipitation, evaporation, and evapotranspiration; and

  - Quantification of the sustainable yield of surface waters and groundwater available to the project. Project developers should evaluate the water sources in terms of existing water rights and management plans for their adequacy with regard to serving project demands while maintaining aquatic, riparian, and other water-dependent resources.

- Project developers shall quantify water use requirements for project construction, operation, and decommissioning.

- Water sources used for potable water supply shall meet federal, state, and local water quality standards (e.g., Sections 303 and 304 of the CWA).

- Developers shall identify wastewater treatment measures and new or expanded facilities, if any, to be included as part of the facility's National Pollutant Discharge Elimination System (NPDES) permit.

- Developers shall coordinate with state/local regulatory agencies regarding the issuance of permits or "will-serve" agreements for the development and use of water and/or the operation of on-site wastewater treatment systems.

- Project developers shall coordinate with appropriate water rights agencies for securing water rights.

- Project developers shall choose appropriate water sources with respect to available water rights and management practices and with respect to maintaining aquatic, riparian, and other water-dependent sources (that may vary in water requirements on a temporal basis).

- Project developers who plan to use groundwater shall develop and implement a groundwater monitoring plan that includes monitoring the effects of groundwater withdrawal for project uses, of vegetation restoration and dust control uses during decommissioning, and of aquifer recovery after project decommissioning. Monitoring frequency shall be decided on a site-specific basis and in coordination with federal, state, and local agencies that manage the groundwater resources of the region.

- If groundwater use is proposed, project developers shall ensure that a comprehensive analysis of the groundwater basin is provided and that the following potential significant impacts are evaluated:

  – Creation or exacerbation of overdraft conditions and their potential to cause subsidence and loss of aquifer storage capacity;

  – Uses that cause injury to other water rights claims in the basin;

  – Estimates of the total cone of depression considering cumulative drawdown from all potential pumping in the basin, including the project, for the life of the project through the decommissioning phase;

  – Changes in water quality that affect other beneficial use; and

  – Effects on surface water resources such as streams, springs, seeps, and wetlands that provide water and associated habitat for plants and animals.

- Project developers who plan to use surface water sources shall develop a surface water monitoring plan that includes monitoring changes in flows, volumes, and water quality during construction and operations, as well as their recovery during decommissioning. Monitoring frequency shall be decided on a site-specific basis and in coordination with federal, state, and local agencies that manage the surface water resources of the region.

- If surface water use is proposed, project developers shall ensure that a comprehensive analysis of the supply is provided and that the following potential significant impacts are evaluated:

  – Effects on other users;

  – Effects on water quality;

  – Effects on other water resources;

  – Effects on other environmental resources, including plants and animals that directly or indirectly depend on those water sources;

  - Effects on the natural hydrograph of the supply; and

  - Effects on the reliability of the supply.

A.2.2.10.2 Site Characterization and Construction

- The facility shall obtain and comply with a construction stormwater permit through the EPA or state-run NPDES program (whichever applies within the state). In addition, the EPA requires that any development larger than 20 acres (0.08 km^2) and begun after August 2011 must comply with a requirement to monitor construction discharges for turbidity concentrations.

- Groundwater wells constructed during any stage of the project shall conform to state and local standards and include:

  - Legal description (township, range, section, and quarter section);

  - Project map with proposed and existing well locations;

  - Well design characteristics: casing diameter, screened interval(s), well depth, and static water level;

  - Results of groundwater pumping tests or other tests done in the well;

  - Anticipated pumping capacity and peak pumping rates;

  - Identification of the groundwater aquifer and its hydrogeologic characteristics;

  - Estimation of the potential cone of depression that might be produced by the proposed pumping throughout the lifetime of a project by using an analytical or numerical model; and

  - Estimate of the total cone of depression considering cumulative drawdown from all potential pumping in the basin, including the project, for the life of the project through the decommissioning phase by using an analytical or numerical model.

- Construction activities shall avoid land disturbance in ephemeral washes and dry lakebeds; any unavoidable disturbance would be minimized. Stormwater facilities shall be designed to route flow around the facility and maintain pre-project hydrographs.

- When stream or wash crossings are constructed, culverts or water conveyances for temporary and permanent roads shall be designed to comply

with county standards or to accommodate the runoff of a 100-year storm, whichever is larger.

- Geotextile mats shall be used to stabilize disturbed channels and streambanks.

- Earth dikes, swales, and lined ditches shall be used to divert work-site runoff that would otherwise enter a disturbed stream.

- Certified weed-free straw bale barriers shall be installed to control sediment in runoff water; straw bale barriers shall be installed only where sediment-laden water can pond, thus allowing the sediment to settle out.

- Check dams (i.e., small barriers constructed of rock, gravel bags, sandbags, fiber rolls, or reusable products) shall be placed across a constructed swale or drainage ditch to reduce the velocity of flowing water, thus allowing sediment to settle and reducing erosion.

- Special construction techniques shall be used, where applicable, in areas of erodible soil, alluvial fans, and stream channel/wash crossings.

- Disturbed soils shall be reclaimed as quickly as possible, or protective covers should be applied.

- Topsoil removed during construction shall be reused for reclamation.

- Foundations and trenches shall be backfilled with originally excavated material as much as possible; excess excavated material shall be disposed of according to state and federal laws.

- If drilling activities are required as part of site characterization, any drilling fluids or cuttings shall be maintained so that cuttings, fluids, or runoff from storage areas will not come in contact with aquatic habitats. Temporary impoundments for storing drilling fluids and cuttings shall be lined to minimize the infiltration of runoff into groundwater or surface water.

- Washing equipment or vehicles in streams and wetlands shall be avoided because doing so increases their sediment loads.

- Entry and exit pits shall be constructed in work areas to trap sediments from vehicles so that they do not enter into streams at stream crossings. Prerequisites to excavating the entry and exit pits shall include:

  – Locating the entry and exit pits far enough from stream banks and at a sufficient elevation to avoid inundation by storm flow stream levels and to minimize excessive migration of groundwater into the entry or exit pits;

  - Isolating the excavation for the entry and exit pits from the surface water by using silt fencing to avoid sediment transport by stormwater; and

  - Isolating the spoils storage resulting from excavation of the entry and exit pits by using silt fencing to avoid sediment transport by stormwater.

- Good waste management practices shall be adopted for handling, storing, and disposing of wastes generated by a construction project to prevent the release of waste materials into stormwater discharges. Waste management includes the following: spill prevention and control, construction debris and litter management, concrete waste management, and liquid waste management.

- Any wastewater generated in association with temporary, portable sanitary facilities shall be periodically removed by a licensed hauler and introduced into an existing municipal sewage treatment facility. Portable sanitary facilities provided for construction crews shall be adequate to support expected on-site personnel.

- The creation of hydrologic conduits shall be avoided between two aquifers during foundation excavation and other activities.

- If chemical dust palliatives (suppressants) are used, they shall be selected and applied in accordance with the facilities Dust Abatement Plan.

- When an herbicide/pesticide is used to control vegetation, the climate, soil type, slope, and vegetation type shall be considered in determining the risk of herbicide/pesticide contamination. In addition, a Nuisance Animal and Pest Control Plan and an Integrated Vegetation Management Plan shall be developed to ensure that applications will be conducted within the framework of BLM and DOI policies and standard operating procedures and will entail the use of only EPA-registered pesticides/herbicides that also comply with state and local regulations.

- All hazardous materials and vehicle/equipment fuels shall be transported, stored, managed, and disposed of in accordance with accepted best management practices (BMPs) and in compliance with all applicable regulations and the requirements of approved plans, including, where applicable, a Stormwater Management Plan, Spill Prevention and Emergency Response Plan, and Hazardous Materials and Waste Management Plan.

- Project developers shall avoid or minimize and mitigate the degradation of water quality (e.g., chemical contamination, increased salinity, increased temperature, decreased dissolved oxygen, and increased sediment loads) that

could result from construction activities. Water quality in areas adjacent to or downstream from development areas shall be monitored during the life of the project to ensure that water quality is protected.

A.2.2.10.3 Operations

- The use of water shall not contribute to the significant long-term decline of groundwater levels or surface water flows and volumes. Any project-related water use shall not contribute to withdrawals that exceed the sustainable yield of the surface water or groundwater source.

- Water use shall be minimized by implementing conservation practices, such as treating spent wash water and storing it for reuse.

- The treatment of sanitary and industrial wastewater either on-site or off-site shall comply with federal, state, and local regulations. Any discharges to surface waters would require NPDES permitting. Any storage or treatment of wastewater on-site shall have to ensure proper lining of holding ponds and tanks to prevent leaks.

- Berms and other controls shall be used at facilities to prevent off-site migration of any leaked or spilled heat transfer fluid (HTF), thermal energy storage (TES) fluids, or any other chemicals stored or used at the site.

- Project developers shall avoid or minimize and mitigate the degradation of water quality (e.g., chemical contamination, increased salinity, increased temperature, decreased dissolved oxygen, and increased sediment loads) that could result from operations. Water quality in areas adjacent to or downstream from development areas shall be monitored during the life of the project to ensure that water quality is protected.

A.2.2.10.4 Decommissioning/Reclamation

- All management plans, design features, and stipulations developed for the construction phase shall be applied to similar activities during the decommissioning/reclamation phase.

- Topsoil removed during construction shall be reused during reclamation.

- Groundwater and/or surface water monitoring activities shall be as outlined in the established groundwater monitoring plan for the site.

A.2.2.11 Design Features for Ecological Resources

Many design features are similar for the different types of ecological resources (plant communities and habitats, wildlife, aquatic resources, and special status species[2]). The more general design features are presented first for each phase, followed by more specific measures for specific resource types.

A.2.2.11.1 Siting and Design

- To the extent practicable, projects shall be sited on previously disturbed lands in close proximity to energy load centers to avoid and minimize impacts on remote, undisturbed lands.

- Existing access roads, utility corridors, and other infrastructure shall be used to the maximum extent feasible.

- As practical, staging and parking areas shall be located within the site of the utility-scale solar energy facility to minimize habitat disturbance in areas adjacent to the site.

- Appropriate agencies (e.g., BLM, USFWS, and state resource management agencies) shall be contacted early in the planning process to identify potentially sensitive ecological resources, including, but not limited to, aquatic habitats, wetland habitats, unique biological communities, crucial wildlife habitats, and special status species locations and habitats, including designated critical habitat, that might be present in the area proposed for a solar energy facility and associated access roads and ROWs. This coordination shall be used to identify the need for and scope of predisturbance surveys of the project area and vicinity.

- All pre-disturbance surveys shall be conducted by qualified biologists following accepted protocols established by the U.S. Army Corps of Engineers (USACE), BLM, USFWS, or other federal or state regulatory agencies, as determined appropriate by the BLM, to identify and delineate the boundaries of important, sensitive, or unique habitats in the project vicinity, including but not limited to, waters of the United States, wetlands, springs, seeps, ephemeral streams, intermittent streams, 100-year floodplains, ponds

[2] Special status species include the following types of species: (1) species listed as threatened or endangered under the ESA; (2) species that are proposed for listing, under review, or candidates for listing under the ESA; (3) species that are listed as threatened or endangered by the state or are identified as fully protected by the state; (4) species that are listed by the BLM as sensitive; and (5) species that have been ranked S1 or S2 by the state or as species of concern by the state or USFWS. Note that some of the categories of species included here do not fit BLM's definition of special status species as defined in BLM Manual 6840 (BLM 2008). These species are included here to ensure broad consideration of species that may be most vulnerable to impacts.

and other aquatic habitats, riparian habitat, remnant vegetation associations, rare or unique natural communities, and habitats supporting special status species populations.

- Projects shall be sited and designed to avoid direct and indirect impacts on important, sensitive, or unique habitats in the project vicinity, including, but not limited to, waters of the United States, wetlands (both jurisdictional and nonjurisdictional), springs, seeps, streams (ephemeral, intermittent, and perennial), 100-year floodplains, ponds and other aquatic habitats, riparian habitat, remnant vegetation associations, rare or unique biological communities, crucial wildlife habitats, and habitats supporting special status species populations (including designated and proposed critical habitat). For cases in which impacts cannot be avoided, they shall be minimized and mitigated appropriately. Project planning shall be coordinated with the appropriate federal and state resource management agencies.

- Projects shall not be sited in designated critical habitat, ACECs, or other specially designated areas that are considered necessary for special status species and habitat conservation.

- Projects shall be designed to avoid, minimize, and mitigate impacts on wetlands, waters of the United States, and other special aquatic sites.

- Project facilities and activities, including associated roads and utility corridors, shall not be located in or near occupied habitats of special status animal species. Buffer zones shall be established (e.g., identified in the land use plan or substantiated by best available information or science) around these areas to prevent any destructive impacts associated with project activities.

- Buffer zones shall be established around sensitive habitats, and project facilities and activities shall be excluded or modified within those areas (e.g., identified in the land use plan or substantiated by best available information or science).

- Habitat loss, habitat fragmentation, and resulting edge habitat due to project development shall be minimized to the extent practicable. Habitat fragmentation could be reduced by consolidating facilities (e.g., access roads and utilities could share common ROWs, where feasible), reducing the number of access roads to the minimum amount required, minimizing the number of stream crossings within a particular stream or watershed, and locating facilities in areas where habitat disturbance has already occurred. Individual project facilities shall be located and designed to minimize disruption of animal movement patterns and connectivity of habitats.

- Locating solar power facilities near open water or other areas that are known to attract a large number of birds shall be avoided.

- Plant species that would attract wildlife shall not be planted along high-speed or high-traffic roads.

- Tall structures shall be located to avoid known flight paths of birds and bats.

- Transmission line conductors shall span important or sensitive habitats within limits of standard structure design.

- If cattle guards are identified for the design for new roads, they shall be wildlife friendly. To the extent practicable, improvements shall be made to existing ways and trails that require cattle to pass through existing fences, fence-line gates, new gates, and standard wire gates alongside them.

- Fences shall be built (as practicable) to exclude livestock and wildlife from all project facilities, including all water sites.

- Project developers shall identify surface water runoff patterns at the project site and develop mitigation that prevents soil deposition and erosion throughout and downhill from the site.

- Developers shall avoid the placement of facilities or roads in drainages and make necessary accommodations for the disruption of runoff.

- Any necessary stream crossings shall be designed to provide in-stream conditions that allow for and maintain uninterrupted movement and safe passage of fish during all project periods. Section 5.9.3 presents mitigation recommendations to minimize impacts on water quality associated with stream crossings.

- Projects shall avoid surface water or groundwater withdrawals that affect sensitive habitats (e.g., aquatic, wetland, and riparian habitats) and any habitats occupied by special status species. Applicants shall demonstrate, through hydrologic modeling, that the withdrawals required for their project are not going to affect groundwater discharges that support special status species or their habitats.

- The capability of local surface water or groundwater supplies to provide adequate water for the operation of proposed solar facilities shall be considered early in the project siting and design. Technologies that would result in large withdrawals that would affect water bodies that support special status species shall not be considered.

- New roads shall be designed and constructed to meet the appropriate BLM road design standards, such as those described in *BLM Manual 9113*, and be no larger than necessary to accommodate their intended functions (e.g., traffic volume and weight of vehicles). Roads internal to solar facility sites shall be designed to minimize ground disturbance.

- Pipelines that transport hazardous liquids (e.g., oils) that will pass through aquatic or other habitats containing sensitive species shall be designed with block or check valves on both sides of the waterway or habitat to minimize the amount of product that could be released as a result of leaks. Such pipelines shall be constructed of double-walled pipe at river crossings.

A.2.2.11.2 General Multiphase Measures

General design features for eliminating or reducing impacts on plant communities and habitats, wildlife resources, aquatic resources, and special status species that apply to all or nearly all of the project phases include the following:

- Project developers shall designate a qualified biologist who will be responsible for overseeing compliance with all design features related to the protection of ecological resources throughout all project phases, particularly in areas requiring avoidance or containing sensitive biological resources, such as special status species and important habitats. Additional qualified biological monitors may be required on site during all project phases as determined by the BLM, USFWS, and appropriate state agencies.

- All personnel shall be instructed on the identification and protection of ecological resources (especially for special status species), including knowledge of required design features. Workers must be aware that only qualified biologists are permitted to handle listed species according to specialized protocols approved by the USFWS. Workers shall not approach wildlife for photographs or feed wildlife.

- The collection, harassment, or disturbance of plants, wildlife, and their habitats (particularly special status species) shall be reduced through employee and contractor education about applicable state and federal laws. In addition, the following measures shall be implemented: (1) all personnel shall be instructed to avoid harassment and disturbance of local plants and wildlife; (2) personnel shall be made aware of the potential for wildlife interactions around facility structures; (3) food refuse and other garbage shall be placed in closed containers so it is not available to scavengers; and (4) workers shall be prohibited from bringing firearms and pets to project sites.

- Projects shall maintain native vegetation cover and soils to the extent possible and minimize grading to reduce flooding, maintain natural infiltration rates,

maintain wildlife habitat, maintain soil health, and reduce erosion potential. All short (i.e., less than 7-in. [18-cm] tall) native vegetation shall be retained to the maximum extent possible. Blading within the project site shall be minimized to the maximum extent possible. Where necessary and feasible, shrub cover may be mowed and/or raked to smooth out the surface. Retention of native root structure and seeds within the project area would help retain soil stability, minimize soil erosion, and minimize fugitive dust pollution. Retention of native seed and roots within the project site will also facilitate recovery of vegetative cover. Use of native plant species will minimize the need to water the vegetation, because native species are already adapted to the local climate and moisture regime of the area.

- Plants, wildlife, and their habitats shall be protected from fugitive dust through measures included in the facility's Dust Abatement Plan.

- Activities shall be timed to avoid, minimize, or mitigate impacts on wildlife. For example, crucial winter ranges for elk, deer, pronghorn, and other species should be avoided, especially during their periods of use. If activities are planned during bird breeding seasons, a nesting bird survey shall be conducted first. If active nests are detected, the nest area shall be flagged, and no activity should take place near the nest (at a distance determined in coordination with the USFWS) until nesting is completed (i.e., nestlings have fledged or the nest has failed) or until appropriate agencies agree that construction can proceed with the incorporation of agreed-upon monitoring measures. The timing of activities shall be coordinated with the BLM, USFWS, and appropriate state agencies.

- Noise reduction devices (e.g., mufflers) shall be employed to minimize the impacts on wildlife and special status species populations. Explosives shall be used only within specified times and at specified distances from sensitive wildlife or surface waters as established by the BLM or other federal and state agencies. Operators shall ensure that all equipment is adequately muffled and maintained in order to minimize disturbance to wildlife.

- Design features for hazardous materials and waste management regarding refueling, equipment maintenance, and spill prevention and response shall be applied to reduce the potential for impacts on ecological resources.

- Low-water crossings (fords) shall be used only as a last resort, and then during the driest time of the year. Rocked approaches to fords shall be used. The pre-existing stream channel, including bed and banks, shall be restored after the need for a low-water ford has passed.

- The number of areas where wildlife could hide or be trapped (e.g., open sheds, pits, uncovered basins, and laydown areas) shall be minimized. For example, an uncovered pipe that has been placed in a trench should be capped at the end

of each workday to prevent animals from entering the pipe. If a special status species is discovered inside a component, that component must not be moved, or, if necessary, moved only to remove the animal from the path of activity, until the animal has escaped.

- During all project phases, buffer zones shall be established around sensitive habitats, and project facilities and activities should be excluded or modified within those areas, to the extent practicable.

- Project activities shall not be located in or near occupied habitats of special status animal species. Buffer zones shall be established around these areas (e.g., identified in the land use plan or substantiated by best available information or science) to prevent any destructive impacts associated with project activities.

- If any federally listed threatened and endangered species are found during any phase of the project, the USFWS shall be consulted as required by Section 7 of the ESA, and an appropriate course of action shall be determined to avoid or mitigate impacts.

- Access roads shall be appropriately constructed, improved, maintained, and provided with signs to minimize potential wildlife/vehicle collisions and facilitate wildlife movement through the project area.

- Project vehicle speeds shall be limited in areas occupied by special status animal species. Traffic shall stop to allow wildlife to cross roads. Shuttle vans or car pooling shall be used where feasible to reduce the amount of traffic on access roads.

- Unless authorized, personnel shall not attempt to move live, injured, or dead wildlife off roads, ROWs, or the project site. Honking horns, revving engines, yelling, and excessive speed are inappropriate and considered a form of harassment. If traffic is being unreasonably delayed by wildlife in roads, personnel shall contact the project biologist and security, who will take any necessary action.

- Road closures or other travel modifications (e.g., lower speed limits, no foot travel) shall be considered during crucial periods (e.g., extreme winter conditions, calving/fawning seasons, raptor nesting). Personnel shall be advised to minimize stopping and exiting their vehicles in the winter ranges of large game while there is snow on the ground.

- Any vehicle-wildlife collisions shall be immediately reported to security. Observations of potential wildlife problems, including wildlife mortality, shall be immediately reported to the BLM or other appropriate agency authorized officer. Procedures for removal of wildlife carcasses on-site and along access

roads shall be addressed in the Nuisance Animal and Pest Control Plan, to avoid vehicle-related mortality of carrion-eaters.

- A Nuisance Animal and Pest Control Plan should be developed that identifies management practices to minimize increases in nuisance animals and pests in the project area, particularly those individuals and species that would affect human health and safety or have the potential to adversely affect native plants and animals. The plan would identify nuisance and pest species that are likely to occur in the area, risks associated with these species, species-specific control measures, and monitoring requirements.

- An Integrated Vegetation Management Plan shall be developed that is consistent with applicable regulations and agency policies for the control of noxious weeds and invasive plant species. The plan shall address monitoring; ROW vegetation management; the use of certified weed-free seed and mulching; the cleaning of vehicles to avoid introducing invasive weeds; and the education of personnel on weed identification, the manner in which weeds spread, and methods for treating infestations. For transmission line ROWs, the plan shall be consistent with the existing vegetation management plan for that ROW. Principles of integrated pest management, including biological controls, shall be used to prevent the spread of invasive species, per the *Vegetation Treatments Using Herbicides on BLM Lands in 17 Western States*, and the *National Invasive Species Management Plan, 2009.* The plan shall cover periodic monitoring, reporting, and immediate eradication of noxious weed or invasive species occurring within all managed areas. A controlled inspection and cleaning area shall be established to visually inspect construction equipment arriving at the project area and to remove and collect seeds that may be adhering to tires and other equipment surfaces. To prevent the spread of invasive species, project developers shall work with the local BLM field office to determine whether a pre-activity survey is warranted, and if so, to conduct the survey. If invasive plant species are present, project developers shall work with the local BLM field office to develop a control strategy. The plan shall include a post-construction monitoring element that incorporates adaptive management protocols.

- Where revegetation and restoration are used as a tool to mitigate or rehabilitate project impacts following construction and/or decommissioning, the proponent shall assist in ongoing BLM efforts to procure and develop locally and regionally appropriate native plant materials. Where conditions permit, the project developer could collect and voucher seeds from native plant species identified on BLM target lists for regional native plant material development by following the BLM Seeds of Success Protocol as described in BLM's Handbook H1740-2, *Integrated Vegetation Management*. On the basis of the expected need for native plant materials, the project developer could contribute funding to support the BLM Native Plant Materials Development Program. The suggested funding rate is $100 in U.S. dollars per acre for each

acre on which restoration or revegetation will be used to mitigate project impacts and for each acre expected to be rehabilitated following site decommissioning.

- To reduce the risk of non-native and nuisance aquatic species introductions, equipment used in surface water should be decontaminated as appropriate, especially equipment used to convey water (i.e., pumps).

- Herbicide use shall be limited to nonpersistent, immobile substances. Only herbicides with low toxicity to wildlife and nontarget native plant species shall be used, as determined in consultation with the USFWS. The typical herbicide application rate rather than the maximum application rate shall be used where this rate is effective. All herbicides shall be applied in a manner consistent with their label requirements and in accordance with guidance provided in the Final PEIS on vegetation treatments using herbicides. No herbicides should be used near or in surface water, streams (including ephemeral, intermittent, or perennial), riparian areas, or wetlands. Setback distances should be determined through coordination with federal and state resource management agencies. Before herbicide treatments are begun, a qualified biologist shall conduct surveys of bird nests and of special status species to identify the special measures or BMPs necessary to avoid and minimize impacts on migratory birds and special status species.

- An Ecological Resources Mitigation and Monitoring Plan shall be developed to avoid, minimize, or mitigate adverse impacts on important ecological resources. The plan shall include, but not necessarily be limited to, the following elements, where applicable:

  – Revegetation, soil stabilization, and erosion reduction measures that shall be implemented to ensure that all temporary use areas are restored. The plan shall require that restoration occurs as soon as possible after activities are completed in order to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.

  – Mitigation and monitoring of unavoidable impacts on waters of the United States, including wetlands.

  – Compensatory mitigation and monitoring to address any significant direct, indirect, and cumulative impacts on, and loss of habitat for, special status plant and animal species.

  – Demonstration of compliance of the project with the regulatory requirements of the BGEPA for bald and golden eagles. The plan should be developed in coordination with the USFWS.

  - Measures to protect birds (including migratory species protected under the MBTA) developed in coordination with the appropriate federal and state agencies (e.g., BLM, USFWS, and state resource management agencies).

  - Measures to protect raptors developed in coordination with the appropriate federal and state agencies (e.g., BLM, USFWS, and state resource management agencies).

  - Measures to protect bats developed in coordination with the appropriate federal and state agencies (e.g., BLM, USFWS, and state resource management agencies).

  - Measures to mitigate and monitor impacts on special status species developed in coordination with the appropriate federal and state agencies (e.g., BLM, USFWS, and state resource management agencies).

  - Monitoring the potential for increase in predation of special status species (e.g., desert tortoise, Utah prairie dog, and greater sage-grouse) from ravens and other species that are attracted to developed areas and use tall structures opportunistically to spot vulnerable prey. Raven and other predator monitoring also should be addressed in the Nuisance Animal and Pest Control Plan.

  - Clearing and translocation of special status species, including the steps to implement the translocation, as well as the follow-up monitoring of populations in the receptor locations, as determined in coordination with the appropriate federal and state agencies. The need for a Special Status Species Clearance and Translocation Plan should be determined on a project-specific basis.

- At the project level, recommendations contained in *Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocol* and *Other Recommendations in Support of Golden Eagle Management and Permit Issuance* shall be considered in project planning, as appropriate. In addition, Instruction Memorandum [IM] 2010-156, the *Bald and Golden Eagle Protection Act–Golden Eagle National Environmental Policy Act and Avian Protection Plan Guidance for Renewable Energy*, shall be adhered to until programmatic permits from the USFWS are available. The analysis of potential impacts on, and mitigation for, golden eagles should be made in coordination with the USFWS, and the initiation of interagency coordination on golden eagle issues should occur early in the planning process.

- Take[3] of golden eagles and other raptors should be avoided. Mitigation regarding the golden eagle should be developed in consultation with the USFWS and appropriate state natural resource agencies. A permit may be required under the Bald and Golden Eagle Protection Act.

- A Water Resources Mitigation and Monitoring Plan shall be developed for each project. Changes in surface water or groundwater quality (e.g., chemical contamination, increased salinity, increased temperature, decreased dissolved oxygen, and increased sediment loads) or flow that result in the alteration of terrestrial plant communities or communities in wetlands, springs, seeps, intermittent streams, perennial streams, and riparian areas (including the alteration of cover and community structure, species composition, and diversity) off the project site shall be avoided to the extent practicable. A monitoring plan shall be developed that determines the effects of groundwater withdrawals on plant communities.

- Ecological monitoring programs shall provide for monitoring during all project phases, including periods prior to construction (to establish baseline conditions) and during construction, operations, and decommissioning.

- The monitoring program requirements, including adaptive strategies, shall be established at the project level to ensure that potential adverse impacts are mitigated. Monitoring programs shall consider the monitoring requirements for each ecological resource present at the project site, establish metrics against which monitoring observations can be measured, identify potential mitigation measures, and establish protocols for incorporating monitoring observations and additional mitigation measures into standard operating procedures.

- A Spill Prevention and Emergency Response Plan shall be developed that considers sensitive ecological resources. Spills of any toxic substances shall be promptly addressed and cleaned up before they can enter aquatic or other sensitive habitats as a result of runoff or leaching. Section 5.9.3 also discusses the need for a Spill Prevention and Emergency Response Plan.

- A Fire Management and Protection Plan shall be developed to implement measures that minimize the potential for a human-caused fire to affect ecological resources and that responds to natural fire situations.

[3] Under the Bald and Golden Eagle Protection Act, "take" means to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, or disturb. "Disturb" means to agitate or bother a bald eagle or a golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle; (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

- A Trash Abatement Plan shall be developed that focuses on containing trash and food in closed and secured containers and removing them periodically to reduce their attractiveness to opportunistic species, such as common ravens, coyotes, and feral dogs, that could serve as predators on native wildlife and special status animals.

- Prior to any ground-disturbing activity, seasonally appropriate walkthroughs shall be conducted by a qualified biologist or team of biologists to ensure that important or sensitive species or habitats are not present in or near project areas. Attendees at the walkthrough shall include appropriate federal agency representatives, state natural resource agencies, and construction contractors, as appropriate. Habitats or locations to be avoided (with appropriately sized buffers) shall be clearly marked.

- If it is determined through coordination with the appropriate federal and state agencies (e.g., BLM, USFWS, and state resource management agencies) that it is necessary to translocate plant and wildlife species from project areas, developers shall ensure that qualified biologists conduct pre- and post-translocation surveys for target species (especially if the target species are special status species) and release individuals to protected off-site locations as approved by the federal and state agencies. The biologists shall coordinate with appropriate agencies in the safe handling and transport of any special status species encountered.

- In accordance with adaptive management strategies, new BLM Instruction Memorandums (IMs) addressing wildlife and plants issues shall be incorporated as appropriate.

A.2.2.11.3 Site Characterization

Site characterization activities would generally result in only minimal impacts on ecological resources. The amount and extent of necessary pre-project survey data shall be determined, in part, on the basis of the environmental setting of the proposed project location. Design features include the following:

- Vehicles and site workers shall avoid entering aquatic habitats, such as streams and springs, during site characterization activities until surveys by qualified biologists have evaluated the potential for unique flora and fauna to be present.

- Meteorological towers and solar sensors shall be located to avoid sensitive habitats or areas where wildlife (e.g., sage-grouse) is known to be sensitive to human activities; applicable land use plans or best available information and science shall be referred to in order to determine avoidance distances. Installation of these components shall be scheduled to avoid disrupting

wildlife reproductive activities or migratory or other important behaviors. Guy wires on meteorological towers shall be avoided. If guy wires are necessary, permanent markers (bird flight diverters) shall be attached to them to increase their visibility.

- Meteorological towers, soil borings, wells, and travel routes shall be located to avoid important, sensitive, or unique habitats, including, but not limited to, wetlands, springs, seeps, ephemeral streams, intermittent streams, 100-year floodplains, ponds and other aquatic habitats, riparian habitat, remnant vegetation associations, rare natural communities, and habitats supporting special status species populations as identified in applicable land use plans or best available information and science.

A.2.2.11.4 Construction

Implementation of design features during the construction phase may eliminate or reduce the potential for direct or indirect impacts on ecological resources. Design features for ecological resources during the construction phase of a solar energy project include the following:

- Prior to construction of the facility, environmental training shall be provided to contractor personnel whose activities or responsibilities could affect the environment during construction. An environmental compliance officer and other inspectors, the contractor's construction field supervisor(s), and all construction personnel are expected to play an important role in maintaining strict compliance with all permit conditions in order to protect wildlife and their habitats to the extent practicable during construction.

- Prior to construction, all areas to be disturbed shall be surveyed by qualified biologists using approved survey techniques or established species-specific survey protocols to determine the presence of special status species in the project area.

- If possible, on-site construction access routes shall be rolled and compacted to allow trucks and equipment to access construction locations. Following construction, disturbed areas shall be lightly raked and/or ripped and reseeded with seeds from low-stature plant species collected from the immediate vicinity.

- To the extent practicable, vegetation clearing, grading, and other construction activities shall occur outside the bird breeding season. If activities are planned for the breeding season, a survey of nesting birds shall be conducted first. If active nests are not detected, construction activities may be conducted. If active nests are detected, the nest area shall be flagged, and no activity shall take place near the nest (at a distance coordinated with the USFWS) until nesting is completed (i.e., nestlings have fledged or the nest has failed) or until

appropriate agencies agree that construction can proceed with the incorporation of agreed-upon monitoring measures. If active nests are not detected, appropriate agencies shall be consulted to confirm that construction may proceed.

- Explosives shall be used only within specified times and at specified distances from sensitive wildlife or surface waters, as established by the BLM or other federal and state agencies. The occurrence of flyrock from blasting shall be limited by using blasting mats.

- The extent of habitat disturbance during construction shall be reduced by keeping vehicles on access roads and minimizing foot and vehicle traffic through undisturbed areas.

- Temporary or project-created access roads shall be closed to unauthorized vehicle use, where appropriate.

- Where a pipeline trench may drain a wetland, trench breakers shall be constructed, and/or the trench bottom shall be sealed to maintain the original wetland hydrology.

- Because open trenches could impede the seasonal movements of large game animals and alter their distribution, they shall be backfilled as quickly as is possible. Open trenches could also entrap smaller animals; therefore, escape ramps shall be installed along open trench segments at distances identified in the applicable land use plan or best available information and science.

- An appropriate number of qualified biological monitors (as determined by the federal authorizing agency and USFWS) shall be on-site during initial site preparation and during the construction period to monitor, capture, and relocate animals that could be harmed and are unable to leave the site on their own.

- When possible, any reptile or amphibian species found in harm's way shall be relocated away from the activity.

- Construction debris, especially treated wood, shall not be stored or disposed of in areas where it could come in contact with aquatic habitats.

- As directed by the local BLM field office, Joshua trees (*Yucca brevifolia*), other *Yucca* species, and most cactus species shall be salvaged prior to land clearing, and they shall be transplanted, held for use to revegetate temporarily disturbed areas, or otherwise protected as prescribed by state or local BLM requirements.

- Project-specific Integrated Vegetation Management Plans shall investigate the possibility of revegetating parts of the solar array area. Where revegetation is accomplished, fire breaks are required, such that the vegetated areas would not result in an increased fire hazard.

- Reestablishment of vegetation within temporarily disturbed areas shall be done immediately following the completion of construction activities, provided such revegetation will not compromise the function of the buried utilities. Species salvaged during construction could be transplanted into these areas at a density similar to preconstruction conditions. Revegetation shall focus on the establishment of native plant communities similar to those present in the vicinity of the project site. Species used shall consist of native species dominant within the plant communities that exist in adjacent areas and have similar soil conditions. Certified weed-free seed mixes of native shrubs, grasses, and forbs of local origin shall be used. In areas where suitable native species are unavailable, other plant species approved by the BLM could be used.

A.2.2.11.5 Operations

Design features that limit periodic or continued impacts from operations of a solar energy facility include the following:

- Areas left in a natural condition during construction (e.g., wildlife crossings) shall be maintained in as natural a condition as possible within safety and operational constraints.

- To minimize habitat loss and fragmentation, as much habitat as possible shall be reestablished after construction is complete by maximizing the area reclaimed during solar energy operations.

- Lighting shall be designed to provide the minimum illumination needed to achieve safety and security objectives. It shall be shielded and orientated to focus illumination on the desired areas and to minimize or eliminate lighting of off-site areas or the sky. All unnecessary lighting shall be turned off at night to limit attracting migratory birds or special status species.

- To minimize the potential for bird strikes, applicants shall use audio visual warning system (AVWS) technology for any structures exceeding 200 ft (60 m) in height. If the FAA denies a permit for use of AVWSs, applicants shall coordinate with the USFWS and appropriate state natural resource agencies to identify lighting that meets the minimum FAA safety requirements and minimizes the possibility of bird strikes.

- Evaporation ponds shall be fenced and netted to prevent use by wildlife where feasible. Open water sources in the desert provide subsidies to ravens and other predators that feed on special status species (e.g., desert tortoise, greater sage-grouse, and Utah prairie dog). In addition, these water sources may have elevated levels of harmful contaminants (e.g., total dissolved solids and selenium) and could attract wildlife into an industrialized area, where they are more likely to be killed. The lower 18 in. (46 cm) of the fencing shall be a solid barrier that would exclude entrance by amphibians and other small animals.

- In order to prevent the effects of the West Nile virus on wildlife, a mosquito abatement program shall be implemented for all evaporation ponds or other standing bodies of water that have the potential to support mosquito reproduction.

- Appropriate fish screens shall be installed on cooling water intakes to limit the potential for impingement impacts on organisms in surface water sources used for cooling water. Intake designs shall minimize the potential for aquatic organisms from surface waters to be entrained in cooling water systems.

- Pesticide/herbicide use should be conducted in accordance with a Nuisance Animal and Pest Control Plan and an Integrated Vegetation Management Plan.

A.2.2.11.6 Decommissioning/Reclamation

Design features to protect ecological resources during and following decommissioning and reclamation include the following:

- A Decommissioning and Site Reclamation Plan that is specific to the project shall be developed, approved by the BLM, and implemented and shall include the following elements:

  – The plan shall contain an adaptive management component that allows for the incorporation of lessons learned from monitoring data.

  – The plan shall require that land surfaces be returned to pre-development contours to the greatest extent feasible immediately following decommissioning.

  – The plan shall be designed to expedite the reestablishment of vegetation and require restoration to be completed as soon as practicable.

  – To ensure rapid and successful reestablishment efforts, the plan shall specify site-specific measurable success criteria, including target dates,

which shall be developed in coordination with the BLM and be required to be met by the operator.

  - Vegetation reestablishment efforts shall continue until all success criteria have been met.

  - Bonding to cover the full cost of vegetation reestablishment shall be required.

  - Species used for reestablishing vegetation shall consist of native species that are dominant within the plant communities in adjacent areas that have similar soil conditions.

  - The plan shall require the use of weed-free seed mixes of native shrubs, grasses, and forbs of local sources where available. When available, seeds of known origin, as labeled by state seed certification programs, shall be used. Local native genotypes shall be used where practicable. If cultivars of native species are used, certified seeds (i.e., blue tag) shall be used. "Source identified" seeds (i.e., yellow tag) shall be used when native seeds are collected from wildland sites.

  - The cover, species composition, and diversity of the reestablished plant community shall be similar to those present on-site prior to project development and in the vicinity of the site. Baseline data should be collected in each project area prior to its development as a benchmark for measuring the success of reclamation efforts. In areas where suitable native species are unavailable, other plant species approved by the BLM could be used. If non-native plants are necessary, they shall be noninvasive, noncompetitive, and, ideally, be short-lived, have low reproductive capabilities, or be self-pollinating to prevent gene flow into the native community. The non-native plants that are used shall not exchange genetic material with common native plant species.

  - The plan shall be developed in coordination with appropriate federal and state agencies.

- Access roads shall be reclaimed when they are no longer needed. However, seasonal restrictions (e.g., nest and brood rearing) shall be considered (e.g., identified in the land use plan or substantiated by best available information or science)

- All holes and ruts created by the removal of structures and access roads shall be filled or graded.

- While structures are being dismantled, care shall be taken to avoid leaving debris on the ground in areas where wildlife regularly move.

- Post-decommissioning protocols shall include monitoring for the recovery of native vegetation, colonization and spread of invasive species, use by wildlife, and use by special status species. Monitoring data shall be used to determine the success of reclamation activities and the need for changes in ongoing management or for additional reclamation measures. Ongoing visual inspections for a minimum of 5 years following decommissioning activities shall be required to ensure that there is adequate restoration and minimal environmental degradation. This period shall be extended until satisfactory results are obtained.

- The facility fence shall remain in place for several years to help reclamation (e.g., the fence could preclude large mammals and vehicles from disturbing revegetation efforts). Shorter times for maintaining fencing may be appropriate in cases where the likelihood of disturbance by cattle and wildlife is low. In some cases, it may be appropriate to replace the original exclusion fence with a new fence that excludes cattle and vehicles but allows for use by pronghorn and large-game wildlife. This secondary fencing shall remain in place until the revegetation efforts meet success criteria.

A.2.2.11.7 Transmission Lines and Roads

Many of the design features presented above could also reduce, minimize, or avoid impacts on ecological resources from the construction and operation of transmission lines. In addition, the following design features are specifically applicable to protecting ecological resources from transmission lines construction, operation, and maintenance:

- The placement of transmission towers within aquatic and wetland habitats shall be avoided whenever feasible. If towers must be placed within these habitats, they shall not impede flows or fish passage.

- If transmission lines are located near aquatic habitats or riparian areas (e.g., minimum buffers identified in the applicable land use plan or best available science and information), vegetation maintenance shall be limited and performed mechanically rather than with herbicides. Cutting in wetlands or stream and wetland buffers shall be done by hand or by feller-bunchers. Tree cutting in stream buffers shall only target trees able to grow into a transmission line conductor clearance zone within 3 to 4 years. Cutting in such areas for construction or vegetation management shall be minimized, and the disturbance of soil and remaining vegetation shall be minimized.

- Habitat disturbance shall be minimized by using helicopters for construction to lessen the need for access roads, and by locating transmission facilities in previously disturbed areas. Existing utility corridors and other support structures shall be used to the maximum extent feasible.

- The establishment and spread of invasive species and noxious weeds within the ROW and in associated areas where there is ground surface disturbance or vegetation cutting shall be prevented. The area shall be monitored regularly, and invasive species shall be eradicated immediately.

- If needed, temporary access roads shall be developed, primarily by the removal of woody vegetation, although temporary timber mats should be used in areas of wet soils. Wide-tracked or balloon-tired equipment, timber corduroy, or timber mat work areas shall be used on wet soils where wetland or stream crossings are unavoidable and where crossing on frozen ground is not possible in winter. Areas rutted by equipment shall be immediately regraded and revegetated. Towers shall be installed by airlift helicopters, where necessary, to avoid extensive crossing of wetlands or highly sensitive areas (such as those identified as rare natural habitats).

- ROW development and construction activities shall adhere to locally established wildlife and/or habitat protection provisions. Exceptions or modifications to spatial buffers or timing limitations will be evaluated on a site-specific/species-specific basis in coordination with the local federal administrator and state wildlife agency.

- Restrictions on timing and duration may be required to minimize impacts on nesting birds (especially neotropical migrants and listed species) and should be developed in coordination with the USFWS.

- To the extent practicable, work personnel shall stay within the ROW and/or easements.

- Removal of raptor nests shall take place only if the birds are not actively using the nest, particularly during the nesting and brood-rearing period. Nests shall be relocated to nesting platforms, when possible; otherwise, they must be destroyed when removed. An annual report on all nests moved or destroyed will be provided to the appropriate federal and/or state agencies. Coordination with the USFWS and BLM project wildlife biologist will occur in the event that a raptor nest is located on a transmission line support structure. Removal or relocation of a golden eagle or bald eagle nest (even an inactive nest) requires a permit from the USFWS.

- Raven nests shall be removed from transmission towers to reduce predation pressure on sensitive species, such as the desert tortoise, greater sage-grouse, and Utah prairie dog. Raven nests can be removed only when inactive (i.e., no eggs or young); if removal is otherwise necessary, an MBTA take permit from the USFWS is required. The removal of raven nests should be addressed in the Nuisance Animal and Pest Control Plan.

- Current guidelines and methodologies would be used in the design and analysis of proposed transmission facilities in order to minimize the potential for raptors and other birds to be electrocuted by them or to collide with them.

- Transmission line support structures and other facility structures shall be designed to discourage their use by raptors for perching or nesting (e.g., by use of anti-perching devices). This design would also reduce the potential for increased predation of special status species, such as the desert tortoise, sage-grouse, and Utah prairie dog. Mechanisms to visually warn birds (permanent markers or bird flight diverters) shall be placed on transmission lines at regular intervals to prevent birds from colliding with the lines.

- To the extent practicable, the use of guy wires shall be avoided because they pose a collision hazard for birds and bats. Guy wires shall be clearly marked with bird flight diverters to reduce the probability of collision.

- Shield wires shall be marked with devices that have been scientifically tested and found to significantly reduce the potential for bird collisions.

- Any mortality of bird species (e.g., raptors) that is associated with power lines shall be monitored and reported to the BLM and the USFWS, and measures shall be taken to prevent future mortality.

A.2.2.12 Design Features for Air Quality and Climate

Most solar facilities would be located in desert environments. Fugitive dust emissions from vehicle traffic on unpaved roads and/or from soil-disturbing activities would be the greatest concern with respect to air quality impacts, especially during construction. These fugitive dust emissions and other combustion-related emissions shall be controlled through stipulations included in the ROW authorization and other permitting processes.

A project- and location-specific Dust Abatement Plan shall be prepared for all solar facilities. Water spraying, which is widely used as a dust control measure, is sometimes not cost effective (in water-deprived locations, for example). Paving is also not justifiable for roads that have a low volume of traffic within and around a solar facility. Gravel can be used to reduce fugitive dust from roads. Another solution for controlling dust is to apply a dust suppressant, although this is not a permanent solution.

A.2.2.12.1 Siting and Design

- All heavy equipment shall meet emission standards specified in the state code of regulations, and routine preventive maintenance, including tune-ups to meet the manufacturer's specifications, shall be implemented to ensure

efficient combustion and minimal emissions. Newer and cleaner equipment that meets more stringent emission controls shall be leased or purchased.

A.2.2.12.2 General Multiphase Measures

- Access roads, on-site roads, and parking lots shall be surfaced with aggregate that is hard enough that vehicles cannot crush it and thus cause dust or compacted soil conditions. Paving could also be used on access roads and parking lots. Alternatively, chemical dust suppressants or durable polymeric soil stabilizers shall be used on these locations. The choice of dust suppression measures shall consider the potential impacts on wildlife from the windborne dispersal of fugitive dust containing dust suppressants and the potential impact on future reclamation.

- All unpaved roads, disturbed areas (e.g., areas of scraping, excavation, backfilling, grading, and compacting), and loose materials generated during project activities shall be watered as frequently as necessary to minimize fugitive dust generation. In water-deprived locations, water spraying shall be limited to active disturbance areas only, and non-water-based dust control measures shall be implemented in areas with intermittent use or use that is not heavy, such as stockpiles or access roads.

- Machinery shall use air-emission-control devices as required by federal, state, and local regulations or ordinances.

- On-site vehicle use shall be reduced to the extent feasible.

- Travel shall be limited to stabilized roads.

- The main access road to the main power block and the main maintenance building area shall be paved.

- Speed limits (e.g., 10 mph [16 km/h]) within the construction site shall be posted with visible signs and enforced to minimize airborne fugitive dust.

- All vehicles that transport loose materials as they travel on public roads shall be covered, and their loads should be sufficiently wet and kept below the freeboard of the truck.

- Workers shall be trained to comply with the speed limit, use good engineering practices, minimize the drop height of materials, and minimize the number and extent of disturbed areas. The project developer shall enforce these requirements.

- Wind fences shall be installed around disturbed areas that could affect the area beyond the site boundaries (e.g., nearby residences).

- All soil disturbance activities and travel on unpaved roads shall be suspended during periods of high winds. A critical site-specific wind speed shall be determined on the basis of soil properties determined during site characterization, and monitoring of the wind speed shall be required at the site during construction, operation, and reclamation.

- Any stockpiles created shall be kept on-site, with an upslope barrier in place to divert runoff. Stockpiles shall be sprayed with water, covered with tarpaulins, and/or treated with appropriate dust suppressants, especially in preparation for high wind or storm conditions. Compatible native vegetative plantings may also be used to limit dust generation from stockpiles that will be inactive for a relatively long period. Chemical dust suppressants that emit volatile organic compounds shall be avoided within or near ozone nonattainment areas.

- All diesel engines used in the facility shall be fueled only with ultra-low sulfur diesel with a sulfur content of 15 parts per million (ppm) or less.

- The idling time of diesel equipment shall be limited to no more than 10 minutes, unless idling must be maintained for proper operation (e.g., drilling, hoisting, and trenching).

- Potential environmental impacts from the use of dust palliatives shall be minimized by taking all necessary measures to keep the chemicals out of sensitive soil and streams. In addition, the application of dust palliatives shall comply with federal, state, and local laws and regulations. Dust palliatives must meet the requirements of the applicable transmission system operator (e.g., Western Area Power Administration construction standards prohibit the use of oil as a dust suppressant).

A.2.2.12.3 Construction

- Access to the construction site and staging areas shall be limited to authorized vehicles only through the designated treated roads.

- Construction shall be staged to limit the exposed area at any time, whenever practical.

- Tires of all construction-related vehicles shall be inspected and cleaned as necessary so they are free of dirt before they enter paved public roadways.

- Visible trackout or runoff dirt on public roadways from the construction site shall be cleaned (e.g., through street vacuum sweeping).

- Topsoil from all excavations and construction activities shall be salvaged and reapplied during reclamation or, where feasible, used for interim reclamation by being reapplied to construction areas not needed for facility operation as soon as activities in that area have ceased.

- Because of low winds and stable atmospheric conditions occurring in the early morning from late fall to early spring, the highest 24-hour concentrations of particulate matter during construction would be attributable to activities occurring during those hours. Thus, soil disturbance activities should be eliminated or minimized under these atmospheric conditions, particularly for construction activities occurring near facility boundaries.

- All soil-disturbing activities and travel on unpaved roads during high-wind events shall be limited.

A.2.2.12.4 Operations

Typically, a utility-scale solar facility would have few emission sources during normal operations; however, the following design features are appropriate:

- All combustion sources shall comply with state emission standards (e.g., best available control technology requirements).

- For portions of facilities that are maintained to be free of vegetation during operations, the dust control design features that were used to limit fugitive dust emissions during the construction phase shall be implemented to minimize fugitive dust emissions from bare surfaces and unpaved access roads.

- Alternative-fuel, electric, or latest-model-year vehicles shall be used, when available, as facility service vehicles.

A.2.2.12.5 Decommissioning/Reclamation

Decommissioning activities are generally the reverse of construction activities, so the design features applied during construction shall also be applied during decommissioning.

A.2.2.12.6 Transmission Lines and Roads

Most design features applied to the construction, operation, and decommissioning activities discussed above shall also be implemented during the entire life of transmission lines. An additional design feature is to access the transmission lines from public roads and designated routes to the maximum extent possible in order to minimize fugitive dust emissions.

A.2.2.13 Design Features for Visual Resources

The nature, extent, and magnitude of visual impacts from utility-scale solar facilities will vary on a site-specific basis and depend on the specific phase of the project (e.g., construction or operation). Similarly, visual impact mitigation measures will vary on a site-specific basis and depend on the specific phase of the project.

The BLM and DOI, as well as other federal agencies such as the U.S. Forest Service (USFS), have established measures for mitigating the visual impacts of energy production, transmission, roads, and other forms of development on federal lands of the western United States. Several of their publications were primary sources for the design features listed in this section.

Solar energy development and related activities proposed on BLM-administered lands and connected actions shall abide by VRM policies and procedures defined in BLM's Manual M-8400, *Visual Resource Management,* and Handbooks H-8410-1, *Visual Resource Inventory*, and H-8431-1, *Visual Resource Contrast Rating*. Other policy requirements and clarifications are available in IM 98-164 and IM 2009-167.

A.2.2.13.1 Siting and Design

The greatest potential for visual impact mitigation associated with a utility-scale solar energy project and associated electricity transmission facilities occurs as a result of decisions made during the siting and design of the project. Visual impacts can be substantially reduced or avoided by careful project siting.

The BLM resource management plans (RMPs) designate VRM Classes I–IV, which establish objectives for managing allowable levels of visual change to the landscape. Solar development and related activities are required to meet the VRM class objectives. Project developers shall consult the VRM class designations and associated management objectives during the early phases of project planning, including those related to project due diligence, site selection, planning, and design. It is the developer's responsibility to conduct an early investigation of the respective project's compatibility with the VRM class objectives and the potential that these objectives can be met by applying thoughtful and creative design principles. Project developers shall document and demonstrate how the visual management objectives were factored into the various phases of project planning and decision rationale.

The BLM visual resource inventory (VRI) class values—including those for scenic quality, sensitivity, and distance zones—shall also be factored into the project planning, design, and decision making. Project developers shall demonstrate how the visual values influence project design and document how impacts on these values are minimized through consideration for the proposed project location and its relationship to the surrounding viewshed. This information shall be included as a part of the critical due diligence information considered when determining and selecting solar development sites and ROW boundaries. ROW location, size, and boundary determinations shall consider terrain characteristics and opportunities for full or partial project concealment by recessing the project into the landscape terrain.

Project developers shall consult with the BLM in the early phases of project planning to help determine the proposed project's potential conformance to the applicable RMP's VRM class designation and other potential constraints, thus avoiding costly unforeseen planning implications and re-design.

A qualified and licensed professional landscape architect with demonstrated experience with the BLM's VRM policies and procedures shall be a part of the developer's and the BLM's respective planning teams, evaluating visual resource issues as project siting options are considered. The visual issues shall be addressed throughout the planning and design process, and the final project plans shall reflect intended methods for mitigating visual impacts.

The appropriate BLM field office and locally based public shall be consulted to provide input on identifying important visual resources in the project area and on the siting and design process. The public shall be involved and informed about the visual site design elements of the proposed solar energy facilities. Possible approaches include conducting public forums for disseminating information, offering organized tours of operating solar energy development projects, and using computer and visualization simulations in public presentations.

Project developers shall also consult on viewshed protection objectives and practices with the respective land management agencies that have been assigned administrative responsibility for landscapes having special designations, such as Wilderness Areas, National Scenic and Historic Trails, Wild and Scenic Rivers, etc., National Parks, and National Wildlife Refuges located within the project's viewshed. Developers shall demonstrate a concerted effort to reconcile conflicts while recognizing that the BLM retains authority for final decisions determining project approval and conditions.

The following are specific to National Historic Trails but possibly pertain to other specially designated lands, such as Wild and Scenic Rivers, Wilderness Areas, National Parks, and National Wildlife Refuges:

- For applications that include artifacts and remnants of a National Historic Trail, are located within the viewshed of a National Historic Trail's designated centerline, or include or are within the viewshed of a trail eligible for listing on the *National Register of Historic Places* (NRHP) by virtue of its important historical or cultural values and integrity of setting, the applicant shall evaluate the potential visual impacts on the trail associated with the proposed

project; minimize, avoid, or mitigate adverse effects through the Section 106 consultation process; and identify appropriate mitigation measures for inclusion as stipulations in the POD. This requirement does not supersede or amend National Historic Trails requirements cited in other sections but is in addition to and supportive of them.

- Because the landscape setting observed from units of the National Park system, national historic sites, national trails, and Tribal cultural resources may be a part of the historic context contributing to the historic significance of the site or trail, project siting shall avoid locating facilities that would alter the visual setting in a way that would reduce the historic significance or function, even if compliant with VRM objectives. This requirement does not supersede or amend national historic sites, national trails, and Tribal cultural resources requirements cited in other sections but is in addition to and supportive of them.

Project developers shall obtain topographical data of engineering-design quality and use digital terrain mapping tools at a landscape-viewshed scale for project location selection, site planning and design, visual impact analysis, and visual impact mitigation planning and design. Visual mitigation planning and design shall be performed through field assessments, applied global positioning system (GPS) technology, photo documentation, use of computer-aided design and development software, three-dimensional GIS modeling software, and imaging software to depict visual simulations to reflect a full range of visual resource mitigation measures. The digital terrain mapping tools shall be at a resolution and contour interval suitable for site design and accurate placement of proposed developments into the digital viewshed. Visual simulations shall be prepared and evaluated in accordance with BLM Handbook H-8431-1 and other agency directives, to create spatially accurate depictions of the appearance of proposed facilities. Simulations shall depict proposed project facilities from key observation points (KOPs) and other visual resource sensitive locations.

The siting and design of solar facilities, structures, roads, and other project elements shall explore and document design considerations for repeating the natural form, line, color, and texture of the existing landscape in accordance and compliance with the VRM class objectives.

The full range of visual BMPs shall be considered, and plans shall incorporate all pertinent BMPs. Visual resource monitoring and compliance strategies shall be included as a part of the project mitigation plans to cover the construction, operation, and decommissioning phases.

Conformance with VRM objectives shall be determined through the use of the BLM contrast rating procedures defined in BLM Handbook H-8431-1. Visual contrast rating mitigation of visual impacts shall abide by the requirements outlined in the handbook and other BLM directives. Plans for facilities determined not to be in conformance with VRM objectives either shall not be approved or shall be redesigned in order to meet the VRM objectives, and updated visual simulations shall be prepared. Revised project plans and simulations shall be reevaluated by using the contrast rating procedures and repeated until the proposed action is found to be in conformance.

KOPs shall be selected by first determining the extent of the viewshed by using the viewshed modeling tools previously cited. The viewshed modeling should illustrate the areas from which the proposed facilities may be seen out to 25 mi (40 km)—line-of-sight measured from the top elevations of facilities out to 5.5 ft (1.7 m) above the ground terrain. From within the areas, KOPs would then be selected at places where people would be expected: at roads, trails, campgrounds, recreationally active river corridors, residential areas, etc. For the purpose of conducting a visual contrast rating evaluation, the number of KOPs would be reduced to those that serve as the best representations for demonstrating conformance to the respective VRM class objectives. The BLM must approve KOP selections, and the BLM reserves the right to require additional KOPs to further determine the extent of visual impact and conformance to VRM class objectives.

Visual design elements shall be integrated into the construction plans, details, shop drawings, and specifications; these shall include, but not be limited to, grubbing and clearing, vegetation thinning and clearing, grading, revegetation, drainage, and structural plans. Visual design elements within the plans shall be measureable and monitored while under construction, while operational, and when decommissioned. The plans shall include a monitoring and compliance plan that establishes the monitoring requirements and thresholds for acceptable performance. The contrast rating procedures shall also be integrated as a field measuring compliance tool during operations and after decommissioning.

The following specific project siting measures can help reduce visual impacts of solar energy development projects and associated but independent facilities. Project planning and designs shall demonstrate the relevance and application of all BLM visual BMPs to the specific project, including, but not limited to, the following:

Viewshed-Based Site Selection and Siting

- Project developers shall exhaust opportunities to minimize visual dominance of projects by siting projects outside the viewsheds of KOPs or by siting them as far away as possible, diminishing dominance by maximizing visible separation with distance.

- Facility siting shall incorporate measures to minimize the profile of all facility-related structures to reduce visibility and visual dominance within the viewshed—particularly for facilities proposed within the foreground/middleground distance zone (0–5 mi [0–8 km]) of sensitive viewing locations with extended viewing opportunities and/or moving viewpoints including, but not limited to, National Scenic Byways, All-American Roads, State Scenic Byways, BLM Backcountry Byways, Special Recreation Management Areas (SRMAs), trails, residential areas, etc.

- Siting shall take advantage of both topography and vegetation as screening or partially screening devices to interrupt and restrict the views of projects from KOPs and visually sensitive areas.

- Locating facilities near visually prominent landscape features (e.g., knobs and waterfalls) that naturally draw an observer's attention shall be avoided.

- Visual "skylining" shall be avoided by placing structures, transmission lines, and other facilities away from ridgelines, summits, or other locations where they would silhouette against the sky from important viewing locations. Siting shall take advantage of opportunities to use topography as a backdrop for views of facilities and structures to avoid skylining. Alternatives shall be evaluated, and the least visually intrusive option shall be selected when linear facilities (e.g. transmission lines) cross over ridgelines.

- Siting of linear features (e.g., ROWs and roads) shall follow natural land contours rather than straight lines, particularly up slopes. Fall-line cuts shall be avoided. Following natural contours echoes the lines found in the natural landscape and often reduces cut-and-fill requirements; straight lines can introduce conspicuous linear contrasts that appear unnatural.

- Linear developments (e.g., transmission lines, pipelines, roads) shall follow the edges of natural clearings or natural lines of transition between vegetation type, topography, etc. (where they would be less conspicuous) rather than pass through the center of clearings.

Reduction of Surface Disturbance, Grading and Edge Treatments

- In visually sensitive areas, air transport capability shall be used to mobilize equipment and materials for clearing, grading, and erecting transmission towers, thereby preserving the natural landscape conditions between tower locations and reducing the need for permanent and/or temporary access roads.

- Vegetation and ground disturbance shall be minimized and take advantage of existing clearings.

- Structures and roads shall be designed and located to minimize and balance cuts and fills. Retaining walls, binwalls, half bridges, and tunnels shall be used to reduce cut and fill.

- Road-cut slopes shall be rounded, and the cut-and-fill pitch shall be varied to reduce contrasts in form and line; the slope shall be varied to preserve specimen trees and nonhazardous rock outcroppings.

- Natural or previously excavated bedrock landforms shall be sculpted and shaped when excavation of these landforms is required. Percent backslope, benches, and vertical variations shall be integrated into a final landform that repeats the natural shapes, forms, textures, and lines of the surrounding landscape. The earthen landform shall be integrated and transitioned into the

excavated bedrock landform. Sculpted rock face angles, bench formations, and backslope need to adhere to the natural bedding planes of the natural bedrock geology. Half-case drill traces from pre-split blasting shall not remain evident in the final rock face. The color contrast from the excavated rock faces shall be removed by color treating with a rock stain. Native vegetation (where feasible) or a mix of native and non-native species (if necessary to ensure successful revegetation) shall be reestablished with the benches and cavities created within the created bedrock formation.

- Where screening topography and vegetation are absent or minimal, natural-looking earthwork landforms, vegetative, or architectural screening shall be used to minimize visual impacts. The shape and height of earthwork landforms must be adapted to the surrounding landscape, and must consider the distance and viewing angle from KOPs in order to ensure that the earthworks are visually unobtrusive.

- Openings in vegetation for facilities, structures, roads, etc., shall be feathered and shaped to repeat the size, shape, and characteristics of naturally occurring openings.

- Topsoil from the site shall be stripped, stockpiled, and stabilized before excavating earth for facility construction.

- All electrical collector lines and pipelines shall be buried in a manner that minimizes additional surface disturbance (e.g., along roads or other paths of surface disturbance).

Building and Structural Materials

Visual impacts associated with solar energy and electricity transmission projects shall be mitigated by choosing appropriate building and structural materials and surface treatments (i.e., paints or coatings designed to reduce contrast and reflectivity). A careful study of the site shall be performed to identify appropriate colors and textures for materials; both summer and winter appearance shall be considered, as well as seasons of peak visitor use. Massing and scale of structures and the architectural character appropriate to the region where a solar facility is to be located shall be considered. Architectural character considerations shall include integration of vertical and horizontal relief variation to create shadow lines that diminish the overall visual scale and dominance of facilities. The choice of colors shall be based on the appearance at typical viewing distances and consider the entire landscape around the proposed development. Appropriate colors for smooth surfaces often need to be two to three shades darker than the background color to compensate for shadows that darken most textured natural surfaces. The BLM Standard Environmental Color Chart CC-001 and guidance shall be referenced when selecting colors.

Specific design features include the following:

- Materials and surface treatments shall repeat and/or blend with the existing form, line, color, and texture of the landscape.

- Appropriately colored materials shall be selected for structures, or appropriate stains/coatings shall be applied to blend with the project's backdrop.

- Solar panel backs shall be color-treated to reduce visual contrast with the landscape setting.

- Solar towers shall be color-treated to reduce visual contrast.

- Materials, coatings, or paints having little or no reflectivity shall be used whenever possible.

- Grouped structures shall be painted the same color to reduce visual complexity and color contrast.

- Multiple color camouflage technology applications shall be considered for projects within sensitive viewsheds and with a visibility distance that is between 0.25 and 2 mi (0.40 and 3.20 km). BLM guidance on the use of color to mitigate visual impacts should be consulted.

- Aboveground pipelines shall be painted or coated to match their surroundings.

- Consideration shall be given to the appropriate choice of monopoles vs. lattice towers for a given landscape setting. Monopoles may reduce visual impacts more effectively than lattice towers in foreground and midground views within built or partially built environments, while lattice towers tend to be more appropriate for less-developed rural landscapes, where the latticework would be more transparent against background textures and colors.

Glint and Glare

- Solar facilities shall be sited and designed properly to eliminate glint and glare effects on roadway users, nearby residences, commercial areas, or other highly sensitive viewing locations or to reduce them to the lowest achievable levels. Regardless of the solar technology proposed, a Glint and Glare Assessment, Mitigation, and Monitoring Plan must assess accurately and quantify potential glint and glare effects and determine the potential health, safety, and visual impacts associated with glint and glare. The assessment shall be conducted by qualified individuals using appropriate and commonly accepted software and procedures. The assessment results must be made available to the BLM in advance of project approval. If the project design is

changed during the siting and design process such that substantial changes to glint and glare effects may occur, glint and glare effects shall be recalculated, and the results shall be made available to BLM.

- Mirrors/heliostats shall be deployed and operated to avoid high-intensity light (glare) being reflected toward off-site ground receptors. Where off-site glare is unavoidable and project site/off-site spatial relationships favor effective results, fencing with privacy slats or similar screening materials shall be employed.

- Electricity transmission/distribution projects shall utilize nonspecular conductors and nonreflective coatings on insulators.

Night-Sky Protection

- A lighting plan shall be prepared that documents how lighting will be designed and installed to minimize night-sky impacts during facility construction and operations. Lighting for facilities shall not exceed the minimum number of lights and brightness required for safety and security and shall not cause excessive reflected glare. Low-pressure sodium light sources shall be used to reduce light pollution. Full cut-off luminaires shall be used to minimize uplighting. Lights shall be directed downward or toward the area to be illuminated. Light fixtures shall not spill light beyond the project boundary. Lights in highly illuminated areas that are not occupied on a continuous basis shall have switches, timer switches, or motion detectors so that the lights operate only when the area is occupied. Where feasible, vehicle-mounted lights shall be used for night maintenance activities. Wherever feasible, consistent with safety and security, lighting shall be kept off when not in use. The lighting plan shall include a process for promptly addressing and mitigating complaints about potential lighting impacts.

- In order to minimize night-sky impacts from hazard navigation lighting associated with solar facilities, the applicant shall use AVWS technology for any structures exceeding 200 ft (61 m) in height. If the FAA denies a permit for use of AVWS, the applicant shall limit lighting to the minimum required to meet FAA safety requirements. The use of red or white strobe lighting shall be prohibited unless BLM approves its use because of conflicting mitigation requirements.

- The use of signs and project construction signs shall be minimized. Necessary signs shall be made of nonglare materials and utilize unobtrusive colors. The reverse sides of signs and mounts shall be painted or coated by using the most suitable color selected from the BLM Standard Environmental Color Chart to reduce color contrasts with the existing landscape; however, placement and

design of any signs required by safety regulations must conform to regulatory requirements.

- Commercial symbols or signs and associated lighting on buildings or other structures shall be prohibited.

A.2.2.13.2 General Multiphase Measures

- "Good housekeeping" procedures shall be developed to ensure that the site is kept clean of debris, garbage, fugitive trash or waste, and graffiti; to prohibit scrap heaps and dumps; and to minimize storage yards. Design features for effective waste management shall be applied.

A.2.2.13.3 Construction

A pre-construction meeting with BLM landscape architects or other designated visual/scenic resource specialists shall be held before construction begins to coordinate the VRM mitigation strategy and confirm the compliance-checking schedule and procedures. Final design and construction documents will be reviewed for completeness with regard to the visual mitigation elements, assuring that requirements and commitments are adequately addressed. The construction documents shall include, but not be limited to, grading, drainage, revegetation, vegetation clearing and feathering plans, and they must demonstrate how VRM objectives will be met, monitored, and measured for conformance.

Project developers shall integrate interim/final reclamation VRM mitigation elements early in the construction process; these may include treatments, such as thinning and feathering vegetation along project edges, enhanced contour grading, salvaging landscape materials from within construction areas, special revegetation requirements, etc. Developers shall coordinate with BLM in advance to have BLM landscape architects or other designated visual/scenic resource specialists on-site during construction to work on implementing visual resource requirements and BMPs.

Visual impacts associated with construction activities can be partially mitigated by implementing the following design features, where feasible:

- Project developers shall reduce visual impacts during construction by clearly delineating construction boundaries and minimizing areas of surface disturbance; preserving vegetation to the greatest extent possible; utilizing undulating surface disturbance edges; stripping, salvaging, and replacing topsoil; using contoured grading; controlling erosion; using dust suppression techniques; and restoring exposed soils to their original contour and vegetation.

- A Decommissioning and Site Reclamation Plan shall be in place prior to construction. Reclamation of the construction site shall begin immediately after construction to reduce the likelihood of visual contrasts associated with erosion and invasive weed infestation and to reduce the visibility of temporarily disturbed areas as quickly as possible.

- Visual impact mitigation objectives and activities shall be discussed with equipment operators before construction activities begin.

- Existing rocks, vegetation, and drainage patterns shall be preserved to the maximum extent possible.

- Brush-beating, mowing, or using protective surface matting rather than removing vegetation shall be employed where feasible.

- Slash from vegetation removal shall be mulched and spread to cover fresh soil disturbances as part of the revegetation plan. Slash piles shall not be left in sensitive viewing areas.

- All areas of disturbed soil shall be reclaimed by using weed-free native grasses, forbs, and shrubs representative of the surrounding and intact native vegetation composition and/or using non-native species, if necessary, to ensure successful revegetation.

- The visual color contrast of graveled surfaces shall be reduced with approved color treatment practices.

- Horizontal and vertical pipeline bending shall be used in place of cut-and-fill activities where feasible.

- Road-cut slopes shall be rounded, and the cut-and-fill pitch shall be varied to reduce contrasts in form and line. The slope shall be varied to preserve specimen trees and nonhazardous rock outcroppings.

- Topsoil from cut-and-fill activities shall be segregated and spread on freshly disturbed areas to reduce color contrast and aid rapid revegetation. Topsoil piles shall not be left in sensitive viewing areas.

- Excess fill material shall not be disposed of downslope, in order to avoid creating color contrast with existing vegetation and soils.

- Excess cut-and-fill materials shall be hauled in or out to minimize ground disturbance and impacts from fill piles.

- Natural or previously excavated bedrock landforms shall be sculpted and shaped when excavation of these landforms is required, and landforms shall

conform to the requirements listed and further described under A.2.2.13.1, Siting and Design. Half-case drill traces from pre-split blasting shall not remain evident in the final rock face. The color contrast from the excavated rock faces shall be removed by color-treating with a rock stain. Native vegetation (where feasible) or a mix of native and non-native species (if necessary to ensure successful revegetation) shall be reestablished with the benches and cavities created within the created bedrock formation.

- Communication and other local utility cables shall be buried where feasible.

- Culvert ends shall be painted or coated to reduce color contrasts with the existing landscape.

- No paint or permanent discoloring agents shall be applied to rocks or vegetation to indicate surveyor construction activity limits.

- All stakes and flagging shall be removed from the construction area and disposed of in an approved facility.

A.2.2.13.4 Operations

Terms and conditions for VRM mitigation compliance shall be maintained and monitored for compliance with visual objectives, adaptive management adjustments, and modifications, as necessary and approved by the BLM landscape architect or other designated visual/scenic resource specialist.

Visual impacts associated with operation and maintenance activities could be partially mitigated by implementing the following measures, where applicable:

- The project developer shall maintain revegetated surfaces until a self-sustaining stand of vegetation is reestablished and visually adapted to the undisturbed surrounding vegetation. No new disturbance shall be created during operations without completion of a VRM analysis and approval by the authorized officer.

- Interim restoration shall be undertaken during the operating life of the project as soon as possible after disturbances.

- Maintenance activities shall include dust abatement (in arid environments) and noxious weed control.

- Road maintenance activities shall avoid blading existing forbs and grasses in ditches and adjacent to roads.

- Painted facilities shall be kept in good repair and repainted when the color fades or flakes.

- Color-treated solar panel/mirror backs/supports shall be kept in good repair and be retreated when the color fades and flakes.

A.2.2.13.5 Decommissioning/Reclamation

A Decommissioning and Site Reclamation Plan, covering visual impact design features, shall be in place prior to construction, and reclamation activities shall be undertaken as soon as possible after disturbances occur and be maintained throughout the life of the project. The following decommissioning/reclamation activities/practices can partially mitigate visual impacts associated with solar energy development, where feasible:

- Predevelopment visual conditions and the inventoried visual quality rating (A, B, C) and integrity shall be reviewed, and the visual elements of form, line, color, and texture shall be restored to predevelopment visual compatibility or to that of the surrounding landscape setting conditions, whichever achieves the better visual quality and most ecologically sound outcome.

- A Decommissioning and Site Reclamation Plan shall be developed, approved by the BLM, and implemented. The plan shall require that all aboveground and near-ground structures be removed. Some structures shall only be removed to a level below the ground surface that will allow reclamation/ restoration. Topsoil from all decommissioning activities shall be salvaged and reapplied during final reclamation. The plan shall include provisions for monitoring and determining compliance with the project's visual mitigation and reclamation objectives.

- Soil borrow areas, cut-and-fill slopes, berms, water bars, and other disturbed areas shall be contoured to approximate naturally occurring slopes, thereby avoiding form and line contrasts with the existing landscapes. Contouring to a rough texture would trap seeds and discourage off-road travel, thereby reducing associated visual impacts.

- Cut slopes shall be randomly scarified and roughened to reduce texture contrasts with existing landscapes and aid in revegetation.

- A combination of seeding, planting nursery stock, and transplanting local vegetation within the proposed disturbance areas and staging of construction enabling direct transplanting shall be considered. Where feasible, native vegetation shall be used for revegetating, to establish a composition consistent with the form, line, color, and texture of the surrounding undisturbed landscape.

- Stockpiled topsoil shall be reapplied to disturbed areas, and the areas shall be revegetated by using a mix of native species selected for visual compatibility with existing vegetation, where applicable, or by using a mix of native and non-native species if necessary to ensure successful revegetation.

- Gravel and other surface treatments shall be removed or buried.

- Rocks, brush, and forest debris shall be restored whenever possible to approximate pre-existing visual conditions.

- Edges of revegetated areas shall be feathered to reduce form and line contrasts with the existing landscapes.

- A decommissioning VRM monitoring and compliance plan shall be prepared by the operator and approved by the BLM that establishes the schedule and terms for monitoring and the conditions and methods of measurement for determining compliance,

A.2.2.13.6 Use of Off-Site Mitigation

- In addition to mitigation measures that directly reduce the impacts of solar energy and associated facilities, the off-site mitigation of visual impacts may be an option in some situations. Off-site mitigation shall be considered in situations where nonconforming proposed actions may lead to changing the VRM class objectives through an RMP amendment. Unavoidable visual impacts may then be mitigated by a correction or remediation of a nonconforming existing condition resulting from a different proposed action located within the same viewshed for impacts of approximately equal magnitude, and within the same or a more protective VRM class. The off-site mitigation serves as a means to offset and recover the loss of visual landscape integrity. For example, off-site mitigation could include reclaiming unnecessary roads, removing abandoned buildings, reclaiming abandoned mine sites, putting utility lines underground, rehabilitating and revegetating existing erosion or disturbed areas, or establishing scenic conservation easements. In situations where off-site mitigation opportunities are absent within the same viewshed, then different viewsheds that need mitigation of visual impacts because they could affect highly sensitive visual resources (for example, along National Scenic and Historic Trails, Wild and Scenic River corridors, Scenic or Backcountry Byways, etc.) may be considered. BLM policy guidance on off-site mitigation procedures is contained in BLM IM 2008-204, *Offsite Mitigation.*

A.2.2.14 Design Features for Noise

A.2.2.14.1 Siting and Design

- Project developers shall take measurements to assess the existing background ambient sound levels both within and outside the project site and compare these with the anticipated noise levels associated with the proposed facility. The ambient measurement protocols of all affected land management agencies shall be considered and utilized. Nearby residences and likely sensitive human and wildlife receptor locations shall be identified at this time.

- Siting of stationary construction equipment (e.g., compressors and generators) shall be far from nearby residences and other sensitive receptors.

- Permanent sound-generating facilities (e.g., compressors, pumps) shall be sited away from residences and other sensitive receptors. In areas of known conflicts, acoustic screening will be required.

- Where feasible, low-noise systems (e.g., for ventilation systems, pumps, generators, compressors, and fans) shall be incorporated, and equipment that has no prominent discrete tones shall be selected.

- If a wet cooling tower is to be used, the louvered side shall be sited to face away from sensitive receptors. The cooling tower shall be located in such a manner that nearby equipment can act as a barrier and further reduce noise. Quieter fans shall be selected in the facility design, and fans operated at a lower speed, particularly if they are to operate at night. If a high degree of reduction in noise is required, silencers shall be used on the fan stacks.

- Noise reduction measures that shall be considered include siting noise sources to take advantage of topography and distance and constructing engineered sound barriers and/or berms or sound-insulated buildings, if needed, to reduce potential noise impacts at the locations of nearby sensitive receptors. As an alternative, solar facilities generating higher operational noise (e.g., a solar dish engine facility) could take advantage of higher background noise. For example, they could be sited within an existing noisy area, such as close to a well-traveled highway, where the ambient sounds partially mask the noise from the facility.

A.2.2.14.2 General Multiphase Measures

- All equipment shall be maintained in good working order in accordance with manufacturers' specifications. For example, suitable mufflers and/or air-inlet

silencers shall be installed on all internal combustion engines (ICEs) and certain compressor components.

- If residences or sensitive receptors are nearby, noisy equipment, such as turbines and motors, shall be placed in enclosures.

- All vehicles traveling within and around the project area shall be operated in accordance with posted speed limits to reduce vehicle noise levels.

- Warning signs shall be posted in high-noise areas, and a hearing protection program shall be implemented for work areas with noise in excess of 85 dBA.

- Project developers shall realize that complaints about noise may still occur, even when the noise levels from the facility do not exceed regulatory levels. Accordingly, a noise complaint process and hotline for the surrounding communities shall be implemented, including documentation, investigation, evaluation, and resolution of all legitimate project-related noise complaints.

A.2.2.14.3 Construction and Decommissioning/Reclamation

- Construction and decommissioning activities and construction traffic shall be scheduled to minimize disruption to nearby residents and existing operations surrounding the project areas.

- If residences or sensitive receptors are nearby, noisy construction and decommissioning activities shall be limited to the least noise-sensitive times of day (daytime between 7 a.m. and 7 p.m.) and weekdays. Quieter activities, such as instrumentation or interior installation, could be conducted at any time.

- Whenever feasible, different noisy activities shall be scheduled to occur at the same time, since additional sources of noise generally do not increase noise levels at the site boundary by much. That is, less-frequent but noisy activities would generally be less annoying than lower-level noise occurring more frequently.

- Noise control measures (e.g., erection of temporary wooden noise barriers) shall be implemented if noisy activities are expected near sensitive receptors.

- If noisy activities, such as blasting or pile driving, are required during the construction or decommissioning period, nearby residents shall be notified in advance.

A.2.2.14.4 Operations

- If a noise from a transformer becomes an issue, a new transformer with reduced flux density, which generates noise levels as much as 10 to 20 dB lower than National Electrical Manufacturers Association (NEMA) standard values, could be installed. Alternatively, barrier walls, partial enclosures, or full enclosures could be adopted to shield or contain the transformer noise, depending on the degree of noise control needed.

A.2.2.14.5 Transmission Lines and Roads

Most design features applied to the construction, operation, and decommissioning activities discussed above shall also be implemented during the entire life of transmission lines. An additional design feature in the case of helicopter use, typically of short duration but with high-level noise, is the following:

- Helicopter flights at low altitude (under 1,500 ft [457 m]) near noise-sensitive receptors shall be minimized except at locations where only helicopter activities can perform the task.

A.2.2.15 Design Features for Paleontological Resources

Coordination between the project developer and the BLM shall be required for all projects before areas are developed. The use of management practices, such as training/education programs to reduce the amount of inadvertent destruction to paleontological sites, could also reduce the occurrences of human-related disturbances to nearby sites. The specifics of these management practices shall be established in project-specific coordination between the project developer and the BLM. BLM IM 2009-011 provides guidance for assessing potential impacts on paleontological resources and determining mitigation measures.

Design features to reduce impacts on paleontological resources shall be required and could include the following:

- Project developers shall determine whether paleontological resources exist in a project area on the basis of the following: the sedimentary context of the area and its potential to contain paleontological resources (potential fossil yield classification [PFYC] class, if it is available); a records search of published and unpublished literature for past paleontological finds in the area; coordination with paleontological researchers working locally in potentially affected geographic areas and geologic strata; and/or depending on the extent of existing information, the completion of a paleontological survey.

- If paleontological resources are present at the site or if areas with a high potential to contain paleontological material have been identified, a

paleontological resources management plan shall be developed. This shall include a mitigation plan; mitigation may include avoidance, removal of fossils (data recovery), stabilization, monitoring, use of protective barriers and signs, or use of other physical or administrative protection measures. The paleontological resources management plan shall also identify measures to prevent potential looting/vandalism or erosion impacts and address the education of workers and the public to make them aware of the consequences of unauthorized collection of fossils on public land.

- If an area has a high potential for fossils but no fossils are observed during the survey, monitoring by a qualified paleontologist may be required by the BLM during all excavation and earthmoving activities in the sensitive area. Development of a monitoring plan is recommended.

- If fossils are discovered during construction, the BLM shall be notified immediately. Work shall be halted at the fossil site and continued elsewhere until a qualified paleontologist can visit the site and make site-specific recommendations for collection or other resource protection. The area of the discovery shall be protected to ensure that the fossils are not removed, handled, altered, or damaged.

Adopting the approaches above does not mean that there would be no impacts on paleontological resources. The exact nature and magnitude of the impacts would vary from project to project and would need to be examined in detail in future NEPA reviews of site-specific projects.

A.2.2.16 Design Features for Cultural Resources

Section 106 consultations between the BLM and SHPOs, appropriate Tribes, and other consulting parties shall be required. Thresholds for the involvement of and review by the Advisory Council on Historic Preservation (ACHP) include nonroutine interstate and/or interagency programs; undertakings directly and adversely affecting National Historic Landmarks or National Register eligible properties of national significance; and/or highly controversial undertakings when ACHP review is requested by the BLM, SHPO, Indian Tribe, local government, or applicant for a BLM authorization. Ongoing Tribal consultation, in accordance with the NHPA, would help in determining areas of sensitivity, appropriate survey and mitigation needs, and other issues of concern (such as access rights or disruption of cultural practices) and taking those concerns into consideration during project development. The following describes the process that the BLM follows to address impacts on historic properties for individual projects.

Site-specific NEPA analyses and a Section 106 review shall be conducted on individual projects. The BLM will require the completion of comprehensive identification (e.g., field inventory), evaluation, protection, and mitigation following the policies and procedures

contained in the 1997 BLM National Programmatic Agreement (PA) and under state protocols.[4] If significant cultural resources are present at the project location or if there is a high potential for the project area to contain significant cultural resources that could be adversely affected, a formalized agreement may be required to address management and mitigation options (e.g., avoidance, data recovery, monitoring, preventative measures for looting/vandalism and erosion, and worker education) in the form of various planning documents (e.g., cultural resources monitoring and mitigation plan, cultural data recovery plan, historic properties treatment plan, etc.). The agreement shall be developed in consultation with the SHPO, appropriate federally recognized Tribes, and any consulting parties. Also, the BLM will continue to implement government-to-government consultation with Tribes and state and local governments on a case-by-case basis.

The BLM does not approve any ground-disturbing activities that may affect any historic properties, sacred sites or landscapes, and/or resources protected under the NHPA; American Indian Religious Freedom Act; Native American Graves Protection and Repatriation Act (NAGPRA); E.O. 13007, "Indian Sacred Sites," (61 FR 26771; May 24, 1996); or other statutes and E.O.s until it completes its obligations under applicable requirements of the NHPA and other authorities. The BLM may require modification to development proposals to protect such properties, or it may disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized, or otherwise mitigated.

The BLM develops specific design features on a project-by-project basis. Avoidance of the resource is the preferred option. Data recovery is a common option for addressing adverse effects, but it does not eliminate the adverse effect. Mitigation of adverse effects can include many other options, such as monitoring and surveillance to protect sites from looting or vandalism; off-site mitigation; education and interpretive programs, including the use of volunteers; and funding of historic preservation efforts proportionate to the anticipated effects. Several design features for other disciplines (soils, air quality, vegetation, hydrology), which encourage use of previously disturbed lands, prevent erosion, and require use of designated routes only to prevent off-road damage, are also appropriate for protecting historic properties, but are not all repeated here (access roads and water control structures would be considered part of the area of potential effect and would require a survey). To protect sacred sites and portions of historic trails that are potentially eligible for listing on the NRHP from visual intrusion, and to maintain the integrity of the historic cultural setting, the BLM could require that surface disturbance be restricted or prohibited within the viewshed of a sacred site or within the viewshed of the trail along those portions of the trail for which eligibility is tied to the visual setting. Mitigation for the demolition of historic structures typically entails detailed architectural records and historical documentation; for impacts on settings of historic structures, measures such as those used for historic trails and sacred sites are appropriate. Ultimately, mitigation strategies will be determined during project-specific consultation.

[4] A PA specific to solar development on BLM-administered lands is under development by the BLM, National Council of SHPOs, and ACHP. This paragraph will be replaced with a summary of relevant information from the Solar PA once it is completed.

Specific design features to reduce impacts on cultural resources shall be required and include the following, as applicable.

A.2.2.16.1 Siting and Design

- The use of previously disturbed lands, rather than pristine lands, shall be encouraged.

- The BLM will consult with the appropriate SHPOs, the ACHP, and affected Native American governments and notify the public early in the planning process to identify issues and areas of concern regarding any proposed solar energy project. Such consultation is required by the NHPA and other authorities.

- Project developers shall conduct a records search of published and unpublished literature for past cultural resource finds in the area; coordinate with researchers working locally in the area; and, depending on the extent of existing information, develop a survey design in coordination with the BLM and SHPO and complete a Class III cultural resources inventory. The inventory shall be conducted according to the standards set forth in the Secretary of Interior's *Standards and Guidelines for Archaeology and Historic Preservation* (48 FR 44716); BLM Handbook H-8110: *Guidelines for Identifying Cultural Resources*, and revised BLM Manual 8110. All inventory data must be provided to the BLM in digitized format that meets the BLM accuracy standards, including shape files for surveyed areas.

- A phased sampling strategy, beginning with a Class II inventory to assess various alternative development areas, is recommended prior to the selection of individual project locations. The Class II inventory shall meet the standards set forth in the Secretary of Interior's *Standards and Guidelines for Archaeology and Historic Preservation*, BLM Handbook H-8110, and revised BLM Manual 8110.

- If significant or NRHP-eligible cultural resources are present at the site and would be adversely affected, or if areas with a high potential to contain additional cultural material have been identified, a formalized agreement will be required to address management and mitigation options in the form of various planning documents (such as a monitoring and mitigation plan, data recovery plan, historic treatment plan, etc.). The agreement shall be developed in consultation with the SHPO, appropriate federally recognized Tribes, and any consulting parties. The agreement also shall identify measures to prevent potential looting/vandalism or erosion impacts and address the education of workers and the public to make them aware of the consequences of unauthorized collection of cultural resources on public land.

- To protect historic properties, sacred sites, and portions of historic trails that are potentially eligible for listing on the NRHP from visual intrusion and to maintain the integrity of the historic cultural setting, the BLM could require that surface disturbance be restricted or prohibited within the viewshed of a historic property, sacred site, or trail segment for which eligibility is tied to the visual setting. These types of adverse effects will be minimized, avoided, or mitigated through the Section 106 consultation process.

A.2.2.16.2 Construction, Operation, and Decommissioning/Reclamation

- In cases where there is a probability of encountering cultural resources during construction that could not be fully detected during a Class III inventory, cultural field monitors (appropriate for the resource anticipated) shall be employed to monitor ground-disturbing activities. Development of a monitoring plan is recommended.

- The unexpected discovery of cultural resources during construction shall be brought to the attention of the responsible BLM authorized officer immediately. Work shall be halted in the vicinity of the find. The area of the find shall be protected to ensure that resources are not removed, handled, altered, or damaged while they are being evaluated and to ensure that appropriate mitigation measures are being developed.

- The use of management practices, such as training/education programs for workers and the public, shall be implemented to reduce occurrences of human-related disturbances to nearby cultural sites. The specifics of these management practices shall be established in project-specific consultations between the applicant and the BLM as well as with the SHPO and Tribes, as appropriate.

A.2.2.17 Design Features for Native American Concerns

Government-to-government consultations among BLM and the directly and substantially affected Tribes are required under E.O. 13175, "Consultation and Coordination with Indian Tribal Governments" (65 FR 67249). In addition, Section 106 of the NHPA requires federal agencies to consult with Indian Tribes for undertakings on Tribal lands and for historic properties of significance to the Tribes that may be affected by an undertaking (36 CFR Part 800.2(c)(2)). BLM Manual 8120 and Handbook H-8120-1 provide guidance for Native American consultations.

For those resources not considered historic properties under NHPA, ongoing Tribal consultation shall be conducted to determine other issues of concern, including, but not limited to, access rights, disruption of cultural practices, impacts on visual resources important to the Tribes, and impacts on subsistence resources. It should be noted that even when consultation and

an extensive inventory or data collection occur, not all impacts on tribally sensitive resources can be fully mitigated.

Some specific design features are listed below:

- The BLM shall consult with Native American governments early in the planning process to identify issues and areas of concern regarding any proposed solar energy project. Such consultation is required by the NHPA and other authorities and is necessary to determine whether construction and operation of the project are likely to disturb Tribally sensitive resources, impede access to culturally important locations, disrupt traditional cultural practices, affect movements of animals important to Tribes, or visually affect culturally important landscapes. It may be possible to negotiate a mutually acceptable means of minimizing adverse effects to resources important to Tribes.

- The importance of any Native American archaeological or other culturally important sites identified in archaeological inventories in project areas shall be determined and validated through consultation with appropriate Native American governments and cultural authorities. Appropriate mitigation steps, such as avoidance, removal, repatriation of Native American human remains and associated items of cultural patrimony, or curation, shall be determined during this consultation.

- Visual intrusion on sacred areas shall be avoided to the extent practical through the selection of the solar facility location and solar technology. When avoidance is not possible, timely and meaningful consultation with the affected Tribe(s) shall be conducted to formulate a mutually acceptable plan to mitigate or reduce the adverse effect.

- Tribal burial sites shall be avoided. A contingency plan for encountering unanticipated burials and funerary goods during construction, maintenance, or operation of a solar facility shall be developed as part of a formalized agreement to address management and mitigation options for significant cultural resources in consultation with the appropriate Tribal governments and cultural authorities well in advance of any ground disturbances. The contingency plan shall include consultation with the lineal descendants or Tribal affiliates of the deceased, and human remains and objects of cultural patrimony shall be protected and repatriated according to NAGPRA statutory procedures and regulations.

- Springs and other water sources that are or may be sacred or culturally important shall be avoided whenever possible. If it is necessary for construction, maintenance, or operational activities to take place in proximity to springs or other water sources, appropriate measures, such as the use of geotextiles or silt fencing, shall be taken to prevent silt from degrading water

sources. The effectiveness of these mitigating barriers shall be monitored. Measures for preventing water depletion impacts on springs shall also be employed. Particular mitigations shall be determined in consultation with the appropriate Native American Tribe(s).

- Culturally important plant species shall be avoided when possible. When it is not possible to avoid these plant resources, consultations shall be undertaken with the affected Tribe(s). If the species is available elsewhere on agency-managed lands, guaranteeing access may suffice. For rare or less common species, establishing (transplanting) an equal amount of the plant resource elsewhere on agency-managed land accessible to the affected Tribe may be acceptable.

- Culturally important wildlife species and their habitats shall be avoided. When it is not possible to avoid these habitats, solar facilities shall be designed to minimize impacts on game trails, migration routes, and nesting and breeding areas of Tribally important species. Mitigation and monitoring procedures shall be developed in consultation with the affected Tribe(s).

- Archaeological sites created by ancestral Native American populations shall be avoided whenever possible. However, when archaeological excavations are necessary, affiliated Tribe(s) shall be consulted, and the concerns of the affected descendant Native American population shall be taken into account when developing a data recovery strategy. Possible mitigations include scientific excavation; monitoring or participation in excavations by Tribal representatives; and repatriation or approved curation of artifacts.

- Rock art (panels of petroglyphs and/or pictographs) shall be avoided whenever possible. These panels may be just one component of a larger sacred landscape, in which avoidance of all impacts may not be possible. Mitigation plans for eliminating or reducing (minimizing) potential impacts on rock art shall be formulated in consultation with the appropriate Tribal cultural authorities.

- Standard noise design features shall be employed when solar facilities would be located near sacred sites to minimize the impacts of noise on culturally significant areas.

- Health and safety design features for the general public shall be employed when solar facilities are located near Native American traditional use areas in order to minimize potential health and safety impacts on Native Americans.

- Prior to construction, training shall be provided to contractor personnel whose activities or responsibilities could affect resources of significance to Native Americans during construction.

- When there is a reasonable expectation of encountering previously unidentified cultural resources during construction, monitoring of construction by a qualified cultural resource specialist shall be considered to minimize impacts on resources of significance to Tribes to the extent possible.

A.2.2.18 Design Features for Socioeconomic Impacts

The economic effects of solar energy projects can be positive, with increases in employment, income, and state tax revenues; thus, few, if any, mitigation measures may be necessary. On the basis of the potential magnitude of employment impacts of each solar technology, however, it is possible that the socioeconomic impacts of solar development projects, notably the impacts of in-migrating workers on local housing markets and on local government expenditures and employment, would require mitigation measures. A large in-migrant labor force has the potential to produce some degree of social disruption, whereby the cultural and social values of in-migrants conflict with those of the resident population, potentially creating alienation, crime, alcoholism, drug use, mental health problems, and the disruption of family life. The following design features shall be applied to avoid or reduce these impacts, depending on site- and project-specific conditions.

- To address impacts to local issues, the BLM may include stipulations in the ROW authorization or require solar developers to enter into mitigation agreements with individual local jurisdictions and county agencies, as necessary.

- Project developers shall collect and evaluate available information describing the socioeconomic conditions in the vicinity of the proposed project, as needed, to predict potential impacts of the project.

- If the BLM authorized officer concludes that the project is likely to have a substantial impact on the economic or social conditions of local communities, the project developers shall work with state, local, and Tribal agencies and governments to develop community monitoring programs that would be sufficient to identify and evaluate socioeconomic impacts resulting from solar energy development. Monitoring programs shall collect data reflecting the economic, fiscal, and social impacts of development at the state, local, and Tribal level. Parameters to be evaluated could include impacts on local labor and housing markets, local consumer product prices and availability, local public services (police, fire, and public health), and educational services. Programs also could monitor indicators of social disruption (e.g., crime, alcoholism, drug use, and mental health) and the effectiveness of community welfare programs in addressing these problems.

- If the BLM authorized officer concludes that the project is likely to have a substantial impact on the economic or social conditions of local communities, the BLM may include stipulations in the ROW authorization or require solar

developers to enter into mitigation agreements with individual local jurisdictions and county agencies, as necessary, to address local issues. Also, project developers shall work with state, local, and Tribal agencies to develop community outreach programs that would help communities adjust to changes triggered by solar energy development. Such programs could include any of the following activities:

- Establishing vocational training programs for the local workforce to promote development of skills required by the solar energy industry.

- Developing instructional materials for use in area schools to educate the local communities on the solar energy industry.

- Supporting community health screenings.

- Providing financial support to local libraries for the development of information repositories on solar energy, including materials on the hazards and benefits of commercial development. Electronic repositories established by the operators could also be of great value.

A.2.2.19 Design Features for Environmental Justice Impacts

Although the environmental impacts of solar development on low-income and minority populations are likely to be small, where such environmental justice impacts occur, the developer shall make a plan to implement a number of design features to mitigate the potential environmental, economic, cultural, and health impacts on low-income and minority populations. These design features may include any or all of the following:

- Focused public information campaigns could be developed and implemented to provide technical and environmental health information directly to low-income and minority groups or to local agencies and representative groups. Key information would include the extent of any likely impact on air quality, drinking water supplies, subsistence resources, public services, and the relevant preventative measures that may be taken.

- Community health screenings for low-income and minority groups.

- Financial support to local libraries in low-income and minority communities could be provided for the development of information repositories on solar energy, including materials on the hazards and benefits of commercial development.

- Vocational training programs for the local low-income and minority workforce could be established to promote development of skills required by the solar energy industry.

- Instructional materials could be developed for use in area schools to educate the local communities on the solar energy industry.

- Key information could be provided to local governments and directly to low-income and minority populations on the scale and timeline of expected solar projects and on the experience of other low-income and minority communities that have followed the same energy development path. In addition, information on planning activities that may be initiated to provide local infrastructure, public services, education, and housing could be made available.

A.2.2.20 Design Features for Transportation Impacts

Depending on site-specific characteristics, a number of design features may be required to mitigate transportation impacts. Appropriate measures shall be determined during the siting and design phase through the development of a Transportation Plan and a Traffic Management Plan. Measures appropriate to implement include the following:

- Easements could be required for public roadway corridors through a site to maintain proper traffic flows and retain more direct routing for the local population.

- To mitigate impacts related to the daily commutes of construction workers, the operator may be required to implement local road improvements, provide multiple site access locations and routes, stagger work schedules, and implement a ride-sharing or shuttle program.

- To reduce hazards for incoming and outgoing traffic, as well as to expedite traffic flow, the operator may be required to implement traffic control measures, such as intersection realignment coupled with speed limit reduction; the installation of traffic lights and/or other signage; and the addition of acceleration, deceleration, and turn lanes on routes with site entrances.

A.2.2.21 Design Features for Hazardous Materials and Waste

Means to eliminate or reduce adverse impacts from hazardous materials and wastes include compliance with applicable laws, ordinances, and regulations and conformance with relevant industry standards (including those issued by nonregulatory bodies, such as the National Fire Protection Association). For the solar facility projects issued ROWs by the BLM, construction and operation plans must also incorporate elements of relevant construction

standards and interconnection requirements of the transmission system operator as well as the reliability requirements of Federal Energy Regulatory Commission (FERC) orders.[5]

A.2.2.21.1 Required Plans

- A Hazardous Materials and Waste Management Plan shall address the selection, transport, storage, and use of all hazardous materials needed for construction, operation, and decommissioning of the facility for local emergency response and public safety authorities and for the designated BLM land manager, and it shall address the characterization, on-site storage, recycling, and disposal of all resulting wastes.[6] The plan shall, at a minimum, include the following: facility identification; comprehensive hazardous materials inventory; Material Safety Data Sheets (MSDSs) for each type of hazardous material; emergency contacts and mutual aid agreements, if any; site map showing all hazardous materials and waste storage and use locations; copies of spill and emergency response plans (see below), and hazardous materials-related elements of a decommissioning/closure plan.

- A Construction and Operation Waste Management Plan shall identify the waste streams that are expected to be generated at the site and address hazardous waste determination procedures, waste storage locations, waste-specific management and disposal requirements, inspection procedures, and waste minimization procedures. The plan shall address all solid and liquid wastes that may be generated at the site in compliance with the CWA requirements to obtain the project's NPDES permit.

- A Fire Management and Protection Plan shall be developed to implement measures to minimize the potential for fires associated with substances used and stored at the site. The flammability of the specific HTF used at the facility shall be considered.

- If pesticides/herbicides are to be used on the site, a Nuisance Animal and Pest Control Plan and an Integrated Vegetation Management Plan shall be developed to ensure that applications will be conducted within the framework of BLM policies and will entail the use of only EPA-registered pesticides/herbicides that are nonpersistent and immobile and approved by the BLM land manager.

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5 See, for example, the construction standards issued by the Western Area Power Administration and the generator responsibilities established by the California independent system operator (http://www.caiso.com/thegrid/operations/opsdoc/gcp/index.html).

6 It is not anticipated that any solar energy facility would have hazardous chemicals present on-site in such quantities as to require development of a Risk Management Plan as specified in 40 CFR Part 68.

- A comprehensive Spill Prevention and Emergency Response Plan shall be developed for the facility, and it shall meet the following criteria. It will be written, periodically updated, and made available to the entire workforce; contain procedures for timely notification of appropriate authorities, including the designated BLM land manager; provide spill/emergency contingency planning for each type of hazardous material present, including the abatement or stabilizing of the release, recovery of the spilled product, and remediation of the impacted environmental media; be supported by the strategic deployment of appropriate spill response materials and equipment, including personal protective equipment (PPE) for individuals with spill or emergency response assignments; provide for prompt response to spills and timely delivery of recovered spill materials and contaminated environmental media to appropriately permitted off-site treatment or disposal facilities; formally assign spill and emergency response duties to specified individuals; provide general awareness training to remaining facility personnel; and provide for written documentation of each event, including root cause analysis, description of corrective actions taken, and characterization of the resulting environmental or health and safety impacts.

A.2.2.21.2 Other Design Features

- All site characterization, construction, operation, and decommissioning activities shall be conducted in compliance with applicable federal and state laws and regulations, including the Toxic Substances Control Act of 1976, as amended (15 USC 2601, et seq.). In addition, any release of toxic substances (leaks, spills, etc.) in excess of the reportable quantity established by 40 CFR Part 117 shall be reported as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, Section 102b. A copy of any report required or requested by any federal agency or state government as a result of a reportable release or spill of any toxic substances shall be furnished to the authorized officer concurrent with the filing of the reports to the involved federal agency or state government. In addition, the United States shall be indemnified against any liability arising from the release of any hazardous substance or hazardous waste on the facility or associated with facility activities.

- Project developers shall survey project sites for unexploded ordnance, especially if projects are within 20 mi (32 km) of a current DoD installation or formally used defense site.

- Pollution prevention opportunities shall be identified and implemented, including material substitution of less hazardous alternatives, recycling, and waste minimization.

- Systems containing hazardous materials shall be designed and operated in a manner that limits the potential for their release; measures shall include construction of compatible materials in good condition (as verified by periodic inspections); provision of secondary containment features (to the extent practical); installation of sensors or other devices to monitor system integrity; installation of strategically placed valves to isolate damaged portions and limit the amount of hazardous materials in jeopardy of release; and use of robust inspection and repair procedures.

- Dedicated areas with secondary containment shall be established for off-loading hazardous materials transport vehicles.

- To the greatest extent practical and by considering the remoteness of a given facility, "just-in-time" ordering procedures shall be employed that are designed to limit the amounts of hazardous materials present on the site to quantities minimally necessary to support continued operations. Excess hazardous materials should receive prompt disposition.

- Written procedures for the storage, use, and transportation of each type of hazardous material present shall be provided, including all vehicle and equipment fuels.

- Authorized users for each type of hazardous material shall be identified.

- Procedures shall be established for fuel storage and dispensing, including shutting off vehicle (equipment) engines; using only authorized hoses, pumps, and other equipment in good working order; maintaining appropriate fire and spill response materials at equipment fueling stations; providing emergency shutoffs for fuel pumps; ensuring that fueling stations are paved; ensuring that both aboveground fuel tanks and fueling both have adequate secondary containment; prohibiting smoking, welding, or open flames in fuel storage and dispensing areas; equipping the area with fire suppression devices, as appropriate; conducting routine inspections of fuel storage and dispensing areas; requiring prompt recovery and remediation of all spills; and providing for the prompt removal of all fuel and fuel tanks used to support construction vehicles and equipment at the completion of facility construction and decommissioning phases.

- Refueling areas shall be located away from surface water locations and drainages and on paved surfaces; features shall be added to direct spilled materials to sumps or safe storage areas where they can be subsequently recovered.

- All vehicles and equipment shall be in proper working condition to ensure that there is no potential for leaks of motor oil, antifreeze, hydraulic fluid, grease, or other hazardous materials.

- Hazardous materials and waste storage areas or facilities shall be formally designated and access to them restricted to authorized personnel. Construction debris, especially treated wood, shall not be disposed of or stored in areas where it could come in contact with aquatic habitats.

- Design requirements shall be established for hazardous materials and waste storage areas that are consistent with accepted industry practices as well as applicable federal, state, and local regulations and that include, at a minimum, (1) containers constructed of compatible materials, properly labeled, and in good condition; (2) secondary containment features for liquid hazardous materials and wastes; (3) physical separation of incompatible chemicals; and (4) fire-fighting capabilities when warranted.

- Written procedures shall be established for inspecting hazardous materials and waste storage areas and for plant systems containing hazardous materials; identified deficiencies and their resolution shall be documented.

- Schedules shall be established for the regular removal of wastes (including sanitary wastewater generated in temporary, portable sanitary facilities) for delivery by licensed haulers to appropriate off-site treatment or disposal facilities.

- During facility decommissioning, the following shall occur: Emergency response capabilities shall be maintained throughout the decommissioning period as long as hazardous materials and wastes remain on-site, and emergency response planning shall be extended to any temporary material and equipment storage areas that may have been established. Temporary waste storage areas shall be properly designated, designed, and equipped. Hazardous materials removed from systems shall be properly containerized and characterized, and recycling options shall be identified and pursued. Off-site transportation of recovered hazardous materials and wastes resulting from decommissioning activities shall be conducted by authorized carriers. All hazardous materials and waste shall be removed from on-site storage and management areas (including surface impoundments), and the areas shall be surveyed for contamination and remediated as necessary.

A.2.2.22 Design Features to Ensure Health and Safety

A.2.2.22.1 Occupational Health and Safety

- All site characterization, construction, operation, and decommissioning activities shall be conducted in compliance with applicable federal and state occupational safety and health standards (e.g., the Occupational Health and

Safety Administration's [OSHA's] Occupational Health and Safety Standards, 29 CFR Parts 1910 and 1926, respectively).

- A safety assessment shall be conducted to describe potential safety issues and the means that would be taken to mitigate them, covering issues such as site access; construction; safe work practices; glare exposure from mirrors, heliostats, and/or power towers; security; heavy equipment transportation; traffic management; emergency procedures; and fire control.

- A health and safety program shall be developed to protect workers during site characterization, construction, operation, and decommissioning of a solar energy project. The program shall identify all applicable federal and state occupational safety standards and establish safe work practices addressing all hazards, including requirements for developing the following plans: general injury prevention; PPE requirements and training; respiratory protection; hearing conservation; electrical safety; hazardous materials safety and communication; housekeeping and material handling; confined space entry; hand and portable power tool use; gas-filled equipment use; and rescue response and emergency medical support, including on-site first aid capability.

- In addition, the health and safety program shall address OSHA standard practices for the safe use of explosives and blasting agents (e.g., if used to construct foundations for power tower facilities); measures for reducing occupational electric and magnetic field (EMF) exposures; the establishment of fire safety evacuation procedures; and required safety performance standards (e.g., electrical system standards and lighting protection standards). The program shall include training requirements for applicable tasks for workers and establish procedures for providing required training to all workers. Documentation of training and a mechanism for reporting serious accidents to appropriate agencies shall be established.

- A health risk assessment shall evaluate potential cancer and noncancer risks to workers from exposure to facility emission sources during construction and operations. If potential risks are found to exceed applicable threshold levels, measures shall be taken to decrease emissions from the source.

- Electrical systems shall be designed to meet all applicable safety standards (e.g., National Electrical Code [NEC]) and comply with the interconnection requirements of the transmission system operator.

- In the event of an accidental release of hazardous substances to the environment, project developers shall document the event, including a root cause analysis, a description of appropriate corrective actions taken, and a characterization of the resulting environmental or health and safety impacts.

Documentation of the event shall be provided to the permitting agencies and other federal and state agencies within 30 days, as required.

- For the mitigation of explosive hazards, workers shall be required to comply with the OSHA standard (29 CFR 1910.109) for the safe use of explosives and blasting agents.

- Measures shall be considered to reduce occupational EMF exposures, such as backing electrical generators with iron to block the EMF, shutting down generators when work is being done near them, and otherwise limiting exposure time and proximity while generators are running.

A.2.2.22.2 Public Health and Safety

- The project health and safety program shall address protection of public health and safety during site characterization, construction, operation, and decommissioning for a solar energy project. The program shall establish a safety zone or setback for solar facilities and associated transmission lines from residences and occupied buildings, roads, ROWs, and other public access areas that is sufficient to prevent accidents resulting from various hazards during all phases of development. It shall identify requirements for temporary fencing around staging areas, storage yards, and excavations during construction or decommissioning activities. It shall also identify measures to be taken during the operations phase to limit public access to facilities (e.g., equipment with access doors shall be locked to limit public access, and permanent fencing with slats shall be installed around electrical substations).

- A Traffic Management Plan shall be prepared for the site access roads to control hazards that could result from increased truck traffic (most likely during construction or decommissioning), to ensure that traffic flow would not be adversely affected and that specific issues of concern (e.g., the locations of school bus routes and stops) are identified and addressed. This plan shall incorporate measures, such as informational signs, flaggers (when equipment may result in blocked throughways), and traffic cones to identify any necessary changes in temporary lane configurations. The plan shall be developed in coordination with local planning authorities.

- Solar facilities shall be sited and designed properly to eliminate glint and glare effects on roadway users, nearby residences, commercial areas, or other highly sensitive viewing locations or to reduce it to the lowest achievable levels (see similar design feature under Section A.2.2.13). Regardless of the solar technology proposed, a Glint and Glare Assessment, Mitigation, and Monitoring Plan must accurately assess and quantify potential glint and glare effects and determine potential health, safety, and visual impacts associated with glint and glare effects. The assessment shall be conducted by qualified

individuals using appropriate and commonly accepted software and procedures. The assessment results must be made available to BLM in advance of project approval. If the project design is changed during the siting and design process such that substantial changes to glint and glare effects may occur, glint and glare effects shall be recalculated, and the results shall be made available to BLM. If any potential for exposure at levels that could cause retinal damage is identified, measures to eliminate the exposure shall be implemented (e.g., slatted fencing to shield views from outside the facility). The Plan shall also set up a system for logging, investigating, and responding to complaints regarding glare.

- A health risk assessment shall evaluate potential cancer and noncancer risks to the general public from exposure to facility emission sources during construction and operations. If potential risks are found to exceed applicable threshold levels, measures shall be taken to decrease emissions from the source.

- Because of the high global warming potential of sulfur hexafluoride (SF_6), the use of alternative dielectric fluids that do not have a high global warming potential shall be required.

- If operation of the solar facility and associated transmission lines and substations is expected to cause potential adverse impacts on nearby residences and occupied buildings from noise, sun reflection, or EMF, recommendations for addressing these concerns shall be incorporated into the project design (e.g., establishing a sufficient setback from transmission lines).

- The project shall be planned to comply with FAA regulations, including lighting requirements, and to avoid potential safety issues associated with proximity to airports, military bases or training areas, or landing strips.

- Operators shall develop a Fire Management and Protection Plan to implement measures to minimize the potential for a human-caused fire and to respond to human-caused or natural-caused fires.

- Project developers shall work with appropriate agencies (e.g., the U.S. Department of Energy [DOE] and Transportation Security Administration [TSA]) to address critical infrastructure and key resource vulnerabilities at solar facilities in order to minimize and plan for potential risks from natural events, sabotage, and terrorism.

A.2.3 Proposed Solar Energy Zone-Specific Design Features

For projects to be located within SEZs, applicable SEZ-specific design features will be required in addition to the programmatic design features. The SEZ-specific design features have

been established to address specific resource conflicts within individual SEZs identified through the course of the PEIS impact analyses. The proposed SEZ-specific design features for all the proposed SEZs are listed in Table A.2-2 (note that the SEZ-specific design features common to all SEZs are listed at the end of the table). These design features are proposed as elements of BLM's Solar Development Program. With the signing of the Record of Decision (ROD) for the Final PEIS, the design features that are carried forward in the ROD will be required for all development within the applicable SEZs.

TABLE A.2-2 Proposed Solar Energy Zone-Specific Design Features

SEZ	SEZ-Specific Design Features[a]
Arizona	
Brenda	*Specially Designated Areas and Lands with Wilderness Characteristics:* To reduce potential impacts on the Plomosa SRMA, consideration should be given to restricting solar energy development in the SEZ to areas east of the county road. In addition, if the SEZ was restricted to the use of lower profile solar energy facilities, potential visual impacts would be reduced in the Plomosa SRMA, the Kofa and New Water WAs, and the Dripping Springs ACEC. *Rangeland Resources (Livestock Grazing)*: Development of range improvements and changes in grazing management should be considered to mitigate the loss of AUMs in the grazing allotment. *Recreation:* To reduce potential impacts on recreation use in the Plomosa SRMA, consideration should be given to restricting solar energy development in the SEZ to areas east of the county road. In addition, if the SEZ was restricted to the use of lower profile solar energy facilities, impacts on recreation use in the SRMA would likely be reduced. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Before drilling a new well within the Ranegras Plain basin, a Notice of Intent to Drill must be filed with ADWR, and any groundwater rights policy of the ADWR must be followed. Land disturbance and operations activities should prevent erosion and sedimentation in the vicinity of the ephemeral washes present on the site. Development should be avoided in the vicinity of Bouse Wash. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of creosotebush-white bursage desert scrub communities and other affected habitats and minimize the potential for the spread of invasive species such as those occurring in Le Paz County or the Lake Havasu Field Office Planning Area, that could be introduced as a result of solar energy project activities.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Arizona (Cont.)	
Brenda *(Cont.)*	All dry wash, dry wash woodland, chenopod scrub habitats, and saguaro cactus communities within the SEZ and all dry wash, dry wash woodland, mesquite bosque, chenopod scrub, and saguaro cactus communities within the assumed transmission line corridor should be avoided to the extent practicable, and any impacts minimized and mitigated. A buffer area should be maintained around dry washes, dry wash woodland, and mesquite bosque habitats to reduce the potential for impacts. Appropriate engineering controls should be used to minimize impacts on dry wash, dry wash woodland, mesquite bosque, and chenopod scrub, including downstream occurrences, resulting from surface water runoff, erosion, sedimentation, altered hydrology, accidental spills, or fugitive dust deposition to these habitats. Appropriate buffers and engineering controls would be determined through agency consultation. Transmission line towers should be sited and constructed to minimize impacts on dry washes, dry wash woodlands, and mesquite bosque communities; towers should span such areas whenever practicable. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on groundwater-dependent communities, such as mesquite bosque communities. *Wildlife (All):* Bouse Wash should be avoided by solar energy development, and Tyson Wash should be spanned by the transmission line. *Wildlife (Mammals)*: The fencing around the solar energy facility should not block the free movement of mammals, particularly big game species. *Special Status Species*: Avoiding or minimizing disturbance of sand dunes, sand transport systems, sand flats, agricultural and riparian habitats in the area of direct effects could reduce impacts on two special status species. Consultation with the USFWS and AZGFD should be conducted to address the potential for impacts on the Sonoran bald eagle as required under the ESA. Consultation would identify an appropriate survey protocol, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Arizona (Cont.)	
Brenda *(Cont.)*	Coordination with the USFWS and AZGFD should be conducted to address the potential for impacts on the Sonoran population of the desert tortoise, a species under review for listing under the ESA. Coordination would identify an appropriate survey protocol and mitigation requirements, which may include avoidance, minimization, translocation, or compensation. *Acoustic Environment*: Dish engine facilities within the Brenda SEZ should be located more than 1 to 2 mi (1.6 to 3 km) from the nearby residences (i.e., the facilities should be located in the northern portion of the proposed SEZ).
Bullard Wash	*Lands and Realty*: Priority consideration should be given to utilizing the existing Alamo Road to provide construction and operational access to the SEZ. *Specially Designated Areas and Lands with Wilderness Characteristics:* Consideration should be given to restricting development of solar facilities within 5 mi (8 km) of the Tres Alamos WA to avoid the most serious impacts on the WA. Consideration should be given to restricting solar facilities within the SEZ to lower profile facilities. *Rangeland Resources (Livestock Grazing)*: Development of additional range improvements within the allotments should be considered to reduce the expected loss of livestock forage. *Water Resources*: Water resource analysis indicates that wet cooling options would not be feasible. Other technologies should incorporate water conservation measures. Before a new well is drilled within the Bill Williams basin, a Notice of Intent to Drill must be filed with ADWR, and any groundwater rights policy of the ADWR must be followed Land disturbance and operations activities should prevent erosion and sedimentation in the vicinity of the ephemeral washes present on the site and downstream in Bullard Wash. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of creosotebush-white bursage desert scrub communities and other affected habitats and to minimize the potential for the spread of invasive species such as those occurring in Yavapai County or the Bradshaw-Harquahala Planning Area, which could be introduced as a result of solar energy project activities.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Arizona (Cont.)	
Bullard Wash *(Cont.)*	All wetland, dry wash, dry wash woodland, mesquite bosque, riparian, Joshua tree, and saguaro cactus communities within the SEZ or corridors should be avoided to the extent practicable and any impacts minimized and mitigated. Any Joshua trees or cacti that cannot be avoided should be salvaged. A buffer area should be maintained around wetland and riparian habitats to reduce the potential for impacts. Transmission line towers should be sited and constructed to minimize impacts on riparian areas and to span them whenever practicable. Appropriate engineering controls should be used to minimize impacts on wetland, dry wash, dry wash woodland, mesquite bosque, and riparian habitats, including downstream occurrences resulting from surface water runoff, erosion, sedimentation, altered hydrology, accidental spills, or fugitive dust deposition. Appropriate buffers and engineering controls would be determined through agency consultation. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on groundwater-dependent communities, such as mesquite bosque communities, or riparian communities associated with springs, such as Yerba Mansa Spring or Tres Alamos Spring, or along the Santa Maria River. *Wildlife (Amphibians and Reptiles)*: Isolated wetlands should be avoided. *Wildlife (Birds)*: Wetland habitats, which could provide occasional watering and feeding sites for some bird species, should be avoided. *Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. Wetland habitats, which could provide occasional watering and feeding sites for some mammal species, should be avoided. *Aquatic Biota*: Any wetlands within the SEZ should be avoided. *Special Status Species*: Avoiding or minimizing disturbance to desert wash and riparian habitats within the area of direct effects could reduce or eliminate impacts on 15 special status species.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Arizona (Cont.)	
Bullard Wash *(Cont.)*	Consultation with the USFWS and AZGFD should be conducted to address the potential for impacts on the following species currently listed as threatened or endangered under the ESA: Arizona cliff rose, desert pupfish, Gila topminnow, Sonoran bald eagle, and southwestern willow flycatcher. Consultation would identify an appropriate survey protocol, avoidance and minimization measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements (if necessary). Coordination with the USFWS and AZGFD should be conducted to address the potential for impacts on the Sonoran population of the desert tortoise, a species under review for listing under the ESA. Coordination would identify an appropriate survey protocol and mitigation requirements, which may include avoidance, minimization, translocation, or compensation. Avoidance or minimization of groundwater withdrawals to serve solar energy development on the SEZ could reduce or eliminate impacts on four status species. In particular, impacts on aquatic and riparian habitat associated with the Tres Alamos and Yerba Mansa springs should be avoided
Gillespie	*Lands and Realty*: Priority consideration should be given to utilizing Agua Caliente Road to provide construction and operational access to the SEZ. *Specially Designated Areas and Lands with Wilderness Characteristics:* Requiring that the solar technologies with lower profiles be used within the SEZ would substantially reduce visual impacts on wilderness and scenic resources. *Rangeland Resources (Livestock Grazing)*: Development of range improvements and changes in grazing management should be considered to mitigate the loss of AUMs in the grazing allotment. *Water Resources*: Wet-cooling options would not be feasible if groundwater was the chosen water source for a solar project; other technologies should incorporate water conservation measures. Before drilling a new well, permits must be obtained from the ADWR, and all groundwater rights policies of the ADWR must be followed. Land disturbance and operations activities should prevent erosion and sedimentation in the vicinity of the ephemeral washes present on the site and downstream in Centennial Wash.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Arizona (Cont.)	
Gillespie *(Cont.)*	*Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of creosotebush-white bursage desert scrub and Sonoran Paloverde-Mixed Cacti Desert Scrub communities, as well as other affected habitats, and to minimize the potential for the spread of invasive species, such as those occurring in Maricopa County. All wetland, dry wash, dry wash woodland, mesquite bosque, riparian, and saguaro cactus communities within the SEZ or access road corridor should be avoided to the extent practicable, and any impacts minimized and mitigated. Any cacti that cannot be avoided should be salvaged. A buffer area should be maintained around dry washes, dry wash woodland, mesquite bosque, wetland, and riparian habitats to reduce the potential for impacts. Appropriate engineering controls should be used to minimize impacts on wetland, dry wash, dry wash woodland, mesquite bosque, and riparian habitats, including downstream occurrences, resulting from surface water runoff, erosion, sedimentation, altered hydrology, accidental spills, or fugitive dust deposition to these habitats. Appropriate buffers and engineering controls would be determined through agency consultation. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on groundwater-dependent communities, such as mesquite bosque communities or riparian habitats along the Gila or Hassayampa Rivers. *Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. *Special Status Species*: Consultation with the USFWS and AZGFD should be conducted to address the potential for impacts on the following species currently listed as threatened or endangered under the ESA: Sonoran bald eagle, southwestern willow flycatcher, and Yuma clapper rail. Consultation would identify an appropriate survey protocol, avoidance and minimization measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements (if necessary).

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Arizona (Cont.)	
Gillespie *(Cont.)*	Coordination with the USFWS and AZGFD should be conducted to address the potential for impacts on the following species that are candidates or under review for listing under the ESA: Sonoran desert tortoise, Tucson shovel-nosed snake, and western yellow-billed cuckoo. Coordination would identify an appropriate survey protocol, and mitigation, which may include avoidance, minimization, translocation, or compensation. Avoiding or minimizing disturbance to desert wash and riparian habitats could reduce impacts on 17 special status species. Avoidance or minimization of groundwater withdrawals to serve solar energy development on the SEZ could reduce or eliminate impacts to nine special status species. *Visual Resources*: The development of power tower facilities should be prohibited within the SEZ. *Acoustic Environment*: Dish engine facilities within the Gillespie SEZ should be located more than 1 to 2 mi (1.6 to 3 km) from the nearest residences (i.e., the facilities should be located in the central or northwestern portion of the proposed SEZ).
California	
Imperial East	*Specially Designated Areas and Lands with Wilderness Characteristics:* Once construction of solar energy facilities begins, the BLM would monitor to determine whether increases in traffic in the ACECs occur and whether additional management measures are required to protect the resources in these areas. *Military and Civilian Aviation*: Should power tower facilities be proposed for the SEZ, coordination across the international border should be required to ensure that there is no airspace management concern associated with the Mexicali Airport. *Minerals*: To protect the option for geothermal leasing under solar energy facilities, ROW authorizations for solar energy facilities shall specifically note the potential for geothermal leasing with no surface occupancy stipulations. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land disturbance activities should avoid impacts in the vicinity of the existing and mitigation wetlands located along the southern boundary of the site.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
California (Cont.)	
Imperial East *(Cont.)*	During site characterization, coordination and permitting with CDFG regarding California's Lake and Streambed Alteration Program would be required for any proposed alterations to surface water features, both perennial and ephemeral. The groundwater-permitting process should be in compliance with the Imperial County groundwater ordinance. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of Sonoran Desert habitats, such as desert scrub and dunes, and to minimize the potential for the spread of invasive species. Wetland, riparian habitats, and desert dry washes, primarily within the western and southern portions of the SEZ, and sand dune habitats and sand transport areas, primarily in the northern and eastern portions of the SEZ, should be avoided to the extent practicable. A buffer area should be maintained around wetlands to reduce the potential for impacts on wetlands on or near the SEZ. An appropriate buffer shall be maintained between project impacts and the wetland south of the Imperial Valley SEZ to ensure all impacts from construction, operations, and maintenance of solar facilities do not impair the current functions and values associated with wetland resources, including habitat support for sensitive species. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on wetland habitats that are associated with groundwater discharges, such as the wetlands near the AAC and EHC. *Wildlife (All):* Wetland habitats along the southern boundary of the SEZ should be avoided to the extent practicable. *Wildlife (Amphibians and Reptiles)*: The potential for indirect impacts on several amphibian species could be reduced by maximizing the distance between solar energy development and the All American Canal. *Wildlife (Birds)*: Pre-disturbance surveys should be conducted within the SEZ for bird species listed under the Migratory Bird Treaty Act. Impacts on potential nesting habitat of these species should be avoided, particularly during the nesting season.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
California (Cont.)	
Imperial East *(Cont.)*	Pre-disturbance surveys should be conducted within the SEZ for the following desert bird focal species: ash-throated flycatcher, black-tailed gnatcatcher, black-throated sparrow, burrowing owl, common raven, Costa's hummingbird, crissal thrasher, ladder-backed woodpecker, Le Conte's thrasher, phainopepla, and verdin. Impacts on potential nesting habitat of these species should be avoided. Plant species that positively influence the presence and abundance of the desert bird focal species should be avoided to the extent practicable. These species include Goodding's willow, yucca, Joshua tree, mesquite, honey mesquite, screwbean, desert mistletoe, big saltbush, smoketree, and catclaw acacia. *Wildlife (Mammals):* Ensure that solar project development does not prevent mule deer free access to the unlined section of the All American Canal. *Special Status Species*: Disturbance of sand dunes and sand transport systems, desert riparian, wash, and wetland habitats should be avoided or minimized to the extent practicable. Avoiding or minimizing disturbance of these habitats could reduce impacts on 30 special status species. Because the California black rail and Yuma clapper rail are fully protected species, direct and indirect impacts on them should be completely avoided. This includes the complete avoidance of occupied and potentially suitable wetlands on and in the vicinity of the SEZ (particularly those seepage wetlands and enhanced wetlands associated with the All-American Canal). Consultations with the CDFG are required to address the potential for impacts on these species as required under the CESA. Consultations with the USFWS and CDFG are required to address the potential for impacts on these species as required under the CESA. Consultations with the USFWS and the CDFG should be conducted to address the potential for impacts on the Yuma clapper rail a species listed as endangered under the ESA and CESA. Consultation would identify an appropriate survey protocol, avoidance measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and determine any additional mitigation requirements beyond those already afforded to the Yuma clapper rail as a California fully protected species. Coordination with the USFWS and CDFG should be conducted to address the potential for impacts on the flat-tailed horned lizard, a species that is proposed for listing under the ESA. Coordination would identify an appropriate survey protocol, avoidance measures, and, potentially, translocation or compensatory mitigation (if necessary).

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
California (Cont.)	
Imperial East *(Cont.)*	*Acoustic Environment*: Dish engine facilities within the Imperial East SEZ should be located more than 1 to 2 mi (1.6 to 3.2 km) from nearby residences located southwest of the SEZ (i.e., the facilities should be located in the central or eastern portion of the proposed SEZ). *Cultural Resources*: Because of the possibility of burials in the vicinity of the proposed Imperial East SEZ, and its location along the Yuma-San Diego Trail, it is recommended that for surveys conducted in the SEZ consideration be given to include Native American representatives in the development of survey designs and historic property treatment and monitoring plans.
Iron Mountain	*Lands and Realty*: Survey of solar energy development sites for possible unexploded military ordnance would be required. *Specially Designated Areas and Lands with Wilderness Characteristics:* Application of SEZ-specific design features for visual resource impacts may reduce the visual impact on wilderness characteristics, scenic resources, and night sky viewing opportunities. *Minerals*: The presence of the KSLA must be addressed to evaluate the compatibility of solar development in the KSLA with continuation of sodium mineral leasing. Alternatively, the KSLA could be excluded from the SEZ. Planning and identification for retention of sand and gravel resources within the SEZ should be completed prior to authorization of solar energy leases. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land disturbance activities should avoid impacts to the extent possible in the vicinity of Danby Lake to reduce impacts to the regional drainage outlet and salt mining operations. During site characterization, coordination and permitting with CDFG regarding California's Lake and Streambed Alteration Program would be required for any proposed alterations to surface water features (both perennial and ephemeral). The groundwater-permitting process should be in compliance with the San Bernardino County groundwater ordinance.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
California (Cont.)	
Iron Mountain *(Cont.)*	Construction of groundwater production wells in the Danby Lake region should be avoided because the water is nonpotable and contains corrosive levels of TDS. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of affected Sonoran Desert habitats and minimize the potential for the spread of invasive species, such as tamarisk, cheatgrass, and sahara mustard. Riparian, playa, chenopod scrub, sand dune, and desert dry wash habitats should be avoided to the extent practicable, and any impacts should be minimized and mitigated. A buffer area should be maintained around riparian areas, playas, and dry washes to reduce the potential for impacts on these habitats on or near the SEZ. Appropriate engineering controls should be used to minimize impacts on these areas resulting from surface water runoff, erosion, sedimentation, altered hydrology, accidental spills, or fugitive dust deposition to these habitats. Appropriate buffers and engineering controls would be determined through agency consultation. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on riparian habitat that is associated with groundwater discharge or groundwater-dependent communities, such as mesquite bosque. *Wildlife (Amphibians and Reptiles)*: Design features should be implemented to reduce the potential for direct effects on amphibians and reptiles that depend on specific habitat types that can be easily avoided (e.g., Colorado River Aqueduct, Homer Wash, and portions of Danby Lake). *Wildlife (Birds):* Pre-disturbance surveys should be conducted within the SEZ for the following desert bird focal species: ash-throated flycatcher, black-tailed gnatcatcher, black-throated sparrow, burrowing owl, common raven, Costa's hummingbird, crissal thrasher, ladder-backed woodpecker, Le Conte's thrasher, phainopepla, and verdin. Impacts on potential nesting habitat of these species should be avoided. Plant species that positively influence the presence and abundance of the desert bird focal species should be avoided to the extent practicable. These species include Goodding's willow, yucca, Joshua tree, mesquite, honey mesquite, screwbean, desert mistletoe, big saltbush, smoketree, and catclaw acacia.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
California (Cont.)	
Iron Mountain *(Cont.)*	Minimize development in Danby Lake and preclude development on Homer Wash. This could reduce impacts on species such as the killdeer, least sandpiper, ash-throated flycatcher, black-tailed gnatcatcher, Costa's hummingbird, Le Conte's thrasher, and verdin. *Wildlife (Mammals)*: Development in Homer Wash should be avoided in order to reduce impacts on species such as the roundtailed ground squirrel, white-tailed antelope squirrel, little pocket mouse, long-tailed pocket mouse, and any other mammal species that inhabit wash habitats. *Wildlife (Aquatic Biota):* The amount of ground disturbance near Danby Lake should be minimized. *Special Status Species*: Disturbance of desert riparian, wash, and playa habitats within the SEZ should be avoided or minimized to the extent practicable. In particular, development should be avoided within Danby Lake, which covers approximately 25,000 acres (100 km^2), and within Homer Wash. Avoiding or minimizing disturbance of these habitats could reduce impacts on four special status species. Avoiding or minimizing disturbance of desert dunes and sand transport systems on the SEZ could reduce impacts on 9 special status species. Avoiding or minimizing disturbance of sand dunes and sand transport systems, rocky cliffs, and outcrops on the SEZ could reduce impacts on 15 special status species. Consultations with the USFWS and the CDFG should be conducted to address the potential for impacts on the desert tortoise, a species listed as threatened under the ESA and CESA. Consultation would identify an appropriate survey protocol, avoidance measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements. *Visual Resources*: Within the SEZ, in areas visible from and within 1 mi (1.6 km) of the boundary of the Old Woman Mountains WA, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from KOPs (to be determined by the BLM) within the WA, and in areas visible from between 1 and 3 mi (1.6 and 4.8 km). Visual impacts should be consistent with VRM Class III management objectives.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
California (Cont.)	
Iron Mountain *(Cont.)*	Within the SEZ, in areas visible from and south of State Highway 62, visual impacts associated with solar energy project operation should be consistent with VRM Class III management objectives, as experienced from KOPs (to be determined by the BLM) within the Palen McCoy WA. Within the SEZ, in areas visible from and within 3 mi (4.8 km) of the boundary of the Turtle Mountains WA, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from KOPs (to be determined by the BLM) within the WA, and in areas visible from between 3 and 5 mi (4.8 and 8 km); visual impacts should be consistent with VRM Class III management objectives. *Acoustic Environment*: Dish engine facilities within the Iron Mountain SEZ should be located more than 1 to 2 mi (1.6 to 3 km) from the nearest residences, west of the west-central SEZ (i.e., the facilities should be located in other portions of the proposed SEZ). *Cultural Resources*: Avoidance of significant sites (historic properties) within the proposed Iron Mountain SEZ, specifically in the vicinity of Danby Lake and near the Iron Mountain Divisional Camp, is recommended. Because of the possibility of burials in the vicinity of the proposed Iron Mountain SEZ and its location along the Salt Song Trail, it is recommended that for surveys conducted in the SEZ, consideration be given to include Native American representatives in the development of survey designs and historic property treatment and monitoring plans. Troops in training for World War II often used the same locations that Native Americans did for similar purposes. Any excavation of historic sites should take into consideration the potential for the co-location of prehistoric and ethnohistoric components.
Pisgah	*Specially Designated Areas and Lands with Wilderness Characteristics:* Application of SEZ-specific design features for visual resource impacts may reduce the visual impact on wilderness characteristics. Once construction of solar energy facilities begins, the BLM would monitor to determine whether increases in traffic to the Ord-Rodman DWMA, Rodman Mountains Cultural Area, and Pisgah ACECs occur and whether additional management measures are required to protect the resources in these areas. *Minerals*: Consideration should be given to altering the boundaries of the SEZ to remove the areas with mining claims.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
California (Cont.)	
Pisgah *(Cont.)*	*Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land disturbance activities should avoid impacts to the extent possible in the vicinity of Troy Lake and ephemeral washes onsite. During site characterization, coordination and permitting with CDFG regarding California's Lake and Streambed Alteration Program would be required for any proposed alterations to surface water features (both perennial and ephemeral). Groundwater should be used in accordance with rules and regulations set forth by the MWA regarding the Mojave River adjudicated groundwater basin for the portions of the SEZ located in Analysis Area 1. The groundwater permitting process should be in compliance with the San Bernardino County groundwater ordinance. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of creosotebush-white bursage desert scrub communities and other affected habitats and to minimize the potential for the spread of tamarisk, Sahara mustard, schismus, or other invasive species. All playa, chenopod scrub, sand dune and sand transport areas, and desert dry wash habitats shall be avoided to the extent practicable, and any impacts minimized and mitigated. A buffer area shall be maintained around riparian areas, playas, and dry washes to reduce the potential for impacts on these habitats on or near the SEZ. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on riparian habitat along the Mojave River that is associated with groundwater-dependent communities, such as mesquite bosque.. *Wildlife (Amphibians and Reptiles)*: Implement design features and other mitigation measures to reduce the potential for effects on amphibians and reptiles, especially for those species that depend on habitat types that can be avoided (e.g., Troy Lake, which could provide habitat for the red-spotted toad).

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
California (Cont.)	
Pisgah *(Cont.)*	*Wildlife (Birds)*: Plant species that positively influence the presence and abundance of the desert bird focal species should be avoided to the extent practicable. These species include Goodding's willow, yucca, Joshua tree, mesquite, honey mesquite, screwbean, desert mistletoe, big saltbush, smoketree, and catclaw acacia. Development within the area of Troy Lake should be avoided. *Wildlife (Mammals)*: Development within the ephemeral drainages should be avoided in order to reduce impacts on species such as the round-tailed ground squirrel, white-tailed antelope squirrel, little pocket mouse, long-tailed pocket mouse, and any other mammal species that inhabit wash habitats. *Special Status Species*: Disturbance of desert playa and wash habitats within the SEZ should be avoided or minimized to the extent practicable. In particular, development should be avoided in and near Troy Lake in the western portion of the SEZ. Avoiding or minimizing disturbance of these habitats could reduce impacts on 11 special status species. Avoiding or minimizing disturbance of sand dunes and sand transport systems, rocky cliffs, and outcrops on the SEZ could reduce impacts on 11 special status species. Avoiding or minimizing groundwater withdrawals from the SEZ would reduce or prevent impacts on 3 special status species that may occur in aquatic habitats outside of the affected area. Because the Mohave tui chub is a California fully protected species, direct and indirect impacts on it should be completely avoided. This includes the avoidance of groundwater withdrawals from the SEZ that may affect habitats at Camp Cady and in the Mojave River. Coordination with the CDFG should be conducted for the Mohave tui chub to address the potential for impact when project-related groundwater demands are better identified. Consultations with the USFWS and CDFG are required to address the potential for impacts on the Mohave tui chub and desert tortoise as required under the ESA and CESA. Consultation would identify appropriate survey protocols, avoidance and minimization measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
California (Cont.)	
Pisgah *(Cont.)*	*Visual Resources*: Within the SEZ, in areas visible from and within 1 mi (1.6 km) of the Cady Mountains WSA, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from KOPs (to be determined by the BLM) within the WSA, and in areas visible from between 1 and 3 mi (1.6 and 4.8 km); visual impacts should be consistent with VRM Class III management objectives. Within the SEZ, in areas located south of I-40 and visible from and between 1 and 3 mi (1.6 and 4.7 km) of the Rodman Mountains WA, visual impacts associated with solar energy project operation should be consistent with VRM Class III management objectives, as experienced from KOPs determined by the BLM within the WA. *Acoustic Environment*: Dish engine facilities within the Pisgah SEZ should be located more than 1 to 2 mi (1.6 to 3.2 km) from nearby residences to the northwest and the south of the SEZ (i.e., the facilities should be located in other portions of the proposed SEZ). *Cultural Resources*: Areas of significant prehistoric remains within the SEZ that are identified through the Calico Solar Power Project (to date an area including a 400-ft [122-m] buffer and in some instances fencing) should be avoided.
Riverside East	*Specially Designated Areas and Lands with Wilderness Characteristics:* Application of SEZ-specific design features for visual resource impacts may reduce the visual impact on wilderness characteristics. Once construction of solar energy facilities begins, the BLM would monitor resource conditions in the seven ACECs near the SEZ to determine whether additional design features would be required to protect the resources in these areas. *Recreation:* A buffer area between the Midland LTVA and solar development should be established to preserve the LTVA area. The size of the buffer should be determined based on the site and visitor specific criteria. *Military and Civilian Aviation:* Coordination with the FAA and local airport authorities should be required early in the project planning process to identify and mitigate potential impacts on the local airports. Precautions should be taken for pilots to avoid interference with flight paths or related flight operations and to avoid reflector glare hazards and thermal plumes.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
California (Cont.)	
Riverside East *(Cont.)*	*Minerals*: Existing mining claims should be avoided. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land disturbance activities should avoid impacts to the extent possible near the regions surrounding Palen Lake, Ford Dry Lake, and McCoy Wash. During site characterization, coordination and permitting with CDFG regarding California's Lake and Streambed Alteration Program would be required for any proposed alterations to surface water features (both perennial and ephemeral). Groundwater withdrawals should comply with rules and regulations set forth by the PVID for the portions of the SEZ located within PVID boundaries. The use of groundwater in the Chuckwalla Valley and Palo Verde Mesa should be planned for and monitored in cooperation with the BOR and the USGS regarding the Colorado River Accounting Surface and the rules set forth in the Law of the River. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of creosotebush-white bursage desert scrub communities and other affected habitats and to minimize the potential for the spread of tamarisk Sahara mustard, cheatgrass, or other invasive species. All wetland, riparian, playa, dry wash (including dry wash microphyll woodland), sand dune and sand transport areas, and chenopod scrub habitats within the SEZ should be avoided to the extent practicable, and any impacts minimized and mitigated. A buffer area should be maintained around wetland, riparian, playa, and dry wash communities to reduce the potential for impacts on these communities on or near the SEZ.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
California (Cont.)	
Riverside East *(Cont.)*	Appropriate engineering controls should be used to minimize impacts on wetland, riparian, playa, dry wash woodland, and chenopod scrub, including downstream occurrences, resulting from surface water runoff, erosion, sedimentation, altered hydrology, accidental spills, or fugitive dust deposition to these habitats. Appropriate buffers and engineering controls would be determined through agency consultation. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on riparian habitat that is associated with groundwater discharge or groundwater-dependent communities, such as mesquite bosque or bush seep-weed communities. *Wildlife (All)*: To the extent practicable, avoid ephemeral drainages, Palen Lake and Ford Dry Lake, wetlands, McCoy Wash, and the Colorado River Aqueduct. *Wildlife (Amphibians and Reptiles):* The potential for indirect impacts on several amphibian species could be reduced by maximizing the distance between solar energy development and the Colorado River Aqueduct. *Wildlife (Birds)*: Plant species that positively influence the presence and abundance of the desert bird focal species should be avoided to the extent practicable. These species include Goodding's willow, yucca, Joshua tree, mesquite, honey mesquite, screwbean, desert mistletoe, big saltbush, smoketree, and catclaw acacia. *Wildlife (Mammals)*: Ensure that fencing around the solar energy development does not block the free passage of mule deer between the Colorado River and mountains or foothills. *Aquatic Biota*: Appropriate engineering controls should be implemented to minimize the amount of surface water runoff that reaches wetlands associated with Palen Lake. *Special Status Species*: Disturbance of desert playa and wash habitats within the SEZ should be avoided or minimized to the extent practicable. In particular, development should be avoided in and near Ford Dry Lake, Palen Lake, and McCoy Wash within the SEZ. Avoiding or minimizing disturbance of these habitats could reduce impacts on 9 special status species. Avoiding or minimizing disturbance of sand dunes and sand transport systems, woodlands, rocky cliffs, and outcrops on the SEZ could reduce impacts on 20 special status species.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
California (Cont.)	
Riverside East *(Cont.)*	Consultations with the USFWS and the CDFG should be conducted to address the potential for impacts on the desert tortoise—a species listed as threatened under the ESA and CESA. Consultation would identify an appropriate survey protocol, avoidance measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements. *Visual Resources:* Within the SEZ, in areas west of the northwest corner of Section 6 of Township 006S Range 017E, and in areas north and west of the northwest corner of Section 30 of Township 005S Range 018E, visual impacts associated with solar energy development in the SEZ should be consistent with VRM Class II management objectives, as determined from KOPs to be selected by the BLM within Joshua Tree NP and the Palen-McCoy WA. Within the SEZ, in areas visible from and within 3 mi (4.8 km) of the Rice Valley or Big Maria Mountains WSAs, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from KOPs (to be determined by the BLM) within the WSAs, and in areas visible from between 3 and 5 mi (4.8 and 8.0 km); visual impacts should be consistent with VRM Class III management objectives. *Acoustic Environment:* Dish engine facilities within the Riverside East SEZ should be located more than 1 to 2 mi (1.6 to 3 km) from the nearby residences to the west and the east of the SEZ (i.e., the facilities should be located in other portions of the proposed SEZ). *Cultural Resources*: Significant resources clustered in specific areas, such as those in the vicinity of Palen and Ford Dry Lakes, focused DTC/C-AMA activity areas that retain sufficient integrity, and Native American trails evident in the desert pavement should be avoided. Troops in training for World War II often used the same locations that Native Americans did for similar purposes. Any excavation of historic sites should take into consideration the potential for the co-location of prehistoric and ethnohistoric components.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado	
Antonito Southeast	*Lands and Realty*: Future management of the 1,240-acre (5-km^2) BLM parcel that would be isolated by development of the proposed SEZ should be addressed as part of the site-specific analysis of any future solar development. *Specially Designated Areas and Lands with Wilderness Characteristics:* Restricting the type of solar technology or eliminating solar development in portions of the visible area of the SEZ within 3 mi (5 km) of the Cumbres & Toltec Scenic Railroad ACEC is recommended to limit impacts on scenic values in the ACEC. Pending congressional review of the BLM recommendations for wilderness designations, restricting or eliminating solar development in portions of the visible area of the SEZ within 5 mi (8 km) of the San Antonio WSA is recommended to avoid impacts on wilderness characteristics in the WSA. Early consultation should be initiated with the entity responsible for developing the management plan for the Sangre de Cristo NHA to understand how development of the SEZ could be consistent with NHA plans/goals. Pending completion of a study on the significance and definition of management needs (if any) of the West Fork of the North Branch of the Old Spanish Trail, solar development should be restricted to areas that do not have the potential to adversely affect the setting of the trail. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land disturbance activities should avoid impacts to the extent possible in the vicinity of Alta Lake and two additional wetland areas, along with ephemeral washes present on the site. Groundwater rights must be obtained from the Division 3 Water Court in coordination with the Colorado Division of Water Resources, existing water right holders, and applicable water conservation districts. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of Inter-Mountain Basins Semi-Desert Shrub Steppe and Inter-Mountain Basins Semi-Desert Grassland habitats and minimize the potential for the spread of invasive species, such as Russian thistle or cheatgrass.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado (Cont.)	
Antonito Southeast *(Cont.)*	All wetland, dry wash, and riparian habitats within the SEZ (e.g., Alta Lake) and assumed transmission line corridor (e.g., the Rio San Antonio) should be avoided to the extent practicable. A buffer area should be maintained around wetlands, dry washes, and riparian habitats to reduce the potential for impacts on Alta Lake and other wetlands on or near the SEZ and riparian habitats associated with the Rio San Antonio, the Rio de los Pinos, the Conejos River, and Cove Lake Reservoir. Appropriate engineering controls should be used to minimize impacts on wetland, dry wash, and riparian habitats, including downstream occurrences, resulting from surface- water runoff, erosion, sedimentation, altered hydrology, accidental spills, or fugitive dust deposition. Appropriate buffers and engineering controls would be determined through agency consultation Transmission line towers should be sited and constructed to minimize impacts on wetlands and riparian areas associated with the Rio San Antonio, the Rio de los Pinos, and the Conejos River and span them whenever practicable. Groundwater withdrawals should be limited to reduce potential for indirect impacts on wetland habitats along the Rio San Antonio or the Conejos River or on springs that are associated with groundwater discharge. *Wildlife (Amphibians and Reptiles)*: All wetland and riparian habitats within the SEZ (e.g., Alta Lake) and transmission line corridor (e.g., the Rio San Antonio) should be avoided to the extent practicable. Appropriate engineering controls should be used to minimize impacts on aquatic, riparian, and wetland habitats associated with Alta Lake, the Rio San Antonio, the Rio de los Pinos, the Conejos River, and Cove Lake Reservoir resulting from surface- water runoff, erosion, sedimentation, accidental spills, or fugitive dust deposition to these habitats. Transmission line towers should be sited and constructed to minimize impacts on wetlands and riparian areas and span them whenever practicable. *Wildlife (Birds)*: All wetland and riparian habitats within the SEZ (e.g., Alta Lake) and transmission line corridor (e.g., the Rio San Antonio) should be avoided to the extent practicable. Transmission line towers should be sited and constructed to minimize impacts on wetlands and riparian areas and to span them whenever practicable. Appropriate engineering controls should be used to minimize impacts on aquatic, riparian, and wetland habitats associated with Alta Lake, the Rio San Antonio, the Rio de los Pinos, the Conejos River, and Cove Lake Reservoir resulting from surface-water runoff, erosion, sedimentation, accidental spills, or fugitive dust deposition to these habitats.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado (Cont.)	
Antonito Southeast *(Cont.)*	Prairie dog colonies (which could provide habitat or food source for some bird species) should be avoided to the extent practicable. *Wildlife (Mammals)*: Prairie dog colonies should be avoided to the extent practicable to reduce impacts on species such as the desert cottontail and thirteen-lined ground squirrel. Construction should be curtailed during winter when big game species are present. Disturbance near the elk and mule deer resident population areas should be avoided. Where big game winter ranges intersect or are within close proximity to the SEZ, use of motorized vehicles and other human disturbances should be controlled (e.g., through road closures). Development in the 253-acre (1- km^2) portion of the SEZ that overlaps the pronghorn summer concentration area should be avoided. The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. Transmission lines should be sited to avoid disturbance of suitable roosting and foraging habitat for bat species that may be affected by such activities. *Aquatic Biota*: All aquatic habitats within the SEZ (e.g., Alta Lake) and transmission line corridor should be avoided to the extent practicable. Transmission line towers should be sited and constructed to minimize impacts on aquatic habitats and span them whenever practicable. *Special Status Species*: Avoiding or minimizing disturbance of wetland, riparian, grassland, sagebrush, and woodland habitats in the area of direct effect could reduce impacts on 19 special status species.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado (Cont.)	
Antonito Southeast *(Cont.)*	Transmission towers should be sited to allow spanning of wetlands and riparian areas whenever such habitats must be crossed. Consultations with the USFWS and CDOW should be conducted to address the potential for impacts on the southwestern willow flycatcher, a species listed as endangered under the ESA. Consultation would identify an appropriate survey protocol, avoidance measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements. Coordination with the USFWS and CDOW should be conducted to address the potential for impacts on the Gunnison's prairie dog and northern leopard frog – species that are either candidate or under review for listing under the ESA. Coordination would identify an appropriate survey protocol, avoidance measures, and, potentially, translocation or compensatory mitigation. *Visual Resources*: The development of power tower facilities should be prohibited within the SEZ. Within the SEZ, in areas visible from and within 3 mi (55 km) of the San Antonio WSA, visual impacts associated with solar energy project operation should be consistent with VRM Class III management objectives. Within the SEZ, in areas visible from and within 3 mi (5 km) of the Cumbres & Toltec Scenic Railroad ACEC, visual impacts associated with solar energy project operation should be consistent with VRM Class III management objectives. Within the SEZ, in areas visible from and within 1 mi (1.6 km) of the centerline of the West Fork of the North Branch of the Old Spanish Trail, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from the WSA, and in areas visible from between 1 and 3 mi (1.2 and 5 km); visual impacts should be consistent with VRM Class III management objectives. *Acoustic Environment*: Dish engine facilities within the SEZ should be located more than 1 to 2 mi (1.6 to 3 km) from nearby residences around the SEZ (i.e., the facilities should be located in the central or southeast area of the proposed SEZ). *Paleontological Resources*: Avoidance of PFYC Class 4/5 areas is recommended for development within the SEZ (i.e., the 4-acre [0.016-km^2] parcel in the north part of the SEZ) and transmission corridor placement. Where avoidance of Class 4/5 deposits is not possible in order to connect to existing transmission, a paleontological survey or monitoring may be required by the BLM.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado (Cont.)	
Antonito Southeast *(Cont.)*	*Cultural Resources*: A PA may need to be developed among the BLM, DOE, Colorado SHPO, ACHP, and the Trail Administration for the Old Spanish Trail to consistently address impacts on significant cultural resources from solar energy development within the San Luis Valley. Additional coordination with the Cumbres & Toltec Scenic Railroad Commission is recommended to address possible mitigation measures for reducing visual impacts.
De Tilla Gulch	*Specially Designated Areas:* Pending completion of a study on the significance and definition of management needs (if any) of the Old Spanish National Historic Trail, solar development should be restricted to areas that do not have the potential to adversely affect the setting of the trail. *Water Resources*: Wet-cooling technologies should incorporate water conservation measures to reduce water needs. Groundwater rights must be obtained from the Division 3 Water Court in coordination with the Colorado Division of Water Resources, existing water right holders, and applicable water conservation districts. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of Shrub Steppe, Greasewood Flat, or Grassland habitats and minimize the potential for the spread of invasive species, such as black henbane or spotted knapweed. Invasive species control should focus on biological and mechanical methods where possible to reduce the use of herbicides. Appropriate engineering controls should be used to minimize impacts on riparian and wetland habitats, including downstream occurrences, such as those associated with Saguache Creek or San Luis Creek, resulting from surface water runoff, erosion, sedimentation, altered hydrology, or accidental spills, and fugitive dust deposition to these and nearby upland habitats. Appropriate engineering controls would be determined through agency consultation. All ephemeral dry wash habitats should be avoided to the extent practicable, and any impacts minimized and mitigated. A buffer area shall be maintained around dry washes to reduce the potential for impacts on these habitats on or near the SEZ.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado (Cont.)	
De Tilla Gulch *(Cont.)*	Appropriate engineering controls should be used to minimize impacts on riparian, dry wash, and wetland habitats, including downstream occurrences, such as those associated with Saguache Creek or San Luis Creek. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on wetlands or springs near or downgradient from the SEZ, such as many of the wetlands south, southwest, or southeast of the SEZ, including the wetland complexes associated with Saguache and San Luis Creeks that are associated with groundwater discharge. *Wildlife (Amphibians and Reptiles)*: Ephemeral drainages within the SEZ should be avoided to the extent practicable. *Wildlife (Amphibians, Reptiles, and Birds)*:Appropriate engineering controls should be used to minimize impacts resulting from surface water runoff, erosion, sedimentation, accidental spills, or fugitive dust deposition on aquatic, riparian, and wetland habitats associated with Saguache Creek, San Luis Creek, Rio Grande Canal, and wetland areas located within the area of indirect effects. *Wildlife (Birds)*: Prairie dog colonies (which could provide habitat or food resources for some bird species) should be avoided to the extent practicable. *Wildlife (Mammals)*: Prairie dog colonies should be avoided to the extent practicable to reduce impacts on species such as the desert cottontail and thirteen-lined ground squirrel. The extent of habitat disturbance should be minimized within elk severe winter range and pronghorn winter concentration area. Construction should be curtailed during winter when big game species are present. Where big game winter ranges intersect or are within close proximity to the SEZ, motorized vehicles and other human disturbances should be controlled (e.g., through road closures). *Aquatic Biota*: Sediment and erosion controls should be implemented along intermittent drainages that drain toward Saguache or San Luis Creeks. *Special Status Species*: Avoiding or minimizing impacts on grassland habitat on the SEZ could reduce impacts on three special status species.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado (Cont.)	
De Tilla Gulch *(Cont.)*	Coordination with the USFWS and CDOW should be conducted to address the potential for impacts on the Gunnison's prairie dog and Gunnison sage-grouse, species that are either a candidate or under review for listing under the ESA. Coordination would identify an appropriate survey protocol, avoidance measures, and, potentially, translocation or compensatory mitigation. *Visual Resources*: The development of power tower facilities should be prohibited within the SEZ. *Acoustic Environment*: Dish engine facilities within the proposed De Tilla Gulch SEZ should be located more than 1 mi (1.6 km) from nearby residences to the east and the south of the SEZ (i.e., the facilities should be located in the western area of the proposed SEZ). *Cultural Resources*: A PA may need to be developed among the BLM, DOE, Colorado SHPO, ACHP, and the Trail Administration for the Old Spanish Trail to consistently address impacts on significant cultural resources from solar energy development in the San Luis Valley.
Fourmile East	*Specially Designated Areas and Lands with Wilderness Characteristics:* Solar technologies in the SEZ should be restricted to those with the lowest profile to minimize the visual impact on nearby specially designated areas. Additionally, lighting within the SEZ should be carefully designed to minimize visual impacts on surrounding specially designated areas. Pending outcome of a study of the significance of potentially affected segments of the Old Spanish National Historic Trail, restrictions on solar facility development that might adversely impact trail resources should be put in place. Solar development on the east side of the Los Caminos Antiguos Scenic Byway should not be approved, in order to reduce the negative visual effect on visitors from traveling on the road. This would also reduce the adverse impact on the scenic view from the highway looking to the east toward Blanca Peak and the WA. It could also reduce the potential impacts on the Old Spanish National Historic Trail. Consultation would be conducted to determine whether there would be adverse impacts on Native American religious values, and if so, what mitigation measures might be possible to reduce or eliminate such impacts. Early consultation should be initiated with the entity responsible for developing the management plan for the Sangre de Cristo NHA to understand how development of the SEZ could be consistent with NHA plans/goals.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado (Cont.)	
Fourmile East *(Cont.)*	Adoption of programmatic design features for visual resources would reduce visual impacts on wilderness, historic, and scenic values and should be considered as part of any solar project analysis. *Recreation:* The portion of the SEZ on the east side of the scenic byway should be eliminated to reduce the negative visual effect on visitors of traveling on the scenic byway, and to reduce the visual impacts looking to the east toward Blanca Peak and the Sangre de Cristo Mountains. Solar technologies in the SEZ should be restricted to those with the lowest profile to minimize the visual impact and the accompanying adverse effect on recreational visitors. *Soil Resources:* A study to evaluate the potential impacts of building a solar facility in close proximity to the Great Sand Dunes may be required. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land disturbance activities should avoid impacts to the extent possible in the wetland areas on the western boundary of the site. Groundwater rights must be obtained from the Division 3 Water Court in coordination with the Colorado Division of Water Resources, existing water right holders, and applicable water conservation districts. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of semidesert shrub steppe and greasewood flat habitats and minimize the potential for the spread of invasive species. All wetland, sand dune, playa, and riparian habitats within the SEZ and assumed transmission line corridor should be avoided to the extent practicable, and any impacts minimized and mitigated. A buffer area should be maintained around wetlands to reduce the potential for impacts on wetlands on or near the SEZ.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado (Cont.)	
Fourmile East *(Cont.)*	Appropriate engineering controls should be used to minimize impacts on wetland, playa, and riparian habitats, including downstream occurrences. Transmission line towers should be sited and constructed to minimize impacts on wetlands and span them whenever practicable. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on wetlands or springs on or near the SEZ associated with groundwater discharge, such as the Blanca wetlands. *Wildlife (Amphibians and Reptiles)*: Wetland habitats within the SEZ should be avoided to the extent practicable. Appropriate engineering controls should be used to minimize impacts on the washes that drain off of the Sangre de Cristo Mountains and on Smith Reservoir resulting from surface water runoff, erosion, sedimentation, accidental spills, or fugitive dust deposition to these habitats. Transmission line towers should be sited and constructed to minimize impacts on wetlands and riparian areas (if present within the finalized ROW location) and span them whenever practicable. *Wildlife (Birds)*: If present, prairie dog colonies should be avoided to the extent practicable. Transmission line towers should be sited and constructed to minimize impacts on wetlands and riparian areas (if present within the finalized ROW location) and span them whenever practicable. *Wildlife (Mammals)*: Prairie dog colonies should be avoided to the extent practicable to reduce impacts on species such as the desert cottontail and thirteen-lined ground squirrel. To the extent practicable, construction activities should be avoided while pronghorn are on their winter range within the immediate area of the proposed Fourmile East SEZ. Development in the 213-acre (0.9-km^2) portion of the SEZ that overlaps elk summer range should be avoided.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado (Cont.)	
Fourmile East *(Cont.)*	*Aquatic Biota*: Undisturbed buffer areas and sediment and erosion controls should be maintained around wetlands on the SEZ. The use of heavy machinery and pesticides should be avoided in the immediate catchment basin for those wetlands. *Special Status Species*: Avoiding or minimizing impacts on grassland habitat in the transmission corridor could reduce impacts on three special status species. Coordination with the USFWS and CDOW should be conducted to address the potential for impacts on the Gunnison's prairie dog, a candidate species for listing under the ESA. Coordination would identify an appropriate survey protocol, avoidance measures, and, potentially, translocation or compensatory mitigation. *Visual Resources*: The development of power tower facilities should be prohibited within the SEZ. Within the SEZ, in areas visible from and within 0.25 mi (0.4 km) of the Los Caminos Antiguos Scenic Byway, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from key observation points on the byway. Within the SEZ, in areas visible from and within 3 mi (4.8 km) of the centerline of the high-potential segment of the Old Spanish National Historic Trail, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from key observation points on the high-potential segment of the Old Spanish National Historic Trail. Within the SEZ, in areas visible from and between 3 mi (4.8 km) and 5 mi (8 km) of the centerline of the high-potential segment of the trail, visual impacts associated with solar energy project operation should be consistent with VRM Class III management objectives, as experienced from key observation points on the high-potential segment of the trail. Within the SEZ, in areas visible from and within 3 mi (4.8 km) of the Sangre de Cristo WA, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from key observation points within the WA. Within the SEZ, in areas visible from and between 3 mi (4.8 km) and 5 mi (8 km) of the WA, visual impacts associated with solar energy project operation should be consistent with VRM Class III management objectives, as experienced from key observation points within the WA.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado (Cont.)	
Fourmile East *(Cont.)*	*Acoustic Environment*: Dish engine facilities within the proposed Fourmile East SEZ should be located more than 1 to 2 mi (1.6 to 3 km) from nearby residences located southwest of the SEZ (i.e., the facilities should be located in the central or northern portion of the proposed SEZ). *Paleontological Resources*: The depth to the Alamosa Formation within the SEZ should be determined to identify what design features might be needed in that area if solar energy development occurs. *Cultural Resources*: A PA may need to be developed among the BLM, DOE, Colorado SHPO, ACHP, and the Trail Administration for the Old Spanish Trail to consistently address impacts on significant cultural resources from solar energy development within the San Luis Valley. Because of the possibility of encountering Native American human remains in the vicinity of the proposed Fourmile East SEZ, it is recommended that consideration be given to include Native American participation in the development of survey designs and historic property treatment and monitoring plans. Ongoing consultation with the Colorado SHPO and the appropriate Native American governments should be continued so that most adverse effects on significant resources in the valley could be mitigated to some degree. Some impacts may not be mitigable.
Los Mogotes East	*Specially Designated Areas and Lands with Wilderness Characteristics:* Impacts on the wildlife values of the Los Mogotes ACEC would likely not be mitigable. Early consultation should be initiated with the entity responsible for developing the management plan for the Sangre de Cristo NHA to understand how development of the SEZ could be consistent with NHA plans/goals. Pending completion of a study on the significance and definition of management needs (if any) of the West Fork of the North Branch of the Old Spanish National Historic Trail, solar development should be restricted to areas that do not have the potential to adversely affect the setting of the trail. After the study is completed, if management actions are warranted for this portion of the trail, solar energy development should be consistent with protection of identified values of the trail.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado (Cont.)	
Los Mogotes East *(Cont.)*	*Rangeland Resources (Livestock Grazing)*: It may be possible to mitigate the loss of livestock grazing from the Capulin and Little Mogotes permits by changing management of the allotments and/or providing new range improvements (e.g., fences, water development) elsewhere in the allotments. It also may be possible to mitigate some or all of the loss by altering allotment boundaries or possibly offering an exchange of allotments with other un-occupied allotments. *Water Resources*: Water resource analysis indicates that wet cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land disturbance activities should avoid impacts to the extent possible near ephemeral washes on site and surrounding wetlands. Groundwater rights must be obtained from the Division 3 Water Court in coordination with the Colorado Division of Water Resources, existing water right holders, and applicable water conservation districts. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of semidesert shrub steppe and semidesert grassland habitats and minimize the potential for the spread of invasive species. All dry wash habitats within the SEZ and all wetland and dry wash habitats within the assumed access road corridor should be avoided to the extent practicable, and any impacts minimized and mitigated. A buffer area should be maintained around wetlands and dry washes to reduce the potential for impacts on these habitats. Appropriate engineering controls should be used to minimize impacts on wetland and riparian habitats, including downstream occurrences. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on wetlands or springs near or downgradient from the SEZ associated with groundwater discharge, such as the wetlands along the Conejos River. *Wildlife (Amphibians and Reptiles)*: Wash habitats within the SEZ should be avoided to the extent practicable.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado (Cont.)	
Los Mogotes East *(Cont.)*	The access road should be sited and constructed to minimize impacts on wetlands (if present within the finalized access road location). *Wildlife (Birds)*: The access road should be sited and constructed to minimize impacts on wetlands and riparian areas (if present within the finalized access road location). If present, prairie dog colonies (which could provide habitat or a food source for some bird species) should be avoided to the extent practicable. *Wildlife (Mammals)*: Prairie dog colonies should be avoided to the extent practicable. This could reduce impacts on species such as the desert cottontail and thirteen-lined ground squirrel. Construction should be curtailed during winter when big game species are present. Where big game winter ranges intersect or are within close proximity to the SEZ, use of motorized vehicles and other human disturbances should be controlled (e.g., through temporary road closures when big game are present). Development in the 135-acre (0.55 km^2) portion of the SEZ that overlaps the mule deer winter range should be avoided. Loss of pronghorn winter concentration area should be minimized. *Aquatic Biota*: Undisturbed buffer areas and sediment and erosion controls should be maintained around drainages associated with wetland areas located in the immediate vicinity of the SEZ. *Special Status Species*: Avoiding or minimizing disturbance of grassland, marsh, meadow, and woodland habitat in the area of direct effects could reduce impacts on 24 special status species. Coordination with the USFWS and CDOW should be conducted to address the potential for impacts on the Gunnison's prairie dog and northern leopard frog – species that are either candidate or under review for listing under the ESA. Coordination would identify an appropriate survey protocol, avoidance measures, and, potentially, translocation or compensatory mitigation.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Colorado (Cont.)	
Los Mogotes East *(Cont.)*	*Visual Resources*: The development of power tower facilities should be prohibited within the SEZ. *Acoustic Environment*: Dish engine facilities within the SEZ should be located more than 1 to 2 mi (1.6 to 3 km) from nearby residences around the SEZ (i.e., the facilities should be located in the western area of the proposed SEZ). *Paleontological Resources*: Avoidance of PFYC Class 4/5 areas is recommended for development within the SEZ and for access road placement. Where avoidance of these areas is not possible, a paleontological survey would be required. *Cultural Resources*: A PA may need to be developed among the BLM, DOE, Colorado SHPO, ACHP and the Trail Administration for the Old Spanish Trail to consistently address impacts on significant cultural resources from solar energy development within the San Luis Valley. Additional coordination with the CTSR Commission is recommended to address possible mitigation measures for reducing visual impacts on the Cumbres and Toltec Scenic Railroad.
Nevada	
Amargosa Valley	*Specially Designated Areas and Lands with Wilderness Characteristics:* Design features for visual resources should be implemented to reduce impacts on wilderness characteristics. Water use for any solar energy development would be reviewed to ensure that impacts on Death Valley NP, the NWR, or ACECs would be neutral or positive. *Recreation:* Relocation of the designated route used for desert racing and commercial tours should be considered at the time specific solar development proposals are analyzed. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land disturbance activities should minimize impacts on natural drainage patterns near the Amargosa River to avoid erosion issues and clogging of groundwater recharge zones and affecting critical habitats.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
Amargosa Valley *(Cont.)*	Siting of solar facilities and construction activities should be avoided within the 100-year floodplain of the Amargosa River (3,915 acres [16 km^2]). Coordination with the NDWR should be conducted during the process of obtaining water rights in the over-allocated Amargosa Desert Basin in order to reduce basin-wide groundwater extractions and to comply with the State Engineer's Order 1197 addressing the priority water rights and protections pertaining to Ash Meadows National Wildlife Refuge and Devils Hole. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of affected habitats and minimize the potential for the spread of invasive species, such as Mediterranean grass. All playa, chenopod scrub, and desert dry wash habitats, shall be avoided to the extent practicable, and any impacts minimized and mitigated. Appropriate engineering controls should be used to minimize impacts on the Amargosa River, and dry wash, playa, riparian, marsh, and greasewood flat habitats, including downstream occurrences. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on groundwater-dependent habitats in the Amargosa Desert groundwater basin, or in other hydraulically connected basins, such as springs at Ash Meadows and Death Valley NP, other locations of groundwater discharge, such as the Amargosa River, or other groundwater-dependent habitats in the vicinity of the SEZ, such as mesquite bosque communities. *Wildlife (All)*: The Amargosa River should be avoided. *Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. *Aquatic Biota*: Appropriate engineering controls should be implemented to minimize the amount of contaminants and sediment entering the Amargosa River.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
Amargosa Valley *(Cont.)*	If groundwater is used, withdrawal should not affect aquatic habitat in the Amargosa River ACEC and the Ash Meadows NWR. *Special Status Species*: Avoiding or minimizing disturbance to desert wash and riparian habitats on the SEZ could reduce impacts on 3 special status species. Avoidance or minimization of groundwater withdrawals from the Amargosa Basin to serve solar energy development on the SEZ would reduce or prevent impacts on the 25 groundwater-dependent special status species. In particular, impacts on aquatic and riparian habitat associated with the Ash Meadows system should be avoided. Consultation with the USFWS and NDOW should be conducted to address the potential for impacts on the following species currently listed as threatened or endangered under the ESA: Amargosa niterwort, Ash Meadows blazingstar, Ash Meadows gumplant, Ash Meadows ivesia, Ash Meadows sunray, spring-loving centaury, Ash Meadows naucorid, Ash Meadows Amargosa pupfish, Ash Meadows speckled dace, Devils Hole pupfish, Warm Springs Amargosa pupfish, and desert tortoise. Consultation would identify an appropriate survey protocol, avoidance and minimization measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements. Coordination with the USFWS and NDOW should be conducted to address the potential for impacts on species under review for listing under the ESA that may be affected by solar energy development on the SEZ: Amargosa tryonia, Ash Meadows pebblesnail, crystal springsnail, distal gland springsnail, elongate gland springsnail, Fairbanks springsnail, median gland springsnail, minute tryonia, Oasis Valley springsnail, Point of Rocks tryonia, sporting goods tryonia, Amargosa naucorid, Oasis Valley speckled dace, and Amargosa toad. Coordination would identify an appropriate survey protocol, and mitigation requirements, which may include avoidance, minimization, translocation, or compensation. Coordination with the USFWS and NDOW should be conducted to address potential indirect impacts (e.g., site runoff and erosion) and the effectiveness of design features for three special status species that are endemic to the Big Dune system. *Visual Resources*: Within the SEZ, in areas visible from and within 5 mi (8 km) of Death Valley NP, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from KOPs (to be determined by BLM) within the NP.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
Delamar Valley	*Lands and Realty*: Consideration should be given to relocating the existing transmission corridor and proposed SNWA ROW outside of the SEZ. Priority consideration should be given to utilizing/improving existing roads to provide construction and operational access to the SEZ. *Specially Designated Areas and Lands with Wilderness Characteristics:* The design features for visual resources should be adopted to minimize impacts on wilderness characteristics. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land-disturbance activities should avoid impacts to the extent possible in the vicinity of the intermittent streams, ephemeral washes, and the dry lake present on the site. Siting of solar facilities and construction activities should avoid any areas identified as within a 100-year floodplain or jurisdictional waters. Groundwater rights must be obtained from the NDWR (dry-cooling and dish engine technologies may have to negotiate with the SNWA for water rights). *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of affected habitats and minimize the potential for the spread of invasive species, such as halogeton or tumbleweed.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
Delamar Valley *(Cont.)*	Dry washes, Delamar Lake playa, and the nearby marsh should be avoided to the extent practicable, and any impacts minimized and mitigated. Appropriate engineering controls should be used to minimize impacts on wetlands within the assumed access road corridor, as well as dry washes, Delamar Lake and other playas, riparian, marsh, and greasewood flat habitats within the SEZ and corridor, including downstream occurrences, resulting from surface water runoff, erosion, sedimentation, altered hydrology, accidental spills, or fugitive dust deposition to these habitats. All wetland, dry wash, and riparian habitats within the assumed access road corridor should be avoided to the extent practicable, and any impacts minimized and mitigated. Joshua tree communities are protected by the State of Nevada and should be avoided in the northern areas of the SEZ and along the assumed access road corridor. Any Joshua trees in areas of direct impacts should be salvaged. Cactus species, including cholla, or ocotillo should be avoided. Any cacti that cannot be avoided should be salvaged. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on springs and wetlands in the vicinity of the SEZ, at Pahranagat NWR. Potential impacts on springs should be determined through hydrological studies. *Wildlife (All)*: Delamar Lake, Jumbo Wash, and the unnamed wash should be avoided. *Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. *Aquatic Biota*: Appropriate engineering controls should be implemented to minimize the amount of contaminants and sediment entering washes and Delamar Lake and Pahranagat Creek. *Special Status Species*: Consultation with the USFWS and NDOW should be conducted to address the potential for impacts on the following five species currently listed as threatened or endangered under the ESA: Hiko White River springfish, Pahranagat roundtail chub, White River springfish, desert tortoise, and southwestern willow flycatcher. Consultation would identify an appropriate survey protocol, avoidance and minimization measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
Delamar Valley *(Cont.)*	Coordination with the USFWS and NDOW should be conducted to address the potential for impacts on the following four species under review for listing under the ESA that may be affected by solar energy development on the SEZ: grated tryonia, Hubbs springsnail, Pahranagat pebblesnail, and northern leopard frog. Coordination would identify an appropriate survey protocol and mitigation requirements, which may include avoidance, minimization, translocation, or compensation. Avoiding or minimizing disturbance to riparian, desert wash, playa, cliff, and rock outcrop habitats on the SEZ could reduce or eliminate impacts on 13 special status species. Avoidance or minimization of groundwater withdrawals to serve solar energy development on the SEZ could reduce or eliminate impacts on 15 special status species. In particular, impacts on aquatic and riparian habitat in the Pahranagat Valley should be avoided. *Visual Resources*: Within the SEZ, in areas visible from and within 3 mi (4.8 km) of the boundary of the Delamar Mountains WA, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from KOPs (to be determined by the BLM) within the WA. In areas visible from between 3 and 5 mi (4.8 and 8 km), visual impacts should be consistent with VRM Class III management objectives. The VRM Class II consistency mitigation would affect approximately 2,080 acres (8.417 km^2) within the western portion of the SEZ. The VRM Class III consistency mitigation would affect approximately 5,485 additional acres (22.20 km^2). Within the SEZ, in areas visible from between 3 and 5 mi (4.8 and 8 km) of the boundary of the South Pahroc Range WA, visual impacts associated with solar energy project operation should be consistent with VRM Class III management objectives, as experienced from KOPs (to be determined by the BLM) within the WA. The VRM Class III consistency mitigation would affect approximately 4,921 acres (19.91 km^2). *Cultural Resources*: Avoidance of significant sites within the proposed SEZ, especially in the vicinity of the dry lake, is recommended.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
Dry Lake	*Specially Designated Areas and Lands with Wilderness Characteristics:* The design features for visual resources should be applied to minimize adverse impacts. *Water Resources*: Wet-cooling and dry-cooling options would not be feasible unless further hydrologic study of the basin reveals that more water is available. Other technologies should incorporate water conservation measures. Land-disturbance activities should avoid impacts to the extent possible in the vicinity of the ephemeral washes and the dry lake present on the site. Siting of solar facilities and construction activities should avoid areas identified as being within a 100-year floodplain, which totals 1,569 acres [6.3 km^2] of the proposed SEZ. Groundwater rights must be obtained from the NDWR. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of desert scrub and other affected habitats, and to minimize the potential for the spread of invasive species such as salt cedar or Mediterranean grass. All dry wash, dry wash woodland, chenopod scrub, and playa communities within the SEZ should be avoided to the extent practicable, and any impacts minimized and mitigated. Any yucca, cacti, or succulent plant species that cannot be avoided should be salvaged. Appropriate engineering controls should be used to minimize impacts on dry wash, dry wash woodland, wetland, and playa habitats, including downstream occurrences. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on groundwater-dependent communities, such as mesquite communities. Potential impacts on springs should be determined through hydrological studies.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.) Dry Lake *(Cont.)*	*Wildlife (All)*: The dry lake and wash habitats, which could provide potential breeding sites for amphibians, including Great Plains and red-spotted toads, should be avoided. *Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. *Aquatic Biota*: Appropriate engineering controls should be implemented to minimize the amount of runoff and fugitive dust that reaches California Wash and Gypsum Wash. Minimize or eliminate the impact of groundwater withdrawals on streams near the SEZ, such as the Muddy River, and springs such as those along the north shore of Lake Meade and within Desert NWR and Moapa NWR. *Special Status Species*: Avoiding or minimizing disturbance to desert wash, playa, and desert pavement habitats on the SEZ could reduce or eliminate impacts on 14 special status species. Avoidance or minimization of groundwater withdrawals to serve solar energy development on the SEZ could reduce or eliminate impacts on 13 special status species. In particular, impacts on aquatic and riparian habitat in the Corn Creek Spring, Moapa Warm Springs and Muddy River should be avoided. Consultation with the USFWS and NDOW should be conducted to address the potential for impacts on the following four species currently listed as threatened or endangered under the ESA: Moapa dace, Pahrump poolfish, desert tortoise, and southwestern willow flycatcher. Consultation would identify an appropriate survey protocol, avoidance and minimization measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements. Coordination with the USFWS and NDOW should be conducted to address the potential for impacts on the following seven species under review for listing under the ESA that may be affected by solar energy development on the SEZ: Las Vegas buckwheat, grated tryonia, Moapa pebblesnail, Moapa Valley pebblesnail, Moapa Warm Spring riffle beetle, Moapa speckled dace, and Moapa White River springfish. Coordination would identify an appropriate survey protocol and mitigation requirements, which may include avoidance, minimization, translocation, or compensation.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
Dry Lake *(Cont.)*	*Cultural Resources*: Coordination with the Trail Administration for the Old Spanish Trail and Old Spanish Trail Association is recommended for identifying potential mitigation strategies for avoiding or minimizing potential impacts on the congressionally designated Old Spanish National Historic Trail and also to any remnants of the NRHP-listed site associated with the Old Spanish Trail/Mormon Road that may be located within the SEZ. Avoidance of the Old Spanish Trail NRHP-listed site within the southeastern portion of the proposed SEZ is recommended.
Dry Lake Valley North	*Lands and Realty*: Priority consideration should be given to utilizing existing county roads to provide construction and operational access to the SEZ. *Rangeland Resources (Livestock Grazing):* Within the Ely Springs cattle allotment, solar development should be sited to minimize the number of pastures affected. *Rangeland Resources (Horses and Burros)*: Installation of fencing and access control, provision for wild horse movement corridors, delineation of open range, traffic management, compensatory habitat restoration, and access to or development of water sources should be coordinated with the BLM. *Recreation:* If solar development obstructs the route currently permitted for desert racing, alternative locations for that use should be considered at the time specific solar development proposals are analyzed. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land disturbance activities should avoid impacts to the extent possible in the vicinity of the ephemeral stream washes and the dry lake present on the site. Groundwater rights must be obtained from the NDWR. Land disturbance activities should avoid impacts to the extent possible in the vicinity of the ephemeral stream washes and the dry lake present on the site.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
Dry Lake Valley North *(Cont.)*	*Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of affected habitats and minimize the potential for the spread of invasive species, such as cheatgrass or halogeton. Dry washes, playas, and wetlands within the SEZ, and dry washes within the access road corridor, should be avoided to the extent practicable, and any impacts minimized and mitigated. A buffer area should be maintained around wetlands, playas, and dry washes to reduce the potential for impacts. Appropriate engineering controls should be used to minimize impacts on dry wash, playa, marsh, scrub-shrub wetland, riparian, and greasewood flat habitats, including downstream occurrences. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on habitats dependent on springs associated with the Dry Lake Valley Basin, Delamar Valley Basin, or other hydrologically connected basins. Potential impacts on springs should be determined through hydrological studies. *Wildlife (All)*: The unnamed dry lake and wash habitats should be avoided. *Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. *Aquatic Biota*: Appropriate engineering controls should be implemented to minimize the amount of contaminants and sediment entering Coyote Wash and the unnamed washes and dry lakes within the SEZ. *Special Status Species*: Avoiding or minimizing disturbance to playa habitat on the SEZ could reduce or eliminate impacts on 5 special status species. Consultation with the USFWS and NDOW may be needed to address the potential for impacts on the desert tortoise. Consultation would identify an appropriate survey protocol, avoidance and minimization measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
East Mormon Mountain	*Specially Designated Areas and Lands with Wilderness Characteristics:* Design features for visual resources should be applied to minimize adverse visual impacts. The access road to the SEZ should be designed and built to minimize impacts on desert tortoises and tortoise habitat within the Mormon Mesa ACEC. *Recreation:* Design features for visual resources should be applied to minimize adverse impacts on wilderness recreation use. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land-disturbance activities should minimize impacts on the ephemeral stream channels found within the SEZ, including but not limited to Toquop Wash and South Fork Toquop Wash, as well as alluvial fan features throughout the SEZ. Groundwater rights must be purchased and transferred through coordination with the NDWR and current water rights holders. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of desert scrub and other affected habitats, and to minimize the potential for the spread of invasive species such as Mediterranean grass. All desert dry wash, playa, riparian, and Joshua tree communities within the SEZ and access road corridor should be avoided to the extent practicable, and any impacts minimized and mitigated. Any Joshua trees, other yucca species, cacti, or succulent plant species in areas of direct impacts that cannot be avoided should be salvaged. Appropriate engineering controls should be used to minimize impacts on dry wash, playa, wetland, and riparian habitats, including downstream occurrences.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
East Mormon Mountain *(Cont.)*	Groundwater withdrawals should be limited to reduce the potential for indirect impacts on wetlands associated with springs, such as Tule Spring and Abe Spring. Potential impacts on springs should be determined through hydrological studies. *Wildlife (All)*: Development in wash, playa and rock outcrop habitats should be avoided. *Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. *Aquatic Biota*: Ground disturbance and contaminant spills near Toquop Wash and the other unnamed washes within the SEZ should be minimized. Appropriate engineering controls should be implemented to minimize the amount of surface water runoff and fugitive dust reaching springs, Toquop Wash and unnamed washes in the SEZ and in the area of indirect effects. The impact of groundwater withdrawals on surface water features near the SEZ (such as Tule Spring, Abe Spring, Gourd Spring and Peach Spring) should be eliminated or minimized. *Special Status Species*: Consultation with the USFWS and the NDOW should be conducted to address the potential for impacts on the desert tortoise. Consultation would identify an appropriate survey protocol, avoidance and minimization measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements. Coordination with the USFWS and NDOW should be conducted to address the potential for impacts on the Las Vegas buckwheat—a candidate species for listing under the ESA. Coordination would identify an appropriate survey protocol and mitigation requirements, which may include avoidance minimization, translocation, or compensation. Avoiding or minimizing disturbance to desert wash, playa, rocky cliffs, and outcrop habitats could reduce or eliminate impacts on 17 special status species. *Visual Resources*: The development of power tower facilities within the SEZ should be prohibited.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
East Mormon Mountain *(Cont.)*	*Cultural Resources*: Avoidance of South Fork and Toquop Wash areas is recommended. Coordination with the Trail Administration for the Old Spanish Trail and Old Spanish Trail Association is recommended to identify potential mitigation strategies for avoiding or minimizing potential impacts, if impacts are identified in future studies, on the congressionally designated Old Spanish National Historic Trail.
Gold Point	*Specially Designated Areas and Lands with Wilderness Characteristics:* Transmission lines should be routed and constructed in such a way as to minimize visual impacts on specially designated areas. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land-disturbance activities should minimize impacts on the unnamed intermittent stream, the playa area in the northeast corner, and ephemeral washes on-site. Groundwater supplies during the construction and operations phases would need to be secured with coordination of the NDWR in terms of obtaining groundwater rights within the Lida Valley groundwater basin, and potentially from off-site sources and adjacent groundwater basins for the construction phase *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of desert scrub, greasewood flat, and other affected habitats, and to minimize the potential for the spread of invasive species. All riparian, dry wash, and playa communities within the SEZ and transmission line corridor should be avoided to the extent practicable, and any impacts minimized and mitigated. Any Joshua tree or other *Yucca* species, cacti, or succulent plant species that cannot be avoided should be salvaged. Appropriate engineering controls should be used to minimize impacts on dry wash, playa, wetland, greasewood flat, and riparian habitats, including downstream occurrences.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
Gold Point *(Cont.)*	Groundwater withdrawals should be limited to reduce the potential for indirect impacts on habitats associated with springs. Potential impacts on springs should be determined through hydrological studies. *Wildlife (All)*: Development in wash and playa habitats should be avoided. *Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. *Special Status Species*: Avoiding or minimizing disturbance to desert wash, playa, and sagebrush habitats could reduce or eliminate impacts on two special status species. Coordination with the USFWS and the NDOW should be conducted for the greater sage-grouse—a candidate species for listing under the ESA. Coordination would identify an appropriate survey protocol and mitigation requirements, which may include avoidance, minimization, translocation, or compensation. *Acoustic Environment*: Dish engine facilities within the Gold Point SEZ should be located more than 1 to 2 mi (1.6 to 3.2 km) from the nearby residences.
Millers	*Rangeland Resources (Livestock Grazing)*: Development of range improvements in the Monte Cristo allotment should be considered if site-specific analysis determines there would need to be a reduction in permitted AUMs because of lost grazing capacity. *Recreation:* Alternative routes for the race course should be considered consistent with local land use plan requirements. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land-disturbance activities should minimize impacts on the ephemeral stream channels of Ione Wash and Peavine Creek, as well as alluvial fan features along the western edge of the SEZ. Groundwater rights must be obtained through coordination with the NDWR and current water rights holders.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
Millers *(Cont.)*	*Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of affected habitats and minimize the potential for the spread of invasive species. Dry washes, Ione Wash, playas, and wetlands within the SEZ should be avoided to the extent practicable, and any impacts minimized and mitigated. A buffer area should be maintained around wetlands, playas, and dry washes to reduce the potential for impacts. Appropriate engineering controls should be used to minimize impacts on the playa wetland and other playas, as well as Ione Wash shrub communities, dry washes, and greasewood flat habitats within the SEZ, and downstream occurrences. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on plant communities that access groundwater, such as those in the vicinity of playas. Potential impacts on springs should be determined through hydrological studies. A qualified botanist or plant ecologist should survey for candelaria blazing star during a period when it is flowering and easily documented prior to any construction activities within the SEZ. If individuals are located, individuals or populations should be avoided through fencing and flagging of the area, including an appropriate buffer zone. *Wildlife (All)*: Wash and playa habitats should be avoided. *Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. *Special Status Species*: Consultations with the USFWS and NDOW should be conducted to address the potential for impacts on the greater sage-grouse, a candidate species for listing under the ESA. These consultations would identify an appropriate pre-disturbance survey protocol, avoidance or minimization measures, and development of other mitigation measures that could include compensation and translocation.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Nevada (Cont.)	
Millers *(Cont.)*	Coordination should be conducted with the USFWS and NDOW for the Crescent Dunes aegialian scarab beetle, Crescent Dunes serican scarab beetle, and greater sage-grouse—species that are candidates or under review for ESA listing. Coordination would identify an appropriate survey protocol and mitigation requirements, which may include avoidance, minimization, translocation, or compensation. *Cultural Resources:* Avoidance of areas with a high potential for a high density of sites, such as in the vicinity of both the former Lake Tonopah and Millers town site, is recommended.
New Mexico	
Afton	*Specially Designated Areas and Lands with Wilderness Characteristics*: Pending congressional review of the BLM recommendations for wilderness designations, restricting or eliminating solar development in portions of the visible area of the SEZ within 5 mi (8 km) of the Aden Lava Flow is recommended to avoid impacts on wilderness characteristics in the WSA. The eastern boundary of the SEZ should be restricted to the top of West Mesa to avoid areas sloping to the east which are more highly visible to the national historic trail, Mesilla Plaza, and to the scenic byway. The height of solar facilities in the SEZ should be restricted to reduce the adverse impact on the specially designated areas within the viewshed of the SEZ. *Rangeland Resources (Livestock Grazing):* Development of range improvements to mitigate the loss of AUMs in the Aden Hills, Corralitos Ranch, and La Mesa allotments should be considered. Consideration should also be given to adding portions of the Home Ranch and Black Mesa allotments outside of, and on the southwestern side of the SEZ, to the Aden Hills and West La Mesa allotments. *Recreation:* The height of solar facilities within the SEZ should be restricted to reduce impacts on recreation use within these areas. *Civilian Aviation:* Because Las Cruces International Airport is within 3 mi (4.8 km) of the SEZ, project developers must provide necessary safety restriction information to FAA addressing required distances from flight paths, hazard lighting of facilities, impacts on radar performance, and other requirements.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
New Mexico (Cont.)	
Afton *(Cont.)*	*Water Resources*: Water resource analysis indicates that wet-cooling and dry-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land-disturbance activities should minimize impacts on ephemeral streams located within the proposed SEZ. Siting of solar facilities and construction activities should avoid the areas identified as within a 100-year floodplain that total 1,654 acres (6.7 km^2) within the proposed SEZ. Groundwater management/rights should be coordinated with the NMOSE with respect to the Lower Rio Grande AWRM priority basin. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of desert scrub, dune, steppe, grassland communities, and other affected habitats and minimize the potential for the spread of invasive species. All wetland, dry wash, playa, riparian, succulent, and dune communities within the SEZ should be avoided to the extent practicable. Any yucca, agave, ocotillo, cacti (including *Opuntia* spp., *Cylindropuntia* spp., and *Echinocactus* spp.) and other succulent plant species that cannot be avoided should be salvaged. Appropriate engineering controls should be used to minimize impacts on wetland, dry wash, playa and riparian habitats, including downstream occurrences. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on groundwater dependent communities, such as wetland or riparian communities associated with the Rio Grande floodplain. *Wildlife (All)*: Wash, riparian, playa, rock outcrop, and wetland habitats should be avoided *Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
New Mexico (Cont.)	
Afton *(Cont.)*	*Aquatic Biota*: Appropriate engineering controls should be implemented to minimize the amount of surface water runoff and fugitive dust that reaches the Rio Grande River and associated wetlands and canals. Wetlands and streams located within the SEZ should be avoided to the extent practicable. *Special Status Species*: Avoiding or minimizing disturbance to desert grasslands, sand dune habitat and sand transport systems, rocky slopes, cliffs, and outcrops on the SEZ could reduce or eliminate impacts on 18 special status species. Consultation with the USFWS and NMDGF should be conducted to address the potential for impacts on the following species currently listed as endangered under the ESA: Sneed's pincushion cactus and northern aplomado falcon. Consultation would identify an appropriate survey protocol, avoidance and minimization measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements. These consultations should include plans to conduct pre-disturbance surveys and identify mitigation requirements, which may include avoidance, minimization, timing restrictions, or compensation. Coordination with the USFWS and NMDGF should be conducted to address the potential for impacts on the western yellow-billed cuckoo, a candidate species for listing under the ESA. Coordination would identify an appropriate survey protocol and mitigation requirements, which may include avoidance, minimization, translocation, or compensation. *Visual Resources*: Within the SEZ, in areas east of a line between the northwest corner of Section 5 of Township 024S Range 001E extending through and beyond the southeast corner of Section 24 of Township 025S Range 001E, visual impacts associated with solar energy development in the SEZ should be consistent with VRM Class II management objectives, as determined from KOPs to be selected by the BLM within the Mesilla Valley west of a line 0.25 mi (0.4 km) east of I-10 (for KOPs south of the I-10/I-25 interchange) or I-25 (for KOPs north of the I-10/I-25 interchange), and east of the toe of the slope of West Mesa. Within the SEZ, in areas visible from and within 3 mi (5 km) of the Aden Lava Flow WSA, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as determined from key observation points to be selected by the BLM within the WSA, and in areas visible from between 3 and 5 mi (5 and 8 km), visual impacts should be consistent with VRM Class III management objectives.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
New Mexico (Cont.)	
Afton *(Cont.)*	Within the SEZ, the height of power towers should be restricted such that the receiver and any navigation hazard lighting would not be directly visible from points within the Mesilla Valley west of a line 0.25 mi (0.4 km) east of I-10 (for points south of the I-10–I-25 interchange) or I-25 (for points north of the I-10–I-25 interchange), and east of the toe of the slope of West Mesa. *Acoustic Environment*: Dish engine facilities in the SEZ should be farther than 1 to 2 mi (1.6 to 3.2 km) from nearby residences around the SEZ (i.e., the facilities would be located anywhere within the SEZ, except the northeastern and southeastern portions of the proposed SEZ). *Paleontological Resources*: Avoidance of the eastern edge of the SEZ may be warranted if a paleontological survey results in findings similar to those known south of the SEZ. *Cultural Resources*: Coordination with trails associations and historical societies regarding impacts on El Camino Real de Tierra Adentro, the Butterfield Trail, and Mesilla Plaza, as well as other NRHP-listed properties is recommended.
Mason Draw	*Specially Designated Areas and Lands with Wilderness Characteristics:* The historic setting of the route of the Butterfield Trail would be adversely affected by construction of solar facilities in the SEZ and would be difficult to mitigate. Pending the outcome of the study of the significance of the trail, restrictions on solar facility development in the SEZ that might affect trail resources should be put in place. Consideration should be given to restricting the height of solar facilities in portions of the SEZ to minimize impacts on the Prehistoric Trackways National Monument and the Robledo Mountains WSA and ACEC. *Rangeland Resources (Livestock Grazing):* The development of range improvements and/or changing existing grazing management to mitigate the loss of AUMs in the Corralitos allotment should be considered. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
New Mexico (Cont.)	
Mason Draw *(Cont.)*	Land-disturbance activities should minimize impacts on ephemeral streams within the proposed SEZ. Siting of solar facilities and construction activities should avoid the areas identified as within a 100-year floodplain of Kimble Draw that total 325 acres [1.3 km2] within the proposed SEZ. Groundwater management/rights should be coordinated with the NMOSE with respect to the Rio Mimbres AWRM priority basin. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of desert scrub, dune, steppe, riparian, playa, and grassland communities, and other affected habitats and minimize the potential for the spread of invasive species. All wetland, dry wash, dry wash woodland, riparian, playa, succulent, and dune communities within the SEZ should be avoided to the extent practicable, and any impacts should be minimized and mitigated. Any yucca, agave, ocotillo, and cacti (including *Opuntia* spp. *Cylindropuntia* spp. and *Echinocactus* spp.) and other succulent plant species that cannot be avoided should be salvaged. A buffer area should be maintained around wetland, dry wash, dry wash woodland, playa, and riparian habitats to reduce the potential for impacts. Appropriate engineering controls should be used to minimize impacts on wetland, dry wash, dry wash woodland, playa, and riparian habitats, including downstream occurrences. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on groundwater-dependent communities, such as mesquite communities. Potential impacts to springs should be determined through hydrological studies. *Wildlife (All)*: Wash, riparian, and rock outcrop habitats should be avoided. *Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
New Mexico (Cont.)	
Mason Draw *(Cont.)*	*Aquatic Biota*: Appropriate engineering controls should be implemented to minimize the amount of ground disturbance, contaminants, runoff, and fugitive dust near wetlands located within the SEZ. *Special Status Species*: Avoiding or minimizing disturbance to desert grasslands, sand dune habitat, and sand transport systems on the SEZ could reduce or eliminate impacts on seven special status species. Consultations with the USFWS and NMDGF should be conducted to address the potential for impacts on the following species currently listed as threatened or endangered under the ESA: Sneed's pincushion cactus and northern aplomado falcon. Consultation would identify an appropriate survey protocol, avoidance and minimization measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements (if necessary). *Cultural Resources*: Coordination with trails associations and historical societies regarding impacts on El Camino Real de Tierra Adentro, the Butterfield Trail, and Mesilla Plaza, as well as other NRHP-listed properties is recommended.
Red Sands	*Specially Designated Areas and Lands with Wilderness Characteristics:* Design features for visual resources should be implemented to reduce adverse impacts on White Sands National Monument, wilderness characteristics in Culp Canyon WSA, and recreation and scenic resources along the Sacramento Front. *Rangeland Resources (Livestock Grazing):* Development of range improvements and changes in grazing management should be considered to mitigate the loss of AUMs in the five affected grazing allotments. *Recreation:* Adoption of design features for visual resources would reduce adverse impacts on recreation use in some specially designated areas and should be considered. *Military and Civilian Aviation:* The BLM should modify its land records to require consultation with the DoD in any areas of the SEZ under military airspace. Because White Sands Regional Airport is within 3 mi (4.8 km) of the SEZ, project developers must provide necessary safety restriction information to FAA addressing required distances from flight paths, hazard lighting of facilities, impacts on radar performance, and other requirements.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
New Mexico (Cont.)	
Red Sands *(Cont.)*	*Soil Resources:* Avoid disturbing gypsite crusts to the extent possible to minimize the risk of soil loss by wind erosion. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land-disturbance activities should minimize impacts on ephemeral streams located within the proposed SEZ. Siting of solar facilities and construction activities should avoid the areas identified as within a 100-year floodplain of the unnamed ephemeral wash running north to south through the center of the proposed SEZ totaling 54 acres (0.22 km2). Groundwater management and water right plans of New Mexico should be followed. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of desertscrub, dune, steppe, riparian, playa, and grassland communities and other affected habitats and to minimize the potential for the spread of invasive species, such as African rue. All wetland, riparian, dry wash, playa, succulent, and sand dune communities within the SEZ should be avoided to the extent practicable, and any impacts minimized and mitigated. A buffer area should be maintained around wetland and riparian habitats to reduce the potential for impacts. Any yucca, agave, ocotillo, and cacti (including *Opuntia* spp., *Cylindropuntia* spp., *Echinocactus* spp., and *Sclerocactus* spp.) and other succulent plant species that cannot be avoided should be salvaged. Appropriate engineering controls should be used to minimize impacts on wetland, dry wash, and playa habitats, including downstream occurrences. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on groundwater-dependent communities, such as mesquite, wetland, or riparian communities, or gypsum dune field communities, including those communities found on White Sands National Monument. Potential impacts on springs should be determined through hydrological studies. *Wildlife (All)*: Wash, playa, and wetland habitats should be avoided.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
New Mexico (Cont.)	
Red Sands *(Cont.)*	*Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. *Aquatic Biota:* Implement appropriate engineering controls to minimize the amount of ground disturbance, contaminants, surface water runoff, and fugitive dust that reaches intermittent streams and wetlands within the SEZ. Implement appropriate engineering controls to minimize the amount of surface water runoff and fugitive dust that reaches Holloman Lake and the intermittent streams and wetlands outside of the SEZ. *Special Status Species*: Avoiding or minimizing disturbance to desert grasslands, sand dune habitat and sand transport systems, and playas on the SEZ could reduce or eliminate impacts on 11 special status species. Avoidance or minimization of groundwater withdrawals from the Tularosa Basin to serve solar energy development on the SEZ could reduce or eliminate impacts on the White Sands pupfish. In particular, impacts on spring-fed habitats in the Lost River and Salt Creek could be reduced with the avoidance of groundwater withdrawals in the region. Consultation with the USFWS and NMDGF should be conducted to address the potential for impacts on the following species currently listed as threatened or endangered under the ESA: Kuenzler's hedgehog cactus, Sacramento Mountains prickly-poppy, interior least tern, and northern aplomado falcon. Consultation would identify an appropriate survey protocol, avoidance and minimization measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements (if necessary). *Visual Resources*: The development of power tower facilities within the SEZ should be prohibited. *Acoustic Environment*: Dish engine facilities within the Red Sands SEZ should be located more than 1 to 2 mi (1.6 to 3 km) from the nearby residences (i.e., the facilities should be located in the western or southern portion of the proposed SEZ). *Cultural Resources*: Coordination with the White Sands National Monument and local historical societies regarding impacts on nearby NRHP-listed properties is recommended.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Utah	
Escalante Valley	*Lands and Realty*: Priority consideration should be given to utilizing existing county roads to provide construction and operational access to the SEZ. *Rangeland Resources (Livestock Grazing)*: Consideration should be given to the feasibility of replacing all or part of the lost AUMs through changes in grazing management or in development of additional range improvements on public lands remaining in the allotment. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land disturbance and operations activities should prevent erosion and sedimentation in the vicinity of the ephemeral washes and dry lake present on the site. Groundwater rights must be obtained from the Utah Division of Water Rights. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of affected habitats and minimize the potential for the spread of invasive species, such as those occurring in Iron County, that could be introduced as a result of solar energy project activities. All playa, sand dune and sand transport areas, and dry wash habitats should be avoided to the extent practicable, and any impacts minimized and mitigated. Appropriate engineering controls should be used to minimize impacts on dry wash and dry lake habitats, including downstream occurrences. *Wildlife (All)*: Ephemeral washes and the dry lakebed in the southwestern portion of the SEZ should be avoided. *Wildlife (Birds):* The steps outlined in the *Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances* should be followed.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Utah (Cont.)	
Escalante Valley *(Cont.)*	*Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. *Special Status Species*: Avoidance of pinyon-juniper and oak/mahogany woodlands in the area of direct effect could reduce impacts on two special status species. Consultation with the USFWS and the UDWR should be conducted to address the potential for impacts on the Utah prairie dog, a species listed as threatened under the ESA. Consultation would identify an appropriate survey protocol, avoidance measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements. Coordination with the USFWS and the UDWR should be conducted to address the potential for impacts on the greater sage-grouse, a candidate species for listing under the ESA. Coordination would identify an appropriate pre-disturbance survey protocol, avoidance measures, and any potential compensatory mitigation actions. *Acoustic Environment*: Dish engine facilities within the Escalante Valley SEZ should be located more than 1 to 2 mi (1.6 to 3 km) from the nearest residences (i.e., the facilities should be located in the eastern or southwestern area of the proposed SEZ). *Cultural Resources*: Avoidance of the dune area within the southwest portion of the proposed SEZ is recommended.
Milford Flats South	*Lands and Realty*: Priority consideration should be given to utilizing upgraded existing county roads to provide construction and operations access to the SEZ. *Rangeland Resources (Livestock Grazing):* Consideration should be given to the feasibility of replacing all or part of the lost AUMs through development of additional range improvements on public lands remaining in the allotment. *Minerals:* Coordination with existing oil and gas lessees should be required in the earliest project planning stages to determine the feasibility of protecting oil and gas lessees' development rights. *Water Resources*: Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Utah (Cont.)	
Milford Flats South *(Cont.)*	Land disturbance and operations activities should prevent erosion and sedimentation in the vicinity of the ephemeral washes on the site. Groundwater rights must be obtained from the Utah Division of Water Rights. *Vegetation*: An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of affected habitats and minimize the potential for the spread of invasive species, such as such as those occurring in Beaver County, that could be introduced as a result of solar energy project activities. All dry wash habitats within the SEZ and all dry wash and riparian habitats within the assumed transmission line corridor should be avoided to the extent practicable, and any impacts minimized and mitigated. Transmission line towers should be sited and constructed to minimize impacts on dry washes and riparian areas; towers should span such areas whenever practicable. Appropriate engineering controls should be used to minimize impacts on dry wash, playa, and greasewood flat habitats, including downstream occurrences. *Wildlife (All):* Minersville Canal should be avoided. *Wildlife (Birds)*: The steps outlined in the *Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances* should be followed. *Wildlife (Mammals)*: The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. *Special Status Species*: Avoidance of woodland habitats, rocky cliffs, and outcrops in the area of direct effects could reduce impacts on six special status species.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Utah (Cont.)	
Milford Flats South *(Cont.)*	Consultations with the USFWS and the UDWR should be conducted to address the potential for impacts on the Utah prairie dog, a species listed as threatened under the ESA. Consultation would identify an appropriate survey protocol, avoidance measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements. Coordination with the USFWS and the UDWR should be conducted to address the potential for impacts on the greater sage-grouse—a candidate species for listing under the ESA. Coordination would identify an appropriate pre-disturbance survey protocol, avoidance measures, and any potential compensatory mitigation actions. *Acoustic Environment*: Dish engine facilities within the Milford Flats South SEZ should be located more than 1 to 2 mi (1.6 to 3 km) from the nearest residence around the SEZ (i.e., the facilities should be located in the central or western area of the proposed SEZ).
Wah Wah Valley	*Livestock Grazing:* Consideration should be given to the feasibility of replacing all or part of any lost AUMs through development of additional range improvements on public lands remaining in the allotment. *Water Resources:* Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. Land disturbance and operations activities should avoid increasing drainage to the Wah Wah Wash to prevent further channel incisions and sedimentation issues. Groundwater rights must be obtained from the Utah Division of Water Rights. *Vegetation:* An Integrated Vegetation Management Plan addressing invasive species control and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of affected habitats and to minimize the potential for the spread of invasive species, such as those occurring in Beaver County, that could be introduced as a result of solar energy project activities. Appropriate engineering controls should be used to minimize impacts on dry wash, playa, and greasewood flat habitats, including downstream occurrences.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Utah (Cont.)	
Wah Wah Valley *(Cont.)*	All dry wash and playa habitats within the SEZ and all dry wash, wetland and riparian habitats within the assumed transmission line corridor (e.g., Beaver Creek) should be avoided to the extent practicable, and any impacts minimized and mitigated. Transmission line towers should be sited and constructed to minimize impacts on wetlands and riparian areas, such as those associated with Beaver Creek, and span them whenever practicable. Groundwater studies should be conducted to evaluate the potential for indirect impacts on springs located in the vicinity of the SEZ. *Wildlife (All):* Wah Wah Wash should be avoided. Instream and nearshore disturbance of the Beaver River should be avoided during construction of the transmission line. *Wildlife (Birds)*: The steps outlined in the *Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances* should be followed. *Wildlife (Mammals):* The fencing around the solar energy development should not block the free movement of mammals, particularly big game species. The inter-mountain basins big sagebrush shrubland cover type in the southeastern portion of the SEZ, which is the only identified suitable land cover for the elk and sagebrush vole and about a third of the suitable habitat for the American black bear in the SEZ, should be avoided. *Wildlife (Aquatic Biota)*: Transmission lines should be sited and constructed to minimize impacts to aquatic habitats whenever possible and transmission lines should span Beaver River. *Special Status Species*: Avoiding or minimizing disturbance of woodland, rocky cliffs, and outcrops in the area of direct effects could reduce impacts on nine special status species.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Utah (Cont.)	
Wah Wah Valley *(Cont.)*	Consultation with the USFWS and the UDWR should be conducted to address the potential for impacts on the Utah prairie dog—a species listed as threatened under the ESA. Consultation would identify an appropriate survey protocol, avoidance measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements. Coordination with the USFWS and UDWR should be conducted to address the potential for impacts on the greater sage-grouse—a candidate species for listing under the ESA. Coordination with the USFWS and UDWR should also be conducted for the following species that are under review for listing under the ESA: Frisco buckwheat, Frisco clover, and Ostler's pepper-grass. Coordination with the USFWS and UDWR would identify an appropriate pre-disturbance survey protocol, avoidance measures, and any potential compensatory mitigation actions for each of these species. *Acoustic Environment:* Dish engine facilities within the Wah Wah Valley SEZ should be located more than 1 to 2 mi (1.6 to 3 km) from the nearest residences (i.e., the facilities should be located in the lower half of the proposed SEZ).
Design Features Applicable to All SEZs	*Water Resources:* During site characterization, hydrologic investigations would need to identify 100-year floodplains and potential jurisdictional water bodies subject to Clean Water Act Section 404 permitting. Siting of solar facilities and construction activities should avoid areas identified as within a 100-year floodplain. Stormwater management plans and BMPs should comply with standards developed by the regulating state agency. Groundwater monitoring and production wells should be constructed in accordance with state standards. Water for potable uses would have to meet or be treated to meet drinking water quality standards. Stormwater management BMPs should be coordinated with the regulating state agency. *Vegetation:* Invasive species control should focus on biological and mechanical methods where possible to reduce the use of herbicides. Appropriate engineering controls should be used to minimize impacts on dry wash and other sensitive habitats resulting from surface water runoff, erosion, sedimentation, altered hydrology, accidental spills, or fugitive dust deposition. Appropriate buffers, BMPs, and engineering controls would be determined through agency consultation. *Wildlife (General):* Indirect impacts should be reduced by implementing design features and engineering controls that reduce runoff, sedimentation, spills, and fugitive dust.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Design Features Applicable to All SEZs *(Cont.)*	*Wildlife (Birds):* For solar energy developments within the SEZ, the requirements contained within the 2010 Memorandum of Understanding between the BLM and USFWS to promote the conservation of migratory birds will be followed. Take of golden eagles and other raptors should be avoided. Mitigation regarding the golden eagle should be developed in consultation with the USFWS and appropriate state agencies. A permit may be required under the Bald and Golden Eagle Protection Act. Pre-disturbance surveys should be conducted within SEZs for bird species listed under the Migratory Bird Treaty Act. Impacts on potential nesting habitat of these species should be avoided, particularly during the nesting season. *Special Status Species*: Pre-disturbance surveys should be conducted within the area of direct effects to determine the presence and abundance of special status species. Disturbance to occupied habitats for these species should be avoided or minimized to the extent practicable. If avoiding or minimizing impacts to occupied habitats is not possible for some species, translocation of individuals from areas of direct effect or compensatory mitigation of direct effects on occupied habitats could reduce impacts. A comprehensive mitigation strategy for special status species that uses one or more of these options to offset the impacts of development should be developed in coordination with the appropriate federal and state agencies. Harassment or disturbance of special status species and their habitats in the affected area should be avoided or minimized. This can be accomplished by identifying any additional sensitive areas and implementing necessary protection measures based upon consultation with the USFWS and the appropriate state agency. *Acoustic Environment:* To reduce noise impacts on nearby residents from parabolic trough and power tower facilities equipped with TES, such facilities should be located so that off-site noise levels are within appropriate guideline levels. Operations at parabolic trough and power tower facilities should be minimized or limited to a few hours after sunset when temperature inversions would be relatively weak. Additional noise control measures for cooling systems, such as installing silencers, operating fans at lower speeds, and/or locating them farther from residences (more than 1 to 2 mi [1.6 to 3.2 km]), would be warranted if a TES option with longer storage time (e.g., 6 hours or more) were used. Direct noise control measures applied to individual dish engine systems may be used to reduce noise impacts on nearby residences. *Paleontological Resources:* The need for and the nature of any SEZ-specific design features would depend on the results of future paleontological investigations.

TABLE A.2-2 (Cont.)

SEZ	SEZ-Specific Design Features[a]
Design Features Applicable to All SEZs *(Cont.)*	*Cultural Resources:* SEZ-specific design features would be determined through consultation with the State SHPO and affected Tribes and would depend on the results of future investigations. *Native American Concerns:* The need for and nature of SEZ-specific design features addressing issues of potential concern would be determined during government-to-government consultation with the affected Tribes.

Abbreviations: ACEC = Area of Critical Environmental Concern; ACHP = Advisory Council on Historic Places; ADWR = Arizona Department of Water Resources; AUM = animal unit month; AZGFD = Arizona Game and Fish Department; BLM = Bureau of Land Management; BMP = best management practice; CDOW = Colorado Division of Wildlife; DOE = Department of Energy; EPA = U.S. Environmental Protection Agency; ESA = Endangered Species Act; CDFG = California Department of Fish and Game; CESA = California Endangered Species Act; DWMA = Desert Wildlife Management Area; KSLA = known sodium leasing area; LTVA – long-term visitor area; NDOW = Nevada Department of Wildlife; NDWR = Nevada Division of Water Resources; NHA = National Heritage Area; NMDGF = New Mexico Department of Game and Fish; NMOSE = New Mexico Office of the State Engineer; NP = National Park; NRHP = *National Register of Historic Places*; PA = Programmatic Agreement; PEIS = programmatic environmental impact statement; PYFC = potential fossil yield classification; ROW = right-of-way; SEZ = solar energy zone; SHPO = State Historic Preservation Office; SNWA = Southern Nevada Water Authority; SRMA = Special Recreation Management Area; USFWS = U.S. Fish and Wildlife Service; VRM = visual resource management; WA = Wilderness Area; WRM = water resource management; WSA = Wilderness Study Area.

[a] The SEZ-specific design features listed in this table are proposed as an element of BLM's Solar Development Program. With the signing of the ROD for the Final PEIS, the design features will be required for all development within the applicable SEZs.

[b] The scientific names of all plants, wildlife, aquatic biota, and special status species are provided in Chapters 8 through 13.

APPENDIX B:

ACTIVE SOLAR APPLICATIONS

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APPENDIX B:

ACTIVE SOLAR APPLICATIONS

B.1 BACKGROUND

The U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) has received more than 300 applications for right of way (ROW) authorizations for utility-scale solar facilities to be located on BLM-administered lands. Some of these applications are being processed in accordance with BLM's existing policies (see Appendix A, Section A.1), while some applications cannot currently be processed because they describe lands already applied for by another company. Other applications have been terminated because the developer withdrew the application or because due diligence requirements were not met. The BLM is processing the remaining applications during the preparation of this PEIS, but it is planning to incorporate the program established through this PEIS into the processing of applications that occurs subsequent to the release of the Record of Decision. As of February 2010, the BLM had 127 active applications for ROW authorizations for solar facilities.[1] These active applications are shown in Table B-1. The majority of the applications are for parabolic trough or power tower facilities. There are also about 30 applications for photovoltaic (PV) facilities and 3 applications for dish engine facilities.

Fourteen of the active applications are being processed as "fast-track" projects (BLM 2010).[2] These projects are applications for which the companies involved have demonstrated to the BLM that they have made sufficient progress to formally start the environmental review and public participation process. The applications are advanced enough in the permitting process that they could potentially be cleared for approval by December 2010. The proposed fast-track projects total approximately 6,022 MW of generating capacity; one is located in Arizona, four are in Nevada, and the rest are in California.[3] The fast-track projects are designated by footnote in Table B-1.

Table B-2 summarizes the locations, acreage, and estimated electric generation capacities of the active applications. The vast majority of the applications are located in three states (Arizona, California, and Nevada); two of the states in the "Programmatic Environmental Impact

1 The applications as of February 2010 were used to support analysis in the PEIS; however, as of December 1, 2010, the BLM had 104 active applications, including 30 in California, 35 in Nevada, 36 in Arizona, and 3 in New Mexico.

2 Table B-1 lists 17 individual applications for fast-track projects. This is because the Ivanpah power tower facility (main application #48668) has also been processed under 3 other application numbers (49502, 49503, 49504). The actual number of solar fast-track projects is 14.

3 Six fast-track projects have been approved in California and two have been approved in Nevada: BrightSource Energy's Ivanpah Solar Electric Generating System, Tessera Solar's Imperial Valley and Calico Solar Projects, Chevron Energy Solution's Lucerne Valley Solar Project, NextEra's Genesis Ford Dry Lake Solar Project, Solar Millennium's Blythe and Amargosa Farm Road Solar Projects, and First Solar's Silver State North Solar Project.

TABLE B-1 Active Solar Applications on BLM-Administered Lands as of February 5, 2010[a]

Serial Number	Customer Name (Project Name and/or Geographic Area)	Application Received	Total Case Acres	MW[b]	Planned Technology	NOI Published	Field Office
AZA 034187[c]	NextEra/Boulevard Assoc., LLC (Sonoran Solar)	June 28, 2007	4,000	375	CSP/trough	July 8, 2009	Lower Sonoran
AZA 034184	Boulevard Assoc., LLC (Aguila)	June 26, 2007	7,375	500	CSP/trough		Hassayampa
AZA 034186	Boulevard Assoc., LLC (Burnt Mountain/ Big Horn)	June 26, 2007	6,232	500	CSP/trough		Hassayampa
AZA 034200	NextEra/Boulevard Assoc., LLC (Mountain Spring)	June 22, 2007	6,705	250	CSP/trough		Kingman
AZA 034201	Boulevard Assoc., LLC (Senator)	June 22, 2007	15,634	250	CSP/trough		Kingman
AZA 034321	Ausra AZ II, LLC (Palo Verde)	Oct. 1, 2007	5,748	840	CSP/CLFR		Hassayampa
AZA 034335	Boulevard Assoc., LLC (Bouse)	June 8, 2007	24,221	500	CSP/trough		Lake Havasu: Yuma
AZA 034357	First Solar (Gila Bend)	Nov. 6, 2007	6,003	500	PV		Lower Sonoran
AZA 034358	First Solar (Saddle Mtn.)	Nov. 6, 2007	5,997	300	PV		Lower Sonoran
AZA 34416	Pacific Solar Invst., Inc. (Iberdrola) (Eagle Trail)	Dec. 2, 2007	19,000	1,500	CSP/trough		Yuma
AZA 034424	Pacific Solar Invst., Inc. (Iberdrola) (Big Horn)	Dec. 4, 2007	13,440	900	CSP		Hassayampa
AZA 034425	Pacific Solar Invst., Inc. (Iberdrola) (Hyder)	Dec. 7, 2007	5,794	300	CSP/trough		Lower Sonoran; Yuma
AZA 034426	Pacific Solar Invst., Inc. (Iberdrola) (Ranegras)	Dec. 2, 2007	25,860	2,000	CSP/trough		Yuma
AZA 034427	Pacific Solar Invst., Inc. (Iberdrola)	Sept. 6, 2007	32,000	2,000	CSP/trough		Yuma
AZA 034540	Horizon Wind Energy, LLC (Aguila)	March 4, 2008	11,535	250	CSP/trough		Hassayampa
AZA 034554	NextLight Renewable Power, LLC (Quartzite)	March 26, 2008	20,699	500	CSP/trough		Yuma
AZA 034560	NextLight Renewable Power, LLC (Vicksburg)	March 26, 2008	15,040	500	CSP/trough		Yuma
AZA 034566	NextLight Renewable Power, LLC (Centennial)	March 26, 2008	13,428	500	CSP/trough		Yuma
AZA 034568	NextLight Renewable Power, LLC (Palomas)	March 26, 2008	20,165	500	CSP/trough		Yuma
AZA 034665	SolarReserve, LLC (Black Rock Hill)	May 27, 2008	5,600	600	CSP/tower		Yuma
AZA 034666	SolarReserve, LLC (Quartzsite)	May 27, 2008	25,204	100	CSP/tower	Jan. 14, 2010	Yuma
AZA 034668	SolarReserve, LLC (Agua Caliente)	May 27, 2008	5,678	600	CSP/tower		Yuma
AZA 034737	Arizona Solar Invst., Inc. (Haraquahala)	July 10, 2008	14,047	500	CSP/trough		Hassayampa
AZA 034739	IDIT, Inc. (Little Horn)	July 9, 2008	15,000	1,000	CSP/trough		Yuma
AZA 034754	Horizon Wind Energy, LLC (Wenden)	March 4, 2008	28,760	250	CSP/trough		Lake Havasu
AZA 034774	Arizona Solar Invst., Inc. (Dendora Valley)	Aug. 12, 2008	14,765	500	CSP/trough		Lower Sonoran
AZA 034797	LSR Jackrabbit, LLC (Jackrabbit)	Aug. 27, 2008	27,036	500	CSP/tower		Hassayampa
AZA 034799	LSR Palo Verde, LLC (Palo Verde)	Aug. 27, 2008	5,855	600	CSP/trough		Lower Sonoran
AZA 034936	Wildcat Quartzsite, LLC (Quartzite)	Jan. 29, 2009	11,960	800	CSP/tower		Yuma
AZA 034946	Wildcat Harcuvar South, LLC (Wenden)	Jan. 28, 2009	10,947	800	CSP/tower		Lake Havasu
AZA 035134	E-ON Climate & Renewables (La Posa)	July 2, 2009	1,780	Unknown	Unknown		Yuma
AZA 035137	E-ON Climate & Renewables	July 2, 2009	590	100	PV		Yuma

TABLE B-1 (Cont.)

Serial Number	Customer Name (Project Name and/or Geographic Area)	Application Received	Total Case Acres	MW[b]	Planned Technology	NOI Published	Field Office
AZA 035166	IDIT, Inc. (Arlington West)	July 27, 2009	5,800	Unknown	PV		Lower Sonoran
AZA 035236	Solar Reserve (Safford Solar Energy Center/ San Simon)	Jan. 4, 2010	22,892	250	PV		Safford
CACA 047740[c]	SES Solar Two, LLC	Jan. 6, 2005	6,017	750	CSP/dish engine	Oct. 17, 2008	El Centro
CACA 048649[c]	First Solar (Desert Sunlight)	Nov. 7, 2006	9,481	550	PV	Jan. 13, 2010	Palm Springs-Southcoast
CACA 048668[c]	Solar Partners I, LLC (Ivanpah SEGS)	Nov. 17, 2006	6,873	400	CSP/tower	Nov. 6, 2007	Needles
CACA 048669	First Solar (Stateline/Ivanpah)	Dec. 14, 2006	4,168	380	PV		Needles
CACA 048728	FPL Energy (McCoy)	Jan. 31, 2007	20,608	250	CSP		Palm Springs-Southcoast
CACA 048741	Solar Investments, LLC (Baker Solar)	Jan. 18, 2007	8,384	800	CSP		Barstow
CACA 048742	Solar Investments, LLC (Silurian Valley)	Jan. 18, 2007	10,611	1,000	CSP		Barstow
CACA 048808	Chuckwalla Solar 1, LLC (Chuckwalla)	Sept. 15, 2006	4,099	200	PV		Palm Springs-Southcoast
CACA 048810[c]	Solar Millenium/Chevron (Palen)	March 14, 2007	5,213	484	CSP/trough	Nov. 23, 2009	Palm Springs-Southcoast
CACA 048811[c]	Solar Millenium/Chevron (Blythe)	Feb. 15, 2007	9,481	968	CSP/trough	Nov. 23, 2009	Palm Springs-Southcoast
CACA 048818	First Solar (Desert Opal)	Feb. 26, 2007	15,824	1,205	PV		Barstow
CACA 048820	First Solar (Desert Sapphire)	Feb. 13, 2007	5,325	745	PV		Ridgecrest
CACA 048875	DPT Broadwell Lake, LLC (Broadwell Dry Lake)	Jan. 24, 2007	8,625	500	CSP		Barstow
CACA 048880[c]	NextEra/Boulevard Assoc., LLC (Genesis/ Ford Dry Lake)	Jan. 31, 2007	4,535	250	CSP/trough	Nov. 23, 2009	Palm Springs-Southcoast
CACA 049002	Leopold Company, LLC (Ward Valley)	April 2, 2007	35,466	4,100	CSP		Needles
CACA 049004	Boulevard Assoc., LLC (Mesquite Hills)	May 14, 2007	13,528	1,000	CSP		Needles
CACA 049006	Boulevard Assoc., LLC (Killbeck)	May 14, 2007	12,046	1,000	CSP		Needles
CACA 049008	Boulevard Assoc., LLC (Cadiz Lake)	May 14, 2007	35,639	1,000	CSP		Needles
CACA 049016[c]	Solar Millenium, LLC (Ridgecrest)	March 23, 2007	3,811	250	CSP/trough	Nov. 23, 2009	Ridgecrest
CACA 049017	First Solar (Desert Garnet)	Nov. 13, 2008	6,719	745	PV		Ridgecrest
CACA 049097	Bull Frog Green Energy, LLC (Mule Mountain)	Oct. 1, 2008	6,634	2,500	PV		Palm Springs-Southcoast
CACA 049150	BCL & Assoc., Inc. (Superstition Solar I)	July 17, 2007	5,464	500	PV		El Centro

TABLE B-1 (Cont.)

Serial Number	Customer Name (Project Name and/or Geographic Area)	Application Received	Total Case Acres	MW[b]	Planned Technology	NOI Published	Field Office
CACA 049423	Solel Inc. (Arrowhead)	July 23, 2007	6,614	Unknown	Unknown		Needles
CACA 049424	Solel, Inc. (Stedman)	July 23, 2007	7,453	600	CSP		Barstow
CACA 049430	Iberdrola Renewables, Inc. (Cadiz)	Dec. 8, 2008	13,373	Unknown	CSP		Needles
CACA 049431	Boulevard Assoc., LLC (Kelbaker Rd./Amboy)	Sept. 21, 2007	10,199	1,000	CSP		Needles
CACA 049432	PG&E (Cadiz/Trilobite)	Sept. 24, 2007	5,313	800	Unknown		Needles
CACA 049488	enXco, Inc. (Little Ford Dry Lake)	Nov. 13, 2007	1,327	300	CSP		Palm Springs-Southcoast
CACA 049490	enXco, Inc. (McCoy)	Nov. 13, 2007	20,608	300	CSP		Palm Springs-Southcoast
CACA 049491	enXco, Inc. (Eagle Mountai)	Nov. 13, 2007	1,327	300	CSP		Palm Springs-Southcoast
CACA 049493	Solel, Inc. (Palen/McCoy)	March 27, 2008	8,750	500	CSP		Palm Springs-Southcoast
CACA 049494	Solel, Inc. (Desert Lily)	Nov. 6, 2007	7,317	500	CSP		Palm Springs-Southcoast
CACA 049502[c]	Solar Partners IV, LLC	Dec. 10, 2007	*See CACA '48668*		CSP/tower	Nov. 6, 2007	Needles
CACA 049503[c]	Solar Partners VIII, LLC	Dec. 10, 2007	*See CACA '48668*		CSP/tower	Nov. 6, 2007	Needles
CACA 049504[c]	Solar Partners II, LLC	Dec. 10, 2007	*See CACA '48668*		CSP/tower	Nov. 6, 2007	Needles
CACA 049511	First Solar (Desert Obsidian)	Nov. 13, 2008	8,943	600	PV		Ridgecrest
CACA 049537[c]	SES Solar Three, LLC (SES One)	March 14, 2007	3,392	350	CSP/dish engine	June 8, 2009	Barstow
CACA 049539[c]	SES Solar Six, LLC (SES One)	March 14, 2007	5,212	500	CSP/dish engine	June 8, 2009	Barstow
CACA 049561[c]	Chevron Energy Solutions Co. (Lucerne)	Dec. 7, 2007	518	45	PV	July 23, 2009	Barstow
CACA 049584	Solenergis, LLC (Caithness Soda Mt.)	Dec. 18, 2007	7,995	350	PV		Barstow
CACA 049585	enXco Development, Inc. (Troy Lake Soleil)	Dec. 12, 2007	3,710	1,000	CSP/tower		Barstow
CACA 049613	First Solar Development, Inc. (Desert Turquoise)	Dec. 3, 2007	7,525	500	PV		El Centro
CACA 049615	Pacific Solar Investments, Inc. (Ogilby Solar)	Sept. 4, 2007	17,807	1,500	PV		El Centro
CACA 049702	Bull Frog Green Energy, LLC (Big Maria Vista)	June 1, 2008	22,717	2,500	PV		Palm Springs-Southcoast
CACA 049811	NextLight Renewable Power, LLC (Ludlow)	March 24, 2008	7,691	500	PV		Barstow
CACA 049813	Iberdrola Renewables, Inc. (Cadiz—East)	April 1, 2008	12,833	1,000	CSP		Needles

TABLE B-1 (Cont.)

Serial Number	Customer Name (Project Name and/or Geographic Area)	Application Received	Total Case Acres	MW[b]	Planned Technology	NOI Published	Field Office
CACA 049884	Solar Reserve, LLC (Solar Reserve/ Imperial County)	April 24, 2008	3,830	100	CSP		El Centro
CACA 050174	LSR Midway Well, LLC (Midway Well)	Aug. 11, 2008	2,571	400	CSP		El Centro
CACA 050379	LightSource Renewables, LLC (Mule Mountain II)	Aug. 8, 2008	2,446	550	CSP		Palm Springs-Southcoast
CACA 050504	Ausra CA III, LLC (Danby Lake/Ward Valley)	Nov. 18, 2008	35,436	Unknown	CSP		Needles
CACA 050506	Ausra CA III, LLC (Danby Lake)	Nov. 18, 2008	22,622	Unknown	CSP		Needles
CACA 051369	Invenergy Solar Development LLC (Salton Sea West)	Sept. 16, 2009	1,081	50	PV		El Centro
CACA 050150	Solel, Inc. (Mojave Solar Park/Johnson Valley)	March 10, 2008	1,800	Unknown	CSP		Barstow
CACA 051579	Franconia Investments, LLC	Jan. 12, 2010	1,600	Unknown	CSP		El Centro
NMNM 119969	enXco Development Corp. (Afton)	Feb. 6, 2008	3,000	600	CSP/trough		Las Cruces
NMNM 120310	Iberdrola Renewables (Lordsburg Mesa)	March 25, 2008	24,320	1,500	CSP/trough		Las Cruces
NMNM 120857	enXco Development Corp.	July 3, 2008	9,600	Unknown	CSP		Las Cruces
NMNM 121092	Solar Reserve, LLC (Lordsburg)	Aug. 11, 2008	5,296	100	CPS		Las Cruces
NVN 083083	Cogentrix Solar Services, LLC (Primm/Jean)	Jan. 18, 2007	9,760	1,000	CSP		Las Vegas
NVN 083129	Cogentrix Solar Services, LLC (McCullough Pass)	Jan. 18, 2007	19,840	1,000	CSP		Las Vegas
NVN 083150	Cogentrix Solar Services, LLC (Amargosa)	Feb. 14, 2007	13,440	1,400	CSP		Pahrump
NVN 083151	Cogentrix Solar Services, LLC (Pahrump)	Feb. 14, 2007	30,720	1,000	CSP		Las Vegas
NVN 083220	Cogentrix Solar Services, LLC (Beatty)	March 5, 2007	12,800	1,400	CSP		Pahrump
NVN 083221	Cogentrix Solar Services, LLC (Big Dune)	March 5, 2007	22,400	1,400	CSP		Pahrump
NVN 083914	BrightSource Engy. Solar Ptnr. (Morman Mesa)	July 25, 2007	10,000	500	CSP		Las Vegas
NVN 084052	NV Power Co. (Dry Lake Valley)	Aug. 14, 2007	1,775	120	CSP		Las Vegas
NVN 084232	First Solar (Desert Spring)	Oct. 22, 2007	5,500	400	PV		Las Vegas
NVN 084236	First Solar (Desert Jade)	Oct. 22, 2007	3,800	400	PV		Las Vegas
NVN 084359[c]	Solar Millenium, LLC (Amargosa Farm Road)	Nov. 20, 2007	13,950	500	CSP/trough	July 13, 2009	Pahrump
NVN 084465	Pacific Solar Investments, Inc. (Iberdrola) (Amargosa North)	Dec. 7, 2007	7,500	300	PV	Dec. 14, 2009	Missing
NVN 084466	Pacific Solar Investments, Inc. (Amargosa South)	Dec. 7, 2007	7,700	500	PV		Pahrump
NVN 084467	Pacific Solar Investments, Inc. (Bowman)	Dec. 7, 2007	11,000	1000	CSP/trough		Las Vegas
NVN 084631	BrightSource Engy. Solar Ptnr.	Jan. 28, 2008	2,000	1,200	CSP		Las Vegas
NVN 084654	Navy Fac. Eng. Cmnd. SW (Fallon NAS Solar)	Jan. 25, 2008	37	4	PV		Stillwater

TABLE B-1 (Cont.)

Serial Number	Customer Name (Project Name and/or Geographic Area)	Application Received	Total Case Acres	MW[b]	Planned Technology	NOI Published	Field Office
NVN 084704	Amargosa Flats Energy, LLC (Crystal/Johnnie)	March 12, 2008	7,040	140	CSP/CLFR		Pahrump
NVN 085077[c]	NextLight Renewable Power, LLC (Silver State [North and South])	March 21, 2008	7,900	420	PV	June 30, 2009	Las Vegas
NVN 085117	Bull Frog Green Energy, LLC (South Keyhole Canyon)	March 18, 2008	3,639	500	PV		Las Vegas
NVN 085201	Ewindfarm, Inc. (Johnnie Pahrump)	May 14, 2008	10,880	500	PV		Pahrump
NVN 085215	Luning (Luning Solar)	May 20, 2008	575	30	PV		Stillwater
NVN 085612	Cogentrix Solar Services, LLC	July 11, 2008	2,012	240	CSP		Las Vegas
NVN 085657	Cogentrix Solar Services, LLC (Amargosa South)	July 11, 2008	7,700	720	CSP/trough		Pahrump
NVN 085773	Cogentrix Solar Services, LLC	July 11, 2008	11,584	1,000	CSP		Las Vegas
NVN 086158	Power Partners Southwest, LLC	Sept. 18, 2008	3,885	250	CSP		Las Vegas
NVN 086159	Power Partners Southwest, LLC	Sept. 19, 2008	1,751	250	CSP		Las Vegas
NVN 086217	Nye County Solar I, LLC (Mercury)	Sept. 29, 2008	14,160	300	CSP/trough		Las Vegas
NVN 086246	Ausra NV I, LLC (Skeleton Hills/Lathrop Wells)	Oct. 6, 2008	4,460	140	CSP/trough		Pahrump
NVN 086248	Ausra NV I, LLC (Highway 160)	Oct. 6, 2008	10,080	420	CSP/trough		Pahrump
NVN 086249	Ausra NV I, LLC (Spector Range)	Oct. 9, 2008	4,480	Unknown	CSP/trough		Pahrump
NVN 086292[c]	Solar Reserve/Tonopah Solar Energy, LLC (Crescent Dunes)	Nov. 5, 2008	7,680	180	CSP/tower	Nov. 24, 2009	Tonopah
NVN 086350	Solar Reserve, LLC (Pahroc Solar)	Oct. 2, 2008	7,680	180	CSP/tower		Caliente
NVN 086571	Abengoa Solar, Inc. (Lathrop Wells Solar)	Dec. 12, 2008	1,920	500	CSP/trough		Pahrump
NVN 086782	Southwest Solar Land Co., LLC (South Solar Ridge)	Feb. 23, 2009	530	138	PV		Pahrump

[a] The applications received as of February 2010 were used to support analysis in the PEIS; however, as of December 1, 2010, the BLM had 104 active applications, including 30 in California, 35 in Nevada, 36 in Arizona, and 3 in New Mexico.

[b] Total MW of all fast-track projects = 6,022.

[c] Serial numbers associated with fast-track solar projects.

Source: Resseguie (2010).

TABLE B-2 Summary Table[a]

State	Active Applications (Serial Numbers)	Approximate Acreage	Estimated MW
Arizona	34	454,790	19,565
California	55	498,109	34,422
Colorado	0	0	0
New Mexico	4	42,216	2,200
Nevada	34	280,178	18,032
Utah	0	0	0
Totals	127	1,275,293	74,219

[a] Data current as of March 1, 2010.

Statement for Solar Energy Development in Six Southwestern States" (Solar PEIS) study area (Colorado and Utah) currently have no active applications.

The total acreage of BLM-administered lands applied for is approximately 1.3 million acres (5,261 km^2), while the estimated total capacity of the facilities is approximately 74,000 MW. These values equate to an average land use of 17 acres/MW for all of the active applications combined. This land use is greater than the land use requirements assumed in the Solar PEIS (i.e., 5 acres/MW for parabolic trough facilities; 9 acres/MW for all other facilities), reflecting the fact that applicants often request additional acreage to allow flexibility in project design or to avoid lands where resource conflicts might exist within the ROW.

B.2 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this PEIS. It is likely that at the time of publication of this PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this PEIS.

BLM (U.S. Bureau of Land Management), 2010, *Fast-Track Renewable Energy Projects*. Available at http://www.blm.gov/wo/st/en/prog/energy/renewable_energy/fast-track_renewable.html. Last updated May 7, 2010. Accessed July 10, 2010.

Resseguie, L.J., 2010, "List of Active Solar Cases," personal communication from Resseguie (Realty Specialist, U.S. Bureau of Land Management, Wyo.) to H.M. Hartmann (Argonne National Laboratory, Ill.), March 3.

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APPENDIX C:

PROPOSED BLM LAND USE PLAN AMENDMENTS UNDER THE BLM ACTION ALTERNATIVES OF THE SOLAR ENERGY DEVELOPMENT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

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APPENDIX C:

PROPOSED BLM LAND USE PLAN AMENDMENTS UNDER THE BLM ACTION ALTERNATIVES OF THE SOLAR ENERGY DEVELOPMENT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Analyses conducted in this programmatic environmental impact statement (PEIS) support the amendment of the U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) land use plans in the six-state study area. Two different action alternatives are evaluated in the PEIS: the solar energy development program alternative and the solar energy zone (SEZ) program alternative (see Section 2.2.2). Under both alternatives, the BLM proposes to amend land use plans within the six-state study area to adopt elements of the BLM's new program. The alternatives differ primarily with respect to which lands the agency would exclude from solar energy development and, therefore, which lands would be available for right-of-way (ROW) application.

The following sections provide information describing the proposed amendments for each land use plan under the two action alternatives and the rationales for the proposed changes. Land use plans that are undergoing revision or amendment concurrent with the Solar PEIS will be reviewed to identify and resolve inconsistencies between the PEIS and individual planning efforts.

C.1 SOLAR ENERGY DEVELOPMENT PROGRAM ALTERNATIVE PROPOSED PLAN AMENDMENTS

Most of the land use plans in the six-state study area would be amended under the solar energy development program alternative to address solar energy development (see the notes in Table C-1 for details about amendments of specific plans in California and Utah). Most plans currently do not address solar energy development, although solar energy resources are widespread. The programmatic policies and required design features in the proposed Solar Energy Program are appropriate for solar energy development activities in these planning areas.

The amendments would identify lands to be included in SEZs and lands that would be excluded from solar energy development. For those areas that would be available for application (i.e., not excluded), the plans would be amended to adopt the policies and design features proposed under this alternative. The specific amendments and the rationales for the amendments are discussed in the following sections and summarized in Table C-1.

C.1.1 Lands Excluded from and Available for Application for Solar Energy Development

As discussed in Section 2.2.1, BLM-administered lands currently off-limits to solar energy development include lands prohibited by law, regulation, Presidential proclamation, or

TABLE C-1 Proposed Acreage Available for Application for Solar Energy Development and Proposed SEZs and Approximate Acreage for Land Use Plan Amendments under the Solar Energy Development Program Alternative[a]

Plan/BLM Office	Approximate Proposed Acreage Available for Application[b]	Proposed SEZ and Approximate Acreage
Arizona		
Agua Fria NM Plan, Hassayampa Field Office	All lands would be excluded.	None.
Arizona Strip RMP, Arizona Strip Field Office	906,507 acres	None.
Bradshaw-Harquahala RMP, Hassayampa Field Office	338,423 acres	Bullard Wash SEZ 7,239 acres, Hassayampa Field Office
Grand Canyon–Parashant NM Plan, Arizona Strip Field Office	All lands would be excluded.	None.
Gila Box Riparian NCA Plan, Safford Field Office	All lands would be excluded.	None.
Goldwater Range RMP, Lower Sonoran Field Office	56 acres	None.
Kingman R.A. RMP, Kingman Field Office	625,801 acres	None.
Lake Havasu RMP, Lake Havasu Field Office	536,993 acres	Brenda SEZ 3,878 acres, Lake Havasu Field Office
Las Cienegas NCA Plan, Tucson Field Office	All lands would be excluded.	None.
Lower Gila North and South RMP Amendment, Lower Sonoran Field Office	542,872 acres	Gillespie SEZ 2,618 acres, Lower Sonoran Field Office
Phoenix R.A. RMP, Lower Sonoran, Safford, and Tucson Field Offices	273,661 acres	None.
Safford RMP, Safford, and Tucson Field Offices	584,664 acres	None.
San Pedro Riparian NCA Plan, Tucson Field Office	All lands would be excluded.	None.

TABLE C-1 (Cont.)

Plan/BLM Office	Approximate Proposed Acreage Available for Application[b]	Proposed SEZ and Approximate Acreage
Arizona (Cont.)		
Vermilion Cliffs NM Plan, Arizona Strip Field Office	All lands would be excluded.	None.
Yuma RMP, Yuma Field Office	676,967 acres	None.
Arizona total	4,485,944 acres	13,735 acres
California		
Alturas RMP, Alturas Field Office	All lands would be excluded.	None.
Arcata RMP, Arcata Field Office	All lands would be excluded.	None.
Bishop RMP, Bishop Field Office	95,506 acres	None.
Caliente RMP, Bakersfield Field Office	337 acres	None.
California Coastal NM Plan, California State Office	All lands would be excluded.	None.
California Desert Conservation Area RMP, Barstow, El Centro, Needles, Palm Springs–South Coast, and Ridgecrest Field Offices[c]	1,670,700 acres	Imperial East SEZ 5,722 acres, El Centro Field Office Iron Mountain SEZ 106,522 acres, Needles Field Office Pisgah SEZ 23,950 acres, Barstow Field Office Riverside East SEZ 202,896 acres, Palm Springs–South Coast Field Office

TABLE C-1 (Cont.)

Plan/BLM Office	Approximate Proposed Acreage Available for Application[b]	Proposed SEZ and Approximate Acreage
California (Cont.)		
Carrizo Plain NM Plan, Bakersfield Field Office	All lands would be excluded.	None.
Eagle Lake RMP, Eagle Lake Field Office	All lands would be excluded.	None.
Eastern San Diego RMP, El Centro Field Office	All lands would be excluded.	None.
Headwaters Forest Reserve Plan, Arcata Field Office	All lands would be excluded.	None.
Hollister RMP, Hollister Field Office	All lands would be excluded.	None.
King Range NCA Plan, Arcata Field Office	All lands would be excluded.	None.
Piedras Blancas Historic Light Station ONA Plan, Bakersfield Field Office	All lands would be excluded.	None.
Redding RMP, Redding Field Office	All lands would be excluded.	None.
Santa Rosa and San Jacinto Mountains NM Plan, Palm Springs–South Coast Field Office	All lands would be excluded.	None.
Sierra RMP, Mother Lode Field Office	All lands would be excluded.	None.
South Coast RMP, Palm Springs–South Coast Field Office	All lands would be excluded.	None.
Surprise RMP, Surprise Field Office	All lands would be excluded.	None.
Ukiah RMP, Ukiah Field Office	All lands would be excluded.	None.
California total	1,766,543 acres	339,090 acres

TABLE C-1 (Cont.)

Plan/BLM Office	Approximate Proposed Acreage Available for Application[b]	Proposed SEZ and Approximate Acreage
Colorado		
Canyon of the Ancients NM Plan, Canyon of the Ancients NM	All lands would be excluded.	None.
Glenwood Springs RMP, Glenwood Springs Field Office	All lands would be excluded.	None.
Grand Junction RMP, Grand Junction Field Office	All lands would be excluded.	None.
Gunnison RMP, Gunnison Field Office	3,124 acres	None.
Gunnison Gorge NCA Plan, Gunnison Field Office	All lands would be excluded.	None.
Kremmling RMP, Kremmling Field Office	All lands would be excluded.	None.
Little Snake RMP, Little Snake Field Office	All lands would be excluded.	None.
McInnis Canyons NCA Plan, Grand Junction Field Office	All lands would be excluded.	None.
Royal Gorge/Northeast RMP, Royal Gorge Field Office	10,755 acres	None.
San Juan Public Lands Center RMP, Columbine, Dolores, Pagosa Springs, and Uncompahgre Field Offices	9,405 acres 363 acres in the Columbine Field Office and 9,042 acres in the Dolores Field Office	None.
San Luis Valley Public Lands Center RMP, Del Norte, La Jara, and Saguache Field Offices	124,787 acres 9,869 acres in the Del Norte Field Office, 76,831 acres in the La Jara Field Office, and 38,088 acres in the Saguache Field Office	Antonito Southeast SEZ 9,729 acres, La Jara Field Office De Tilla Gulch SEZ 1,522 acres, Saguache Field Office

TABLE C-1 (Cont.)

Plan/BLM Office	Approximate Proposed Acreage Available for Application[b]	Proposed SEZ and Approximate Acreage
Colorado (Cont.)		
		Fourmile East SEZ 3,882 acres, La Jara Field Office
		Los Mogotes East SEZ 5,918 acres, La Jara Field Office
Uncompahgre RMP, Uncompahgre Field Office	All lands would be excluded.	None.
White River RMP, White River Field Office	All lands would be excluded.	None.
Colorado total	148,072 acres	21,050 acres
Nevada		
Black Rock Desert—High Rock Canyon Emigrant Trails NCA Plan Winnemucca District Office	All lands would be excluded.	None.
Carson City Consolidated RMP, Carson City District	856,308 acres	None.
U.S. Department of Energy Plan, Southern Nevada District Office[d]	All lands would be excluded.	None.
Elko RMP, Elko District Office	All lands would be excluded.	None.
Ely RMP, Ely District Office	3,329,753 acres	Delamar Valley SEZ 16,552 acres, Caliente Field Office
		Dry Lake Valley North SEZ 76,874 acres, Caliente Field Office

TABLE C-1 (Cont.)

Plan/BLM Office	Approximate Proposed Acreage Available for Application[b]	Proposed SEZ and Approximate Acreage
Nevada (Cont.)		
		East Mormon Mountain SEZ 8,968 acres, Caliente Field Office
Las Vegas RMP, Southern Nevada District Office	785,955 acres	Amargosa Valley SEZ 31,625 acres, Pahrump Field Office
		Dry Lake SEZ 15,649 acres, Las Vegas Field Office
Nellis Non-renewal Area Plan, Southern Nevada District Office[d]	All lands would be excluded.	None.
Nellis Test & Training Range RMP, Southern Nevada District Office[d]	All lands would be excluded.	None.
Paradise-Denio RMP, Winnemucca District Office	All lands would be excluded.	None.
Red Rock Canyon NCA Plan, Southern Nevada District Office	All lands would be excluded.	None.
Shoshone-Eureka RMP, Battle Mountain District Office	877,039 acres	None.
Sloan Canyon NCA Plan, Southern Nevada District Office	All lands would be excluded.	None.
Sonoma-Gerlach RMP, Winnemucca District Office	74,771 acres	None.
Tonopah RMP, Battle Mountain District Office	3,160,224 acres	Gold Point SEZ 4,810 acres, Tonopah Field Office
		Millers SEZ 16,787 acres, Tonopah Field Office

TABLE C-1 (Cont.)

Plan/BLM Office	Approximate Proposed Acreage Available for Application[b]	Proposed SEZ and Approximate Acreage
Nevada (Cont.)		
Wells RMP, Elko District Office	All lands would be excluded.	None.
Nevada total	9,084,050 acres	171,265 acres
New Mexico		
Carlsbad RMP, Carlsbad Field Office	258,526 acres	None.
El Malpais NCA Plan, Rio Puerco Field Office	All lands would be excluded.	None.
Farmington RMP, Farmington Field Office	364,507 acres	None.
Kasha-Katuwe Tent Rocks NM Plan, Rio Puerco Field Office	All lands would be excluded.	None.
McGregor Range RMP, Las Cruces District Office	All lands would be excluded.	None.
Mimbres RMP, Las Cruces District Office	1,382,842 acres	Afton SEZ 77,623 acres, Las Cruces District Office Mason Draw SEZ 12,909 acres, Las Cruces District Office
Rio Puerco RMP, Rio Puerco Field Office	287,327 acres	None.
Roswell RMP, Roswell Field Office	721,379 acres	None.
Socorro RMP, Socorro Field Office	633,379 acres	None.
Taos RMP, Taos Field Office	10,346 acres	None.

TABLE C-1 (Cont.)

Plan/BLM Office	Approximate Proposed Acreage Available for Application[b]	Proposed SEZ and Approximate Acreage
New Mexico (Cont.)		
White Sands RMP, Las Cruces District Office	410,019 acres	Red Sands SEZ 22,520 acres, Las Cruces District Office
New Mexico total	4,068,324 acres	113,052 acres
Utah		
Box Elder RMP, Salt Lake City Field Office[e]	All lands would be excluded.	None.
Cedar-Beaver-Garfield-Antimony RMP, Cedar City Field Office	275,590 acres	Escalante Valley SEZ 6,614 acres, Cedar City Field Office Milford Flats South SEZ 6,480 acres, Cedar City Field Office
Grand Staircase-Escalante NM Plan, Grand Staircase-Escalante NM	All lands would be excluded.	None.
House Range RMP, Fillmore Field Office[e]	205,770 acres (all inside the UTTR)	None.
Kanab RMP, Kanab Field Office	23,572 acres	None.
Moab RMP, Moab Field Office	1,210 acres	None.
Monticello RMP, Monticello Field Office	85,721 acres	None.
Park City MFP, Salt Lake City Field Office	All lands would be excluded.	None.
Pinyon MFP, Cedar City Field Office[e]	528,587 (522,059 outside the UTTR) (6,528 inside the UTTR)	Wah Wah Valley SEZ 6,097 acres, Cedar City Field Office

TABLE C-1 (Cont.)

Plan/BLM Office	Approximate Proposed Acreage Available for Application[b]	Proposed SEZ and Approximate Acreage
Utah (Cont.)		
Pony Express RMP, Salt Lake City Field Office[e]	All lands would be excluded.	None.
Price RMP, Price Field Office	All lands would be excluded.	None.
Randolf MFP, Salt Lake City Field Office	All lands would be excluded.	None.
Richfield RMP, Richfield Field Office	122,646 acres	None.
St. George RMP, St. George Field Office	8,608 acres	None.
Vernal RMP, Vernal Field Office	All lands would be excluded.	None.
Warm Springs RMP, Fillmore Field Office[e]	776,517 acres (193,660 outside the UTTR) (582,857 inside the UTTR)	None.
Utah total	2,028,222 acres (1,233,067 outside the UTTR) (795,155 inside the UTTR)	19,192 acres

[a] Totals may be off due to rounding. This table lists plans as of August 2010. Abbreviations: MFP = Management Framework Plan; NCA = National Conservation Area; NM = National Monument; ONA = Outstanding Natural Area; RMP = Resource Management Plan; SEZ = solar energy zone; UTTR = Utah Test and Training Range.

[b] These acreage estimates include the acreage in the proposed SEZs. The estimates were calculated on the basis of the best available geographic information system (GIS) data. GIS data were not available for the entire set of exclusions, so the exact acreage could not be calculated. Exclusion areas that could not be mapped due to lack of data would be identified during pre-application consultations with local BLM staff or site-specific evaluation of individual ROW applications.

Footnotes continued on next page.

TABLE C-1 (Cont.)

[c] Currently, the California Desert Conservation Area (CDCA) RMP requires a plan amendment for individual energy projects; the amendment to this plan pursuant to the Solar PEIS Record of Decision (ROD) would remove this requirement for individual plan amendments for utility-scale solar energy projects.

[d] Public lands in these planning areas in Nevada have been temporarily withdrawn for use by another federal agency.

[e] Section 2815(d) of the National Defense Authorization Act (NDAA) for Fiscal Year 2000 (P.L. 106-65) placed a moratorium on planning efforts on BLM-administered lands "adjacent to, or near the Utah Test and Training Range (UTTR) and Dugway Proving Grounds or beneath Military Operating Areas, Restricted Areas, and airspace that make up the UTTR," NDAA § 2815(a), 113 Stat. 512, 852 (1999). This area encompasses a portion of the lands within the boundaries of the Box Elder, Pony Express, House Range, Warm Springs, and Pinyon land use plans. Within these areas, decisions related to whether lands would be available for ROW application, and adoption of the policies and design features of the PEIS, cannot be implemented via land use plan amendments at this time. Solar energy development ROW applications would be deferred until such time plan amendments or new land use plan(s) address solar energy development. No SEZs are located within the UTTR affected areas.

Executive Order (e.g., lands in the National Landscape Conservation System [NLCS][1,2]). As discussed in Section 2.2.2.2, under this alternative the BLM proposes to exclude additional lands from solar energy development to ensure that, subject to further project-specific reviews and approvals, solar energy development would occur only on BLM-administered lands suited for solar energy development (i.e., lands with a slope of less than 5%), with appropriately high levels of energy development potential (i.e., lands with ≥6.5 kWh/m^2/day direct normal insolation), and where potential conflicts with special resources or uses would be minimized. The exclusions proposed under this alternative would apply only to the siting of utility-scale solar energy generation facilities and not to any required supporting linear infrastructure, such as roads, transmission lines, and natural gas or water pipelines. Management decisions for supporting linear infrastructure, including available lands, are defined in existing applicable land use plans. Siting supporting infrastructure would be analyzed in project-specific environmental reviews.

On the basis of these exclusions, the BLM has identified lands that would be available for ROW application for solar energy development. The amount of BLM-administered land that would be available within each plan area is identified in Table C-1.[3] In some planning areas, all BLM-administered lands would be excluded from solar energy development; these are also identified in Table C-1.

C.1.2 Adoption of the New Solar Energy Program Polices and Required Design Features

For each of the plans listed in Table C-1 where lands would be available for ROW application, the programmatic policies and design features of the proposed Solar Energy Program, discussed in Section 2.2.2.1 and listed in Appendix A, Section A.2, would be adopted and would be applicable to all solar energy development in the planning areas. (The same policies and design features are proposed under both of the BLM's action alternatives.) The proposed policies specify how solar energy development activities will be administered and authorized. The proposed design features, which would be incorporated into project-specific Plans of Development and ROW lease authorization stipulations, establish the minimum specifications for management of individual solar energy projects and mitigation of adverse impacts.

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1 The boundaries of NLCS units may be expanded by legislation, or Congress may establish entirely new NLCS units. See, for example, Public Law (P.L.) 111-11. Such lands would be automatically removed from the area of BLM-administered public lands available for solar energy development.

2 Wilderness areas within the NLCS do not include the Tabeguache Area in Colorado because it is not officially designated as wilderness; however, by act of Congress, this area is to be managed as wilderness and, as a result, solar energy development is prohibited in the Tabeguache Area.

3 It was not possible to obtain complete geographic information system (GIS) data across the six-state study area for the entire set of exclusions, so the exact acreage could not be calculated. Exclusion areas that could not be mapped due to lack of data would be identified during pre-application consultations with local BLM staff or site-specific evaluation of individual ROW applications.

The proposed policies have been developed in order to ensure that solar energy development on BLM-administered lands would be administered efficiently and consistently. The proposed design features include specific measures to avoid and/or minimize potential impacts on environmental, cultural, and economic resources. The design features were developed by the BLM on the basis of a detailed, comprehensive analysis of the potential impacts of utility-scale solar energy development and potentially applicable mitigation measures (Chapter 5); reviews of existing, relevant mitigation guidance (Section 3.7.3); and comments received during scoping for the Draft PEIS (summarized in Section 14.1).

C.1.3 Solar Energy Zones

The BLM has identified specific areas as proposed SEZs within some of the planning areas. The BLM would prioritize solar energy development in these SEZs (as well as development of associated transmission infrastructure). Additional SEZ-specific design features would be applied to development in these areas, as listed in Appendix A, Section A.2. (The same SEZ-specific design features are proposed under both of the BLM's action alternatives.) As discussed in Section 2.2.2.2, the lands included within these SEZs have been identified as the areas best-suited for utility-scale production of solar energy that are relatively free of potential conflicts with solar energy development. The SEZ-specific design features, which would be applicable in addition to the programmatic design features discussed in Section C.1.2, were developed to reduce adverse impacts on specific resources, uses, or conditions present in the SEZ.

C.2 SOLAR ENERGY ZONE PROGRAM ALTERNATIVE PROPOSED PLAN AMENDMENTS

Most of the land use plans in the six-state study area would be amended under the SEZ program alternative to address solar energy development (see the notes in Table C-2 for details about amendments of specific plans in California and Utah). Most plans currently do not address solar energy development, although solar energy resources are widespread. The programmatic policies and design features in the proposed Solar Energy Program are appropriate for solar energy development activities in these planning areas.

The amendments would identify lands that would be excluded from solar energy development and lands that would be included in SEZs. The plans for areas where SEZs are proposed would be amended to adopt the proposed policies and design features proposed under this alternative. The specific amendments and the rationales for the amendments are discussed in the following sections and summarized in Table C-2.

C.2.1 Lands Excluded from and Available for Application for Solar Energy Development

Under the SEZ program alternative, the BLM proposes that all BLM-administered lands in the six-state study area would be excluded from solar energy development, except those

TABLE C-2 Proposed SEZs and Approximate Acreage for Land Use Plan Amendments under the SEZ Program Alternative[a]

Plan/BLM Office	Proposed SEZ and Approximate Acreage[b]
Arizona	
Agua Fria NM Plan, Hassayampa Field Office	All lands would be excluded.
Arizona Strip RMP, Arizona Strip Field Office	All lands would be excluded.
Bradshaw-Harquahala RMP, Hassayampa Field Office	Bullard Wash SEZ 7,239 acres, Hassayampa Field Office
Grand Canyon–Parashant NM Plan, Arizona Strip Field Office	All lands would be excluded.
Gila Box Riparian NCA Plan, Safford Field Office	All lands would be excluded.
Goldwater Range RMP, Lower Sonoran Field Office	All lands would be excluded.
Kingman R.A. RMP, Kingman Field Office	All lands would be excluded.
Lake Havasu RMP, Lake Havasu Field Office	Brenda SEZ 3,878 acres, Lake Havasu Field Office
Las Cienegas NCA Plan, Tucson Field Office	All lands would be excluded.
Lower Gila North and South RMP Amendment, Lower Sonoran Field Office	Gillespie SEZ 2,618 acres, Lower Sonoran Field Office
Phoenix R.A. RMP, Lower Sonoran, Safford, and Tucson Field Offices	All lands would be excluded.
Safford RMP, Safford, and Tucson Field Offices	All lands would be excluded.
San Pedro Riparian NCA Plan, Tucson Field Office	All lands would be excluded.
Vermilion Cliffs NM Plan, Arizona Strip Field Office	All lands would be excluded.
Yuma RMP, Yuma Field Office	All lands would be excluded.
Arizona total	13,735 acres
California	
Alturas RMP, Alturas Field Office	All lands would be excluded.
Arcata RMP, Arcata Field Office	All lands would be excluded.
Bishop RMP, Bishop Field Office	All lands would be excluded.
Caliente RMP, Bakersfield Field Office	All lands would be excluded.
California Coastal NM Plan, California State Office	All lands would be excluded.

TABLE C-2 (Cont.)

Plan/BLM Office	Proposed SEZ and Approximate Acreage[b]
California (Cont.)	
California Desert Conservation Area RMP, Barstow, El Centro, Needles, Palm Springs–South Coast, and Ridgecrest Field Offices[c]	Imperial East SEZ 5,722 acres, El Centro Field Office Iron Mountain SEZ 106,522 acres, Needles Field Office Pisgah SEZ 23,950 acres, Barstow Field Office Riverside East SEZ 202,896 acres, Palm Springs-South Coast Field Office
Carrizo Plain NM Plan, Bakersfield Field Office	All lands would be excluded.
Eagle Lake RMP, Eagle Lake Field Office	All lands would be excluded.
Eastern San Diego RMP, El Centro Field Office	All lands would be excluded.
Headwaters Forest Reserve Plan, Arcata Field Office	All lands would be excluded.
Hollister RMP, Hollister Field Office	All lands would be excluded.
King Range NCA Plan, Arcata Field Office	All lands would be excluded.
Piedras Blancas Historic Light Station ONA Plan, Bakersfield Field Office	All lands would be excluded.
Redding RMP, Redding Field Office	All lands would be excluded.
Santa Rosa and San Jacinto Mountains NM Plan, Palm Springs–South Coast Field Office	All lands would be excluded.
Sierra RMP, Mother Lode Field Office	All lands would be excluded.
South Coast RMP, Palm Springs–South Coast Field Office	All lands would be excluded.
Surprise RMP, Surprise Field Office	All lands would be excluded.
Ukiah RMP, Ukiah Field Office	All lands would be excluded.
California total	339,090 acres
Colorado	
Canyon of the Ancients NM Plan, Canyon of the Ancients NM	All lands would be excluded.

TABLE C-2 (Cont.)

Plan/BLM Office	Proposed SEZ and Approximate Acreage[b]
Colorado (Cont.)	
Glenwood Springs RMP, Glenwood Springs Field Office	All lands would be excluded.
Grand Junction RMP, Grand Junction Field Office	All lands would be excluded.
Gunnison RMP, Gunnison Field Office	All lands would be excluded.
Gunnison Gorge NCA Plan, Gunnison Field Office	All lands would be excluded.
Kremmling RMP, Kremmling Field Office	All lands would be excluded.
Little Snake RMP, Little Snake Field Office	All lands would be excluded.
McInnis Canyons NCA Plan, Grand Junction Field Office	All lands would be excluded.
Royal Gorge/Northeast RMP, Royal Gorge Field Office	All lands would be excluded.
San Juan Public lands Center RMP, Columbine, Dolores, Pagosa Springs, and Uncompahgre Field Offices	All lands would be excluded.
San Luis Valley Public Lands Center RMP, Del Norte, La Jara, and Saguache Field Offices	Antonito Southeast SEZ 9,729 acres, La Jara Field Office De Tilla Gulch SEZ 1,522 acres, Saguache Field Office Fourmile East SEZ 3,882 acres, La Jara Field Office Los Mogotes East SEZ 5,918 acres, La Jara Field Office
Uncompahgre RMP, Uncompahgre Field Office	All lands would be excluded.
White River RMP, White River Field Office	All lands would be excluded.
Colorado total	21,050 acres
Nevada	
Black Rock Desert—High Rock Canyon Emigrant Trails NCA Plan Winnemucca District Office	All lands would be excluded.
Carson City Consolidated RMP, Carson City District	All lands would be excluded.
U.S. Department of Energy Plan, Southern Nevada District Office[d]	All lands would be excluded.

TABLE C-2 (Cont.)

Plan/BLM Office	Proposed SEZ and Approximate Acreage[b]
Nevada (Cont.)	
Elko RMP, Elko District Office	All lands would be excluded.
Ely RMP, Ely District Office	Delamar Valley SEZ 16,552 acres, Caliente Field Office
	Dry Lake Valley North SEZ 76,874 acres, Caliente Field Office
	East Mormon Mountain SEZ 8,968 acres, Caliente Field Office
Las Vegas RMP, Southern Nevada District Office	Amargosa Valley SEZ 31,625 acres, Pahrump Field Office
	Dry Lake SEZ 15,649 acres, Las Vegas Field Office
Nellis Non-renewal Area Plan, Southern Nevada District Office[d]	All lands would be excluded.
Nellis Test and Training Range RMP, Southern Nevada District Office[d]	All lands would be excluded.
Paradise-Denio RMP, Winnemucca District Office	All lands would be excluded.
Red Rock Canyon NCA Plan, Southern Nevada District Office	All lands would be excluded.
Shoshone-Eureka RMP, Battle Mountain District Office	All lands would be excluded.
Sloan Canyon NCA Plan, Southern Nevada District Office	All lands would be excluded.
Sonoma-Gerlach RMP, Winnemucca District Office	All lands would be excluded.
Tonopah RMP, Battle Mountain District Office	Gold Point SEZ 4,810 acres, Tonopah Field Office
	Millers SEZ 16,787 acres, Tonopah Field Office
Wells RMP, Elko District Office	All lands would be excluded.
Nevada total	171,265 acres
New Mexico	
Carlsbad RMP, Carlsbad Field Office	All lands would be excluded.

TABLE C-2 (Cont.)

Plan/BLM Office	Proposed SEZ and Approximate Acreage[b]
New Mexico (Cont.)	
El Malpais NCA Plan, Rio Puerco Field Office	All lands would be excluded.
Farmington RMP, Farmington Field Office	All lands would be excluded.
Kasha-Katuwe Tent Rocks NM Plan, Rio Puerco Field Office	All lands would be excluded.
McGregor Range RMP Amendment, Las Cruces District Office	All lands would be excluded.
Mimbres RMP, Las Cruces District Office	Afton SEZ 77,623 acres, Las Cruces District Office Mason Draw SEZ 12,909 acres, Las Cruces District Office
Rio Puerco RMP, Rio Puerco Field Office	All lands would be excluded.
Roswell RMP, Roswell Field Office	All lands would be excluded.
Socorro RMP, Socorro Field Office	All lands would be excluded.
Taos RMP, Taos Field Office	All lands would be excluded.
White Sands RMP, Las Cruces District Office	Red Sands SEZ 22,520 acres, Las Cruces District Office
New Mexico total	113,052 acres
Utah	
Box Elder RMP, Salt Lake City Field Office[e]	All lands would be excluded.
Cedar-Beaver-Garfield-Antimony RMP, Cedar City Field Office	Escalante Valley SEZ 6,614 acres, Cedar City Field Office Milford Flats South SEZ 6,480 acres, Cedar City Field Office
Grand Staircase–Escalante NM Plan, Grand Staircase–Escalante NM	All lands would be excluded.
House Range RMP, Fillmore Field Office[e]	All lands would be excluded.
Kanab RMP, Kanab Field Office	All lands would be excluded.
Moab RMP, Moab Field Office	All lands would be excluded.
Monticello RMP, Monticello Field Office	All lands would be excluded.

TABLE C-2 (Cont.)

Plan/BLM Office	Proposed SEZ and Approximate Acreage[b]
Utah (Cont.)	
Park City MFP, Salt Lake City Field Office	All lands would be excluded.
Pinyon MFP, Cedar City Field Office[e]	Wah Wah Valley SEZ 6,097 acres, Cedar City Field Office
Pony Express RMP, Salt Lake City Field Office[e]	All lands would be excluded.
Price RMP, Price Field Office	All lands would be excluded.
Randolf MFP, Salt Lake City Field Office	All lands would be excluded.
Richfield RMP, Richfield Field Office	All lands would be excluded.
St. George RMP, St. George Field Office	All lands would be excluded.
Vernal RMP, Vernal Field Office	All lands would be excluded.
Warm Springs RMP, Fillmore Field Office[e]	All lands would be excluded.

[a] Totals may be off due to rounding. This table lists plans as of August 2010. Abbreviations: MFP = Management Framework Plan; NCA = National Conservation Area; NM = National Monument; ONA = Outstanding Natural Area; RMP = Resource Management Plan; SEZ = solar energy zone; UTTR = Utah Test and Training Range.

[b] These acreage estimates were calculated on the basis of the best available GIS data. GIS data were not available for the entire set of exclusions, so the exact acreage could not be calculated. Exclusion areas that could not be mapped due to lack of data would be identified during pre-application consultations with local BLM staff or site-specific evaluation of individual ROW applications.

[c] Currently, the California Desert Conservation Area (CDCA) RMP requires a plan amendment for individual energy projects; the amendment to this plan pursuant to the Solar PEIS ROD would remove this requirement for individual plan amendments for utility-scale solar energy projects.

[d] Public lands in these planning areas in Nevada have been temporarily withdrawn for use by another federal agency.

[e] Section 2815(d) of the NDAA for Fiscal Year 2000 (P.L. 106-65) placed a moratorium on planning efforts on BLM-administered lands "adjacent to, or near the Utah Test and Training Range (UTTR) and Dugway Proving Grounds or beneath Military Operating Areas, Restricted Areas, and airspace that make up the UTTR," NDAA § 2815(a), 113 Stat. 512, 852 (1999). This area encompasses a portion of the lands within the boundaries of the Box Elder, Pony Express, House Range, Warm Springs, and Pinyon land use plans. Within these areas, decisions related to whether lands would be available for ROW application, and adoption of the policies and design features of the PEIS, cannot be implemented via land use plan amendments at this time. Solar energy development ROW applications would be deferred until such time plan amendments or new land use plan(s) address solar energy development. No SEZs are located within the UTTR affected areas.

identified in SEZs. The exclusions proposed under this alternative would apply only to the siting of solar energy generation facilities and not to any required supporting linear infrastructure, such as roads, transmission lines, and natural gas or water pipelines. (Management decisions for supporting linear infrastructure, including available lands, are defined in existing applicable land use plans. Siting supporting infrastructure would be analyzed in project-specific environmental reviews.) These exclusions would serve to limit the amount of BLM-administered land that would be available and prioritized for solar energy development. This limitation might serve to reduce impacts by promoting the consolidation of development and associated infrastructure in discrete areas.

The amount of BLM-administered land that would be available within each plan area is identified in Table C-2. In many plan areas, all BLM-administered lands would be excluded from solar energy development; these are also identified in Table C-2.

C.2.2 Adoption of the New Solar Energy Program Polices and Required Design Features

For each of the plans listed in Table C-2 where SEZs have been identified, the programmatic policies and design features of the proposed Solar Energy Program, discussed in Section 2.2.2.1 and listed in Appendix A, Section A.2, would be adopted and would be applicable to all solar energy development in the planning areas. (The same policies and design features are proposed under both of the BLM's action alternatives.) The purpose and rationales for adopting the proposed policies and design features are the same for the SEZ program alternative as they are for the solar energy development program alternative, as discussed in Section C.1.2.

C.2.3 Solar Energy Zones

As discussed in Section C.1.3, the BLM has identified specific areas within some of the planning areas as proposed SEZs. The BLM would prioritize solar energy development in these SEZs (as well as development of associated transmission infrastructure). Additional SEZ-specific design features would be applied to development in these areas, as listed in Appendix A, Section A.2. (The same SEZ-specific design features are proposed under both of the BLM's action alternatives.) The purpose and rationale for adopting the proposed SEZ-specific design features are the same for the SEZ program alternative as they are for the solar energy development program alternative, as discussed in Section C.1.3.

APPENDIX D:

SUMMARY OF REGIONAL INITIATIVES AND STATE PLANS FOR SOLAR ENERGY DEVELOPMENT AND TRANSMISSION DEVELOPMENT TO SUPPORT RENEWABLE ENERGY DEVELOPMENT

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APPENDIX D:

SUMMARY OF REGIONAL INITIATIVES AND STATE PLANS FOR SOLAR ENERGY DEVELOPMENT AND TRANSMISSION DEVELOPMENT TO SUPPORT RENEWABLE ENERGY DEVELOPMENT

A number of regional and state initiatives have been started in the six-state study area evaluated in the "Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States" (Solar PEIS) whose mission is to facilitate development of renewable energy resources and necessary expansion of the electricity transmission system. These include efforts by the Western Governors' Association (WGA) to identify optimal areas for renewable energy development and transmission expansion. They also include state-level efforts, such as the passage of Renewable Portfolio Standards (RPSs) requiring that specific amounts of a state's electricity capacity be supplied by renewable resources, renewable energy resource assessments, and energy transmission planning efforts. Additional regional and state-level efforts are underway that are relevant to, although not specifically focused on, renewable energy development (e.g., state-level wildlife action plans, the California essential Habitat Connectivity Project).

This appendix provides an overview of the regional and state initiatives that specifically address renewable energy development in the six-state study area. It also includes maps depicting how these efforts relate to the solar-energy-related designations being proposed by the U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) in the Solar PEIS, including lands proposed by the BLM as being available for solar energy development (BLM Lands Available) and as solar energy zones (SEZs). In addition, a recent initiative by the U.S. Department of Defense (DoD) regarding solar energy potential on major DoD installations is discussed.

D.1 WESTERN GOVERNORS' ASSOCIATION WESTERN RENEWABLE ENERGY ZONE INITIATIVE

The WGA is an association of governors from 19 western states and three Pacific Islands. The WGA works to identify and address policy and governance issues related to natural resource management, the environment, human services, economic development, and more. The organization supports governors in developing strategies to manage complex, long-term issues facing the region. More information about the WGA is available on its Web site (http://www.westgov.org).

One of the WGA initiatives that is especially pertinent to solar power development is the establishment of Western Renewable Energy Zones (WREZs), areas within the Western Interconnection that have high potential for utility-scale renewable energy development with

relatively low or easily mitigated environmental impacts.[1] The scope of the WREZ initiative includes solar, wind, biomass, geothermal, and hydropower resources. The initiative, which is being conducted jointly with the U.S. Department of Energy (DOE), is intended to facilitate the construction of utility-scale renewable energy facilities and expansion of the electricity transmission system needed to deliver the energy to load centers across the Western Interconnection.

The WREZ initiative consists of a broad-based process involving federal agencies (U.S. Department of the Interior, U.S. Department of Agriculture, Federal Energy Regulatory Commission), Canadian provincial premiers, and other stakeholders representing renewable energy developers, Tribal interests, utilities, environmental groups, and government policymakers. The work is being conducted in four phases, the first of which was documented in the June 2009 Phase 1 Report (WGA and DOE 2009).

D.1.1 WREZ Initiative Phase 1 Results

The WREZ Phase 1 Report (WGA and DOE 2009) identifies and maps the preliminary WREZs and describes the criteria and methodology used to define these areas. The multistep process presented in the Phase 1 report included the following:

- Identifying renewable energy resources within the Western Interconnection with the potential for utility-scale development;

- Identifying Candidate Study Areas (CSAs) as those areas with the highest quality and most cost-effective renewable resources within each state or province; and

- Screening CSAs to identify Qualified Resource Areas (QRAs) as those areas with potential generation capacity to justify the construction of new regional transmission while excluding lands on the basis of statutory or regulatory limitations and existing conflicts. (The QRAs identified in the Phase 1 Report will be further analyzed in the next phase of work and, ultimately, may be designated as WREZs.)

To support this Phase 1 work, a Zone Identification and Technical Analysis (ZITA) working group was formed. The ZITA group developed the initial set of resource characteristics and criteria to be used in defining the WREZs. These criteria included land use restrictions (including engineering aspects), regulatory limitations, and environmental factors.

[1] The Western Interconnection is the name of the electricity grid, overseen by the Western Electricity Coordinating Council, that serves the states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming; part of west Texas; the Canadian provinces of Alberta and British Columbia; and a small portion of northern Mexico in Baja California.

Two additional working groups were formed and tasked with supporting roles for zone identification. The Environmental and Lands (E&L) working group categorized the resource potential of zones on the basis of land use, wildlife, and environmental considerations and identified specific lands to be excluded from the QRAs. U.S. federal lands where renewable energy development is precluded by law, such as national parks, national monuments, federally designated Wilderness Areas, and U.S. Forest Service primitive areas, are a few examples. Similar information from the appropriate Canadian federal and provincial ministries and state land management agencies was incorporated. Additional lands, including BLM Areas of Critical Environmental Concern, state parks, and state wildlife management areas, were excluded to avoid other existing conflicts. The Generation and Transmission Modeling (G&TM) working group was responsible for (1) developing a model to evaluate generating costs, delivered costs, and the relative economic "attractiveness" of renewable energy generated by development of specific zones and (2) engaging with the Western Electricity Coordinating Council in an evaluation of transmission requirements to move power from the zones to load centers.

QRAs were defined primarily on the basis of the potential for utility-scale solar or wind resources. If other renewable energy resources (e.g., biomass, geothermal, and hydropower) were present within these same areas, their potential development was also assessed; however, QRAs were not defined on the basis of these resources alone. For the purpose of defining WREZs on the basis of solar energy resources, the ZITA working group initially eliminated any location that received less than 6.5 kWh/m^2/day of direct normal insolation (DNI) and had a slope greater than 5%. The slope minimum was further refined to 2% when the QRAs were identified. These criteria represent the minimum conditions that were assumed in order for an area to be developable at the utility scale for either solar thermal or photovoltaic technologies. Details about the criteria for defining other renewable energy resources (e.g., wind, biomass, geothermal, or hydropower) are outlined in the Phase 1 report, and the report also provides additional details on the process and criteria for developing CSA areas, as a prelude to identifying QRA areas.

The Phase 1 Report also describes the tools developed by the G&TM working group that can be used to estimate (1) delivery costs (including transmission costs) for delivering renewable energy from specific WREZs to specific load centers (the Generation and Transmission Model [GTM]) and (2) the theoretical supply curves for any given load center that could be supplied from the entire list of WREZs (the Peer Analysis Tool [PAT]). The models are publicly available from the WGA's WREZ Initiative Web site (http://www.westgov.org/index.php?option=com_content&view=article&catid=102%3Ainitiatives&id=220%3Awrez-transmission-model-page&Itemid=81).

Figure D-1 shows the QRAs that were designated through the Phase 1 effort. These areas define the geographic extent of the renewable energy resources meeting the QRA parameters. The potential total amount of electricity in terawatt-hours (TWh) that could be produced over the course of 1 year using the resources within general areas of high renewable resource concentrations, referred to as "Hubs," is also shown in Figure D-1. Table D-1 presents the potential renewable energy generation in gigawatt-hours per year (GWh/yr) calculated for each of the Hubs by state, with separate calculations for each type of renewable energy resource present. Similarly, Table D-2 shows the potential renewable capacity in MW calculated for each of the Hubs by state, with separate calculations for each type of renewable energy resource

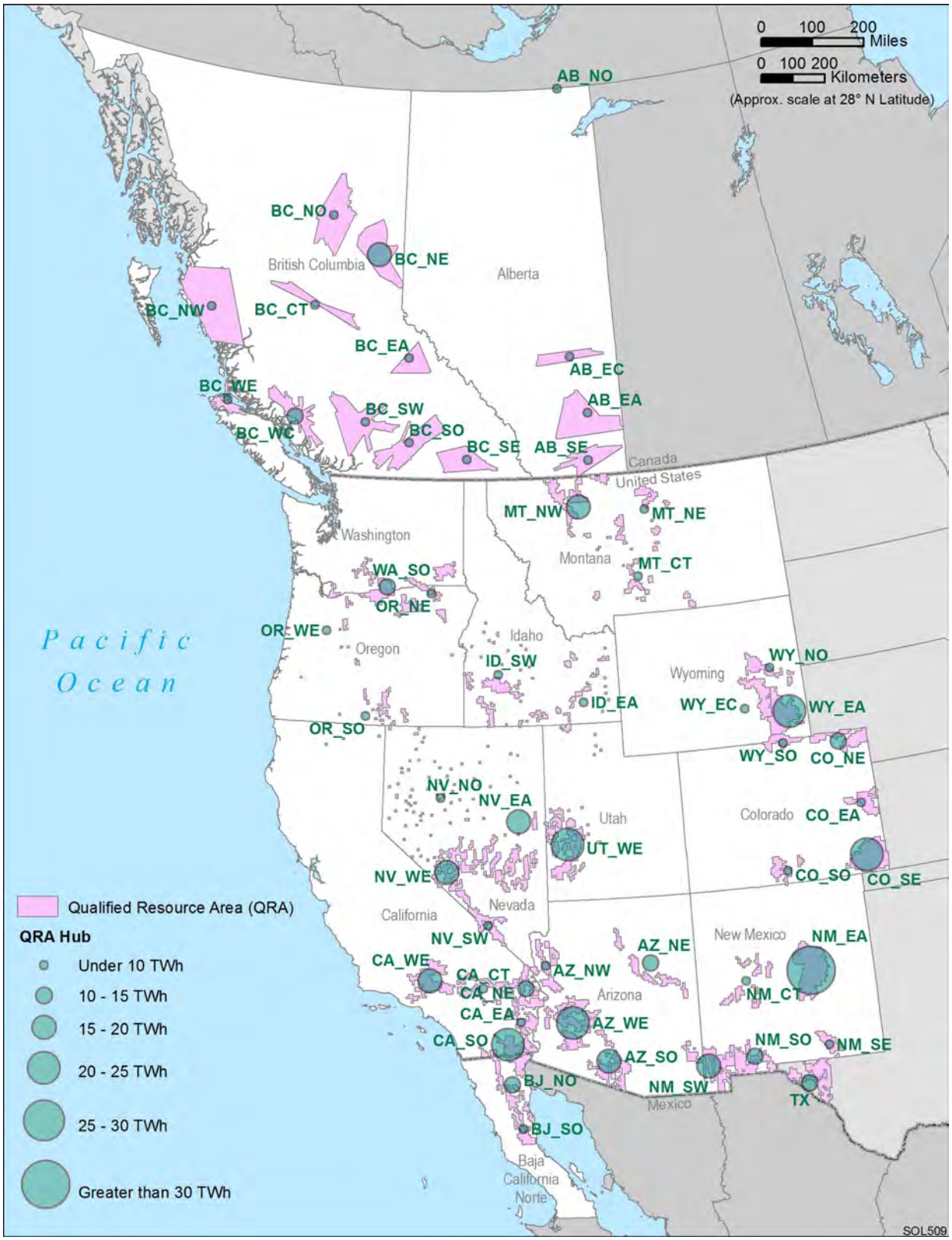


FIGURE D-1 WREZ Initiative Phase 1 Qualified Resource Areas and Hubs (based on WGA and DOE 2009)

TABLE D-1 Potential Renewable Energy Generation for WREZ Initiative Phase 1 Hubs (GWh/yr)

		Solar Thermal GWh/yr by DNI Level (kWh/m^2/day)[a]						Wind GWh/yr by Wind Power Class[a]				Geothermal GWh/yr				Total GWh/yr
Hub State/Prov.	Hub Name	6.5–6.75	6.75–7.0	7.0–7.25	7.25–7.5	7.5+	Solar Total	3	4	5+	Wind Total	Discov-ered	Undis-covered[b,c]	Hydro GWh/yr[d]	Biomass GWh/yr	WREZ-Only
AZ	AZ NE	[e]	[e]	[e]	696	0	696	8,107	371	182	8,661	0	[e]	0	1,903	11,260
AZ	AZ NW	[e]	[e]	84	6,595	1,505	8,184	512	19	5	536	0	[e]	0	127	8,847
AZ	AZ SO	[e]	[e]	[e]	15,607	0	15,607	[e]	[e]	[e]	[e]	0	[e]	0	59	15,665
AZ	AZ WE	[e]	[e]	[e]	18,912	3,790	22,702	[e]	[e]	[e]	[e]	0	[e]	0	350	23,051
AZ Total		0	0	84.32473	41,809	5,295	47,188	8,619	390	188	9,197	0	7,309	0	2,438	58,824
CA	CA CT	[e]	[e]	1,191	2,123	2,069	5,383	2,850	561	134	3,545	0	[e]	0	83	9,011
CA	CA EA	[e]	[e]	2,375	3,615	158	6,148	522	53	14	589	0	[e]	0	83	6,821
CA	CA NE	[e]	[e]	2,836	6,693	1,407	10,937	1,199	202	7	1,407	0	[e]	0		12,344
CA	CA SO	[e]	[e]	6,937	915	83	7,934	1,170	376	429	1,976	11,074	[e]	8	142	21,134
CA	CA WE	[e]	[e]	1,139	2,984	2,717	6,840	3,093	2,239	3,282	8,615	0	[e]	0	786	16,241
CA Total		0	0	14,477	16,330	6,434	37,241	8,834	3,432	3,867	16,132	11,074	79,471	8	1,095	65,550
CO	CO EA	[e]	[e]	0	0	0	0	[e]	6,640	0	6,640	0	[e]	0	50	6,689
CO	CO NE	[e]	[e]	0	0	0	0	[e]	10,904	623	11,527	0	[e]	0	94	11,621
CO	CO SE	[e]	[e]	0	0	0	0	[e]	23,836	109	23,944	0	[e]	0	120	24,065
CO	CO SO	[e]	[e]	4,617	326	0	4,943	[e]	303	299	602	0	[e]	0	875	6,421
CO Total		0	0	4,617	326	0	4,943	0	41,683	1,031	42,714	0	7,744	0	1,139	48,796
ID	ID EA	[e]	[e]	[e]	[e]	[e]	0	1,515	182	38	1,735	1,034	[e]	0	1,936	4,704.756
ID	ID SW	[e]	[e]	[e]	[e]	[e]	0	2,189	36	4	2,229	1,079	[e]		728	4,036.080
ID Total		0	0	0	0	0	0	3,705	217	43	3,965	2,113	13,119	0	2,663	8,741
MT	MT CT	[e]	[e]	[e]	[e]	[e]	0	[e]	[e]	8,224	8,224	0	[e]	0	570	8,794
MT	MT NE	[e]	[e]	[e]	[e]	[e]	0	[e]	[e]	7,429	7,429	0	[e]	0	32	7,461
MT	MT NW	[e]	[e]	[e]	[e]	[e]	0	[e]	[e]	16,932	16,932	0	[e]	0	494	17,427
MT Total		0	0	0	0	0	0	0	0	32,585	32,585	0	5,403	0	1,097	33,682
NM	NM CT	[e]	[e]	6,126	1,049	0	7,175	[e]	[e]	[e]	[e]	0	[e]	0	823	7,998
NM	NM EA	[e]	[e]	183	0	0	183	[e]	26,768	4,427	31,196	0	[e]	0	330	31,708
NM	NM SE	[e]	[e]	0	0	0	0	[e]	3,632	1,748	5,381	0	[e]	0	162	5,542
NM	NM SO	[e]	[e]	7,317	2,850	0	10,167	[e]	[e]	[e]	[e]	0	[e]	0	92	10,258
NM	NM SW	[e]	[e]	4,298	10,515	0	14,814	[e]	[e]	[e]	[e]	0	[e]	0	254	15,067
NM Total		0	0	17,924	14,414	0	32,338	0	30,400	6,176	36,576	0	10,400	0	1,659	70,573

TABLE D-1 (Cont.)

Hub State/Prov.	Hub Name	Solar Thermal GWh/yr by DNI Level (kWh/m^2/day)[a] 6.5–6.75	6.75–7.0	7.0–7.25	7.25–7.5	7.5+	Solar Total	Wind GWh/yr by Wind Power Class[a] 3	4	5+	Wind Total	Geothermal GWh/yr Discovered	Undiscovered[b,c]	Hydro GWh/yr[d]	Biomass GWh/yr	Total GWh/yr WREZ-Only
NV	NV EA	[e]	[e]	9,076	7,354	952	17,382	[e]	[e]	[e]	[e]	168	[e]	0	995	18,546
NV	NV NO	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	7,799	[e]	9	991	8,799
NV	NV SW	[e]	[e]	840	2,760	4,316	7,916	520	42	19	581	0	[e]	0	88	8,584
NV	NV WE	[e]	[e]	4,916	9,655	2,170	16,741	391	73	39	503	2,074	[e]	0	161	19,479
NV Total		0	0	14,832	19,769	7,438	42,039	911	115	58	1,083	10,041	30,583	9	2,235	55,408
OR	OR NE	[e]	[e]	[e]	[e]	[e]	[e]	3,619	1,259	325	5,204	0	[e]	0	2,892	8,095
OR	OR SO	[e]	[e]	[e]	[e]	[e]	[e]	951	188	181	1,320	3,550	[e]	0	876	5,747
OR	OR WE	[e]	[e]	[e]	[e]	[e]	[e]	481	244	191	916	2,596	[e]	16	1,040	4,567
OR Total		0	0	0	0	0	0	5,051	1,691	698	7,439	6,146	13,266	16	4,808	18,409
TX	TX	1,001	8,275	15	0	0	9,291	510	639	197	1,346	0	[e]	0	26	10,663
TX Total		1,001	8,275	15	0	0	9,291	510	639	197	1,346	0	0	0	26	10,663
UT	UT WE	10,147	4,618	503	0	0	15,268	3,718	361	95	4,174	1,594	[e]	0	674	21,711
UT Total		10,147	4,618	503	0	0	15,268	3,718	361	95	4,174	1,594	10,260	0	674	21,711
WA	WA SO	[e]	[e]	[e]	[e]	[e]	0	6,295	1,635	295	8,225	0	[e]	2,531	754	11,509
WA Total		0	0	0	0	0	0	6,295	1,635	295	8,225	0	2,102	2,531	754	11,509
WY	WY EA	[e]	[e]	[e]	[e]	[e]	0	[e]	[e]	24,570	24,570	0	[e]	0	35	24,605
WY	WY EC	[e]	[e]	[e]	[e]	[e]	0	[e]	[e]	8,801	8,801	0	[e]	0	0	8,801
WY	WY NO	[e]	[e]	[e]	[e]	[e]	0	[e]	[e]	9,606	9,606	0	[e]	0	41	9,647
WY	WY SO	[e]	[e]	[e]	[e]	[e]	0	[e]	1,670	4,457	6,126	0	[e]	0	41	6,168
WY Total		0	0	0	0	0	0	0	1,670	47,434	49,104	0	1,219	0	117	49,221
AB	AB EA	[e]	[e]	[e]	[e]	[e]	0	[f]	[f]	[f]	4,044	0	[e]	0	713	4,757
AB	AB EC	[e]	[e]	[e]	[e]	[e]	0	[f]	[f]	[f]	2,146	0	[e]	0	907	3,053
AB	AB NO	[e]	[e]	[e]	[e]	[e]	0	[f]	[f]	[f]	0	0	[e]	6,307	1	6,308
AB	AB SE	[e]	[e]	[e]	[e]	[e]	0	[f]	[f]	[f]	7,389	0	[e]	0	376	7,765
AB Total		0	0	0	0	0	0	0	0	0	13,579	0	0	6,307	1,997	21,883

TABLE D-1 (Cont.)

Hub State/Prov.	Hub Name	Solar Thermal GWh/yr by DNI Level (kWh/m^2/day)[a] 6.5–6.75	6.75–7.0	7.0–7.25	7.25–7.5	7.5+	Solar Total	Wind GWh/yr by Wind Power Class[a] 3	4	5+	Wind Total	Geothermal GWh/yr Discovered	Undiscovered[b,c]	Hydro GWh/yr[d]	Biomass GWh/yr	Total GWh/yr WREZ-Only
BC	BC CT	e	e	e	e	e	0	f	f	f	1,953	0	e	10	905	2,868
BC	BC EA	e	e	e	e	e	0	f	f	f	0	224	e	437	250	911
BC	BC NE	e	e	e	e	e	0	f	f	f	11,389	112	e	4,953	811	17,265
BC	BC NO	e	e	e	e	e	0	f	f	f	5,730	0	e	420	588	6,738
BC	BC NW	e	e	e	e	e	0	f	f	f	3,159	224	e	1,984	632	5,999
BC	BC SE	e	e	e	e	e	0	f	f	f	252	224	e	508	447	1,432
BC	BC SHPC	g	g	g	g	g	g	g	g	g	g	g	g	g	g	15,797[g]
BC	BC SO	e	e	e	e	e	0	f	f	f	4,786	224	e	630	815	6,455
BC	BC SW	e	e	e	e	e	0	f	f	f	3,630	112	e	717	1,204	5,663
BC	BC WC	e	e	e	e	e	0	f	f	f	0	1,419	e	12,546	949	14,914
BC	BC WE	e	e	e	e	e	0	f	f	f	3,205	0	e	167	393	3,766
BC Total		0	0	0	0	0	0	0	0	0	34,104	2,540	0	22,372	6,994	66,010
BJ	BJ NO	e	e	7,026	2,218	30	9,274	e	2,058	3,110	5,169	0	e	e	e	14,443
BJ	BJ SO	e	e	1,022	1,218	117	2,357	e	1,668	2,078	3,745	0	e	e	e	6,102
BJ Total		0	0	8,048	3,436	146	11,631	0	3,726	5,188	8,915	0	0	0	0	20,545
Grand Total		11,147	12,893	60,500	96,085	19,313	199,939	37,642	85,959	97,853	269,138	33,509	180,876	31,243	27,698	561,527

[a] Only the best classes of wind and solar resources in each state were quantified. Quantifications for wind resources represent each state's minimum wind power class and higher, and for solar resources each state's minimum direct normal insolation level and higher. In Canada, renewable energy resources were quantified using a different methodology. It assessed resources at the site level as opposed to using raw resource data; therefore, the "best in state" criteria were not applied and Canadian resources were not discounted. Wind potential was not quantified in QRAs with less than 100 MW of total wind resource potential. Additional information is available on the Web at http://www.westgov.org/wga/initiatives/wrez/zita/index.htm.

[b] Undiscovered geothermal resources are believed to exist in certain areas because of the presence of geologic systems that have been correlated with geothermal resource potential in other areas. This undiscovered potential has not yet been quantified at specific locations where a geothermal plant could be built, but it can be estimated at the state level with different levels of confidence. As a result, these resources are not quantified at the QRA level or included in the economic modeling of QRAs. When undiscovered geothermal potential is believed to exist in a QRA, it will be noted, even though it will not be quantified. The mean estimated potential from these resources by state is quantified in this table by state and province. It is not captured in the QRA MW total, because these resources are not being quantified at the QRA level. U.S. estimates are from the U.S. Geological Survey (USGS), and Canadian estimates are from the Canadian Geothermal Energy Association.

[c] Data on undiscovered geothermal resources were not available for Baja California Norte and Texas at the time of publication.

[d] Small and large hydropower are quantified in Canada. Incremental additions to powered or non-powered dams are quantified in the United States.

Footnotes continued on next page.

TABLE D-1 (Cont.)

[e] These resources may exist, but they are not quantified in this study.

[f] As noted above, a different resource assessment methodology was used to quantify the MW of renewable energy resources available in Canada. Data on the wind power class in British Columbia and Alberta are not available from this assessment. As a result, only the total potential of wind resources is shown here and is not broken down into different wind class categories.

[g] British Columbia voluntarily provided a hub on the British Columbia–Washington border to the WREZ process. This represents a 16,000 GW-hour per year shaped energy product that British Columbia could provide to load-serving entities (LSEs) at the border. The intention of this additional hub and associated cost curve is not to represent a specific product offered to LSEs at the border, but to illustrate the benefits of a shaped and firmed decarbonized energy product to encourage further discussion. This hub and its energy and production profile will be selectable when using the Generation and Transmission Modeling tool. The energy resources that make up this cost curve are not specified; therefore, they are not broken down by resource type or class. The generation available from this additional QRA is not included in the B.C. subtotal or the grand total in this table.

Source: WGA and DOE (2009).

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TABLE D-2 Potential Renewable Capacity for WREZ Initiative Phase 1 Hubs (Total MW)

		Solar Thermal MW by DNI Level (kWh/m^2/day)[a]						Wind MW by Wind Power Class[a]				Geothermal MW				Total MW
Hub State/Prov.	Hub Name	6.5–6.75	6.75–7.0	7.0–7.25	7.25–7.5	7.5+	Solar Total	3	4	5+	Wind Total	Discov-ered	Undis-covered[b,c]	Hydro MW[d]	Biomass MW	WREZ-Only
AZ	AZ NE	[e]	[e]	[e]	309	0	309	3,305	137	57	3,499	0	[e]	0	256	4,064
AZ	AZ NW	[e]	[e]	36	2,841	648	3,525	209	7	2	217	0	[e]	0	17	3,760
AZ	AZ SO	[e]	[e]	[e]	6,623	0	6,623	[e]	[e]	[e]	[e]	0	[e]	0	8	6,631
AZ	AZ WE	[e]	[e]	[e]	7,766	1,558	9,322	[e]	[e]	[e]	[e]	0	[e]	0	47	9,369
AZ Total		0	0	36.324947	17,539	2,204	19,780	3,514	144	59	3,717	0	1,043	0	327	23,824
CA	CA CT	[e]	[e]	500	891	868	2,259	1,162	207	41	1,410	0	[e]	0	11	3,680
CA	CA EA	[e]	[e]	1,035	1,575	69	2,679	213	20	5	237	0	[e]	0	11	2,927
CA	CA NE	[e]	[e]	1,213	2,862	602	4,676	489	74	2	565	0	[e]	0	0	5,241
CA	CA SO	[e]	[e]	2,977	392	36	3,405	477	139	129	744	1,434	[e]	2	19	5,604
CA	CA WE	[e]	[e]	508	1,331	1,212	3,050	1,261	825	1,000	3,085	0	[e]	0	106	6,241
CA Total		0	0	6,232	7,051	2,786	16,069	3,602	1,264	1,176	6,042	1,434	11,340	2	147	23,693
CO	CO EA	[e]	[e]	0	0	0	0	[e]	2,445	0	2,445	0	[e]	0	7	2,452
CO	CO NE	[e]	[e]	0	0	0	0	[e]	4,016	203	4,218	0	[e]	0	13	4,231
CO	CO SE	[e]	[e]	0	0	0	0	[e]	8,777	36	8,813	0	[e]	0	16	8,829
CO	CO SO	[e]	[e]	2,151	152	0	2,303	[e]	112	92	203	0	[e]	0	118	2,624
CO Total		0	0	2,151	152	0	2,303	0	15,350	330	15,679	0	1,105	0	153	18,135
ID	ID EA	[e]	[e]	[e]	[e]	[e]	0	618	67	12	696	125	[e]	0	260	1,081
ID	ID SW	[e]	[e]	[e]	[e]	[e]	0	893	13	1	907	154	[e]	8	98	1,167
ID Total		0	0	0	0	0	0	1,510	80	13	1,603	279	1,872	8	358	2,249
MT	MT CT	[e]	[e]	[e]	[e]	[e]	0	[e]	[e]	2,527	2,527	0	[e]	0	77	2,604
MT	MT NE	[e]	[e]	[e]	[e]	[e]	0	[e]	[e]	2,337	2,337	0	[e]	0	4	2,341
MT	MT NW	[e]	[e]	[e]	[e]	[e]	0	[e]	[e]	5,194	5,194	0	[e]	0	66	5,261
MT Total		0	0	0	0	0	0	0	0	10,059	10,059	0	771	0	147	10,206
NM	NM CT	[e]	[e]	2,679	459	0	3,138	[e]	[e]	[e]	[e]	0	[e]	0	110	3,249
NM	NM EA	[e]	[e]	83	0	0	83	[e]	9,857	1,433	11,290	0	[e]	0	44	11,418
NM	NM SE	[e]	[e]	0	0	0	0	[e]	1,338	557	1,894	0	[e]	0	22	1,916
NM	NM SO	[e]	[e]	3,128	1,219	0	4,347	[e]	[e]	[e]	[e]	0	[e]	0	12	4,359
NM	NM SW	[e]	[e]	1,784	4,365	0	6,149	[e]	[e]	[e]	[e]	0	[e]	0	34	6,183
NM Total		0	0	7,675	6,042	0	13,718	0	11,195	1,989	13,184	0	1,484	0	223	27,124

TABLE D-2 (Cont.)

		Solar Thermal MW by DNI Level (kWh/m^2/day)[a]						Wind MW by Wind Power Class[a]				Geothermal MW				Total MW
Hub State/Prov.	Hub Name	6.5–6.75	6.75–7.0	7.0–7.25	7.25–7.5	7.5+	Solar Total	3	4	5+	Wind Total	Discov-ered	Undis-covered[b,c]	Hydro MW[d]	Biomass MW	WREZ-Only
NV	NV EA	[e]	[e]	4,079	3,305	428	7,812	[e]	[e]	[e]	[e]	24	[e]	0	134	7,970
NV	NV NO	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	1,048	[e]	2	133	1,183
NV	NV SW	[e]	[e]	369	1,212	1,895	3,475	212	16	6	233	0	[e]	0	12	3,720
NV	NV WE	[e]	[e]	2,142	4,207	946	7,294	160	27	12	198	296	[e]	0	22	7,810
NV Total		0	0	6,590	8,724	3,268	18,582	371	42	18	431	1,368	4,364	2	300	20,683
OR	OR NE	[e]	[e]	[e]	[e]	[e]	[e]	1,476	464	104	2,043	0	[e]	0	388	2,431
OR	OR SO	[e]	[e]	[e]	[e]	[e]	[e]	388	69	54	511	501	[e]	0	118	1,130
OR	OR WE	[e]	[e]	[e]	[e]	[e]	[e]	196	90	57	343	331	[e]	3	140	817
OR Total		0	0	0	0	0	0	2,059	623	215	2,897	832	1,893	3	646	4,378
TX	TX	461	3,809	7	0	0	4,277	208	235	64	507	0	[e]	0	3	4,787
TX Total		461	3,809	7	0	0	4,277	208	235	64	507	0	0	0	3	4,787
UT	UT WE	4,786	2,178	237	0	0	7,202	1,516	133	29	1,678	225	[e]	0	91	9,196
UT Total		4,786	2,178	237	0	0	7,202	1,516	133	29	1,678	225	1,464	0	91	9,196
WA	WA SO	[e]	[e]	[e]	[e]	[e]	0	2,566	602	92	3,260	0	[e]	544	101	3,905
WA Total		0	0	0	0	0	0	2,566	602	92	3,260	0	300	544	101	3,905
WY	WY EA	[e]	[e]	[e]	[e]	[e]	0	[e]	[e]	7,257	7,257	0	[e]	0	5	7,262
WY	WY EC	[e]	[e]	[e]	[e]	[e]	0	[e]	[e]	2,594	2,594	0	[e]	0	0	2,594
WY	WY NO	[e]	[e]	[e]	[e]	[e]	0	[e]	[e]	3,063	3,063	0	[e]	0	5	3,069
WY	WY SO	[e]	[e]	[e]	[e]	[e]	0	[e]	615	1,324	1,939	0	[e]	0	6	1,945
WY Total		0	0	0	0	0	0	0	615	14,239	14,854	0	174	0	16	14,869
AB	AB EA	[e]	[e]	[e]	[e]	[e]	0	[f]	[f]	[f]	1,319	0	[e]	0	96	1,415
AB	AB EC	[e]	[e]	[e]	[e]	[e]	0	[f]	[f]	[f]	700	0	[e]	0	122	822
AB	AB NO	[e]	[e]	[e]	[e]	[e]	0	[f]	[f]	[f]	0	0	[e]	1,800	0	1,800
AB	AB SE	[e]	[e]	[e]	[e]	[e]	0	[f]	[f]	[f]	2,410	0	[e]	0	51	2,461
AB Total		0	0	0	0	0	0	0	0	0	4,429	0	0	1,800	268	6,497

TABLE D-2 (Cont.)

Hub State/Prov.	Hub Name	Solar Thermal MW by DNI Level (kWh/m²/day)[a] 6.5–6.75	6.75–7.0	7.0–7.25	7.25–7.5	7.5+	Solar Total	Wind MW by Wind Power Class[a] 3	4	5+	Wind Total	Geothermal MW Discovered	Undiscovered[b,c]	Hydro MW[d]	Biomass MW	Total MW WREZ-Only
BC	BC CT	e	e	e	e	e	0	f	f	f	902	0	e	4	122	1,027
BC	BC EA	e	e	e	e	e	0	f	f	f	0	32	e	1,076	34	1,142
BC	BC NE	e	e	e	e	e	0	f	f	f	4,081	16	e	1,006	109	5,212
BC	BC NO	e	e	e	e	e	0	f	f	f	2,176	0	e	87	79	2,342
BC	BC NW	e	e	e	e	e	0	f	f	f	1,285	32	e	572	85	1,974
BC	BC SE	e	e	e	e	e	0	f	f	f	138	32	e	165	60	396
BC	BC SHPC	g	g	g	g	g	g	g	g	g	g	g	g	g	g	21,600[g]
BC	BC SO	e	e	e	e	e	0	f	f	f	2,300	32	e	196	109	2,638
BC	BC SW	e	e	e	e	e	0	f	f	f	1,744	16	e	196	162	2,119
BC	BC WC	e	e	e	e	e	0	f	f	f	0	180	e	2,737	127	3,044
BC	BC WE	e	e	e	e	e	0	f	f	f	1,318	0	e	50	53	1,421
BC Total		0	0	0	0	0	0	0	0	0	13,943	340	0	6,092	939	21,315
BJ	BJ NO	e	e	3,015	952	13	3,980	e	758	925	1,684	0	e	e	e	5,664
BJ	BJ SO	e	e	439	523	50	1,012	e	614	639	1,253	0	e	e	e	2,264
BJ Total		0	0	3,454	1,475	63	4,991	0	1,372	1,564	2,937	0	0	0	0	7,928
Grand Total		5,247	5,988	26,382	40,982	8,322	86,921	15,347	31,654	29,846	95,219	4,478	25,810	8,452	3,720	198,789

[a] Only the best classes of wind and solar resources in each state were quantified. Quantifications for wind resources represent each state's minimum wind power class and higher, and for solar resources each state's minimum direct normal insolation level and higher. In Canada, renewable energy resources were quantified using a different methodology. It assessed resources at the site level as opposed to using raw resource data; therefore, the "best in state" criteria were not applied and Canadian resources were not discounted. Wind potential was not quantified in QRAs with less than 100 MW of total wind resource potential. Additional information is available on the Web at http://www.westgov.org/wga/initiatives/wrez/zita/index.htm.

[b] Undiscovered geothermal resources are believed to exist in certain areas because of the presence of geologic systems that have been correlated with geothermal resource potential in other areas. This undiscovered potential has not yet been quantified at specific locations where a geothermal plant could be built, but it can be estimated at the state level with different levels of confidence. As a result, these resources are not quantified at the QRA level or included in the economic modeling of QRAs. When undiscovered geothermal potential is believed to exist in a QRA, it will be noted, even though it will not be quantified. The mean estimated potential from these resources by state is quantified in this table by state and province. It is not captured in the QRA MW total, because these resources are not being quantified at the QRA level. U.S. estimates are from the USGS, and Canadian estimates are from the Canadian Geothermal Energy Association.

[c] Data on undiscovered geothermal resources were not available for Baja California Norte and Texas at the time of publication.

[d] Small and large hydropower are quantified in Canada. Incremental additions to powered or non-powered dams are quantified in the United States.

[e] These resources may exist, but they are not quantified in this study.

Footnotes continued on next page.

TABLE D-2 (Cont.)

[f] As noted above, a different resource assessment methodology was used to quantify the MW of renewable energy resources available in Canada. Data on the wind power class in British Columbia and Alberta are not available from this assessment. As a result, only the total potential of wind resources is shown here and is not broken down into different wind class categories.

[g] British Columbia voluntarily provided a hub on the British Columbia–Washington border to the WREZ process. This represents a 16,000 GWh/yr shaped energy product that British Columbia could provide to LSEs at the border. The intention of this additional hub and associated cost curve is not to represent a specific product offered to LSEs at the border, but to illustrate the benefits of a shaped and firmed decarbonized energy product to encourage further discussion. This hub and its energy and production profile will be selectable when using the Generation and Transmission Modeling tool. The energy resources that make up this cost curve are not specified; therefore, they are not broken down by resource type or class. The generation available from this additional QRA is not included in the B.C. subtotal or the grand total in this table.

Source: WGA and DOE (2009).

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present. Maps showing the location of the QRAs and Hubs with respect to BLM-administered lands and lands proposed by the BLM as being available for solar energy development (BLM Lands Available) and as SEZs are shown for Arizona, California, Colorado, Nevada, New Mexico, and Utah in Figures D-2 through D-7, respectively.

D.1.2 WREZ Initiative Next Steps

The Phase 1 Report identified the next steps to be taken under the WREZ initiative:

- Complete Phase 1: Defining the WREZs. The QRAs identified in the Phase 1 Report have not yet been identified as WREZs and analyses of these areas are ongoing. In particular, the QRAs still need to be filtered for wildlife considerations.

- Phase 2: Forging Transmission Plans. The modeling tool developed by the G&T Modeling working group will be finalized and used in regional transmission planning efforts to identify logical transmission corridors and rights-of-way between the WREZs and regional load centers.

- Phase 3: Coordinating Energy Purchasing from the WREZs. Phase 3 is expected to facilitate coordination among stakeholders, such as utility commissions, utilities, and generators, to aid in development of region-wide energy markets for the renewable resources.

- Phase 4: Fostering Interstate Cooperation for Renewable Energy Generation and Transmission. In Phase 4, efforts will be undertaken to enhance interstate cooperation for renewable energy generation and transmission. This phase will address political and regulatory obstacles that often occur in permitting when projects such as transmission-line construction or installation of renewable energy projects involve cross-jurisdictional approvals.

D.2 ARIZONA PLANNING ACTIVITIES

D.2.1 Arizona's Renewable Portfolio Standard

In November 2006, Arizona adopted a mandatory RPS that calls for 15% of total electricity sales from investor-owned utilities (IOUs), rural cooperatives, and retail suppliers to be derived from renewable sources by the year 2025. The standards specify annual targets leading up to the 15% requirement. For 2010, the target is 2.5%, increasing in 0.5% increments through the year 2015 (5.0% in that year), and then increasing in 1.0% increments to the 15% goal in the year 2025. This target of 15% by 2025 was established under rules adopted by the Arizona Corporation Commission contained in the *Arizona Administrative Code*, Title 14, Chapter 2, Article 18, "Renewable Energy Standard and Tariff."

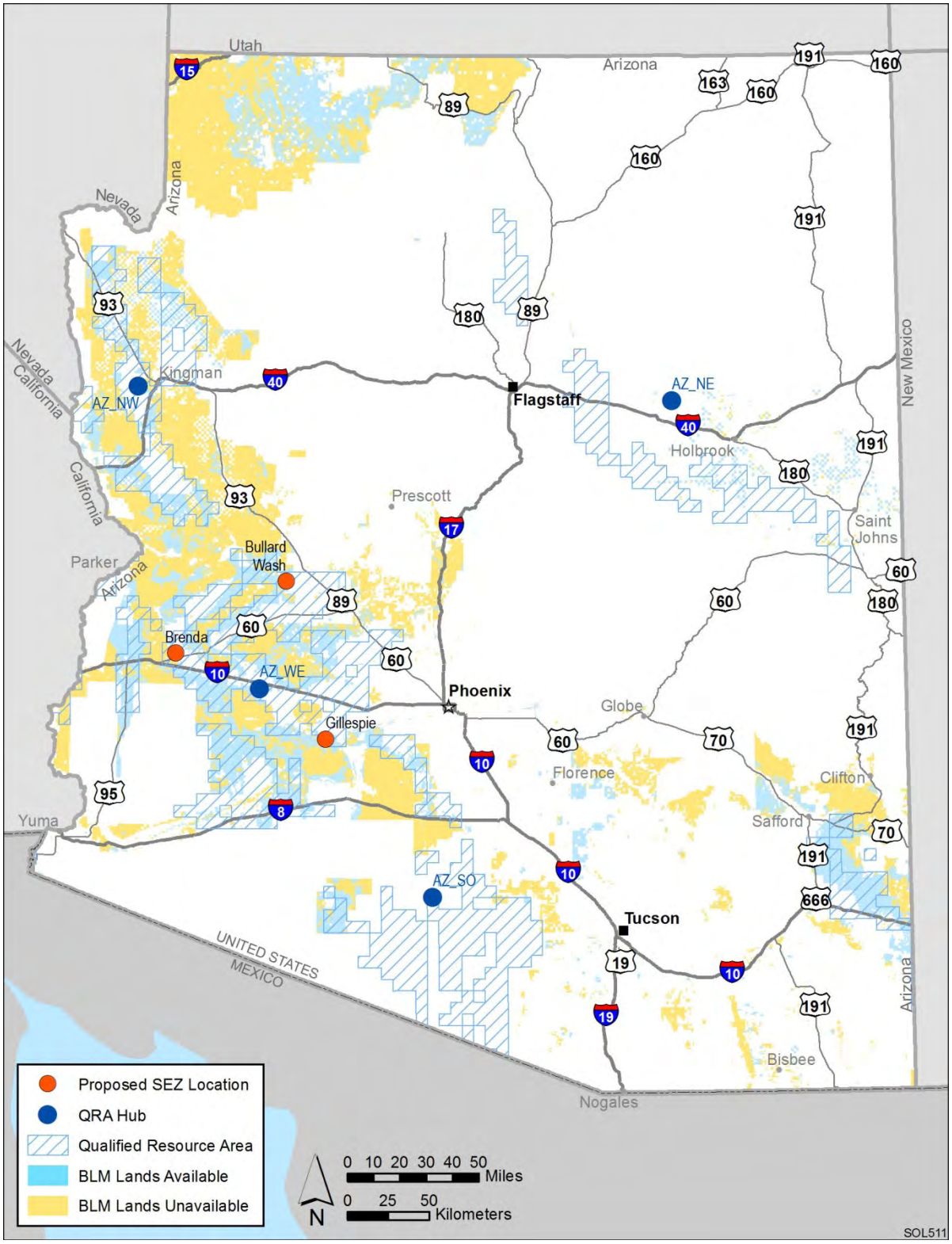


FIGURE D-2 WGA QRAs and Hubs in Arizona and BLM-Administered Lands and Proposed BLM Lands Available for Solar Energy Development and SEZs (Source for WGA units: WGA and DOE 2009)

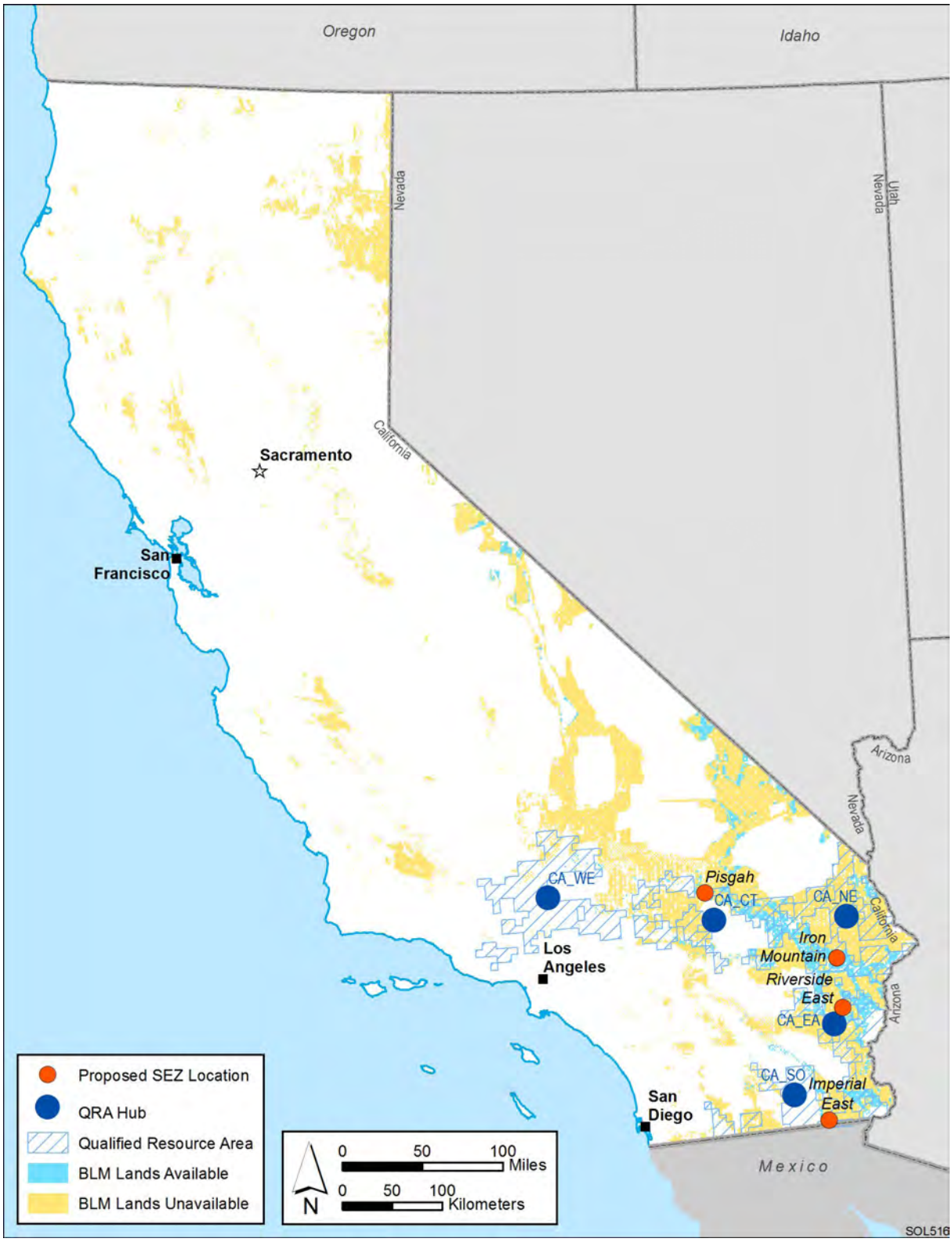


FIGURE D-3 WGA QRAs and Hubs in California and BLM-Administered Lands and Proposed BLM Lands Available for Solar Energy Development and SEZs (Source for WGA units: WGA and DOE 2009)

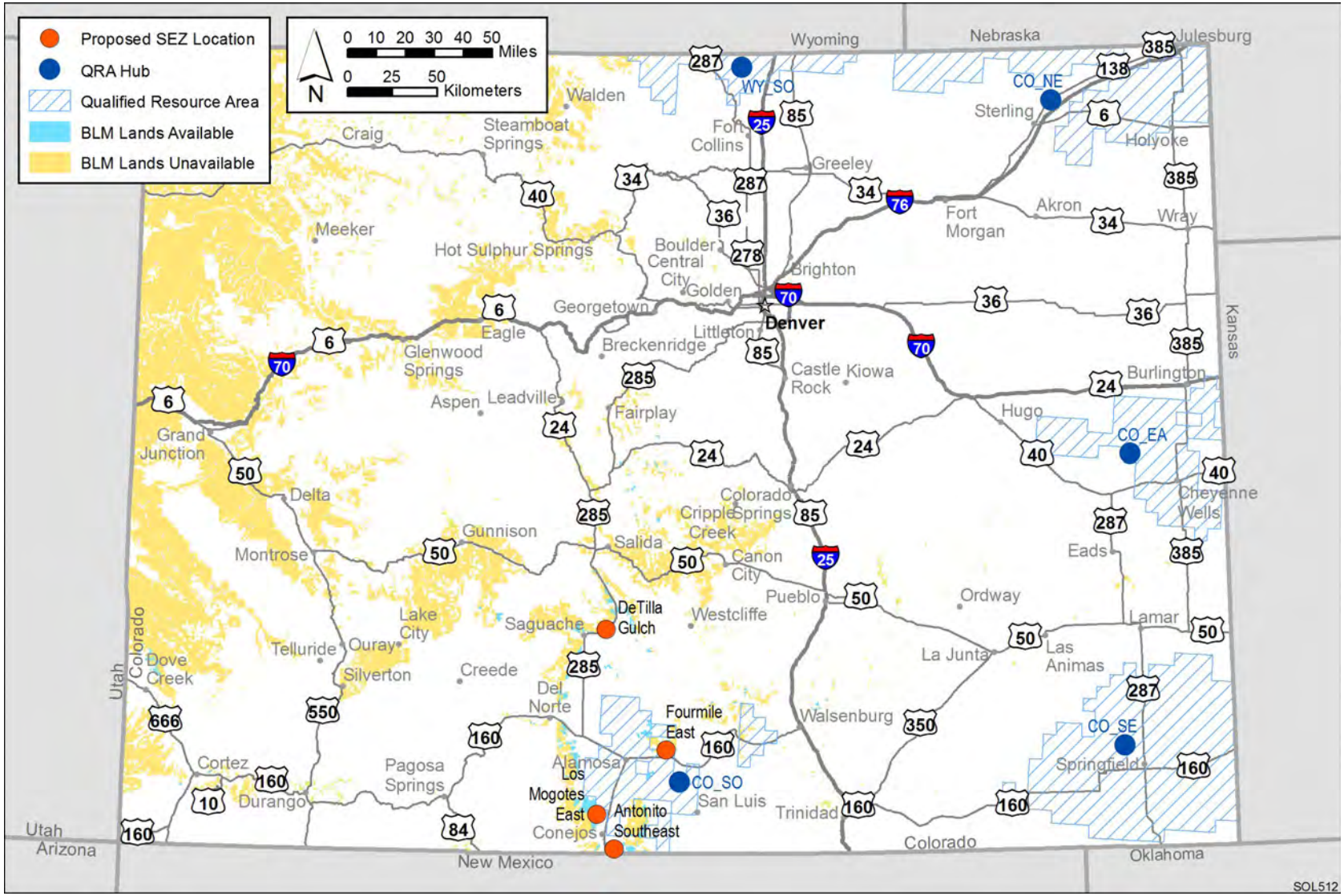


FIGURE D-4 WGA QRAs and Hubs in Colorado and BLM-Administered Lands and Proposed BLM Lands Available for Solar Energy Development and SEZs (Source for WGA units: WGA and DOE 2009)

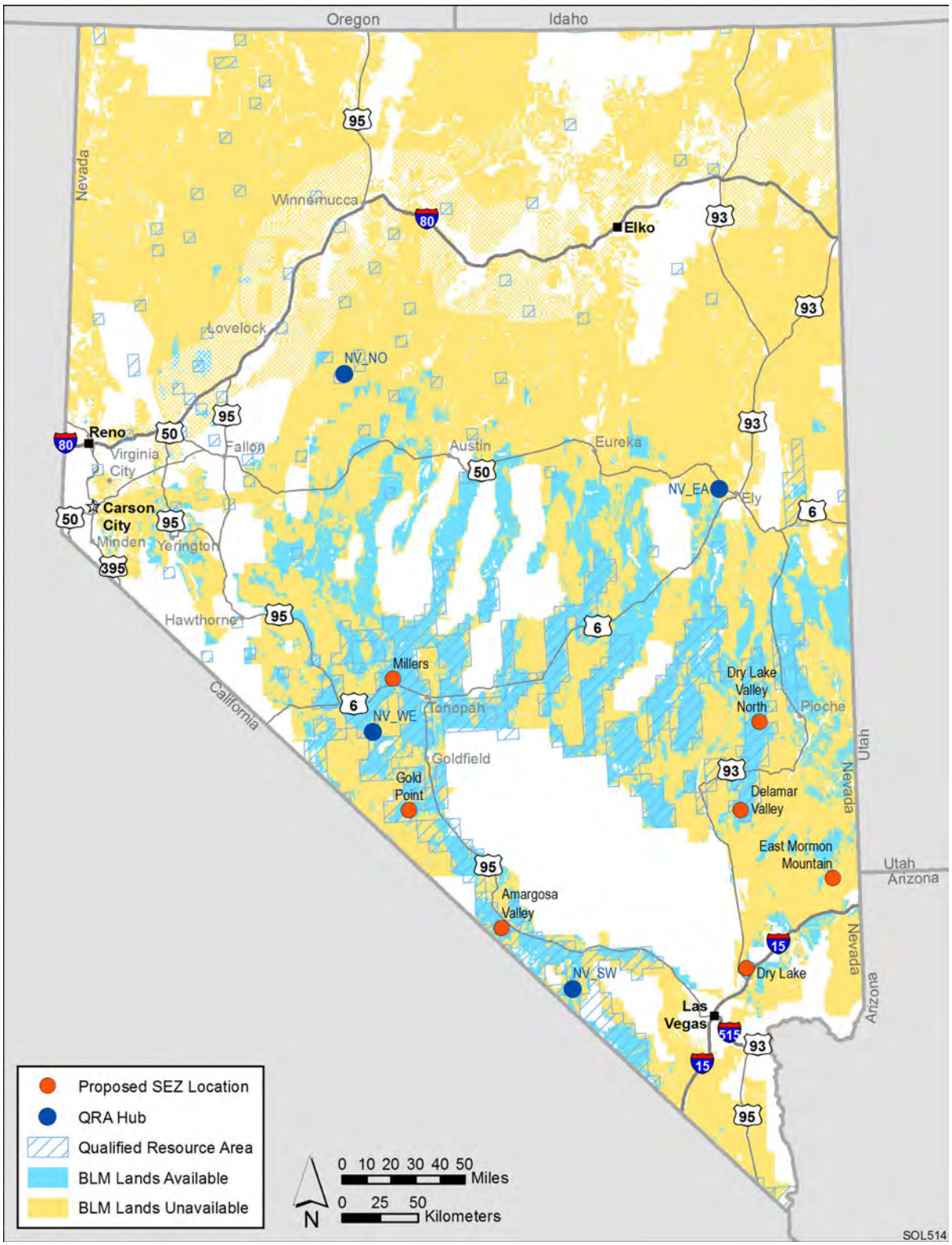


FIGURE D-5 WGA QRAs and Hubs in Nevada and BLM-Administered Lands and Proposed BLM Lands Available for Solar Energy Development and SEZs (Source for WGA units: WGA and DOE 2009)

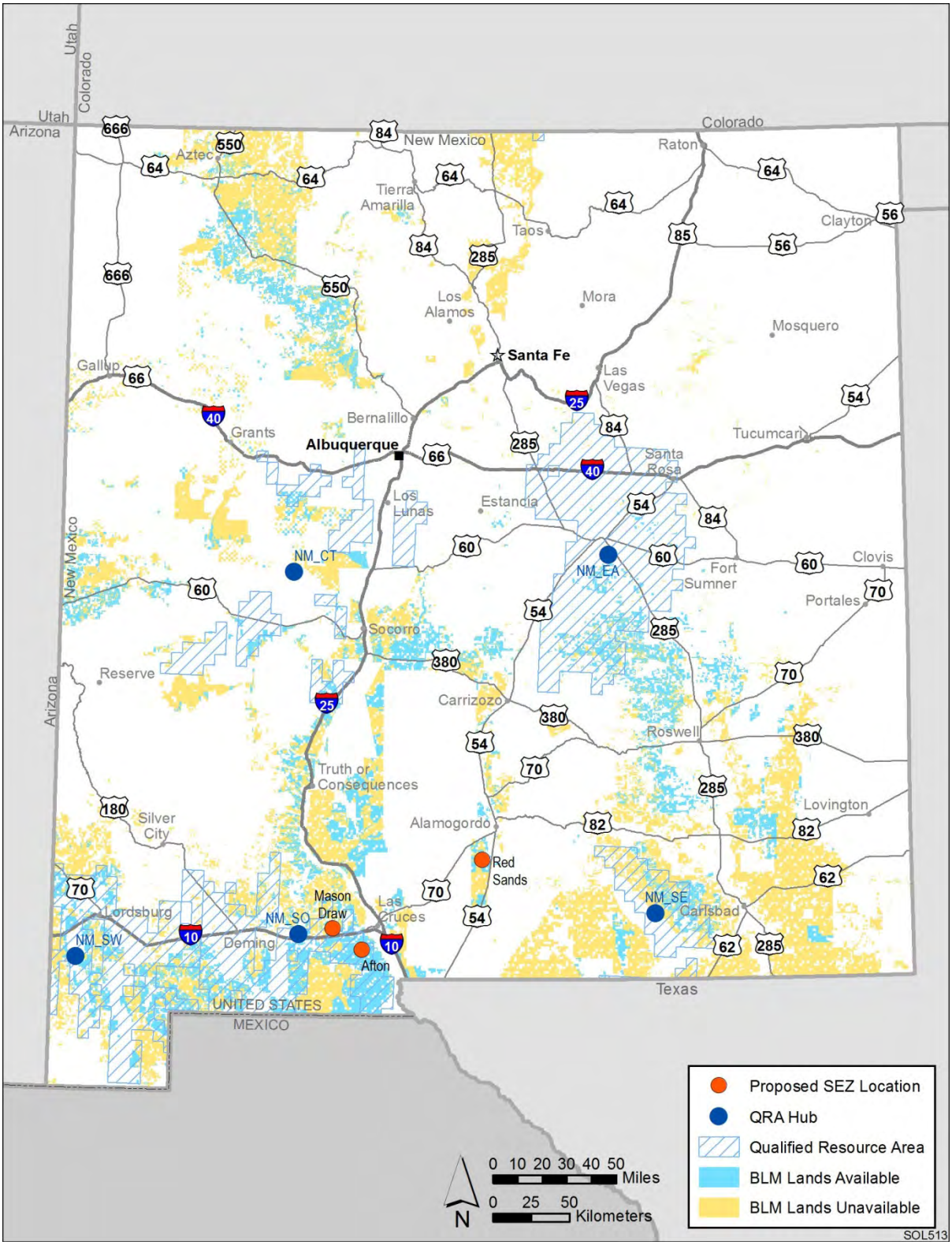


FIGURE D-6 WGA QRAs and Hubs in New Mexico and BLM-Administered Lands and Proposed BLM Lands Available for Solar Energy Development and SEZs (Source for WGA units: WGA and DOE 2009)

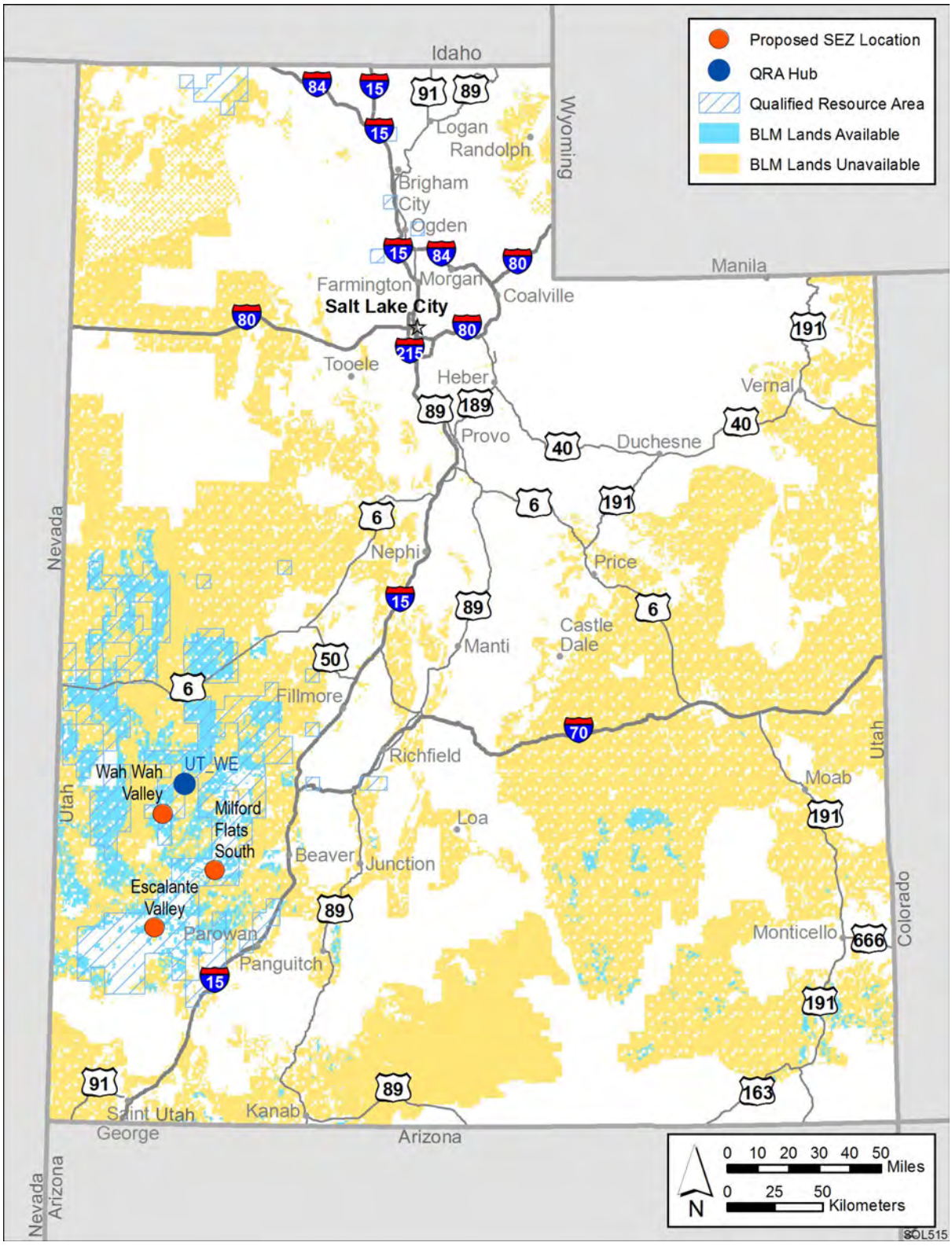


FIGURE D-7 WGA QRAs and Hubs in Utah and BLM-Administered Lands and Proposed BLM Lands Available for Solar Energy Development and SEZs (Source for WGA units: WGA and DOE 2009)

Arizona further specifies that a portion of the renewable energy generation must originate from distributed energy technologies. By 2012, the portion from distributed generation must reach 30%, which is equivalent to 4.5% of total retail electricity sales, and this level must be maintained through 2025. While hydroelectric sources are included as qualifying renewable technologies, the contributions must in general be from newer/smaller installations (e.g., facilities installed prior to January 1, 1997, are not eligible).

Table D-3 summarizes these RPS specifications for Arizona and for each of the other five states in the study area.

TABLE D-3 Renewable Portfolio Standard Requirements Summary as of July 2010

RPS Specification[a]	Arizona	California	Colorado	Nevada	New Mexico	Utah
Designated RPS year	2025	2020	2020	2025	2020	2025
Primary RPS specifications						
Total renewables (% of sales)	15%	33%[b]	–[c]	–	–	20%
Total renewables for IOUs (% of sales)	–	–	30%	25%	20%	–
Total renewables for POUs (% of sales)	–	–	10%	–	10%	–
Additional RPS specifications						
Distributed generation (% of sales)	4.5% (by 2012)	–	3% (IOUs)	–	0.6% (IOUs by 2015)	–
Wind (% of sales)	–	–	–	–	4% (IOUs)	–
Solar (thermal and photovoltaic) (% of sales)	–	–	–	1.5% (IOUs)	4% (IOUs)	–
Biomass and geothermal (% of sales)	–	–	–	–	2% (IOUs)	–
Mandatory (M) or voluntary (V)	M	M	M	M	M	V
Requirements for hydroelectric sources to be new/small (Y/N)	Y	Y	N	Y	Y	N

[a] Where presented, % of sales refers to % of electricity sales.

[b] The 33% standard is a goal established in 2009 by Governor Schwarzenegger in E.O. S-21-09 and has not been adopted by law or regulation as a requirement.

[c] A dash indicates no standard has been established for this specification.

Abbreviations: IOU = investor-owned utility; POU = publicly owned utility.

Source: Database of State Incentives for Renewables & Efficiency (North Carolina Solar Center and Interstate Renewable Energy Council 2010).

D.2.2 Arizona Renewable Resource and Transmission Identification Subcommittee

The Arizona Renewable Resource and Transmission Identification Subcommittee (ARRTIS) was created in January 2009 in response to a decision by the Arizona Corporation Commission to explore methods for developing new transmission projects. Participants in the subcommittee included utilities, renewable energy developers, federal and state land and resource management agencies, environmental advocacy groups, consultants, and other stakeholders. The purpose of ARRTIS was to collect, review, and map renewable resources for Arizona and, on the basis of those data, locate areas of technically ideal conditions for solar and wind resource development, locate environmentally sensitive areas, and identify other exclusion areas on the basis of existing laws and statutes. The ARRTIS efforts were intended to support the Renewable Transmission Task Force (RTTF), a component of the Southwest Area Transmission (SWAT) Subregional Planning Group.

The ARRTIS analyses produced a four-tier system for categorizing areas in Arizona within which solar and wind energy development might be constrained (AARTIS 2009). The categorizations are (1) Exclusion Areas, (2) High Sensitivity Areas, (3) Moderate Sensitivity Areas, and (4) Low Sensitivity Areas. The AARTIS participants agreed that the Exclusion Areas represent areas where "utility-level" development would have very low to no probability for permitting. However, the report indicates that the viability of a specific renewable energy project should not be based on its location in any of the four constraint regions.

The ARRTIS final report includes maps showing the solar and wind resources in Arizona along with the environmental exclusion and sensitivity areas for solar and wind energy development (AARTIS 2009). The final report also includes a map of the areas not excluded from solar energy development, which encompasses all lands not designated as an Exclusion Area. Approximately half of Arizona falls outside Exclusion Area designations. More information about the ARRTIS, including the final report and accompanying maps, is available at http://www.westconnect.com/planning_swat_rttf_arrtis.php.

D.3 CALIFORNIA PLANNING ACTIVITIES

California is involved in a large number of planning activities with respect to renewable energy development. Three of the most pertinent efforts are discussed below; they include (1) the establishment of a RPS, (2) the Renewable Energy Transmission Initiative (RETI), (3) the California Transmission Planning Group, (4) the California Desert Renewable Energy Conservation Plan (DRECP), and (5) the California Interim Mitigation Strategy.

D.3.1 California's Renewable Portfolio Standard

California has adopted a mandatory RPS specifying quantities of electrical power sales that must originate from renewable energy sources in future years. The RPS was first established in 2002 under Senate Bill 1078, requiring that 20% of the state's electrical power sales be from renewable energy by 2017. The RPS was accelerated in 2006 under Senate Bill 107 to push the

date forward, requiring 20% renewable energy by 2010. The program is jointly implemented by the California Public Utilities Commission (CPUC) and the California Energy Commission (CEC).

In 2008, California Governor Arnold Schwarzenegger issued Executive Order (E.O.) S-14-08 establishing a new goal of 33% renewable energy by 2020. In 2009, Governor Schwarzenegger signed E.O. S-21-09 directing the California Air Resources Board (ARB) to adopt regulations increasing the state's RPS to 33% by 2020. In September 2010, the ARB adopted regulations placing the highest priority on the development of renewable resources located in California and throughout the Western Interconnection that could provide significant environmental benefits and support reliable, efficient, and cost-effective electricity system operations. For more information please visit: http://www.arb.ca.gov/energy/res/res.htm.

Solar power represents one of many qualifying renewable sources, which also include hydroelectric, wind, geothermal, and biomass technologies. The RPS established for California under E.O. S-14-08 is specified for the year 2020, and does not identify specific fractions of each type of qualifying source. Table D-3 presents the specified RPS values. As shown in this table, California has not included distinctions or assigned portions for IOUs or publicly owned utilities (POUs). Because solar-specific fractions of the 33% RPS have not been specified, it is difficult to make definitive estimates of likely solar power contributions.

In support of the California RPS goals, the Global Warming Solutions Act of 2006 (AB 32) established a first-in-the-world comprehensive program of regulatory and market mechanisms to achieve real, quantifiable, cost-effective reductions of greenhouse gas emissions. The law will reduce carbon emissions in California to 1990 levels by 2020. Mandatory caps will begin in 2012 for significant sources and become more stringent to meet the 2020 goals. The Governor has also called for the state to reduce carbon emissions to 80 percent below 1990 levels by the year 2050.

D.3.2 California Renewable Energy Transmission Initiative

In August 2007, California launched the RETI as a statewide initiative to identify transmission projects needed to accommodate its RPS goals, support future energy policy, and facilitate energy transmission corridor planning and project siting and permitting. The RETI includes (1) an assessment of renewable energy resources in California and, possibly, in neighboring states to identify potentially developable zones where renewable energy can be developed in the most cost-effective and environmentally benign manner and (2) transmission development planning to support energy development in these zones. The RETI is jointly supervised by the CPUC, CEC, California Independent System Operator, and POUs. More information about the RETI, including access to all related publications, is available on its Web site (http://www.energy.ca.gov/reti/index.html).

The RETI effort involves three phases:

- Phase 1: Identification, characterization, and ranking of Competitive Renewable Energy Zones (CREZs) in California and neighboring regions;

- Phase 2: Development of a statewide conceptual transmission plan to access priority CREZs, based on more detailed analysis of CREZs; and

- Phase 3: Development of detailed plans of service for priority components of the statewide transmission plan.

The Phase 1A Final Report, released in April 2008, describes the methodology, assumptions, and resource information used in the Phase 1 efforts to identify, characterize, and rank CREZs in California and neighboring regions and broadly identify transmission requirements to access these CREZs (RETI 2008). The Phase 1B Final Report, released in January 2009, presents the results of a high-level screening assessment of renewable energy resources to group potential projects into CREZs based on geographical proximity, development time frame, shared transmission constraints, and additive economic benefits (RETI 2009a). The CREZs are ranked according to cost-effectiveness, environmental concerns, development and schedule certainty, and other factors.

The Phase 2A Final Report, released in September 2009, describes the planning process and the steps taken to further define and rank the CREZs, including (1) an expanded evaluation and re-ranking of CREZs initially described in Phase 1 and (2) development of a statewide conceptual transmission expansion plan to access the CREZs (RETI 2009b). The first of these tasks re-examined ranking and screening criteria used to identify CREZs in Phase 1, and incorporated a wide spectrum of environmental considerations, including the concerns of local citizen groups, water districts, agricultural interests, counties, utilities, renewable power developers, transmission owners/developers, Native American Tribes, state agencies, and the U.S. military. The Phase 2A Final Report acknowledges limitations of environmental screening criteria, recognizing that the screening factors were applied at a high level and that significant environmental impacts could occur within the designated CREZs. Thus, any of the areas would require more detailed investigation to assure compliance with environmental regulations and considerations. The CREZ development process used qualitative and quantitative measures for environmental and economic factors, assigning scores for some measures and relative indicators for other factors. Based on a matrix of scores and measures, the CREZs were defined and revised through various phases of development. The process is described in more detail in the Phase 2A Final Report.

The second task in Phase 2A focused on development of a conceptual transmission plan to facilitate meeting the state's 33% RPS goal by 2020. In this planning process, RETI recognized and acknowledged that the transmission plan is not strictly driven by, nor dedicated to, renewable energy development objectives, but rather, accommodates a full array of future electrical power needs. The RETI transmission planning efforts have been "conceptual," and they do not address critical engineering considerations, such as energy flows in specific line segments, reliability issues, or other dynamic operational issues. The RETI Phase 2A Final Report reiterates many times that the current conceptual transmission plan is a work in progress and is likely to change over time. However, the report states that within these acknowledged limitations, one of the noteworthy conclusions was a consensus on the need for two sets of major transmission lines to deliver renewable energy and provide important additional benefits to the grid. The report also concluded that there is a clear need for a transparent and objective

process to evaluate transmission service for renewable energy that involves a broad range of stakeholders.

The transmission plan describes three types of enhancements that would be pursued: (1) renewable foundation lines, (2) renewable delivery lines, and (3) renewable collector lines. The first two categories represent major upgrades to the California grid, with the goal of increasing capacity of the grid and allowing energy to flow north and south to load centers as needed. Some of the new lines are designated "least-regrets" additions, since they would likely be needed in future grid developments regardless of the role or extent of renewable power implementation. The third category of lines, namely "collector" lines, are defined as those that would provide access to adjacent CREZ areas.

The RETI will include continuing efforts to refine and update initial findings, as it proceeds with Phase 2B and beyond. The planned efforts will include (1) reducing and prioritizing the number of transmission lines identified in Phase 2A, (2) re-examining capacities and economies of out-of-state resources, and (3) identifying near-term measures that would facilitate renewable energy grid connections in the next few years (i.e., prior to completion of more extensive grid enhancements). These efforts can be expected to result in changes in the CREZ area definitions, as well as the conceptual transmission upgrade plans. The RETI Phase 2B Final Report, issued in May 2010, documents changes made to the economic model, technology assumptions, CREZs, and out-of-state resources (RETI 2010).

Figure D-8 shows the areas currently included in the CREZs as part of the Phase 2B efforts to refine these areas' boundaries. The figure also shows the transmission lines proposed in the Phase 2A transmission plan. Table D-4 identifies the CREZs included in the Phase 2B Final Report along with the estimated capacity potential. Figure D-9 shows the locations of the CREZs with respect to the BLM-administered lands and lands proposed by the BLM as being available for solar energy development (BLM Lands Available) and as SEZs.

D.3.3 California Transmission Planning Group

The California Transmission Planning Group (CTPG) is a forum for conducting joint transmission planning and coordination in transmission activities to meet the needs of California, consistent with Federal Energy Regulatory Commission Order 890. The CTPG includes transmission owners and transmission operators with the technical capability to perform detailed transmission planning. CTPG is committed to developing a California state-wide transmission plan to meet the state's 33% by 2020 renewable portfolio standard goal. This transmission plan will leverage a diverse portfolio of renewable energy generation technologies (wind, geothermal, hydro-electric, biomass, and solar) available to supply projected electricity demand in California from now to beyond 2020. In this effort, CTPG is utilizing the RETI conceptual plan as a starting point. For more information please visit: http://www.ctpg.us/public/index.php.



FIGURE D-8 California Renewable Energy Transmission Initiative CREZs and Transmission Segments (Note: The CREZ boundaries reflect decisions made as part of Phase 2b efforts, while the transmission segments were defined as part of Phase 2A.) (Source: Snyder 2010)

TABLE D-4 CREZ Designations with Estimated Potential Capacity

	Capacity (MW)				
CREZ	Biomass	Geothermal	Solar Thermal	Wind	Total
Barstow			1,400	936	2,336
Carrizo North			1,600		1,600
Carrizo South			3,000		3,000
Cuyama			400		400
Fairmont	138		1,800	712	2,650
Imperial East			1,500	74	1,574
Imperial North-A		1,370			1,370
Imperial North-B	30		1,800		1,830
Imperial South	36	64	3,570	45	3,715
Inyokern			2,145	287	2,432
Iron Mountain			4,800	62	4,862
Kramer		24	6,185	203	6,412
Lassen North				1,467	1,467
Lassen South				410	410
Mountain Pass			780	178	958
Owens Valley			5,000		5,000
Palm Springs				333	333
Pisgah			2,200		2,200
Riverside East			10,550		10,550
Round Mountain-A		384			384
Round Mountain-B				132	132
San Bernardino – Baker			3,350		3,350
San Bernardino – Lucerne	91		1,540	599	2,230
San Diego North Central				200	200
San Diego South				678	678
Santa Barbara				433	433
Solano				894	894
Tehachapi	37		7,195	3,193	10,425
Twentynine Palms			1,805		1,805
Victorville			1,200	436	1,636
Westlands			5,000		5,000
Grand total	332	1,842	66,820	11,273	80,267

Source: RETI (2010).

D.3.4 California Desert Renewable Energy Conservation Plan

In response to Governor Schwarzenegger's November 2008 E.O. S-14-08 and associated Memorandum of Understanding (MOU) among several state and federal agencies, joint federal and state cooperation on renewable energy development commenced with the forming of the Renewable Energy Action Team (REAT). Using the foundation of the March 2009 Secretary of the Interior's Secretarial Order 3285 and the previous agreements, an October 2009 MOU between Governor Schwarzenegger and Secretary of the Interior Ken Salazar formally launched

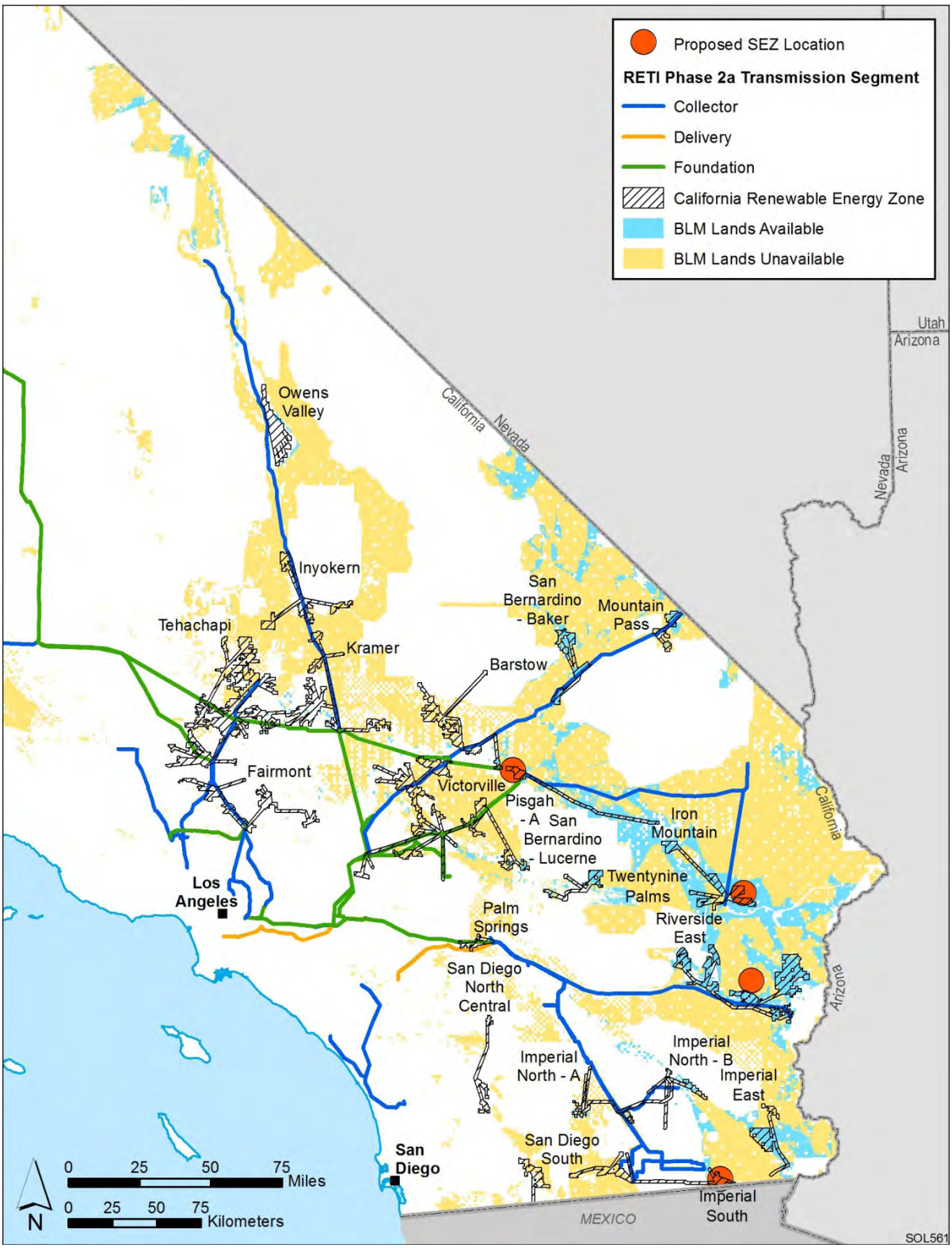


FIGURE D-9 California Renewable Energy Transmission Initiative CREZs and Transmission Segments and BLM-Administered Lands and Proposed BLM Lands Available for Solar Energy Development and SEZs (Source for CREZs and Transmission Segments: Snyder 2010)

the DRECP initiative. The October 2009 MOU also created the Renewable Energy Policy Group (REPG). For the full text of the MOU, please visit: http://gov.ca.gov/pdf/press/2009-CA-INTERIOR-MOU.pdf.

The DRECP is intended to advance state and federal natural resource conservation goals in the Mojave and Colorado desert regions of southern California, while also facilitating the timely and streamlined permitting of renewable energy projects. The DRECP will include a strategy that identifies and maps areas for renewable energy development and areas for long-term natural resource conservation. The plan is being developed under California's Natural Communities Conservation Planning Act and the Endangered Species Act, Section 10, habitat conservation planning program. More information about the REAT is available on the CEC Web site (http://www.energy.ca.gov/33by2020/index.html); more information about the DRECP is available at http://www.drecp.org.

As part of the DRECP effort, in March 2010, the federal and state agencies developed a preliminary "starting point" map that includes "starting point" renewable energy Study Areas and Conservation Opportunity Areas for discussion with DRECP stakeholders and the public. The intent of this preliminary mapping exercise was to foster the deliberative process. The "starting point" Study Areas are those areas with the potential for utility-scale renewable energy development and where sensitive biological resource values were estimated to be lower than other areas. Other factors (e.g., land ownership, land use planning and zoning requirements, archaeological resources, visual resources, and recreation use) were not considered in developing the starting point Study Areas.

The "starting point" Conservation Opportunity Areas are those areas with known or estimated high biological value that support key populations or connections between key populations. The intent of identifying Conservation Opportunity Areas is not to preclude development in those areas, but rather, to highlight the potential conflicts between development and resource conservation and the resultant need, potentially, for greater mitigation and longer permit processing time.

In August 2010, the DRECP Independent Science Advisors (ISAs) submitted a report that among other items, found flaw with the "starting point" maps (Desert Renewable Energy Conservation Plan Independent Science Advisors, 2010). Their primary input was that the maps should be improved with more careful use of existing data, increased transparency in methods, and more rigorous application of reserve-design principles and models. Based on new data, the DRECP ISA comments, and comments from stakeholders, the REAT is beginning the process of creating the next version of the map.

Figure D-10 shows the DRECP "Starting Point" Study Areas and Conservation Opportunity Areas within the DRECP boundary along with the lands proposed by the BLM as being available for solar energy development (BLM Lands Available) and as SEZs.

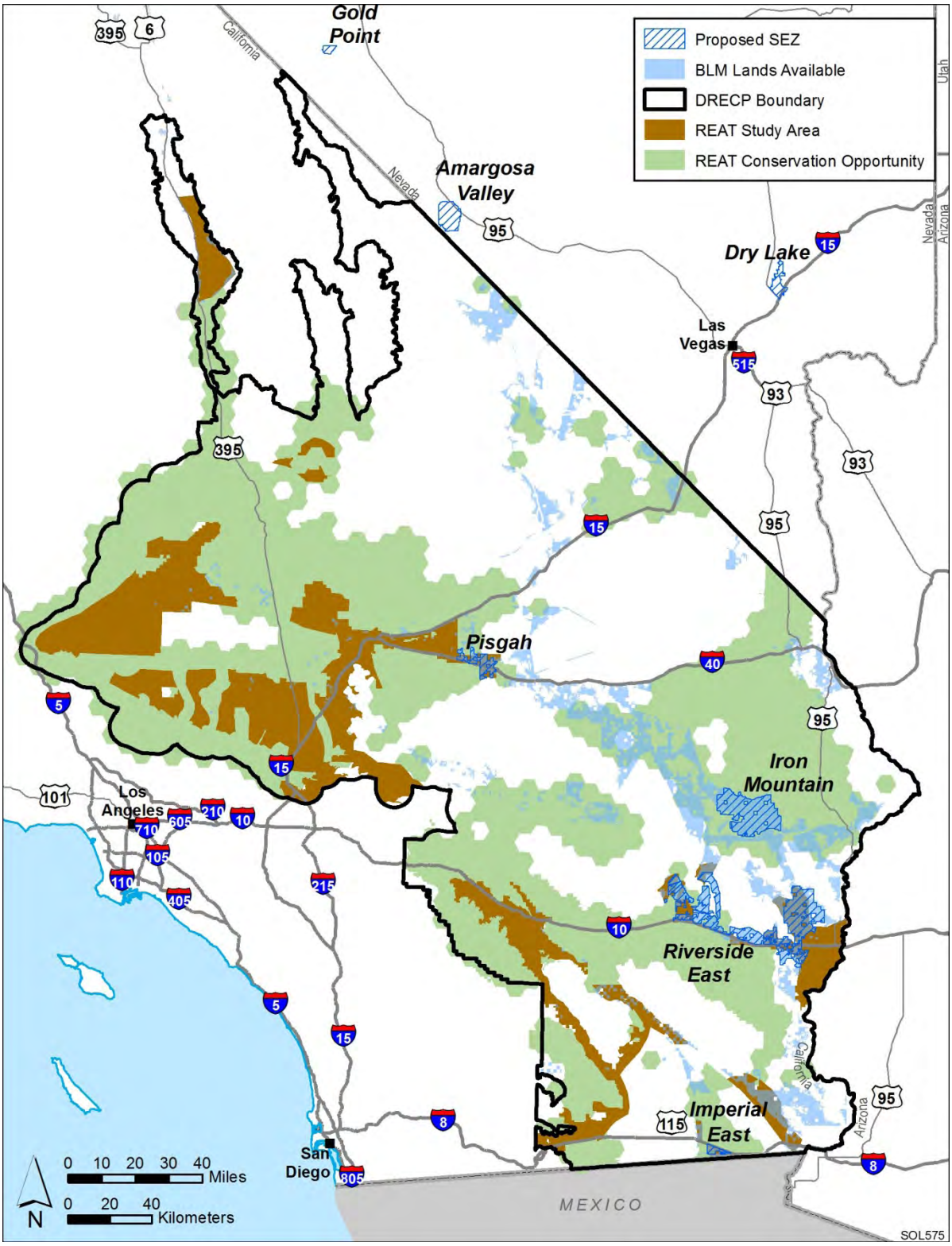


FIGURE D-10 "Starting Point" Study Areas and Conservation Opportunity Areas in the DRECP and BLM-Administered Lands and Proposed BLM Lands Available for Solar Energy Development and SEZs (Source for DRECP boundary and "Starting Point" areas: Marks 2010)

D.3.5 California Interim Mitigation Strategy

Senate Bill X8 34 (Padilla) (SB 34), was enacted on March 22, 2010 to facilitate project mitigation actions for certain proposed renewable energy projects in the California desert that are seeking federal American Recovery and Reinvestment Act funding. Among other provisions, the bill allows eligible project developers to pay in-lieu fees that would then be used by the California Department of Fish and Game (CDFG) to acquire and restore habitat lands as mitigation for project impacts on species listed as endangered, threatened, and candidate species under the California Endangered Species Act (CESA). The bill authorizes CDFG, in consultation with the CEC, BLM, and the U.S. Fish and Wildlife Service, to design and implement advanced mitigation actions, including the purchase of land and conservation easements to protect, restore, and enhance the habitat of CESA-listed plants and animals, consistent with an Interim Mitigation Strategy (IMS). The purpose of the IMS is to develop and articulate a conceptual approach to conservation investments (land acquisition, enhancements, restoration) that guides the implementation of project mitigation required of eligible renewable energy projects. The intent is to pool financial resources from eligible renewable energy projects needing to mitigate impacts on listed and candidate species and target conservation investments to maximize protection of habitat values, connectivity, and ecological processes in the California desert region. Eight areas within the DRECP boundary were identified as generalized target sub-regions within which to target mitigation for initial priority acquisition under the IMS and were developed through collaboration between desert land trust experts, BLM, and CDFG biologists.

D.4 COLORADO PLANNING ACTIVITIES

D.4.1 Colorado's Renewable Portfolio Standard

Colorado has adopted a mandatory RPS. Colorado voters passed the first RPS in November 2004 through Amendment 37, which required large utilities to purchase 10% of their retail electricity sales from renewable energy sources. In March 2007, the legislature enacted House Bill 07-1281, which increased the RPS to 20% by 2020 and made other modifications. In March 2010, House Bill 10-1001 further increased the RPS, calling for 30% of total sales from IOUs and 10% of sales from POUs to be derived from renewable sources by 2020 (see Table D-3). The standards specify additional time-stepped targets at various intervals leading up to the 30% requirement. For example, for the years 2011 to 2014, the requirement is 12% for IOUs, and for 2015 to 2019 the target is 20% for IOUs.

Colorado further specifies that 3% of the IOU's electric sales in 2020 must come from distributed energy technologies. The distributed energy requirements are also time-stepped up to the year 2020. In contrast to some of the other states, Colorado does not require hydroelectric sources to originate from newer/smaller installations. So it appears that all hydroelectric generation in the state qualifies as contributing to the RPS totals. (Utah is the one other state in the PEIS six-state study area that has adopted this convention for hydroelectric resources.)

D.4.2 Colorado Renewable Energy Development Infrastructure

The Colorado Governor's Energy Office has sponsored work intended to facilitate renewable energy development in Colorado. An initial report, titled *Connecting Colorado's Renewable Resources to the Markets*, presented maps of renewable resources in Colorado and identified Generation Development Areas for utility-scale wind and solar projects (Colorado Governor's Energy Office 2007). A subsequent report, referred to as the *Renewable Energy Development Infrastructure* (REDI) report, focused on options for achieving the state's carbon emission reduction goals (a 20% reduction by 2020 from 2005 baseline) with particular emphasis on utility-scale renewable energy development and high-voltage transmission. More information about these efforts is available on the Colorado Governor's Energy Office Web site (http://rechargecolorado.com/index.php/programs_overview/utilities_and_transmission/renewable_energy_development_infrastructure).

The REDI report specifically addresses baseline and historical information on generation and transmission infrastructure, roles of various supply and demand resources and options, regional financial and regulatory transmission issues, high-voltage transmission expansion plans, permitting and siting processes, and opportunities and options to improve connectivity for renewables. Discussions of transmission expansion options are included along with maps identifying environmentally sensitive areas, wildlife habitat areas, regional (interstate) transmission limitations, airport and military constraints, solar energy study areas, and current ownership.

The report cites an abundance of renewable resources within the state and focuses on development of high-voltage transmission infrastructures to convey the available power to appropriate demand areas. The report concludes that the lines in or near the identified Generation Development Areas for wind or solar are largely constrained with little capacity to accommodate new electricity development. Figure D-11 shows Colorado's primary wind and solar Generation Development Areas with respect to the location of BLM-administered lands and lands proposed by the BLM as being available for solar energy development (BLM Lands Available) and as SEZs.

D.5 NEVADA PLANNING ACTIVITIES

D.5.1 Nevada's Renewable Portfolio Standard

Nevada has adopted a mandatory RPS that calls for 25% of total electricity sales from IOUs to be derived from renewable sources by the year 2025 (see Table D-3). The standard specifies time-stepped targets at various intervals leading up to the 25% requirement. For example, for the years 2011 to 2012, the requirement is 15% for IOUs, and for 2015 to 2019 the target is 20% for IOUs. Nevada's RPS was first established in 1997 and increased in 2001, requiring 15% by 2013. The current standard of 25% by 2025 was established in 2009 by Senate Bill 358.

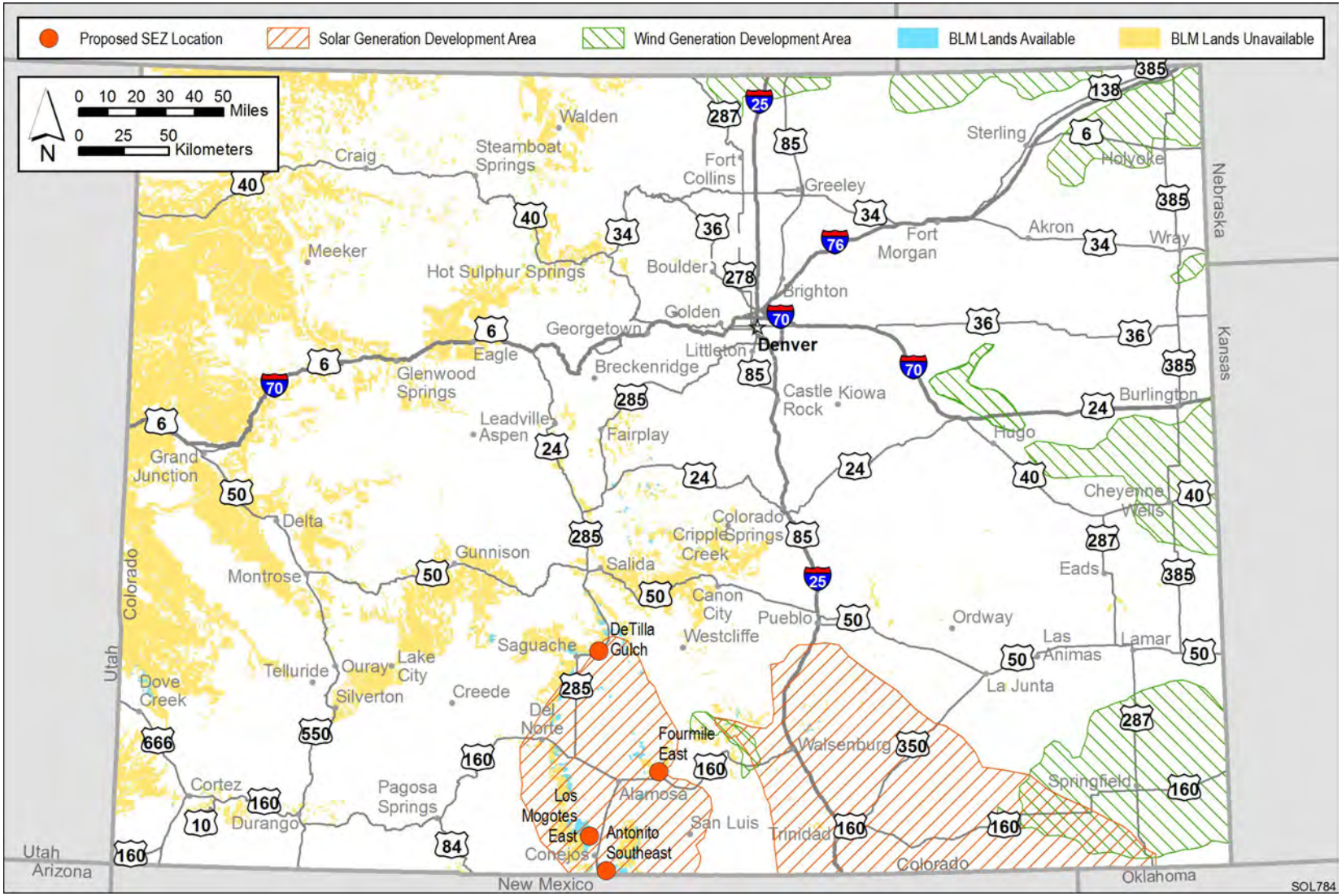


FIGURE D-11 Colorado Wind and Solar Generation Development Areas and BLM-Administered Lands and Proposed BLM Lands Available for Solar Energy Development and SEZs (Source for Generation Development Areas: Colorado Governor's Energy Office 2007 and 2009)

Nevada's RPS specifies that through the year 2015, 5% of the renewable energy must be derived from solar technologies, equal to 1.2% of total electricity sales. For the years 2016 through 2025, solar technologies must account for 6% of renewable energy or 1.5% of total sales. Nevada requires hydroelectric sources to originate from newer/smaller installations in order to qualify for RPS contributions.

D.5.2 Nevada Renewable Energy Transmission Access Advisory Committee

The Nevada Renewable Energy Transmission Access Advisory Committee (RETAAC) was established by an executive order issued by Nevada's governor in May 2007. The purpose of the RETAAC is to propose recommendations for improving access to the electricity transmission system specifically to support renewable energy development. In its Phase I report, the committee identified Renewable Energy Zones for solar, wind, geothermal, and biomass resources, identified potential constraints to development, and recommended numerous potential transmission routes to connect renewable power resources with load centers (State of Nevada 2007).

In June 2008, the governor issued another executive order launching Phase II of the RETAAC with the objectives of determining the power potential for the Renewable Energy Zones identified in Phase I; examining environmental, land use, and permitting constraints to renewable energy development; identifying construction "corridors" that could avoid such constraints; and examining revenue issues for construction requirements. The Phase II report, issued in July 2009, summarizes the process and findings of this work (State of Nevada 2009). One key finding of the RETAAC was that additional evaluation of potential environmental and land use constraints did not reveal any "fatal flaws" for the proposed transmission interconnections. In addition, the Phase II report ranked the Phase I Renewable Energy Zones on the basis of economic feasibility and identified which transmission routes would be needed to access electricity developed in those zones. (More information about the RETAAC is available at http://www.retaac.org.)

Figure D-12 shows the RETAAC Renewable Energy Zones and recommended transmission routes based on the Phase II report with respect to the location of BLM-administered lands and lands proposed by the BLM as being available for solar energy development (BLM Lands Available) and as SEZs. Additional maps in the Phase I and Phase II reports show potential constraints, energy export alternatives, and potential development phases.

D.6 NEW MEXICO PLANNING ACTIVITIES

D.6.1 New Mexico's Renewable Portfolio Standard

In March 2007, New Mexico passed Senate Bill 418, adopting a mandatory RPS that calls for 20% of total electricity sales from IOUs and 10% of sales from rural cooperatives to be derived from renewable sources by the year 2020 (see Table D-3).

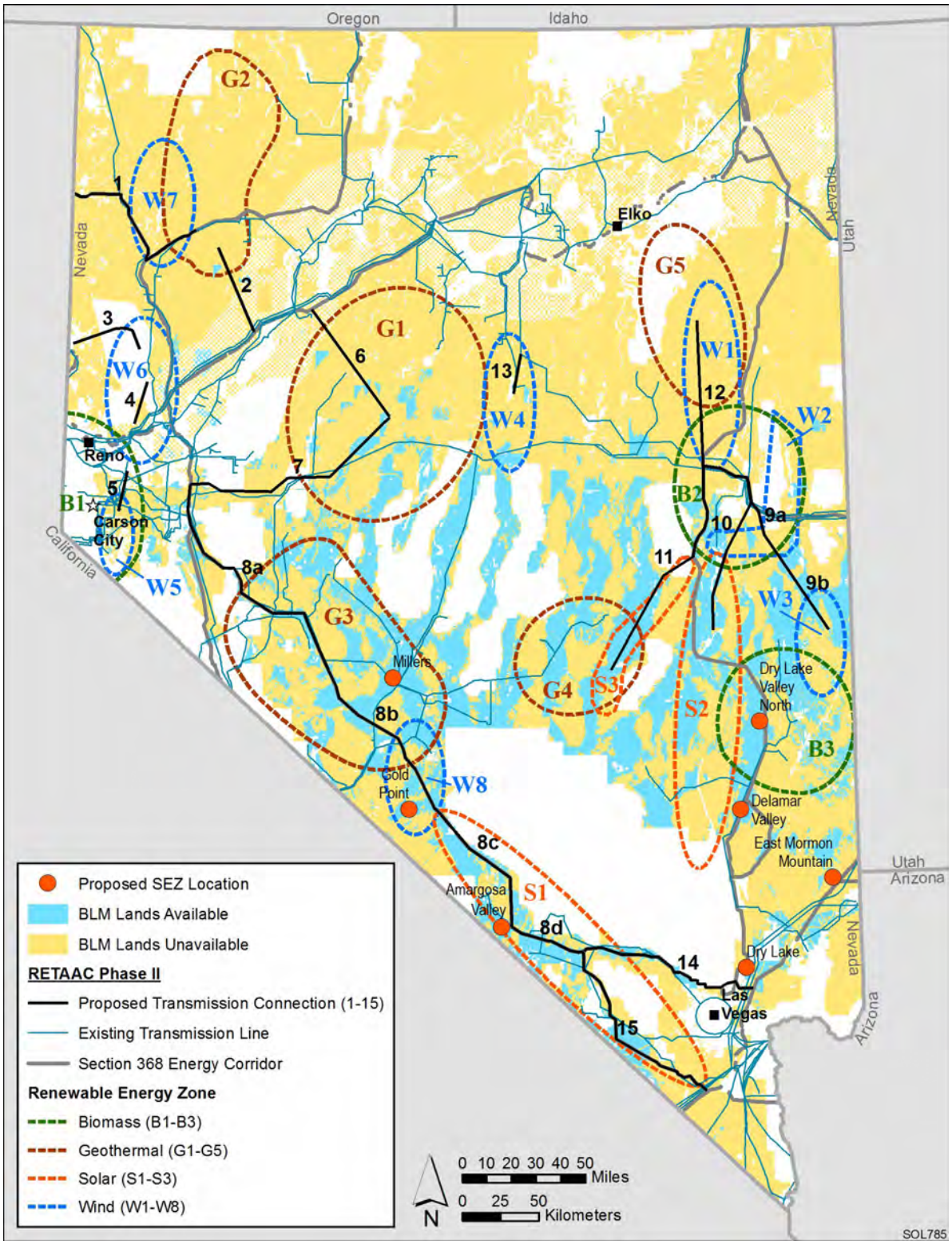


FIGURE D-12 Nevada RETAAC Renewable Energy Zones and Proposed Transmission Interconnections and BLM-Administered Lands and Proposed BLM Lands Available for Solar Energy Development and SEZs (Source for RETAAC designations: State of Nevada 2009)

New Mexico further specifies for IOUs that 20% of the renewable energy generation must come from solar generation by 2020, equal to 4% of total sales. In addition, 20% must come from wind generation (4% of total sales); 10% from biomass, hydro, and "other" renewables (2% of total sales); and, by 2015, 3.0% from distributed energy technologies (equal to 0.6% of total sales). New Mexico requires hydroelectric sources to originate from newer/smaller installations in order to qualify for RPS contributions.

D.6.2 New Mexico Renewable Energy Transmission Authority

The New Mexico Renewable Energy Transmission Authority (RETA), which was formed in response to House Bill 188, the Renewable Energy Transmission Authority Act of 2007, focuses on developing new transmission projects that will promote renewable energy development in the state. Specific responsibilities of RETA include mapping existing transmission lines and renewable energy resources, coordinating with other agencies to prioritize regions with minimal land development conflicts, and prioritizing the best options for new transmission corridors. To support this objective, the Transmission Corridor Committee (TCC) of RETA has published maps showing proposed new transmission corridors with overlays for solar, wind, and geothermal resources. The TCC also acknowledges that, in addition to establishing new corridors, existing transmission lines could be upgraded without requiring new corridors or rights-of-way. Additional information about RETA is available on its Web site (http://www.nmreta.com).

Figure D-13 shows the TCC's proposed corridors as of August 2010, along with existing transmission lines and the location of BLM-administered lands and lands proposed by the BLM as being available for solar energy development (BLM Lands Available) and as SEZs. The RETA is soliciting comments from its stakeholders and anticipates releasing final corridors in late 2010.

D.7 UTAH PLANNING ACTIVITIES

D.7.1 Utah's Renewable Portfolio Standard

Utah, unlike the other five states, has adopted a voluntary RPS that recommends 20% of adjusted retail electricity sales be derived from renewable sources by 2025 (see Table D-3). This was enacted in March 2008 by Senate Bill 202. Like Colorado, and in contrast to the other four states, Utah does not require hydroelectric sources to originate from newer/smaller installations. So it appears that all hydroelectric generation in the state qualifies as contributing to the RPS totals.

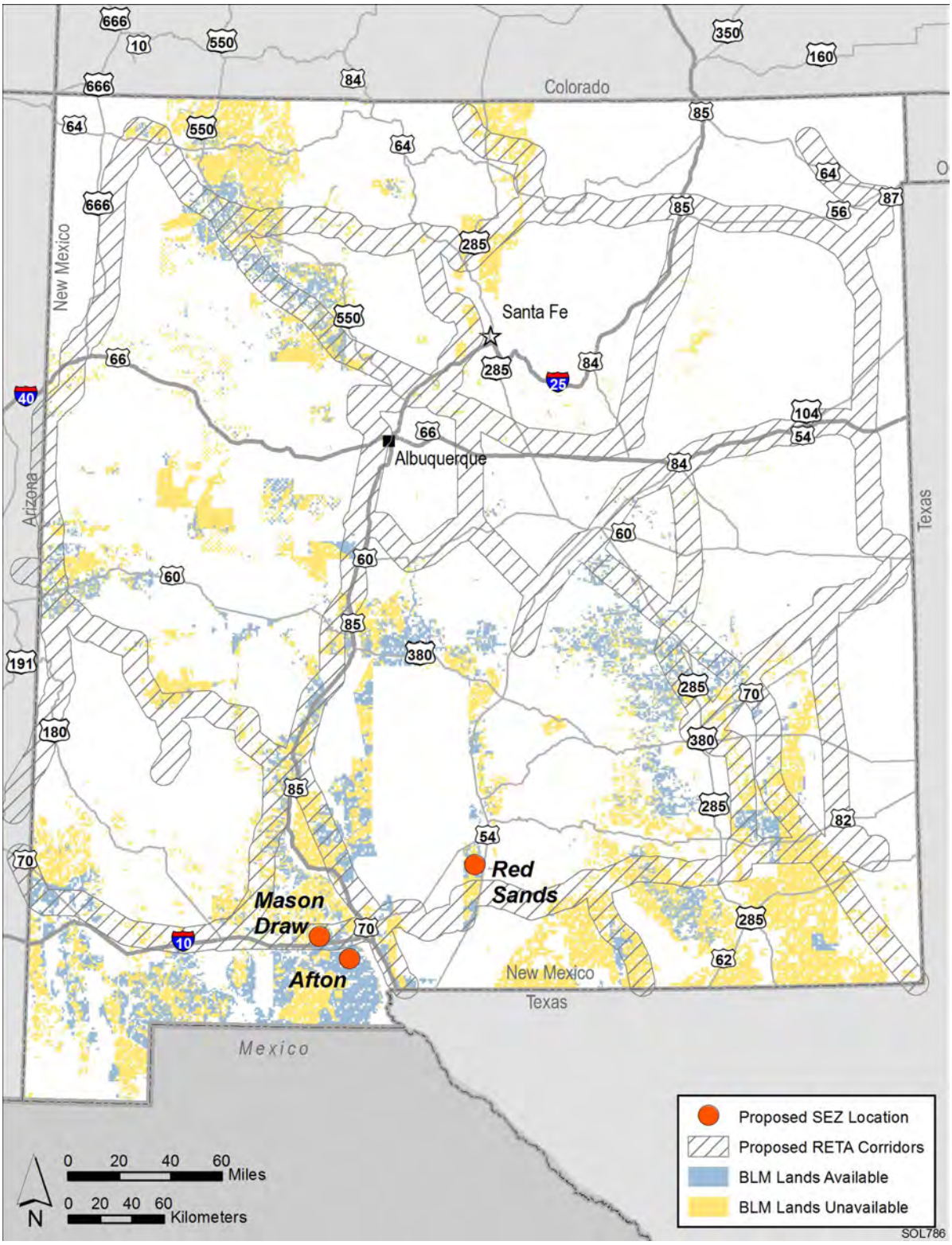


FIGURE D-13 New Mexico RETA Proposed Transmission Corridors, Existing Transmission in New Mexico, and BLM-Administered Lands and Proposed BLM Lands Available for Solar Energy Development and SEZs (Source for RETA designations and existing transmission: Albrecht 2010a,b)

D.7.2 Utah Renewable Energy Zone Selection Working Group

The Utah Renewable Energy Zone (UREZ) Task Force was established in 2008 to promote renewable energy development and help utilities meet the state's RPS goal of 20% by 2025. Specifically, the Task Force is responsible for identifying renewable energy zones and resource areas, identifying policies to support the development of renewable resources, and facilitating transmission planning and permitting to connect renewable resources with demand areas. (More information about the UREZ Task Force is available at http://geology.utah.gov/sep/renewable_energy/urez/index.htm.)

The UREZ work was divided into two phases. In Phase I, the emphasis was on identifying REZs and determining which areas inside and outside of the REZs have the greatest potential for larger-scale energy production (Berry et al. 2009). In Phase II, the Task Force focused attention on ways to facilitate transmission planning and permitting processes, including quantifying cost-effective renewable generation potential and transmission needed to realize the potential. With respect to solar energy development, in Phase II, the solar zones were further refined by choosing solar resources with DNI levels of 6–6.5 kWh/m^2/day for terrain with slopes ≤1%, and with DNI levels of 6.5–7.25 kWh/m^2/day for terrain with slopes ≤3% (State of Utah 2010).

The Phase II analysis found approximately 25,000 MW of renewable resource capabilities in 27 REZs in Utah, with significant resources also present outside of these zones. REZs were defined as being large enough to justify new transmission construction for bringing the power to the power grid and load centers and were ranked according to estimated costs and economic value of the available resources, and assumptions about anticipated transmission costs. The Task Force analyzed multiple scenarios and defined a conceptual transmission grid that would convey renewable energy production to Utah customers and other Western Interconnection customers.

Figure D-14 shows the REZs and the conceptual transmission grid with respect to and the location of BLM-administered lands and lands proposed by the BLM as being available for solar energy development (BLM Lands Available) and as SEZs.

D.8 SOLAR ENERGY POTENTIAL AT DOD INSTALLATIONS IN THE COLORADO AND MOJAVE DESERTS

The DoD has been tasked with determining the extent to which solar energy generation can be sited within the boundaries of eight military installations located in the Mojave and Colorado deserts of southern California and Nevada. First, the study will evaluate the technical and economic feasibility of locating solar energy generation within the military installations and identify potential areas for solar energy development. Second, the study will assess the potential policy barriers to developing on-installation solar energy facilities, including evaluating potential limitations on the use of solar energy because of military mission, environmental, and jurisdictional constraints, as well as identifying potential policy drivers and restrainers created by the federal, California, and Nevada governments. Third, the study will assess the pertinent siting

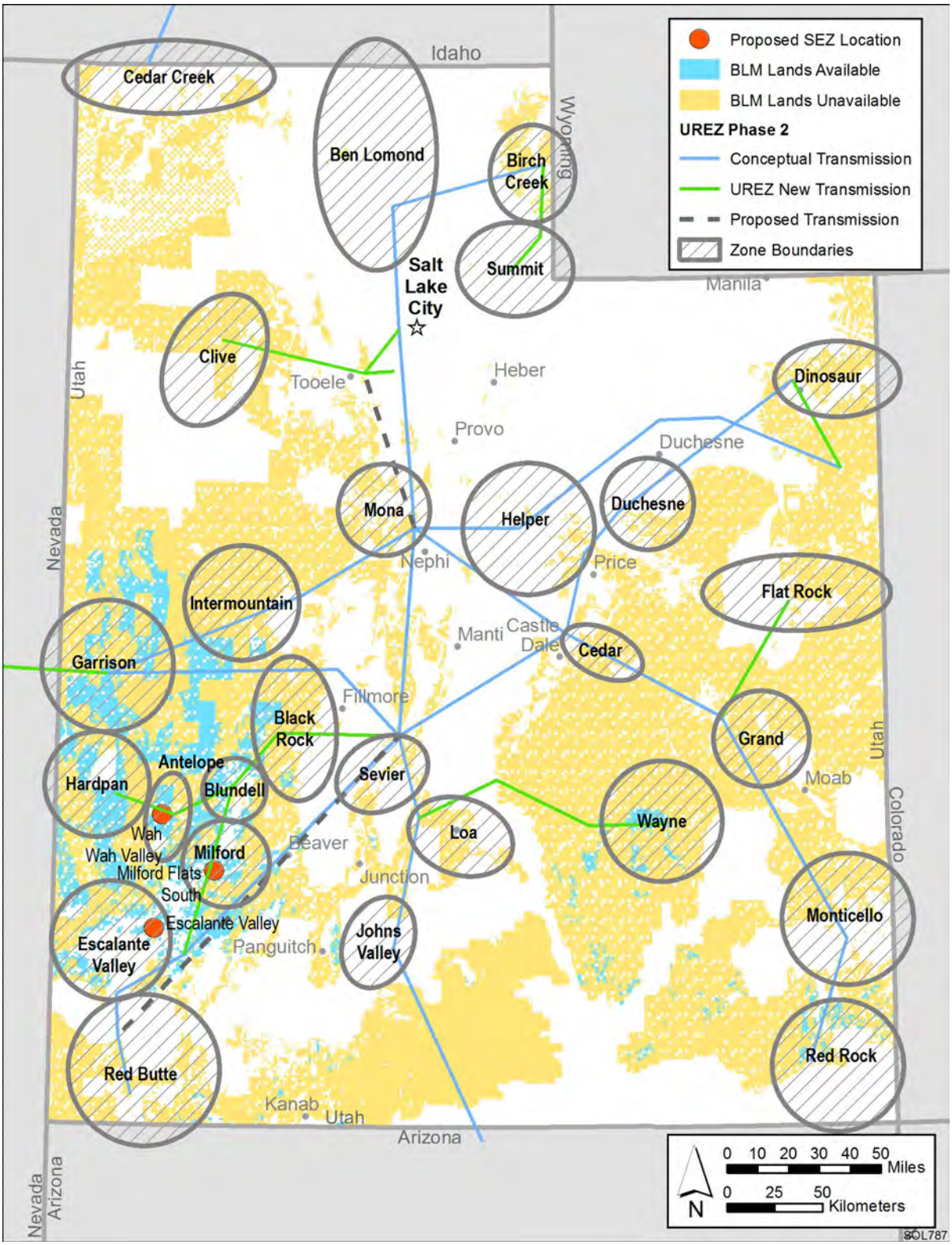


FIGURE D-14 Utah Renewable Energy Zone Task Force Proposed REZs and Conceptual Transmission Grid and BLM-Administered Lands and Proposed BLM Lands Available for Solar Energy Development and SEZs (Source for UREZ designations: State of Utah 2010)

and permitting standards for on-installation solar energy generation and compare these standards with those used for solar energy development on private and other public lands. This study will also analyze the feasibility and potential for on-installation solar energy generation to provide additional security benefits for the military installations. Finally, the study will provide recommendations for how on-installation solar energy opportunities can be encouraged and the development process streamlined.

D.9 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this PEIS. It is likely that at the time of publication of this PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this PEIS.

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APPENDIX E:

METHODS FOR ESTIMATING REASONABLY FORESEEABLE DEVELOPMENT SCENARIOS FOR SOLAR ENERGY DEVELOPMENT

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APPENDIX E:

METHODS FOR ESTIMATING REASONABLY FORESEEABLE DEVELOPMENT SCENARIOS FOR SOLAR ENERGY DEVELOPMENT

To aid in impact analysis for the "Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States" (Solar PEIS), a reasonably foreseeable development scenario (RFDS) for solar energy development in the six-state study area was incorporated into the analyses. Two methods of estimating the RFDS are detailed in this appendix: one using the National Renewable Energy Laboratory's (NREL's) Regional Energy Deployment System (ReEDS) model (Section E.1), the other based on each state's Renewable Portfolio Standard (RPS) requirements (Section E.2). The RFDS estimates resulting from these methods are presented in Section 2.4 of the Solar PEIS, in terms of total megawatts (MW) of solar facility capacity available by the year 2030.

E.1 RFDS ESTIMATES USING THE ReEDS MODEL

The ReEDS model was developed at NREL. It is a model of the current U.S. electric sector and its expansion potential that includes detailed treatment of renewable energy technologies. A detailed description of the model prepared by NREL is provided as Attachment 1 to this Appendix.

The ReEDS model was used to estimate the growth in both concentrating solar power (CSP) and photovoltaic (PV) solar capacity in the six-state study area through 2030 for aid in analyses for the Solar PEIS. The values obtained for CSP are presented in Table E.1-1; those for PV are presented in Table E.1-2.

E.2 RFDS ESTIMATES USING STATE RPS LEVELS TO PREDICT SOLAR CAPACITY

RPSs have been passed in many states and require that a certain percentage of that state's electricity capacity requirements be supplied from renewable sources (e.g., solar, wind, geothermal, or biomass) by a given year. The six states in the Solar PEIS study area all have RPSs; these standards are mandatory in each of the states except Utah. Meeting these RPS levels likely would require solar energy development either within those states or in the region.

To establish a RFDS to support analyses in the PEIS, the levels of solar energy development within each of the six states were developed by (1) using state-level RPSs and regional growth rates to establish the basic amounts of new renewable generation needed in each state and (2) applying various assumptions about the amount of each RPS to be provided from solar energy versus other renewable sources.

TABLE E.1-1 ReEDS Model Estimates of CSP Solar Development on BLM and Non-BLM Administered Lands, May 11, 2010

State		Cumulative MW by year (assumes 31 MW/km^2) 2010	2014	2030
Arizona	Non-BLM[a]	0.000	0.000	0.000
	BLM	0.000	0.000	0.000
California	Non-BLM	0.000	203.893	305.087
	BLM	0.000	123.792	173.761
Colorado	Non-BLM	0.000	0.000	0.000
	BLM	0.000	0.000	0.000
New Mexico	Non-BLM	0.000	0.000	0.000
	BLM	0.000	0.000	0.000
Nevada	Non-BLM	41.683	159.700	159.700
	BLM	0.000	0.000	0.000
Texas	Non-BLM	0.000	0.000	0.000
	BLM	0.000	0.000	0.000
Utah	Non-BLM	0.000	0.000	0.000
	BLM	0.000	0.000	0.000

[a] BLM = Bureau of Land Management.

TABLE E.1-2 ReEDs Model Estimates of PV Solar Development on BLM and Non-BLM Administered Lands, May 10, 2010

State		Cumulative MW by year 2010	2014	2030
Arizona	Non-BLM[a]	0.00	190.02	1,724.06
	BLM	0.00	194.89	1,768.23
California	Non-BLM	0.00	649.53	8,181.56
	BLM	0.00	109.89	2,033.49
Colorado	Non-BLM	83.44	306.71	2,197.31
	BLM	3.74	13.73	98.39
New Mexico	Non-BLM	174.57	891.73	3,204.23
	BLM	19.76	97.08	353.00
Nevada	Non-BLM	0.00	91.99	387.78
	BLM	0.00	273.60	1,153.31
Utah	Non-BLM	0.00	0.00	0.00
	BLM	0.00	0.00	0.00

[a] BLM = Bureau of Land Management.

Estimates of future levels of solar energy development in each state depend on a number of factors not well-defined at this time. For example, most of the RPSs do not specify the amount of renewable energy to be generated by the different qualifying resources, which creates uncertainty regarding the mix of solar energy within each state. In addition, the total RPS requirements are expressed in terms of percentage of future electricity sales, and projections of these future sales (11 to 16 years out) are not readily available for each state. Also, the potential exists for utilities to import renewable energy in order to meet RPS requirements, or to develop renewable energy specifically for export to other states. Developments such as these are difficult to predict with accuracy. Consequently, the estimates of future solar development levels in each state required approximation methods and assumptions and, as a result, there are significant uncertainties in the final results for the solar generation and capacity estimates.

The following sections present the analytical approach and results. For perspective, Section E.2.3 presents these results in the context of projections from other sources.

E.2.1 Overview

The overall approach that was adopted for estimating solar capacity and energy futures for each of the six states included:

1. Identifying the percentages of total future electricity sales to be supplied by renewable energy sources (i.e., the RPS requirements) for each state;

2. Identifying current capacities, generation, and electricity sales statistics for each state;

3. Applying regional projected growth rates to determine anticipated total electricity sales for each state in the designated RPS years;

4. Applying RPS requirements to determine anticipated renewable energy development;

5. Making adjustments for contributions to the RPS requirements, as allowed, for existing conventional hydroelectric sources or other qualifying technologies;

6. Postulating several fractional "market shares" for solar as percentages of total renewable generation/sales needed to satisfy the RPS requirements in each state;

7. Deriving the amounts of energy associated with each of the postulated fractions that might be anticipated from solar contributions; and

8. Deriving the associated capacities for solar power based on the results from Step 7 and estimated capacity factors.

Additional details for these steps are described in the sections that follow.

E.2.1.1 RPS Requirements for Each State

The first step in estimating future solar power development for each state was a review of the RPS requirements. Table E.2-1 summarizes the RPS specifications for all six states. While RPS requirements provided a reasonable starting point for this analysis, it was recognized that many dynamic factors will affect actual outcomes for renewable power development. Issues such as siting, permitting, technology costs, transmission linkages, and other utility integration factors, will all influence whether RPSs are met and how they might evolve over time. The uncertainties in using RPS requirements for estimating renewable energy development, and in particular solar energy development, were recognized and acknowledged for the analysis that follows. With those considerations in mind, the approach described yielded a range of possible outcomes for solar development that are intended to cover the realm of feasible and likely development scenarios.

Table E.2-1 illustrates that each of the six states has adopted different types of renewable energy requirements. Three of the six states designate a percentage that applies to total electricity sales in the state, while the other three make distinctions between requirements for investor-owned utilities (IOUs) and publicly owned utilities (POUs).[1] Four of the states (Arizona, Colorado, Nevada, and New Mexico) have included additional specifications for types of total renewable sources to be developed. Two of the states (Nevada, and New Mexico) provide specific requirements for solar energy contributions, and one state (New Mexico) specifies minimum requirements for other renewable technologies (wind, biomass, and geothermal) needed to meet RPSs.

E.2.1.2 Treatment of Hydroelectric Sources

One important criterion for estimating future solar contributions is whether "conventional" hydroelectric generation, or hydropower, is considered as a qualifying option. Conventional hydropower refers to standard hydroelectric dams as contrasted with pumped storage, tidal, wave, or ocean thermal technologies. For most of the six states, conventional hydropower represents a significant fraction of existing "renewable" energy generation and could potentially deliver a large share of the future RPS requirements. However, Arizona, California, Nevada, and New Mexico have all included stipulations for limiting hydroelectric contributions to meet RPSs.[2] In general, these four states require that the hydroelectric facilities be relatively new (i.e., installed after a given year) or be of limited capacity/generation (such as used to "firm" the generation from other variable output renewable technologies like wind or solar).

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[1] POUs include municipal and cooperative entities. In Nevada, RPS summaries use notation that a requirement "[applies to] Investor-Owned Utility and Retail Supplier," which raises some question about the requirements' applicability to POUs. Most of the other states specifically identify POUs when they are included in the RPS requirements; thus, in this analysis, it was assumed that POUs are not mandated to meet the RPS requirements in Nevada.

[2] The RPS summaries for California and Nevada include references to "certain hydro" sources as qualifying sources for RPS requirements, but do not define which types of hydropower sources would qualify.

TABLE E.2-1 RPS Requirements Summary as of July 2010

RPS Specification[a]	Arizona	California	Colorado	Nevada	New Mexico	Utah
Designated RPS year	2025	2020	2020	2025	2020	2025
Primary RPS specifications						
Total renewables (% of sales)	15%	33%[b]	–[c]	–	–	20%
Total renewables for IOUs (% of sales)	–	–	30%	25%	20%	–
Total renewables for POUs (% of sales)	–	–	10%	–	10%	–
Additional RPS specifications						
Distributed generation (% of sales)	4.5% (by 2012)	–	3.0% (IOUs)	–	0.6% (IOUs)	–
Wind (% of sales)	–	–	–	–	4% (IOUs)	–
Solar (thermal and photovoltaic [PV]) (% of sales)	–	–		1.5% (IOUs)	4% (IOUs)	–
Biomass and geothermal (% of sales)	–	–	–	–	2% (IOUs)	–
Mandatory (M) or voluntary (V)	M	M[b]	M	M	M	V
Requirements for hydroelectric sources to be new/small (Y/N)	Y	Y	N	Y	Y	N

[a] Where presented, % of sales refers to % of electricity sales.

[b] In 2006, Senate Bill 107 established a mandatory standard of 20% renewable energy by 2010. In 2009, Governor Schwarzenegger established a higher goal of 33% by 2020 in Executive Order S-21-09. Although the 33% goal has not been adopted by law or regulation, it is used in this analysis to provide a conservatively high projection of future renewable energy development in California.

[c] A dash indicates no standard has been established for this specification.

Source: Database of State Incentives for Renewables & Efficiency (North Carolina Solar Center and Interstate Renewable Energy Council 2010).

These stipulations for hydroelectric power were recognized in deriving the results described in Section E.2.2. The approach used in this analysis estimated total electricity sales for the RPS years and subtracted existing hydroelectric generation from those totals for Colorado and Utah, where it appears that conventional and existing hydroelectric sources are allowed to contribute to the RPSs.

E.2.1.3 Additional Considerations

Also of potential significance in the renewable estimation process is Utah's allowance of (1) nuclear power, (2) demand-side management (DSM), and (3) carbon-sequestered fossil

generation (CSFG) in directly subtracting from total electricity sales figures to which RPS requirements apply. Thus in Utah, if nuclear power, DSM, and CSFG were responsible for a total of 1,000 GWh and total sales were 10,000 GWh, then the 20% RPS requirement would translate into a need for 1,800 GWh from qualifying renewable sources (20% of 9,000 GWh). Currently, there are no nuclear generating facilities in Utah, and DSM and CSFG programs are highly uncertain; thus these issues are subject to considerable variability for long-term projections. As a result, no adjustments were made in this analysis to the Utah RPS requirements for these other qualifying technologies.

E.2.1.4 Current Capacities, Generation, and Electricity Sales for Each State

Table E.2-2 summarizes the existing capacity, generation, and sales numbers for each of the six states.

E.2.1.5 Regional Electricity Growth Rates

In translating the RPS requirements into anticipated electricity sales, generation, and capacity estimates for future years, this analysis relied on long-term growth rate projections developed by the U.S. Department of Energy's (DOE's) Energy Information Administration (EIA). The annual growth rates were derived for each electric region that cover the six-state study area and for each end-year that was designated in the state-specific RPS requirements. The

TABLE E.2-2 Existing Capacity, Generation, and Electricity Sales in 2007

Parameter/State	Arizona	California	Colorado	Nevada	New Mexico	Utah
Capacity (MWe)						
Hydroelectric	2,720	10,041	665	1,048	82	255
Solar/PV	9	404	8	79	0	0
Other renewables	7	5,329	1,073	189	500	38
Total renewables	2,736	15,774	1,746	1,316	582	293
Total capacity[a]	25,579	63,813	12,288	9,954	7,202	7,122
Generation (GWh)						
Hydroelectric	6,598	27,328	1,730	2,003	268	539
Solar/PV	9	557	2	44	0	0
Other renewables	32	24,288	1,322	1,253	1,409	195
Total renewable	6,639	52,173	3,054	3,300	1,677	734
Total generation[a]	113,341	210,848	53,907	32,670	35,985	45,373
Total state sales (GWh)	77,193	264,235	51,299	35,643	22,267	27,785

[a] Includes both renewable and non-renewable electricity sources.

Sources: EIA (2007a) for capacity and generation and EIA (2007b) for total state sales.

use of regional growth rates (rather than state-specific rates) was necessary because EIA does not develop or publish long-term projections on a state basis. Still, the EIA projections were chosen because of the consistency in projection methodologies and assumptions as they apply across the six-state study area.

Figure E.2-1 illustrates the EIA electric market regions and shows the level of regional detail that is available for forecasted electricity sales, generation, and capacity estimates from the EIA. These regions also correspond approximately to North American Electric Reliability Corporation (NERC) sub-areas. For the six-state study area, the alignments between states and regions are as follows:

Arizona, Colorado, New Mexico, and Nevada	Region 12 (Rocky Mountain Sub-Area),
California	Region 13 (California Sub-Area), and
Utah	Region 11 (Northwest Sub-Area).

(Note: While the majority of land area from Nevada is in Region 11, the majority of electrical load is located in Region 12. Thus for this analysis, Nevada was treated as being part of Region 12.)

Table E.2-3 shows the existing and projected statistics for each of the three relevant electric market regions that are aligned with the six states. The end-year data reflect different RPS target years; thus even though a common EIA market region may apply to multiple states, the statistics can vary because of different RPS years.

E.2.1.6 Application of Regional Growth Rates to State-Level Generation and Electricity Sales Estimates

The regional annual average electricity sales growth rates provided in Table E.2-3 can be used to estimate state-level projections for future years. Table E.2-4 shows total state-level electric sales estimates for the various RPS years. The bottom row of results in Table E.2-4 provides a basis for estimating renewable energy development in each state for each of the RPS years.

E.2.1.7 Derivation of Combined Investor-Owned and Publicly Owned RPS Multipliers

In those states where there are different RPS requirements for IOUs and POUs (i.e., Colorado, Nevada, and New Mexico), it is necessary to develop a weighted average RPS requirement in order to calculate the amount of electricity that must be derived from renewable resources. Weighted averages were derived by using the relative percentages of IOUs and POUs for historical generation, as shown in Table E.2-5. These derivations are based on 1999 estimates because data for POU sales and total state sales were available for that year.



1 East Central Area Reliability Coordination Agreement (ECAR)
2 Electric Reliability Council of Texas (ERCOT)
3 Mid-Atlantic Area Council (MAAC)
4 Mid-America Interconnected Network (MAIN)
5 Mid-Continent Area Power Pool (MAPP)
6 New York (NY)
7 New England (NE)
8 Florida Reliability Coordinating Council (FRCC)
9 Southeastern Electric Reliability Council (SERC)
10 Southwest Power Pool (SPP)
11 Northwest Power Pool (NWPP)
12 Rocky Mountain Power Area (RMPA)
13 California (CA)

FIGURE E.2-1 EIA Electricity Market Module Regions (Source: EIA 2009a)

TABLE E.2-3 Regional Generation and Electricity Sales Growth Rates

EIA Electricity Market Module Region[a]	RMPA (12)	CA (13)	RMPA (12)	RMPA (12)	RMPA (12)	NWPP (11)
Parameter/state	Arizona	California	Colorado	Nevada	New Mexico	Utah
RPS year	2025	2020	2020	2025	2020	2025
Total regional sales (1,000 GWh)						
In 2007	185	257	185	185	185	223
In RPS year	226	285	209	226	209	263
Average annual regional sales growth rate (%/yr)	1.118	0.799	0.943	1.118	0.943	0.921

[a] CA = California; NWPP = Northwest Power Pool; RMPA = Rocky Mountain Power Area.

Source: EIA (2009b; Tables 82–84) for total regional sales.
Average annual regional sales growth =
$(10^{(\log[\text{total regional sales in RPS year} \div \text{total regional sales 2007}] \div (\text{RPS year} - 2007))} - 1) \times 100$.

TABLE E.2-4 Projected Electric Sales for Each State

EIA Electricity Market Module Region[a]	RMPA (12)	CA (13)	RMPA (12)	RMPA (12)	RMPA (12)	NWPP (11)
Parameter/state	Arizona	California	Colorado	Nevada	New Mexico	Utah
RPS year	2025	2020	2020	2025	2020	2025
Total state sales in 2007 (GWh)	77,193	264,235	51,299	35,643	22,267	27,785
Average annual regional sales growth rate (%/yr)	1.118	0.799	0.943	1.118	0.943	0.921
Years between 2007 and RPS year	18	13	13	18	13	18
Estimated total state sales in RPS year (GWh)	94,295	293,036	57,956	43,540	25,157	32,770

[a] CA = California; NWPP = Northwest Power Pool; RMPA = Rocky Mountain Power Area.

Sources: EIA 2007b for total state sales in 2007 and Table E.2-3 for average annual growth rate.

TABLE E.2-5 Net IOU/POU-Weighted Average RPS Requirements

Parameter	Arizona	California	Colorado	Nevada	New Mexico	Utah
Total state sales (GWh) (1999)	57,662	234,831	40,571	26,253	18,041	21,879
POU sales (GWh) (1999)	NA[a]	NA	11,123	2,264	1,630	NA
Percentage IOU	NA	NA	72.6	91.4	91.0	NA
Percentage POU	NA	NA	27.4	8.6	9.0	NA
Designated RPS year	2025	2020	2020	2025	2020	2025
Primary RPS specifications						
Total renewables (% of sales)	15%	33%	–[b]	–	–	20%
Total renewables for IOUs (% of sales)	–	–	30%	25%	20%	–
Total renewables for POUs (% of sales)	–	–	10%	–	10%	–
Weighted average RPS requirement (% of total state sales)	15%	33%	24.5%	22.8%	19.1%	20%

[a] NA = not applicable. (The relative percentages of POU/IOU generation are only needed for Colorado, Nevada, and New Mexico.)

[b] A dash indicates no standard has been established for this specification.

Sources: EIA (2007c) for total state sales and EIA (1999) for POU sales.

E.2.2 Results

To estimate state-level solar power generation and capacity, several calculations were made: (1) total electricity sales estimates from Table E.2-4 were multiplied by the weighted-average RPS requirements from Table E.2-5 to derive total sales expected to be generated from renewable power sources in the RPS year; (2) electricity sales estimates were translated into generation requirements by applying a uniform factor for line losses and internal use; (3) adjustments were made for Colorado and Utah, where conventional hydroelectric sources qualify for meeting the RPS; (4) resulting electricity sales estimates were multiplied by alternative solar market share assumptions to yield several estimates for the generation to be derived from solar power in each state; and (5) resulting generation levels were translated into capacity estimates by using representative solar capacity factors published by the EIA.

The details for these final steps and the corresponding outcomes are described in the following sections.

E.2.2.1 Electricity Sales and Generation Estimates to Meet State RPS Requirements

Table E.2-6 combines total state sales estimates from Table E.2-4 with the weighted RPS percentages of Table E.2-5, and displays the state-specific results for estimated total renewable electricity sales in the RPS years. The values in the bottom row of Table E.2-6 present the estimated total generation required to satisfy the renewable energy sales, taking into consideration a loss factor of 12.5% to account for internal use and line losses (EIA 2008).

TABLE E.2-6 Estimated Total Renewable Energy Sales and Generation for Each State

Parameter	Arizona	California	Colorado	Nevada	New Mexico	Utah
RPS year	2025	2020	2020	2025	2020	2025
Estimated total state sales in RPS year (GWh)	94,295	293,036	57,956	43,540	25,157	32,770
Weighted average RPS requirement (% of total state sales)	15%	33%	24.5%	22.8%	19.1%	20%
Total estimated renewable energy sales in RPS year (GWh)	14,144	96,701	14,199	9,927	4,805	6,554
Total estimated renewable generation in RPS year (GWh)[a]	15,912	108,789	15,974	11,168	5,405	7,373

[a] Assumed to be 112.5% of the energy sales to adjust for projected internal use and line loss (EIA 2008).

Sources: Table E.2-4 for estimated total state sales in RPS year and Table E.2-5 for weighted average RPS requirement.

E.2.2.2 Adjustments for Hydroelectric Generation

Table E.2-7 shows the adjustments made for two states (Colorado and Utah) that allow conventional hydroelectric generation to contribute to RPSs. The underlying assumption for this adjustment is that a portion of the RPS requirements would be offset by the conventional hydropower generation, assuming it will be delivered in similar magnitudes in future years.

E.2.2.3 Postulated Solar Market Shares

Because of uncertainties and market forces that will shape the long-term trends in solar energy and other renewable technology developments, different scenarios were evaluated to reflect the large range of possibilities. The amount of solar energy generation, relative to other renewable energy generation to meet RPSs, was set at three levels to represent a high-solar scenario (50% solar/50% other renewables), medium-solar scenario (25% solar/75% other renewables), and low-solar scenario (10% solar/90% other renewables).[3] By choosing these types of specific values, a range of alternatives was quantified in terms of the corresponding solar generation and capacity outcomes.

Table E.2-8 shows the estimated solar generation results for each state and for each of the three alternate renewable mix levels. The table also shows the generation that would need to be supplied by other renewable technologies in order to satisfy the overall RPS requirements.

TABLE E.2-7 Net Renewable Generation after Adjustments for Conventional Hydroelectric Power (GWh)

Parameter	Arizona	California	Colorado	Nevada	New Mexico	Utah
RPS year	2025	2020	2020	2025	2020	2025
Total estimated generation in RPS year	15,912	108,789	15,974	11,168	5,405	7,373
Hydroelectric generation in 2007	NA[a]	NA	1,730	NA	NA	539
Total net renewable generation (total minus hydroelectric)	15,912	108,789	14,244	11,168	5,405	6,834

[a] NA = not applicable (these states have provisions excluding conventional hydroelectric generation from RPSs).

Sources: Table E.2-6 for total estimated generation in RPS year and EIA (2007a) for hydroelectric generation in 2007.

[3] The "high," "medium," and "low" labels represent relative magnitudes for the percentage ranges as applied uniformly across the entire study area. These labels do not represent state-specific expectations for solar implementation.

TABLE E.2-8 Solar Generation Needed to Meet RPS Requirements at Selected Market Share Levels

Parameter/State	Arizona	California	Colorado	Nevada	New Mexico	Utah
RPS year	2025	2020	2020	2025	2020	2025
Total net renewable generation (GWh)	15,912	108,789	14,244	11,168	5,405	6,834
Solar generation at alternate renewable mix levels (GWh) (percent of total net renewable generation provided by solar/other renewables)						
50% Solar	7,956	54,394	7,122	5,584	2,702	3,417
50% Other renewables	7,956	54,394	7,122	5,584	2,702	3,417
25% Solar	3,978	27,197	3,561	2,792	1,351	1,708
75% Other renewables	11,934	81,592	10,683	8,376	4,054	5,126
10% Solar	1,591	10,879	1,424	1,117	540	683
90% Other renewables	14,321	97,910	12,820	10,051	4,864	6,151

Source: Table E.2-7 for total net renewable generation.

E.2.2.4 Translation of Solar Generation into Corresponding Capacity Estimates

For purposes of potential impact analysis, the solar generation estimates (GWh) provided in Table E.2-8 were translated into corresponding installed capacity estimates (MWe). This translation is dependent on the annual capacity factor(s) expected for solar technologies. Because the population of solar generators is likely to span a significant range of designs, performance characteristics, electric utility environments, and other factors, the annual capacity factor can vary significantly. To keep this portion of the estimating procedure as straightforward as possible, generic capacity factors projected by EIA through 2030 were adopted and applied to the derivations. For solar PV technologies the capacity factor is 21%, and for solar thermal (ST) technologies the capacity factor is 31% (EIA 2009c).

Two approaches were examined for estimating capacity on the basis of these capacity factors. One approach applied the average capacity factor for PV and ST options of 26% to the generation estimates in Table E.2-8. The other approach applied the assumptions of 21% for PV and 31% for ST to EIA's regional projections for the relative amounts of PV and ST expected for future years (EIA 2009b) to derive a weighted solar capacity factor. Table E.2-9 presents the capacity factors based on these two approaches.

In Table E.2-10, the weighted average capacity factors from Table E.2-9 were applied, in combination with the solar generation estimates in Table E.2-8, to derive estimated solar capacities needed to provide the associated generation levels.

TABLE E.2-9 Average Solar Capacity Factors[a]

Parameter	Arizona	California	Colorado	Nevada	New Mexico	Utah
RPS year	2025	2020	2020	2025	2020	2025
50/50 PV/ST ratio assumption						
PV/ST ratio	50/50	50/50	50/50	50/50	50/50	50/50
Average solar capacity factor	26%	26%	26%	26%	26%	26%
PV/ST ratio from regional EIA projections						
EIA Electricity Market Module Region[b]	RMPA (12)	CA (13)	RMPA (12)	RMPA (12)	RMPA (12)	NWPP (11)
PV/ST ratio[c]	29/71	8/92	32/68	29/71	32/68	70/30
Weighted average solar capacity factor	28.1%	30.2%	27.8%	28.1%	27.8%	24.0%

[a] PV generic capacity factor = 21%, ST generic capacity factor = 31% (EIA 2009c).

[b] CA = California; NWPP = Northwest Power Pool; RMPA = Rocky Mountain Power Area.

[c] Regional PV/ST ratio from EIA (2009b; Tables 98–100).

TABLE E.2.10 Solar Generation and Capacity Needed to Meet RPS Requirements at Selected Market Share Levels

Parameter	Arizona	California	Colorado	Nevada	New Mexico	Utah
RPS year	2025	2020	2020	2025	2020	2025
Total net renewable generation (GWh)	15,912	108,789	14,244	11,168	5,405	6,834
Weighted average solar capacity factor	28.1%	30.2%	27.8%	28.1%	27.8%	24.0%
Solar generation and capacity required at alternate renewable mix levels						
50% Solar						
Solar generation (GWh)	7,956	54,394	7,122	5,584	2,702	3,417
Solar capacity (MWe)	3,232	20,561	2,925	2,268	1,110	1,625
25% Solar						
Solar generation (GWh)	3,978	27,197	3,561	2,792	1,351	1,708
Solar capacity (MWe)	1,616	10,280	1,462	1,134	555	813
10% Solar						
Solar generation (GWh)	1,591	10,879	1,424	1,117	540	683
Solar capacity (MWe)	646	4,112	585	454	222	325

Sources: Table E.2-7 for total net renewable generation, Table E.2-8 for solar generation, and Table E.2-9 for weighted average solar capacity factor. For solar capacity derivations, capacity(MWe) = (generation(GWh) × 1000) ÷ (capacity factor × 8760).

E.2.3 Perspective

For perspective, the outcomes shown in Table E.2-10 are represented in this section as percentages of total estimated sales. The results are also displayed in context with other sources of solar development projections.

E.2.3.1 Results Expressed As Percentages of Total Electricity Sales

Table E.2-11 displays the solar generation estimates as percentages of total future sales (all in the RPS year for a given state). With the exception of California, for the high-solar case (50% solar/50% other), the projected solar generation estimates represent 8 to 12% of total state sales. And for the low-solar case (10% solar/90% other), the projected solar generation estimates represent approximately 2% of total state sales.

For California, the percentages are nearly double those of the other states, with results for the high-solar case (50% solar/50% other) representing 19% of total sales, and 4% for the low-solar case (10% solar/90% other). The reasons California shows significantly higher results are (1) the RPS total renewable requirement of 33% is significantly higher than any of the other states, (2) the "weighted average RPS requirement" as calculated in Table E.2-5 is substantially higher than for the other states, and (3) there are no adjustments for conventional hydroelectric contributions as shown for Colorado and Utah in Table E.2.7.

TABLE E.2-11 RPS Solar Generation Estimates Relative to Total Electricity Sales and Solar-Specific Provisions

RPS Specification	Arizona	California	Colorado	Nevada	New Mexico	Utah
Designated RPS year	2025	2020	2020	2025	2020	2025
Estimated total state sales in RPS year (GWh)	94,295	293,036	57,956	43,540	25,157	32,770
Estimated solar generation (% of total state sales)						
50% Solar case	8.4	18.6	12.3	12.8	10.7	10.4
25% Solar case	4.2	9.3	6.1	6.4	5.4	5.2
10% Solar case	1.7	3.7	2.5	2.6	2.1	2.1

Source: Table E.2-4 for estimated total state sales in RPS year.

Estimated solar generation (as % of total state sales) was calculated as the percentage of total state sales in the RPS year derived from the estimated solar generation presented in Table E.2-10 for each case.

E.2.3.2 Comparisons of Results with Solar-Specific RPS Requirements

For Nevada and New Mexico, the estimates can be compared with the solar-specific RPS specifications (Arizona, California, Colorado, and Utah have not adopted solar-specific RPS requirements). Table E.2-12 displays the results for these comparisons. Because both Nevada and New Mexico assign solar-specific RPS specifications for IOUs (shown in Table E.2-1), the comparisons in Table E.2-12 for these states are expressed as percentages of IOU sales.

For Nevada, the estimated percentages of IOU sales that would be derived from solar generation are larger than the RPS requirement, even in the low-solar case in which solar generation is assumed to provide only 10% of the total renewable needs. This observation does not constitute a contradiction, because the RPS solar-specific specifications represent lower bounds for solar development rather than expected penetration levels or upper bounds. Relative economics of solar and other renewable technology costs, land use issues, tax credits, and a host of other factors will determine the final development levels for each renewable technology.

TABLE E.2-12 Solar Generation Estimates Relative to Solar-Specific RPS Provisions

RPS Specification	Arizona	California	Colorado	Nevada[a]	New Mexico[a]	Utah
Designated RPS year	2025	2020	2020	2025	2020	2025
Estimated total state sales in RPS year (GWh)	94,295	293,036	57,956	43,540	25,157	32,770
Estimated IOU sales in RPS year (GWh)	NA[b]	NA	NA	39,796	22,893	NA
Solar-specific RPS Specifications						
Solar (thermal and PV) (% of sales)	NA	NA	NA	1.5% (IOUs)	4% (IOUs)	NA
Estimated solar generation (percent of IOU sales)[c]						
50% Solar case	NA	NA	NA	14.0	11.8	NA
25% Solar case	NA	NA	NA	7.0	5.9	NA
10% Solar case	NA	NA	NA	2.8	2.4	NA

[a] Comparisons for Nevada and New Mexico are based on IOU sales.

[b] NA = not applicable.

[c] Estimated solar generation (% of IOU sales) was calculated from: Estimated solar generation (%) = (solar generation [from Table E.2-10] ÷ estimated IOU sales in RPS year) × 100.

Source: Estimated IOU sales =
(Estimated total state sales [from Tables E.2-4] × Percentage IOU [from Table E.2-5]) ÷ 100.

For New Mexico, the RPS stipulation for 4% of IOU sales from solar generation falls within the range covered by high-, medium- and low-solar assumptions of this study. The low-solar case (10% solar/90% other) yields a solar penetration of 2.4% of total sales, well below the 4% RPS stipulation. The medium-solar case (25% solar/75% other) results in 5.9% of total sales, slightly higher than the 4% RPS specification. The high-solar case (50% solar/50% other) yields a net result of 11.8% of total sales being supplied by solar generation. As noted for Nevada above, the cases showing higher penetrations of solar than the RPS specifications are not in conflict with the RPS requirements, since those specifications represent minimum requirements rather than expected outcomes.

E.2.3.3 Comparisons with NREL Projections

As another source for comparison, NREL has developed projections for future distributed solar capacity development (i.e., rooftop PV). Table E.2-13 shows how those estimates compare with the range of estimates found in this six-state analysis. While the estimates in this report are for utility-scale applications, the table shows that these estimates fall within the range of NREL's "base-case" results and "technical potential" for distributed rooftop installations. The projection years do not match in these comparisons; they are presented here as a relative indicator for the order of magnitudes of estimates. As might be expected, all of the low-solar utility-scale results (10%-solar) developed in this analysis are higher than the NREL base-case distributed generation results. All of the high-solar utility-scale results (50%-solar) are lower than the technical resource potential as estimated by NREL.

TABLE E.2-13 Solar Capacity Estimates Relative to NREL Projections

Parameter	Arizona	California	Colorado	Nevada	New Mexico	Utah
RPS year	2025	2020	2020	2025	2020	2025
Solar capacity required at alternate renewable mix levels (MWe)						
50% Solar/50% other	3,232	20,561	2,925	2,268	1,110	1,625
25% Solar/75% other	1,616	10,280	1,462	1,134	555	813
10% Solar/90% other	646	4,112	585	454	222	325
NREL distributed capacity – base case (MWe) for 2015	408	3,202	146	203	110	2
NREL distributed capacity – technical potential (MWe) for 2015	19,671	80,798	13,184	9,911	4,549	6,407

Sources: Table E.2-10 for solar capacity at alternate renewable mix levels and Paidipati et al. (2008) for NREL distributed capacity projections.

E.2.3.4 Comparisons with EIA Projections

For additional perspective, Table E.2-14 presents the solar capacity estimates from Table E.2-10 along with regional projections from EIA. Because the EIA projections are not prepared at the state level, it is more difficult to draw any clear conclusions. Table E.2-14, however, provides some degree of benchmarking, at least for general order of magnitude comparisons.

For example, in California (which basically constitutes a separate EIA region), the estimated solar capacities from this analysis (4,112 to 20,561 MWe) are significantly higher than the EIA projections for solar (710 MWe). These differences are reconciled by recognizing that the EIA projection for total renewable capacity (including hydropower) in the California region (21,400 MWe) only represents half of the capacity required to satisfy the total RPS requirement (i.e., roughly 41,500 MWe operating at 30% capacity factor would be needed to generate 109,000 GWh), and that EIA projections for wind and solar combined capacities only account for one-fourth of the capacity needed to meet the RPS in California by 2020.

For states in the Rocky Mountain Power Area (RMPA) (Arizona, Colorado, Southern Nevada, and New Mexico), comparisons with regional projections are somewhat similar to observations for California. In general, the solar capacity estimates derived in this study are significantly higher than shown in the EIA projections. The total renewable capacity estimates

TABLE E.2-14 Solar Capacity Estimates Relative to EIA Projections

Parameter	Arizona	California	Colorado	Nevada	New Mexico	Utah
RPS year	2025	2020	2020	2025	2020	2025
Solar capacity required at alternate renewable mix levels (MWe)[a]						
50% Solar/50% other	3,232	20,561	2,925	2,268	1,110	1,625
25% Solar/75% other	1,616	10,281	1,462	1134	555	812
10% Solar/90% other	646	4,112	585	454	222	325
EIA regional renewable energy capacity projections (MWe)[b]	RMPA	CA	RMPA	RMPA	RMPA	NWPP
Solar	220	710	210	220	210	100
Wind	1,660	10,820	1,660	1,660	1,660	12,140
Hydroelectric	(5,470)[c]	(9,870)[c]	(5,470)[c]	5,470	(5,470)[c]	34,230
Total Solar, Wind, and Hydroelectric	7,350	21,400	7,340	7,350	7,340	46,470

[a] Solar capacity required at alternate renewable mix levels from Table E.2-10.

[b] CA = California; NWPP = Northwest Power Pool ; RMPA = Rocky Mountain Power Area.

[c] Hydroelectric sources must be new and small to contribute to RPS requirements in these states. Most of these capacities do not qualify.

Source: EIA (2009b; Tables 98–100) for regional renewable energy capacity projections.

for the four states sum to more than 19,000 MWe based on RPS requirements. This is more than double the EIA projection of 7,340 MWe for the corresponding RMPA region in 2020. And since three of the four states also require hydroelectric sources to be new and small, subtracting hydropower (5,470 MWe) from the EIA total projected renewables only leaves about 1,870 MWe for nonhydropower sources (i.e., only 10% of the total renewable requirements based on RPS specifications).

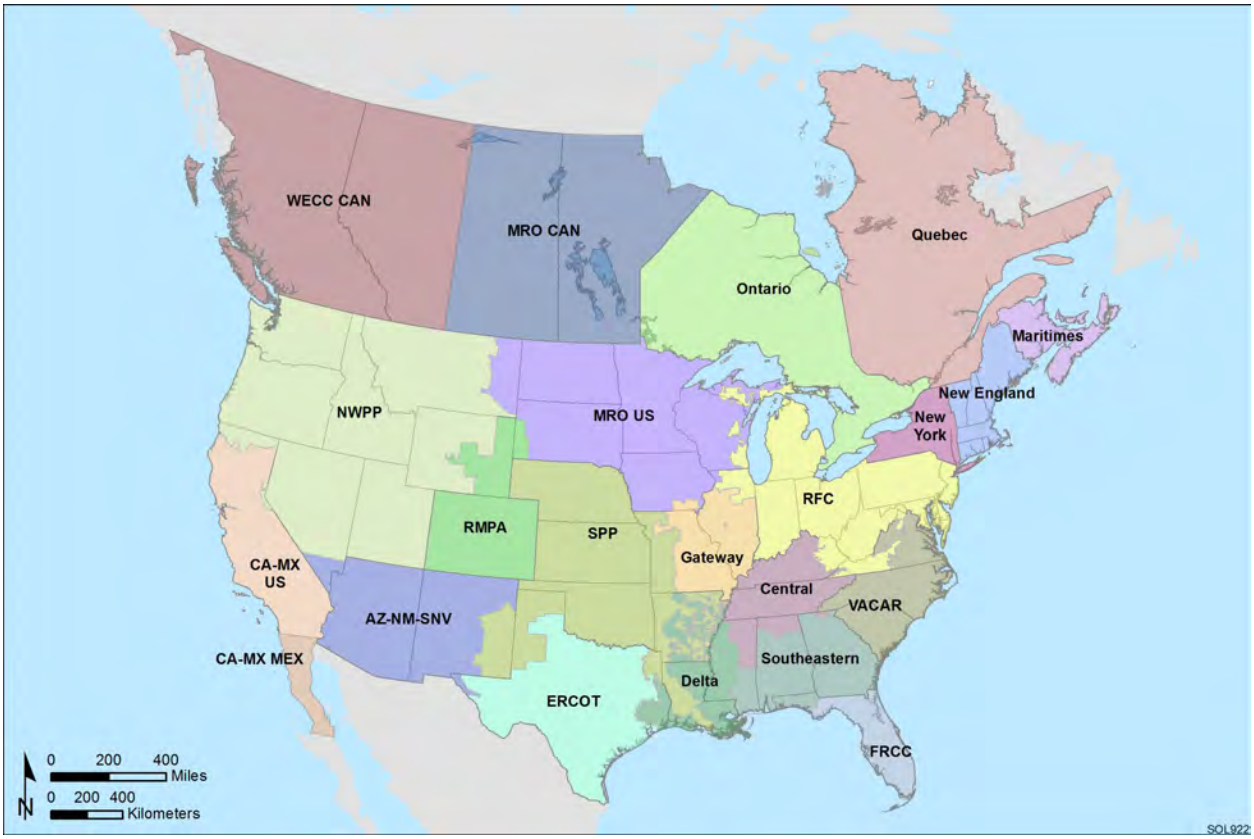
Comparisons for Utah are difficult to make because that state represents only a small portion of the regional totals for the Northwest Power Pool (NWPP). EIA does not publish long-term projections for states or regions smaller than the regions shown in Figure E.2-1.

Across each of the regions, if the EIA total renewable projections were scaled up to match the RPS requirements, the corresponding solar capacity projections would likely fall within the ranges developed for this analysis.

E.2.3.5 Comparisons with NERC Projections

As a final comparison, NERC makes annual assessments and projections of national electric power system adequacy and reliability. As part of its assessments, it has estimated renewable generating capacity expectations on a regional basis; Figure E.2-2 shows the NERC subregions. Table E.2-15 compares the NERC estimates for the regions that overlap the PEIS study area with the results of this RPS capacity analysis. These comparisons are not precise because of the state-level orientation for this analysis and mismatches between the reference years. Nonetheless, the comparisons lend additional perspective to the range of estimates developed in this analysis.

The NERC projections show a total of 16,164 MWe of solar generating capacity to be installed for the entire Western Electricity Coordinating Council (WECC) region (which encompasses all four subregions AZ-NM-SNV, CA-MX, NWPP, and Rocky Mountain Power Area [RMPA]) by the year 2018 (NERC 2009). Most of that capacity, 15,076 MWe, is projected for the CA-MX US subregion, and 1,075 MWe is anticipated for the Arizona-New Mexico-Southern Nevada subregion. These estimates fall well within the ranges prepared for this six-state analysis. For CA-MX US, the NERC estimates are mid-way between the 50% solar and 25% solar scenarios. For Arizona-New Mexico-Southern Nevada, the NERC estimate compares roughly to the combined 10% solar scenario outcomes for those three states in this six-state analysis. The two noteworthy differences are in the NERC estimates for: (1) the Northwest Power Pool (NWPP), and (2) the RMPA. The NWPP region shows zero solar capacity by 2018 in NERC projections. This contrasts with the estimates for Utah in this analysis, which range from a low of 325 MWe to a high of 1,625 MWe. And for RMPA, NERC projections only show 13 MWe by 2018 as contrasted with the low estimate in this analysis for Colorado of 585 MWe.



United States Subregions
AZ-NM-SNV = Arizona, New Mexico, Southern Nevada Subregion
CA-MX US = California-Mexico Subregion – U.S.
Central = Central Subregion
Delta = Delta Subregion
ERCOT = Electric Reliability Council of Texas
FRCC = Florida Reliability Coordinating Council
Gateway = Gateway Subregion
MRO US = Midwest Reliability Organization – U.S.
New England = New England Subregion
New York = New York Subregion
NWPP = Northwest Power Pool
RFC = Reliability First Corporation
RMPA = Rocky Mountain Power Area Subregion
Southeastern = Southeastern Subregion
SPP = Southwest Power Pool
VACAR = Virginia-Carolinas Subregion

Mexico and Canada Subregions
CA-MX MEX = California-Mexico Subregion – Mexico
Maritimes = Maritimes Subregion– Canada
MRO CAN = Midwest Reliability Organization – Canada
Ontario = Ontario Subregion – Canada
Quebec = Quebec Subregion – Canada
WECC CAN = Western Electricity Coordinating Council – Canada

FIGURE E.2-2 NERC Subregions (Sources: NERC 2009 and Platts 2010 [region boundaries])

TABLE E.2-15 Solar Capacity Estimates Relative to NERC Projections

Parameter	Arizona	California	Colorado	Nevada	New Mexico	Utah
RPS year	2025	2020	2020	2025	2020	2025
Solar capacity required at alternate renewable mix levels (MWe)[a]						
50% Solar/50% other	3,232	20,561	2,925	2,268	1,110	1,625
25% Solar/75% other	1,616	10,281	1,462	1,134	555	812
10% Solar/90% other	646	4,112	585	454	222	325
NERC regional solar capacity projections[b] (MWe)	AZ-NM-SNV (2018)	CA-MX US (2018)	RMPA (2018)	AZ-NM-SNV (2018)	AZ-NM-SNV (2018)	NWPP (2018)
Solar	1,075	15,076	13	1,075	1,075	0

[a] Solar capacity required at alternate renewable mix levels from Table E.2-10.

[b] AZ-NM-SNV = Arizona-New Mexico-Southern Nevada; CA-MX US = California-Mexico; NWPP = Northwest Power Pool; RMPA = Rocky Mountain Power Area (Colorado-Eastern Wyoming).

Source: NERC (2009).

E.2.4 Additional Considerations

E.2.4.1 Timelines in RPS Schedules

It is noteworthy that many of the states include additional detail in the compliance schedules. Some (like Arizona) include annual targets beginning upon implementation of the RPS and continuing through the RPS time horizon. Other states (such as California) do not include annual schedules, but do include interim targets for specific years (such as for 2010). These details may have subtle or unpredictable impacts on the ultimate sources of generation adopted to meet the RPS requirements. For utilities that postpone their actions until close to the deadlines, the choices may be limited to technologies with the shortest lead times or stocks of available equipment.

E.2.4.2 Hydroelectric Facility Qualification for Meeting RPS Standards

As noted in Sections E.2.1 and E.2.2, each state has adopted alternative criteria for what technologies can qualify for meeting RPS requirements. For hydroelectric sources, as discussed in Section E.2.1.2, the following gives a brief overview of state-by-state treatments:

- Arizona: Only allows "incremental generations from hydroelectric, …or hydroelectric output used to firm intermittent renewables." Facilities installed before January 1, 1997, are not eligible.

- California: Only "certain" hydro facilities are eligible. For most technologies, facilities must have been installed after September 26, 1996, or represent a small qualifying facility.

- Colorado: Hydroelectric contributions to RPS appear to be unrestricted.

- Nevada: Only "certain" hydroelectric sources qualify.

- New Mexico: Only hydroelectric sources brought on line after July 1, 2007, qualify.

- Utah: Hydroelectric contributions to RPS appear to be unrestricted.

E.3 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this PEIS. It is likely that at the time of publication of this PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this PEIS.

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ATTACHMENT 1:

ReEDS Model Documentation:
Base Case Data and Model Description

ReEDS Model Documentation: Base Case Data and Model Description

Walter Short, Nate Blair, Patrick Sullivan, Matt Mowers
National Renewable Energy Laboratory [1]
1617 Cole Boulevard
Golden, CO 80401
walter_short@nrel.gov
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1. Introduction

The Regional Energy Deployment Systems (ReEDS) model is a multiregional, multitime-period, Geographic Information System (GIS), and linear programming model of capacity expansion in the electric sector of the United States. The model, developed by NREL's Strategic Energy Analysis Center (SEAC), is designed to conduct analysis of the critical energy issues in today's electric sector with detailed treatment of the full potential of renewable electric technologies. The principal issues addressed include access to and cost of transmission, access to and quality of renewable resources, the variability of wind and solar power, and the influence of variability on the reliability of the grid. ReEDS addresses these issues through a highly discretized regional structure, explicit accounting for the variability in wind and solar output over time, and consideration of ancillary services requirements and costs.

1.1. Qualitative Model Description

ReEDS minimizes system-wide costs of meeting electric loads, reserve requirements, and emission constraints by building and operating new generators and transmission in 23 two-year periods from 2008 to 2050. The primary outputs of ReEDS are the amount of capacity and generation of each type of prime mover—coal, natural gas, nuclear, wind, etc.—in each year of each 2-year period. Figure 1 shows an example of ReEDS capacity estimates for the United States for different generation technologies over the 42 year evaluation period.

[1] NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by the Alliance for Sustainable Energy

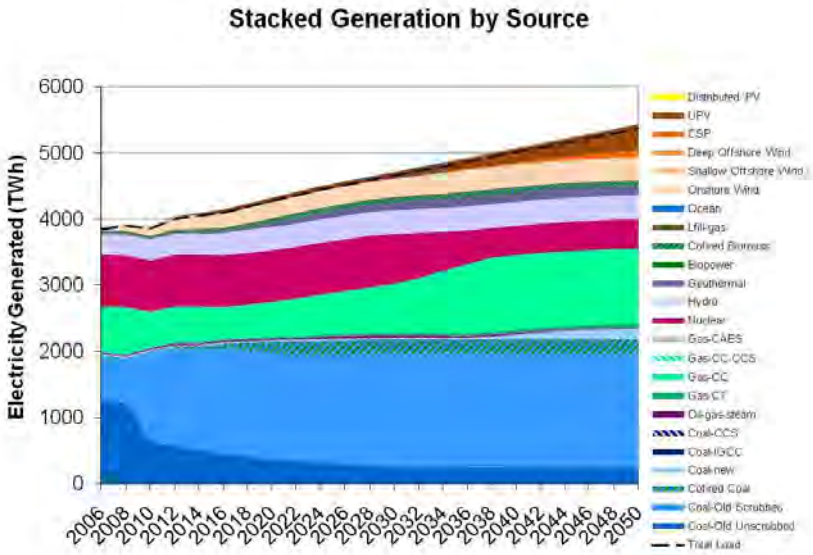


Figure 1. Capacity Buildout in ReEDS

Time in ReEDS is also subdivided within each two-year time period; each year is divided into four seasons, and each season into four diurnal time-slices. There is also one superpeak time-slice. These 17 annual time-slices allow ReEDS to capture the intricacies of meeting electric loads that vary throughout the day and year both with conventional and renewable generators.

While ReEDS includes all major generator types, it has been designed primarily to address the market issues of greatest significance to carbon-constrained scenarios—carbon taxes or caps. As a result, renewable and carbon-free energy technologies are a focus.

Diffuse resources, such as wind and solar power, come with concerns that conventional dispatchable power plants do not have, particularly regarding transmission and variability. The ReEDS model examines these issues primarily by using a much higher level of geographic disaggregation than other models: 356 different regions in the continental United States. These 356 resource supply regions are then grouped into four levels of larger regional groupings—balancing authorities, Regional Transmission Operators (RTO), North American Electric Reliability Council (NERC) regions, and national interconnect regions.

Much of the data inputs to ReEDS are tied to these regions and derived from a detailed GIS model/database of the wind and solar resource, transmission grid, and existing plant data. The geographic disaggregation of renewable resources allows ReEDS to calculate transmission distances, as well as the benefits of dispersed wind farms or solar plants supplying power to a demand region. Both the wind and solar supply curves are broken up into 5 resource classes, based on the quality of the resource—strength and dependability of wind or solar insolation—that are further described in the appropriate sections of this document.

Regarding resource variability and grid reliability, ReEDS also allows electric storage to be built—either co-located with wind farms or sited at load centers—and used for load

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shifting, resource firming, and ancillary services. Three varieties of storage are supported: pumped hydropower, batteries, and compressed air energy storage.

Along with wind and solar power, ReEDS has supply curves for biomass and geothermal resource and allows biopower and geothermal plants to be built in each balancing authority. The geothermal supply curve is in MW of recoverable capacity while the biomass supply curve is in MMBtu of annual feedstock production.

Other carbon-reducing options are considered as well. Nuclear power is an option, as is carbon capture and sequestration (CCS) on some coal and natural gas plants. For now, CCS is treated simply, with only an additional capital cost for the extra equipment and an efficiency penalty to account for the parasitic loads of the separation process. In the future, it is intended that ReEDS will have geographically varying costs for CCS as well as piping and sequestering constraints on the CO2.

The major conventional electricity generating technologies considered in ReEDS include: hydropower; both simple- and combined-cycle natural gas; several varieties of coal; oil/gas steam; and nuclear. These technologies are characterized in ReEDS by their:

- equipment lifetime (years)
- capital cost ($/MW)
- fixed and variable operating costs ($/MWh)
- fuel costs ($/MMbtu)
- heat rate (MMbtu/MWh)
- escalation in operating costs and heat rates with plant aging (%/year)
- construction period (years)
- financing costs
  - (nominal interest rate, loan period, debt fraction, debt-service-coverage ratio)
- tax credits (investment or production)
- minimum turndown ratio (%)
- quick-start capability and cost (%, $/MW)
- operating reserve capability
- planned and unplanned outage rates (%).

Renewable and storage technologies are governed by similar parameters, accounting for fundamental differences, of course. For instance, heat rate is replaced with round-trip-efficiency for storage technologies, and the dispatchability parameters—fuel cost, heat rate, turndown ratio, quickstart, and operating reserve capability—are not used for non-dispatchable wind and solar.

The model includes consideration of distinguishing characteristics of each conventional generating technology. For example, there are several types of coal-fired power plants within ReEDS, including gasification, biomass cofiring, and CCS options. Any of these plants can burn either high-sulfur or, for a cost premium, low-sulfur coal. Generation by coal plants is restricted to be base- and intermediate load with cost penalties (representing ramping/spinning costs) if power production during peak load periods exceeds production in shoulder-peak hours. New coal plants are assumed to be able to provide more spinning reserve capability than older units. Combined-cycle natural-gas plants are considered to be able to provide some operating/spinning reserve and quick-start capability, while simple-cycle gas plants can be cheaply and easily used for reserves and quick-starts. Nuclear power is considered to be base load. Hydroelectricity is not allowed to increase in capacity, due to resource and environmental limitations. Hydropower is also energy-constrained, due to water resource limitations, but is assumed to be able to provide both quick-start capability and operating/spinning reserve.

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Retirements of conventional generation can be modeled either through exogenous specification of planned retirements (currently used for nuclear, hydro, and oil/gas steam plants), economic retirements, or as a fraction of remaining capacity each period. All retiring wind turbines are assumed to be refurbished or replaced immediately—because the site is already developed with transmission access, and the cost of wind energy technology is only getting cheaper while the fuel cost of conventional generation is generally assumed to continue to climb. Similarly, any storage at the wind site is assumed to be replaced immediately upon retirement while grid-sited storage retires automatically when its assumed lifetime has elapsed but is not automatically replaced.

ReEDS tracks emissions from both generators and storage technologies of carbon, sulfur dioxide, nitrogen oxides, and mercury. Caps can be imposed at the national level on any of these emissions. There is also the option of applying a carbon tax instead of a cap; the tax level and ramp-in pattern can be exogenously defined.

ReEDS is a national electric capacity expansion model, not a general equilibrium model. To define each time period of the optimization, the model requires that the scenario be exogenously specified in terms of fuel costs and electric loads for each NERC region over the 44-year time horizon of ReEDS. To allow for the evaluation of scenarios that might depart significantly from the scenario used to develop the input fuel prices and electricity demands, there are price elasticities of demand and demand elasticities of fuel prices integrated into the model. For demand, the exogenously defined demand escalation is adjusted up or down based on the price of electricity; while for coal and natural gas, the price is adjusted based on how the calculated fuel usage compares to the usage assumed in the inputs.

1.2. Linear Program Formulation

This section qualitatively describes the basic LP formulation of ReEDS, followed by additional qualitative detail on transmission and variability.

The objective function in the ReEDS linear program is a minimization of all the costs of the U.S. electric sector including:

- the present value of the cost for both generation and transmission capacity installed in each period
- the present value of the cost for operating that capacity during the next 20 years to meet load, i.e., fixed and variable operation and maintenance (O&M) and fuel costs
- the cost of several categories of ancillary services and storage.

By minimizing these costs while meeting the system constraints (discussed below), the linear program determines which types of new capacity are the most economical to add in each period, in each balancing authority. Simultaneously, the linear program determines what capacity should be dispatched to provide the necessary energy in each of the 17 annual time-slices. Therefore, the capacity factor for each dispatchable technology in each region is an output of the model, not an input.

The cost minimization that occurs within ReEDS is subject to more than 80 different types of constraints, which result in hundreds of thousands of equations in the model (due primarily to the large number of regions). These constraints fall into several main categories, including:

- Resource constraints: The total amount of wind capacity of each type (onshore, offshore shallow, offshore deep) installed in each region, in each wind class must be less than the wind resource potentially available.

  Similarly, the total amount of CSP capacity installed in reach region, in each

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insolation class must be less than the solar resource potentially available; geothermal capacity installed in each balancing authority in each price bin must be less than the recoverable geothermal resource in the area; and annual generation from biofuels—whether in dedicated biomass plants or cofired in coal plants—is constrained by the amount of biomass generated in each balancing authority.

- Transmission constraints: In ReEDS, there are several forms of constraints on transmission of both renewable and conventional generation:
  - General transmission in any given time-slice is constrained by the capacity of all transmission lines between any two balancing authorities.
  - General transmission capacity must also be available to accommodate the transfer of firm power between balancing authorities (these are transfers to ensure adequate capacity is available to meet reserve margin requirements).
  - Wind and CSP transmission on the existing grid is constrained by:
    - The cost to build transmission from the wind/CSP site to the nearest existing transmission line with adequate capacity to carry the expected generation.
    - The total available capacity of all existing transmission lines out of the supply region and into a demand region.
    - The transmission capacity between balancing authorities available for generation from renewable or conventional sources.
  - Wind and CSP can also be transmitted on new transmission lines constructed specifically to carry them. Although these lines are not constrained in ReEDS, the model does include a cost for their construction that varies with the length and capacity of the line, as well as the slope of the terrain in the origination and destination regions, and the population density of those regions. New transmission built for wind and CSP can be constructed between supply/demand regions and/or within a supply region.

- Load constraints: The primary load constraint is that the electric load in each balancing authority (there are 134 of them in ReEDS) must be met in each time-slice throughout a year. While the load in 2008 is based on actual loads in each balancing authority, the annual rate of load growth must be input and is assumed to be uniform over time and within each NERC region.

  There is an option in ReEDS to subdivide certain time-slices in certain regions if there are substantial amounts of both wind and baseload capacity compared to load. The mini-slices are a 20%-60%-20% hourly division and the wind capacity factor is adjusted for the 20% segments to represent those hours when the wind blows most and least. With this, we hope to more closely match the tail of the load-duration curve (Figure 4) by explicitly including hours when load minus wind cuts into baseload generation forcing curtailment of either wind or coal.

Reserve margin constraint: Operating reserve requirements ensure that there is enough responsive demand (interruptible load) and flexible generator capacity (spinning or quick-start capable) online that can be dispatched to meet unanticipated changes in loads and/or power availability. In ReEDS, these requirements must be satisfied in each region transmission operator (RTO) in each timeslice.

The resources that can contribute to these reserve requirements in ReEDS are:

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- ***Spinning reserves:*** Conventional and storage technologies that are generating power can operate below maximum capacity and keep the remainder on reserve. The amount of capacity that may be counted toward the requirements depends on the amount that can be ramped up rather quickly (0-10 minutes).

- ***Quick-start reserves:*** These are technologies that can start up quickly (~10 minutes) from an off state, such as gas-combustion turbines.

- ***Interruptible load:*** Agreements between utilities and consumers that allow partial utility control of demand times.

- Operating reserve constraint: There are three types of operating reserve requirements in the model including:
  - ***Contingency reserve requirement:*** Large power plant failures, for example. Contingency reserve requirements vary by utility, and are approximated as 7% of average time-slice demand in ReEDS. At least half of this requirement must be met by spinning reserves and interruptible load.
  - ***Frequency regulation reserve requirement:*** Rapid fluctuations in demand. In ReEDS, this is approximated as 1.5% of average time-slice demand. Only spinning reserves can be used to meet this requirement.
  - ***VRRE forecasting error reserve requirement:*** fluctuations in wind and PV power output (CSP without storage is considered to have enough thermal inertia (~30 minutes) to not require additional operating reserves). This requirement explained in more detail below. Quick-start reserves can account for up to 5/6 of this requirement in ReEDS. The forecasting error reserve requirements for wind and PV were estimated at 2 standard deviations of the forecast errors. The forecasts for wind were simple hourly persistence forecasts, based on simulated wind power output data for each power class of each ReEDS region. In other words, the wind forecast errors were simply the differences between simulated power output from one hour to the next. Forecasts for PV were based on simulated PV power output for each region from the Solar Advisor Model (SAM). Forecasts for a given hour were estimated as the output from the previous hour plus the average change between those two hours over the previous fifteen days.

- Emissions constraints: At the national level, ReEDS caps the emissions from fossil-fueled generators for sulfur dioxide, nitrogen oxides, mercury, and carbon dioxide. The annual national emission caps and the emissions per MWh by fuel and plant type are inputs to the model.

  In carbon-constrained scenarios, CO2 can be either capped or taxed, and either a cap or tax can be finely adjusted to match proposed legislation.

- RPS constraints: ReEDS allows the user to input Renewable Portfolio Standard (RPS) constraints at either the national or state level. All non-hydroelectric renewable generation counts toward this requirement, a category that includes wind, CSP, geothermal, and biopower (including the biomass fraction of cofiring plants). The RPS can ramp in either

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linearly over time or according to an externally defined profile. A penalty can also be imposed for each MWh shortfall in the nation or state.

1.3. Qualitative Details on Transmission

ReEDS considers the availability of capacity on existing transmission lines, the cost of accessing and using those lines, and the cost of building new transmission lines for new generation (e.g. dedicated to new wind or CSP farms) when existing lines are not available. To determine how much wind or CSP can access existing transmission lines and the cost of building a line from the wind site to the grid, we use a Geographic Information System (GIS) database to develop a four-step supply curve for each class of wind/solar in each supply region that presents the amount of capacity that can access the grid at each of four different costs. (The supply curve is formed of discrete steps, with each step represented by a different variable within the linear program.)

The costs increase with increasing distance from the resource to an existing transmission line that has adequate remaining capacity available to accommodate the generation. Although the lines are usually carrying generation from other sources, at any given instant, they may or may not have the capacity to transmit additional power from new wind or CSP generators. It is practically impossible at the national level to assess the capacity available at any given time on each line in the country. Thus, ReEDS requires that the user input the fraction of the capacity of each line that will be available for wind or CSP; the default fraction is set at 10% for all lines. This transmission availability constraint severely limits the amount of wind or CSP that can be transmitted on existing lines, well below that found in previous studies (Parsons and Wan 1995) that required only that the wind resource be within 20 miles of an existing transmission line.

In addition to the cost of building a line from the wind/CSP site to the grid, ReEDS also allows the user to input a cost for the use of the grid. That cost can be based on the distance the power is transmitted or on the number of power control areas thatthe electricity must pass through (called a "pancake rate").

ReEDS also verifies that the existing transmission lines crossing the border of a supply/demand region have enough capacity to carry the wind and CSP generation into and out of the region. In addition, all generation (that from both renewable and conventional generators) is constrained from flowing between any two balancing authorities in each time-slice by the capacity of lines that connect the two balancing authorities. ReEDS does not account for loop-flows, contingencies, etc. that could further restrict transmission on existing lines.

While new transmission lines dedicated to renewables are not constrained by the remaining transmission capacity available, they do have additional cost. For lines built to serve remote sites, the entire cost of constructing and maintaining a new line is attributed to the wind or CSP capacity at that site. This means that the lines are used only when the wind is blowing (or sun is shining), and their costs must be amortized over that intermittent power. The costs of new transmission lines can vary significantly based on terrain, congestion, labor costs, etc. Currently, ReEDS assumes a single cost for new lines expressed in $/MW-mile, which is increased for rough terrain and population congestion. In the future, we anticipate modifying ReEDS to vary the new transmission line cost per mile with the length of the transmission line and the amount of renewable capacity potentially available within the supply region.

New transmission lines dedicated to wind or CSP can be built either between supply/demand regions as described above or within a region. Dedicated inregion transmission lines are assumed to transport the electricity generation directly from the

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wind/CSP site to a load center within the region, bypassing the transmission grid and connecting to the distribution system within the load center. As with the construction of lines connecting renewables to the grid described above, the GIS is used to develop supply curves for each resource class in each supply region for the cost of building these intraregional transmission lines directly to load centers.

New transmission lines are also built in ReEDS to transmit power from one balancing authority to another. These lines can be accessed by either conventional or renewable generators. ReEDS builds these lines when it is cost-effective and there is a need for more transmission capacity between the balancing authorities in one or more of the 16 time-slices in each year; or when it is needed to ensure capacity reserve margins are met in the different balancing authorities, NERC regions, or interconnection regions.

Transmission losses are modeled in ReEDS as a linear function of the distance the power is transmitted. These losses apply to the transmission of both renewable and conventional generation, and are currently specified in terms of the fraction of power lost per MWh-mile.

1.4. Qualitative Details on Resource Variability

Wind power, because the resource is variable and unpredictable and neither the resource nor the resulting electricity can readily be stored, is complicated to model. ReEDS, in an attempt to capture the peculiarities of wind power, has a detailed, stochastic treatment of wind power that is unique among power sources. Variable resource renewable energy (VRRE) technologies, which include wind, CSP without storage, and distributed and central PV, produce power that is both variable and non-dispatchable. Greater penetrations of these technologies leads to greater levels of curtailment, required operating reserves, as well as potentially more requirements for capacity to fulfill reserve margin requirements. These requirements are explained more in-depth in the following sub-sections.

In ReEDS, the variability of each VRRE technology is derived from simulated hourly power output data. For the solar VRRE technologies, the Solar Advisor Model (SAM) was used to develop hourly power output profiles in each region and, in the case of CSP, for each class. These were used to characterize the standard deviation of power output from the mean output in each of the ReEDS time-slices.

Correlation statistics were also calculated between the power outputs of geographically separated wind, CSP, and PV plants. In general, greater geographic distance between two CSP, PV, or wind plants leads to a lower degree of correlation between power outputs, which decreases the variability of their combined generation. Because of this, all else being equal, ReEDS will choose to separate generators of a given type to reduce variability of the output.

The standard deviations and correlation statistics, along with the capacity factors for each technology in each time-slice, were used in calculations of curtailment, capacity value, and operating reserve requirements, described below.

Electric power demand requirements and VRRE curtailment

In ReEDS, demand requirements must be met in each power control authority (PCA) region in each time-slice. This demand is met through a combination of conventional power generators, renewable generators, storage, and power transmitted from other PCAs.

The expected capacity factors from VRRE technologies in each time-slice cannot be counted in full toward fulfilling demand in, however, since there are certain times that VRRE power

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exceeds that which can be used in the system. This is often due to higher-than-expected VRRE outputs, lower-than-expected electrical demand, transmission constraints, and minimum loading constraints that force other generators to stay online. At these times the generated power is in excess of the demand, and the excess power must be curtailed.

ReEDS estimates expected levels of curtailment induced by VRRE technologies (as a fraction of VRRE generation) for each time-slice in each Regional Transmission Operator (RTO) region through a statistical expected value calculation. This calculation depends on the probability distributions of electrical demand and VRRE output to that RTO, minimum loading requirements of other generators, and the amount of electrical storage, since storage may be used to shift power that would otherwise have been curtailed to times in which the power is needed.

Reserve margin requirements and VRRE capacity value

Reserve margin requirements ensure that adequate generating capacity is available during times of peak demand. In ReEDS, reserve margin requirements must be satisfied in each Regional Transmission Operator (RTO) for the peak demand of each time-slice. The specific reserve margin that must be satisfied depends on the region, and Table 1 shows these requirements by NERC region.

Table 1. Reserve margin requirements (above peak demand) by NERC region

nr1	ECAR	12%
nr2	ERCOT	15%
nr3	MAAC	15%
nr4	MAIN	12%
nr5	MAPP	12%
nr6	NY	18%
nr7	NE	15%
nr8	FL	15%
nr9	STV	13%
nr10	SPP	12%
nr11	NWP	8%
nr12	RA	14%
nr13	CNV	13%

Most generator-types count their full capacity toward the reserve margin requirement. This is also true for CSP systems with storage in ReEDS. This is not the case for VRRE technologies (wind, CSP without storage, and PV). These technologies can contribute no more than their capacity factor (as a fraction of capacity) toward the reserve margin, and most often contribute even less. The amount they contribute is called the "capacity value". To determine the capacity value given to VRRE technologies, a statistical "effective load carrying capability" (ELCC) calculation is performed in ReEDS. The ELCC is the amount of electrical demand that may be added (in MW) in each time-slice for an increase in capacity of a given VRRE technology, without increasing the probability of a loss of load event.

In a given RTO, for a given year, there will be only one time-slice for which the reserve margin requirement is "binding" in ReEDS. In other words, in this time-slice the requirement will be only just met, whereas in the other timeslices the requirement will be exceeded. As

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variable solar penetration increases, as in the Solar Vision scenarios, the binding time-slice often switches from H3 (summer, 1:00pm-5:00pm) to H4 (5:00pm-10:00pm), because the capacity value contribution of variable solar is very high during H3and very low luring H4.

2. ReEDS Base Case Data

This section summarizes the key data inputs to the Base Case of the ReEDS model. The Base Case was developed simply as a point of departure for other analyses to be conducted with the ReEDS model. It does not represent a forecast of the future, but rather is a consensus scenario whose inputs depend strongly on others' results and forecasts. For example, the ReEDS Base Case derives many of its inputs from the EIA's *Annual Energy Outlook* (EIA 2008)—in particular, its fossil fuel price forecasts, and its electric-sector load-growth rates.

2.1. Financials

ReEDS optimizes the build-out of the electric power system based on projected life-cycle costs, which include capital costs and cumulative discounted operating costs over a fixed evaluation period. The "overnight" capital costs are adjusted to reflect the actual total cost of construction, including tax effects, interest during construction, and financing mechanisms. Table 2 provides a summary of the financial values used to produce the net capital and operating costs.

Table 2. Base Case Financial Assumptions

Name	Value	Notes and Sources
Inflation Rate	3%	Based on recent historical inflation rates.
Investment Discount Rate (real)	10.5%	Basecase assumption
rate of return on equity (real)	10.5%	Basecase assumption
interest rate (nominal)	8%	Basecase assumption
loan term (renewables and natural gas)	15 yrs	Basecase assumption
loan term (coal and nuclear)	20 yrs	Basecase assumption
maximum debt fraction	60%	Basecase assumption
Marginal Income Tax Rate	40%	Combined Federal/State Corporate Income Tax Rate.
Evaluation Period	20 years	Base Case Assumption.
Depreciation Schedule:		
Conventionals and Hydropower	15 year	MACRS
Non-Hydro Renewables	5 year	MACRS
Nominal Interest Rate During Construction	10%	Base Case Assumption.

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2.2. Power System Characteristics

2.2.1. ReEDS Regions

There are five types of regions used in the ReEDS model; these are:

- ***CSP/Wind resource regions:*** There are 356 CSP and wind resource regions. This is the level at which CSP and wind capacity expansion occurs.
- ***Power Control Authorities (PCAs):*** There are 134 PCAs. This is the regional level at which demand requirements are set and must be satisfied.
- ***Regional Transmission Operator (RTO) regions:*** There are 20 RTOs. This is the regional level at which reserve margin and operating reserve requirements must be met, and the level at which curtailment is calculated
- ***National Electric Reliability Council (NERC) regions:*** There are 13 NERC regions, defined in Table 3. This is the regional level at which most fuel costs are adjusted.
- ***Interconnect regions:*** There are three major interconnects in the United States: The Eastern Interconnect, Western Interconnect, and the ERCOT (Electric Reliability Council of Texas) Interconnect. Transmission capacity must pay an additional cost to cross interconnect boundaries.

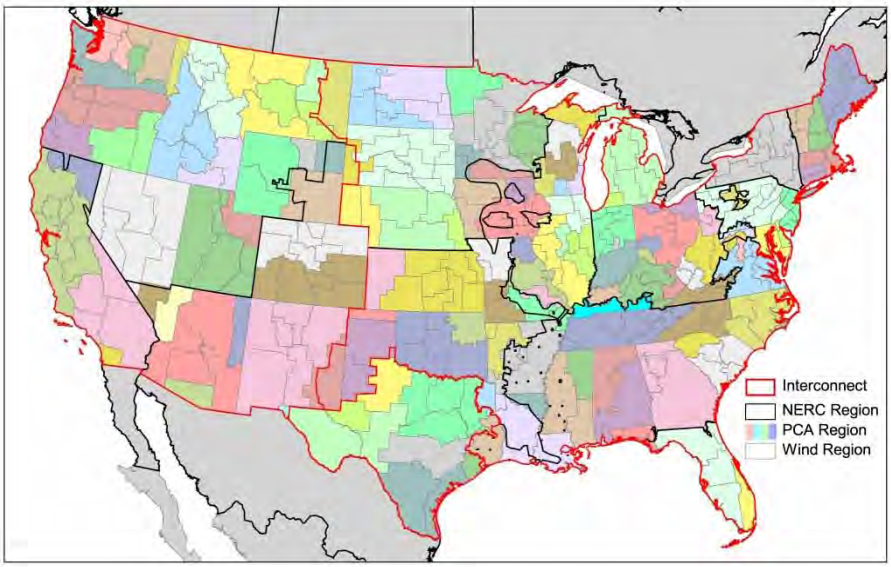


Figure 3. Regions used in ReEDS

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Table 3. NERC Regions Used in ReEDS

Number	Abbreviation	Region Name
1	ECAR	East Central Area Reliability Coordination Agreement
2	ERCOT	Electric Reliability Council of Texas
3	MAAC	Mid-Atlantic Area Council
4	MAIN	Mid-America Interconnected Network
5	MAPP	Mid-Continent Area Power Pool
6	NY	New York
7	NE	New England
8	FRCC	Florida Reliability Coordinating Council
9	SERC	Southeast Reliability Council
10	SPP	Southwest Power Pool
11	NWP	Northwest
12	RA	Rocky Mountain Area
13	CNV	California/Nevada

Note: NERC regions in ReEDS are based on the pre-2006 regional definitions defined by the EIA (2008c). In January 2006, NERC regions were redefined. The EIA has not incorporated these changes through publication of AEO 2008; therefore, ReEDS will continue to use pre-2006 definitions until the EIA modifies its data. Similarly, some of the recent changes to balancing area boundaries (now referred to as balancing authorities) are not yet reflected in ReEDS (e.g. the formation of the Texas Regional Transmission Organization) but will be when the NERC regions are updated.

Interconnects, NERC regions, RTOs, and balancing authorities are defined by various regulatory agencies (see Table 3 for a definition of NERC regions). Wind Resource Regions were created specifically for the ReEDS model. The regions have been selected using the following rules and criteria:

- Build up from counties (so that electric load can be determined for each wind supply/demand region based on county population).
- Avoid crossing state boundaries (so that state-level policies can be modeled).
- Conform to balancing areas as much as possible (to better capture the competition between wind and other generators).
- Separate concentrations of wind and solar resource from load centers where possible (so that the distance from a wind resource to a load center can be better approximated).
- Conform to NERC region/subregion boundaries (so that the results are comparable to results produced by integrating models that use the NERC regions/subregions).

A detailed map with all resource regions and balancing authorities is provided in Figure 3. The need for multiple levels of geographical resolution is based on several different components of the ReEDS model. For example, load growth rates are based on data from the NERC region level, while wind-generator performance is modeled at the wind-resource region level. The use of these various regions is discussed in further detail in Section 3.

2.2.2. Electric System Loads

Loads are defined by region and by time-slice. ReEDS meets both the energy requirement and the power requirement for each of the 134 balancing areas. Load requirements are set for each balancing authority in each of 16 time-slices, for each year modeled by ReEDS. Table 4 defines these time-slices.

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Table 4. ReEDS Demand Time-Slice Definitions

Slice Name	Hours Per Year	Season	Time Period
H1	736	Summer	10:00 p.m. to 6:00 a.m.
H2	644	Summer	6:00 a.m. to 1:00 p.m.
H3	328	Summer	1:00 p.m. to 5:00 p.m.
H4	460	Summer	5:00 p.m. to 10:00 p.m.
H5	488	Fall	10:00 p.m. to 6:00 a.m.
H6	427	Fall	6:00 a.m. to 1:00 p.m.
H7	244	Fall	1:00 p.m. to 5:00 p.m.
H8	305	Fall	5:00 p.m. to 10:00 p.m.
H9	960	Winter	10:00 p.m. to 6:00 a.m.
H10	840	Winter	6:00 a.m. to 1:00 p.m.
H11	480	Winter	1:00 p.m. to 5:00 p.m.
H12	600	Winter	5:00 p.m. to 10:00 p.m.
H13	736	Spring	10:00 p.m. to 6:00 a.m.
H14	644	Spring	6:00 a.m. to 1:00 p.m.
H15	368	Spring	1:00 p.m. to 5:00 p.m.
H16	460	Summer	5:00 p.m. to 10:00 p.m.
H17	40	Summer	40 highest demand summer hours

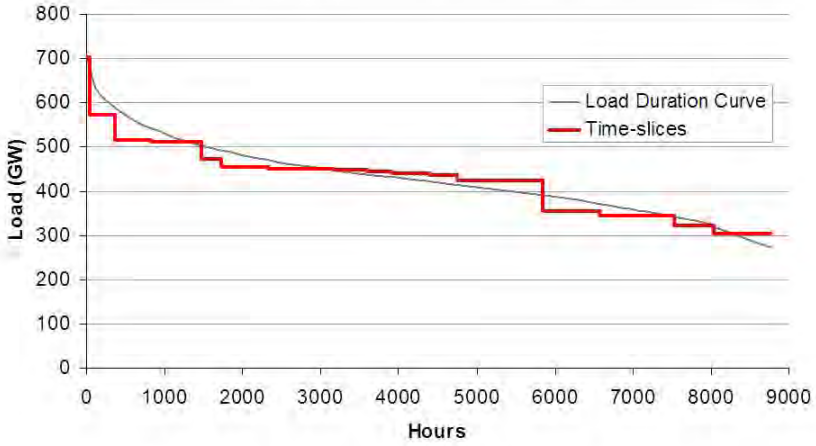


Figure 4. National Load Duration Curve in ReEDS

The electric load in 2006 for each balancing authority and time-slice is derived from the Platts Energy Markets database (2006). Figure 4 illustrates the ReEDS load duration curve for the entire United States for the base year, illustrating the 17 load time-slices. As a reference, the actual U.S. coincident load duration curve—also derived from the Platts database—is depicted in the figure as well. The aggregated data for the United States that are

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shown in Figure 4 are not used directly in ReEDS, as the energy requirement is met in each balancing area. This curve does, however, give a general idea of the ReEDS energy requirement.

2.2.3. Growth Rate

Load growth rates are taken from AEO forecasts at the NERC region level. Loads in all balancing areas within each NERC region are assumed to grow at the same rate to 2050 for the baseline, though demand elasticities are applied to the growth rate based onelectricity price (see Appendix 6). Table 5 contains the 2006 load and annual growth rates for each NERC region. ReEDS assumes that the growth rate in each time-slice is constant; i.e. the load shape remains the same throughout time.

The peak reserve margin for each RTO is provided in Table 4. The reserve margin fraction is ramped from its actual value in 2006 to the 2010 requirement, and is maintained at the 2010 level thereafter. It is assumed that energy growth and peak demand grow at the same rate, and the load shape stays constant from one year to the next.

Table 5. Base Load and Load Growth in the ReEDS Base Case

NERC Region/Subregion		2006 Load (TWh/year) 1	Annual Load Growth (%) 2	Reserve Margin (%) 3
1	ECAR	553	0.7	12
2	ERCOT	323	1.0	15
3	MAAC	292	0.6	15
4	MAIN	274	0.6	12
5	MAPP	165	0.8	12
6	NY	159	0.3	18
7	NE	142	0.7	15
8	FL	228	1.1	15
9	SERC	920	1.0	13
10	SPP	202	0.6	12
11	NWP	278	0.8	08
12	RA	158	1.3	14
13	CNV	315	1.1	13

[1] (Platts 2006). [2] (EIA 2008). [3] (PA Consulting Group 2004)

2.2.4. Capacity Requirements

For each RTO, ReEDS requires sufficient capacity to meet the peak instantaneous demand throughout the course of the year, plus a peak reserve margin. The reserve margin requirement can be met by any generator type, although the generator must have the appropriate capacity value. In the cases of wind and solar power, the actual capacity value is a minority fraction of the nameplate capacity.

2.3. Wind

2.3.1. Wind Resource Definition

Wind power classes are defined as in Table 6. Wind power density and speed are not

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used explicitly in ReEDS. Instead, the different classes of wind power are distinguished in ReEDS through the resource levels, capacity factors, turbine costs, etc., all of which are discussed below.

Table 6. Classes of Wind Power Density

Wind Power Class	Wind Power Density (W/m^2)	Speed (m/s)
3	300-400	6.4-7.0
4	400-500	7.0-7.5
5	500-600	7.5-8.0
6	600-800	8.0-8.8
7	>800	>8.8

Note: Wind speed measured at 50 m above ground level
Source: Elliott and Schwartz (1993)

A map of wind resource by class is shown in Figure 5. The supply curve used in ReEDS includes both onshore and offshore wind resources and distinguishes between shallow and deep offshore wind turbines. Shallow-water turbines are assumed to have lower initial costs than deep offshore turbines, because they employ a solid tower with an ocean bottom pier; while deep-water turbines are assumed to be mounted on floating platforms tethered to the ocean floor.

These different classes and types of wind have different costs and performance characteristics. Generally, the higher wind class sites (i.e. Class 7) are the preferred sites. However, in selecting the installation sites, ReEDS considers not only the resource quality, but also includes factors such as transmission availability, costs, and losses; correlation of the wind output with neighboring sites; environmental exclusions; site slope; and population density. As a result, in any given period, the wind turbines installed will be at a mix of sites with different wind resource classifications.

2.3.2. Wind Resource Data

The wind-resource dataset for the ReEDS model is based on separate sets of supply curves for each of onshore, shallow offshore, and deep offshore. This regional wind-resource dataset is generated by multiplying the total available area of a particular wind resource by an assumed wind-farm density of 5 MW/km^2 (NREL 2006). The amount of land available for each class is based on a dataset for each of the 356 resource regions for onshore, shallow offshore, and deep offshore.

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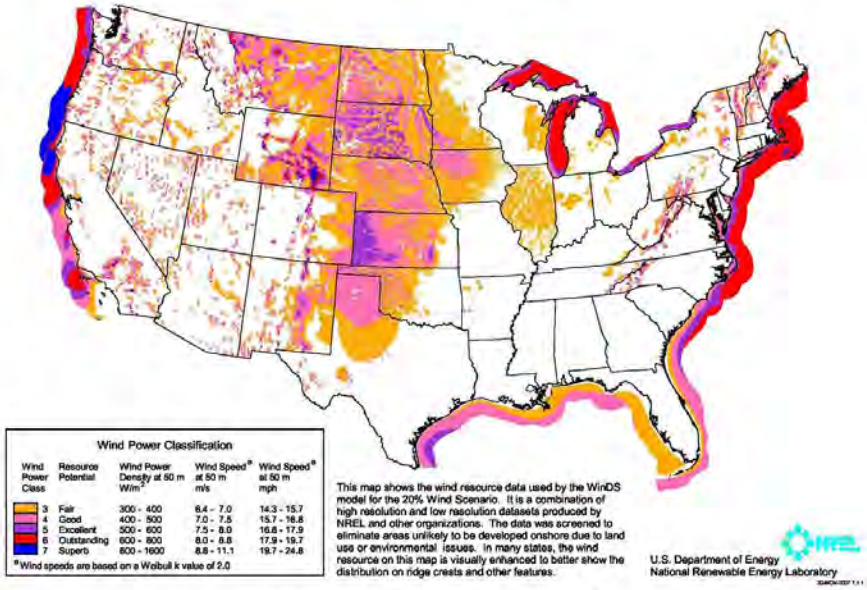


Figure 5. Wind Resource in ReEDS

2.3.3. Wind Technology Cost and Performance

ReEDS considers five power classes of wind, shown in Table 7, based on wind power density and wind speed.

Table 7. Classes of wind power density

Wind Class	Wind Power Density, W/m2	Speed, m/s
1	5-6.25	6.4-7.0
2	6.25-7.25	7.0-7.5
3	7.25-7.5	7.5-8.0
4	7.5-7.75	8.0-8.8
5	>7.75	>8.8

Notes: W/m^2 = watts per square meter; m/s = meters per second. Wind speed measured at 50 m above ground level.
Source: Elliott and Schwartz (1993)

Available land area of each wind class in each CSP/wind resource region is derived from state wind resource maps and modified for environmental and land-use exclusions. These maps are the most recent available from the Wind Powering America (WPA) initiative (EERE) and individual state programs. The maps depict estimates of the wind resource at 50 m above the ground. The available wind area is converted to available wind capacity using

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the constant multiplier of 5 MW/km^2.

Wind cost and performance parameters were developed by Black and Veatch in conjunction with the Renewable Electricity Futures (REF) study, and are shown in Table 8. Capacity factor adjustments by timeslice were made for each class of each region, derived from AWST text supplemental database files and the National Commission on Energy Policy/National Center for Atmospheric Research (NCEP/NCAR) global reanalysis mean values (Kalnay et al. 1996).

Table 8. Land-based wind technology cost and performance projections

		capital costs ($/kW)	fixed O&M ($/kW-yr)	variable O&M ($/MWh)	capacity factor (%)
onshore wind	2010	1980	59.4	0	0.32-0.46
	2030	1980	59.4	0	0.35-0.46
	2050	1980	59.4	0	0.35-0.46
(fixed bottom) offshore wind	2010	3310	99	0	0.36-0.50
	2030	2990	99	0	0.38-0.50
	2050	2990	99	0	0.38-0.50

In each CSP/wind resource region, a supply curve for cost of connecting the wind resource to the existing grid, as well as to local demand centers, was developed from GIS data of the resource, existing grid, and demand centers. In these supply curves, the availability of the existing grid was limited to 10%. Wind resource was also allowed to connect to the grid at a cost equivalent to construction of a transmission line from the center of the respective CSP/wind region to the demand center* of the larger Power Control Authority (PCA) region.

2.4. Solar Power

2.4.1 Solar PV

There are three PV technologies modeled in ReEDS, listed here.

- Central PV
- Distributed Wholesale PV
- Distributed PV

Each of these technologies is described in its own section.

2.4.1.1: Central PV

Costs for Central PV derived from the DOE Solar Program, shown in table 9. The costs represent 100 MW systems. Linear interpolations on the costs are used for the intermediate years.

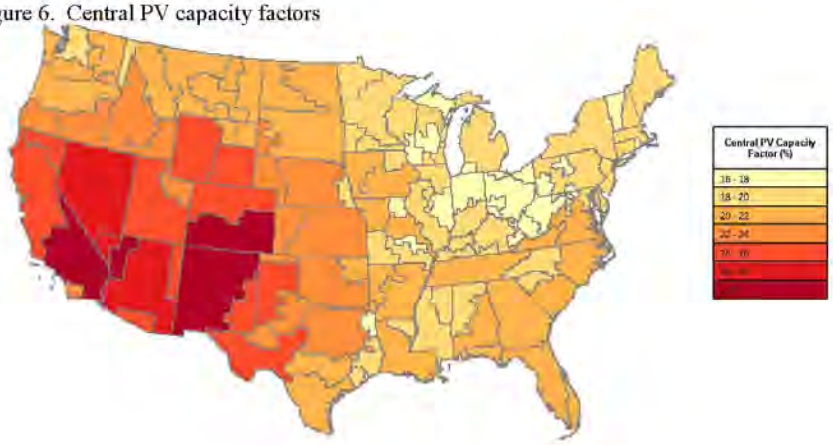
Table 9. Central PV technology cost projections

		capital costs ($/kW)	fixed O&M ($/kW-yr)	variable O&M ($/MWh)	capacity factor (%)	heat rate (MMBtu/MWh)
utility-scale (1-axis) PV	2010	2940	36.6	0	0.16-0.28	n/a
	2030	2310	29.8	0	0.16-0.28	n/a
	2050	2030	24.3	0	0.16-0.28	n/a

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Performance characteristics for Central PV were developed with the PV module of the Solar Advisor Model (SAM) using weather TMY files located at all TMY3 stations throughout the contiguous United States. The TMY site that had the highest predicted annual capacity factor in each ReEDS Power Control Authority (PCA) region was used to represent the performance of a Central PV plant in that PCA (i.e. capacity factors in each time-slice). A map of the resulting annual capacity factors for Central PV by PCA is shown in Figure 6.

Figure 6. Central PV capacity factors



2.4.1.2: Distributed Wholesale PV

Distributed wholesale PV in ReEDS represents utility-scale systems (~50 MW) that are located within and directly connected to distribution networks. Capacity of these systems is limited to less than 15% of the distribution network capacity. Costs for distributed wholesale PV are an estimated 8.5% higher than Central PV costs (Black and Veatch), shown in table 10. Linear interpolations on the costs are used for the intermediate years. Partly offsetting this additional cost, interconnection fees for distributed wholesale PV are an estimated 100$/kW less than those for central PV.

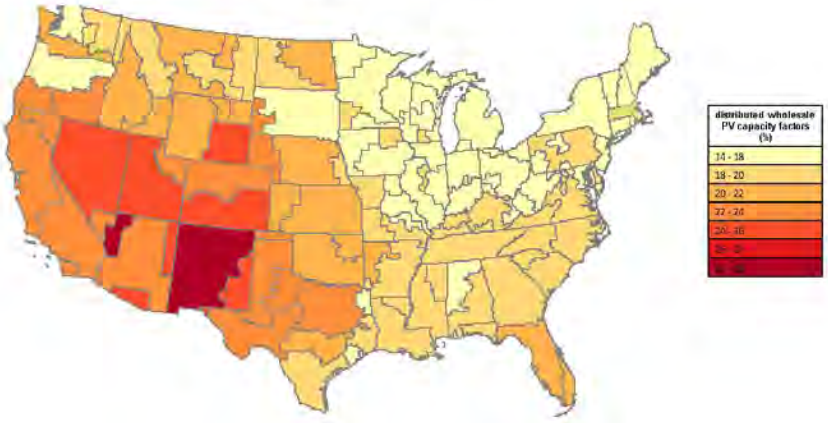
Table 10. Distributed wholesale PV technology cost projections

		capital costs ($/kW)	fixed O&M ($/kW-yr)	variable O&M ($/MWh)	capacity factor (%)	heat rate (MMBtu/MWh)
commercial rooftop PV	2010	4790	34.7	0	0.10-0.18	n/a
	2030	2960	28.2	0	0.10-0.18	n/a
	2050	2620	23	0	0.10-0.18	n/a

Similar to central PV, performance characteristics for distributed wholesale PV were developed with the PV module of the Solar Advisor Model (SAM) using weather TMY files located at all TMY3 stations throughout the contiguous United States. The average power output across all TMY sites in each ReEDS Power Control Authority (PCA) region was used to represent the performance of a distributed wholesale PV plant in that PCA (i.e. capacity factors in each time-slice). A map of the resulting annual capacity factors for distributed wholesale PV by PCA is shown in Figure 7. Note that the distribution losses that apply to central technologies (estimated at 5.3%) as well as transmission losses do not apply to distributed wholesale PV.

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Figure 7. Distributed Wholesale PV capacity factors



2.4.1.3: Distributed Rooftop PV
Capacity expansion of distributed rooftop PV is handled in SolarDS (a secondary model for residential PV market penetration) and is passed exogenously into ReEDS. Capacity factors of distributed rooftop PV in each ReEDS time-slice reflect the mix of orientations built in SolarDS within each ReEDS PCA. As with distributed wholesale PV, distribution losses (estimated at 5.3%) and transmission losses that apply to central technologies do not apply to distributed rooftop PV.

2.4.2: Concentrating Solar Power (CSP)
There are three CSP technologies modeled in ReEDS, listed here:

- Troughs with no storage
- Troughs with at least 5 hours storage
- Towers with at least 5 hours storage

The particulars of each technology are discussed more in-depth in individual sections.

2.4.2.1 CSP Resource
ReEDS considers five power classes of CSP, shown in table 11, based on direct normal insolation (DNI) (Perez). Available land area of each CSP class in each CSP/wind resource region was limited to area with less than 3% slope.

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Table 11. CSP power classes

CSP Class	Insolation (kWh/m2/day)
1	5-6.25
2	6.25-7.25
3	7.25-7.5
4	7.5-7.75
5	>7.75

In each CSP/wind resource region, a supply curve for cost of connecting the CSP resource to the existing grid, as well as to local demand centers, was developed from GIS data of the resource, existing grid, and demand centers. In these supply curves, the availability of the existing grid was limited to 10%. CSP resource was also allowed to connect to the grid at a cost equivalent to construction of a transmission line from the center of the respective CSP/wind region to the demand center* of the larger Power Control Authority (PCA) region.

CSP performance for each CSP power class was developed using a single site's typical DNI year (TDY) hourly resource data from each CSP/wind resource region (selected by hand, as close as possible to the center of the resource of that class in the region). The TDY weather files were processed through the CSP modules of the Solar Advisor Model (SAM) for each type of CSP system considered in ReEDS. From this, capacity factors for each ReEDS class in each ReEDS time-slice were developed.

Additionally, a variety of exclusions are applied to the solar resource if the slope exceeds 1%, average annual radiation is less than 6.75 kWh/m2/day, the area is a major urban or wetland area or a protected federal land. If the remaining resource lands are less than 5 contiguous sq. km, they are excluded. Figure 8 maps the location of the solar resource that is used within ReEDS.

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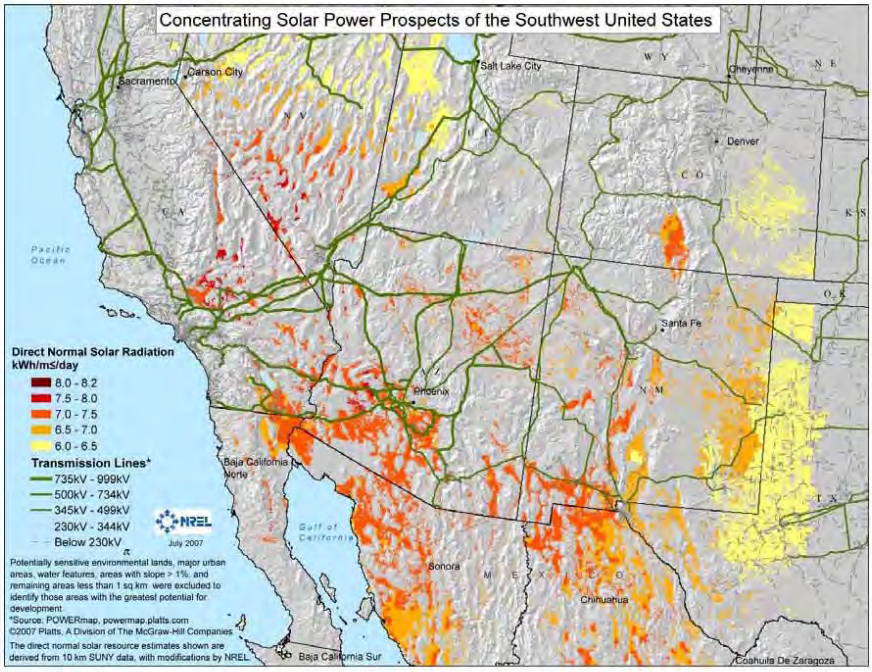


Figure 8. Solar Resource in ReEDS

2.4.2.2: CSP without storage

The CSP system without storage in ReEDS was represented as a trough with a solar multiple of 1.4. Cost projections were developed by the DOE solar program, and are shown in table 12. Linear interpolations on the costs are used for the intermediate years.

Table 12. CSP without storage technology cost projections

		capital costs ($/kW)	fixed O&M ($/kW-yr)	variable O&M ($/MWh)	capacity factor (%)	heat rate (MMBtu/MWh)
concentrated solar power (no storage)	2010	4910	49.5	0	0.19-0.29	n/a
	2030	4170	49.5	0	0.19-0.29	n/a
	2050	3490	49.5	0	0.19-0.29	n/a

Performance characteristics for CSP without storage were developed with the CSP module of the Solar Advisor Model (SAM), configured with a 100 MW turbine and solar multiple of 1.4, using the weather TDY files located at the hand-picked sites of each class in each CSP/wind region. The average power output across all sites of each class was used to represent the performance of a CSP plant with no storage of that particular class (i.e., capacity factors in each time-slice). The average annual capacity factors of each class are shown in table 13.

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Table 13. CSP without storage average annual capacity factors for each class

CSP Class	Average CF
1	0.20
2	0.26
3	0.29
4	0.30
5	0.31

2.4.2.3: CSP with storage

There are two CSP-with-storage systems represented in ReEDS. Troughs with at least 5 hours of storage, and towers with at least 5 hours of storage. Only troughs are allowed to be built before 2020, and only towers are allowed to be built after 2020.

In ReEDS, each CSP-with-storage system is represented by three separate components: the field (collectors), storage, and turbine (power block). Systems are allowed to have variable solar multiples and variable amounts of storage, within boundaries discussed later. These systems are allowed to dispatch optimally, under the restriction that they abide by the appropriate energy balance between the components, i.e. that the energy in storage at the end of a time-slice is equal to the energy in storage at the beginning of the time-slice plus the energy input from the field (collectors) during the time-slice minus the energy output to the grid during the time-slice.

Capacity factors by time-slice of with-storage CSP systems in ReEDS are an output of the model, not an input, since ReEDS is allowed to dispatch CSP plants optimally. Instead, the profile of power input from the collectors (field portion) of the with-storage CSP plants are the inputs, and these profiles were developed with the CSP module of the Solar Advisor Model (SAM), using the weather TDY files located at the hand-picked sites of each class in each CSP/wind region. Profiles were averaged across all sites of a given class to represent performance of the field portion of the CSP-with-storage systems for each class. In ReEDS, input from the field is then scaled with the solar multiple of the CSP plant.

The CSP-with-storage system configurations must abide by a few restrictions. First, both systems must have at least 5 hours of storage and at least a 40% capacity factor. Under this restriction, these systems are given full capacity credit. These systems are also restricted to capacity factors of less than 70% and solar multiples of less than 3.4 for troughs and 2.7 for towers, as hourly and sub-hourly curtailment effects (which are not captured well by the broad ReEDS time-slices) become significant at these higher solar multiples. SAM was used to develop a linear relationship between required hours of storage and solar multiple, displayed here for troughs and towers:

Troughs: (Hours of storage) > 6.4*(Solar multiple) – 7.9
Towers: (Hours of storage) > 7.8*(Solar multiple) – 8

Average annual capacity factors for example CSP-with-storage systems are shown in table 14.

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Table 14: Average annual capacity factors for CSP-with-storage example trough and tower systems.

CSP Class	Trough SM=2, 5 hrs	Tower SM =2.45, 11 hrs
1	0.29	0.45
2	0.37	0.59
3	0.42	0.64
4	0.44	0.67
5	0.46	0.70

Costs for CSP systems with storage are shown in Table 15 and are higher (as well as capacity factors) than CSP troughs with no storage.

Table 15 Costs for CSP systems with storage

		capital costs ($/kW)	fixed O&M ($/kW-yr)	variable O&M ($/MWh)	capacity factor (%)	heat rate (MMBtu/MWh)
concentrated solar power (6 hrs storage)	2010	7060	49.5	0	0.27-0.43	n/a
	2030	5310	49.5	0	0.35-0.54	n/a
	2050	4700	49.5	0	0.35-0.54	n/a

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2.5. Conventional Generation

2.5.1. Generator Types

Available generator types that may be built are based on the most likely types as determined by the DOE Energy Information Administration (EIA 2008a). The generator types, with shorthand notation, are as follows:

- Conventional hydropower, hydraulic turbine — Hydro
- Natural gas combustion turbine — Gas-CT
- Combined cycle gas turbine — Gas-CC
- Combined cycle gas turbine with carbon capture and sequestration (CCS) — Gas-CCS
- Conventional pulverized coal steam plant (no SO2 scrubber) — CoalOldUns
- Conventional pulverized coal steam plant (with SO2 scrubber) — CoalOldScr
- Conventional pulverized coal steam plant (with SO2 scrubber and biomass cofiring) — CofireOld
- Advanced supercritical coal steam plant (with SO2 and NO2 controls) — CoalNew
- Advanced supercritical coal steam plant (with biomass cofiring) — CofireNew
- Integrated gasification combined cycle (IGCC) coal — Coal-IGCC
- IGCC with carbon capture and sequestration (CCS) — Coal-CCS
- Oil/gas steam turbine — OGS
- Nuclear plant — Nuclear
- Municipal solid waste/landfill gas plant — MSW
- Biomass gasification plant — Biomass
- Geothermal plant — Geothermal

Several adjustments are applied to the capital cost, including financing, interest during construction, learning, and rapid growth. In the Base Case, financing is not treated explicitly[3]. It is assumed to be captured by the real discount rate of 8.5%, which is a weighted cost of capital. As the capital costs of conventional technologies are acquired from Black & Veatch and have already been adjusted for learning, no additional learning is assumed for these technologies in the Base Case.

Interest during construction can increase the effective capital cost for each technology. Table 16 indicates the construction time and schedule for each conventional technology. Lifetimes for conventional generating facilities are used for retirement calculations, not as a financial evaluation period (the evaluation period is 20 years for all technologies).

[3]A full range of financing options are built into the model as detailed in Appendix 10.

Table 16. Construction Parameters for Conventional Generation

Plant Type	New Builds in REEDS?	Construction Time (years)	Construction Schedule (Fraction of cost in each Year)						Lifetime (years)
Hydro	No	NA	-	-	-	-	-	-	100
Gas-CT	Yes	3	0.8	0.1	0.1	-	-	-	30
Gas-CC	Yes	3	0.5	0.4	0.1	-	-	-	30
Gas-CCS	Yes	3	0.5	0.4	0.1	-	-	-	30
CoalOldUns	No	NA	-	-	-	-	-	-	60
CoalOldScr	No	NA	-	-	-	-	-	-	60
CofireOld	No	NA	-	-	-	-	-	-	60
CoalNew	Yes	4	0.4	0.3	0.2	0.1	-	-	60
CofireNew	Yes	4	0.4	0.3	0.2	0.1	-	-	60
Coal-IGCC	Yes	4	0.4	0.3	0.2	0.1	-	-	60
Coal-CCS	Yes	4	0.4	0.3	0.2	0.1	-	-	60
OGS	No	NA	-	-	-	-	-	-	50
Nuclear	Yes	6	0.1	0.2	0.2	0.2	0.2	0.1	30
MSW	No	NA	-	-	-	-	-	-	30
Biomass	Yes	4	0.4	0.3	0.2	0.1	-	-	45
Geothermal	Yes	4	0.4	0.3	0.2	0.1	-	-	20

ReEDS considers the outage rate when determining the net capacity available for generation described among the calculations in Section 4, and in determining the capacity value of each technology. Planned outages are assumed to occur in all seasons except the summer. Table 17 provides the outage rate for each conventional technology (NERC 2008). Emission rates are estimated for SO2, NOx, Mercury (Hg), and CO2. Table 17 provides the input emission rates (lbs/MMBtu of input fuel) for plants that use combustible fuel. Output emission rates (lb/MWh) may be calculated by multiplying input emission rate by heat rate.

Table 17. Outage rates, minimum plant loading requirements, and emissions rates of conventional technologies in ReEDS.

	Forced Outage	Planned Outage	Minimum Plant Loading	Emission Rates (lbs/MMBtu fuel SO2	NOx	Hg	CO2
Hydro	0.05	0.02	0.55	0	0	0	0
Gas-CT	0.03	0.05	0.00	0.0006	0.08	0	122
Gas-CC	0.04	0.06	0.00	0.0006	0.02	0	122
CoalOldScr	0.06	0.10	0.40	0.157	0.448	4.6E-06	204
CoalOldUns	0.06	0.10	0.40	1.57	0.448	4.6E-06	204
CoalNew	0.06	0.10	0.40	0.0785	0.02	4.6E-06	204
Coal-IGCC	0.08	0.12	0.50	0.0184	0.02	4.6E-06	204
OGS	0.10	0.12	0.40	0.026	0.1	0	122
Nuclear	0.04	0.06	1.00	0	0	0	0
Geothermal	0.13	0.02	0.90	0	0	0	0
Biomass	0.09	0.08	0.40	0.08	0	0	0
CofireOld	0.07	0.09	0.40	0.157	0.448	4.6E-06	204
CofireNew	0.07	0.09	0.40	0.0785	0.02	4.6E-06	204
lfill-gas	0.05	0.05	0.00	0	0	0	-157

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Sources and Notes on Emissions:

1. SO2 emissions result from the oxidization of sulfur contained in the fuel. Natural gas emissions rates are from an EPA air pollution study (1996); SO2 input emissions rate for coal is based on the sulfur content of the fuel, and the use of post-combustion controls. The "base" emissions rate for existing and new conventional coal plants is based on a national average sulfur content of 0.9 lbs/MMBtu (1.8 lb SO2/MMBtu). ReEDS assumes the national average for "low sulfur" coal is 0.5 lbs SO2/MMBtu from values based on national averages from AEO Assumptions (EIA 2006 - Table 73). Scrubber removal efficiency is assumed to be 90% for retrofits, 95% for new plants. (EPA 2006)
2. NO2 emissions result from the oxidization of Nitrogen in the air. It is not a result of the type of fuel burned, but the combustion characteristics of the generator. NO2 emissions can be reduced through a large variety of combustion controls, or post combustion controls. NO2 emissions are not restricted in the ReEDS Base Case (see Section 1 on federal emissions standards). The emissions rates in Table 17 are national averages. (EPA 2005b)
3. Mercury is a trace constituent of coal. Mercury emissions are unrestricted in the ReEDS Base Case (see section on federal emissions standards). Emissions rates in Table 17 are averages and do not consider control technologies. (EPA 2005b)
4. CO2 emissions result from the oxidization of carbon in the fuel, and the emissions rate is based solely on fuel type, and therefore constant (per fuel input) for all plants burning the same fuel type. Natural gas emissions rates are from an EPA air pollution study (1996); CO2 content for coal is based on the national average from AEO Assumptions (EIA 2006 - Table 73). Biofuels are assumed to be carbon neutral. Landfill gas is assumed to have zero carbon emissions, since the gas would be flared otherwise. CSP plants burn a small amount of natural gas, resulting in CO2 emissions. CO2 emissions are not constrained in the ReEDS Base Case.

2.5.2. Cost and Basic Performance

Values for capital cost, heat rate (efficiency), fixed O&M, and variable O&M for conventional technologies that can be added to the electric system are provided in Table 18. Cost and performance values for natural gas, nuclear, and coal technologies are based on recent project costs according to Black & Veatch experience. Pulverized coal plants continue to operate in ReEDS, and Sulfur dioxide scrubbers can be added to unscrubbed coal plants for $200/kW. Oil/gas steam, and unscrubbed coal plants cannot be added to the electric system, but those currently in operation are maintained until retired. ReEDS sites conventional generation technology in the balancing area that is closest to the load being served and does not require new transmission. California law prohibits building new coal plants or purchasing power from out-of-state coal plants. ReEDS approximates that by outlawing new coal plants in the state and by restricting coal generation in other western states to only what they themselves can consume.

Roughly accounting for construction times, capital costs for 2010, 2030, and 2050 are based on proposed engineering, procurement, and construction (EPC) estimates for plants that will be commissioned in 2010, 2030, and 2050. A wet scrubber is included in the EPC costs for new pulverized coal plants.

Table 18. Cost and Performance Characteristics for Conventional Generation

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Technology	Cost Variable (2009$)	2010	2030	2050
pulverized coal	investments ($/kW)	2890	2490	2490
	fixed O&M ($/kW-yr)	22.8	22.8	22.8
	variable O&M ($/MWh)	3.67	3.67	3.67
	heat rate (MBtu/MWh)	9.37	8.99	8.99
coal IGCC-CCS*	investments ($/kW)	n/a	6600	6600
	fixed O&M ($/kW-yr)	n/a	44	44
	variable O&M ($/MWh)	n/a	10.5	10.5
	heat rate (MBtu/MWh)	n/a	10.4	10.4
natural gas combined cycle	investments ($/kW)	1230	1230	1230
	fixed O&M ($/kW-yr)	6.25	6.25	6.25
	variable O&M ($/MWh)	3.63	3.63	3.63
	heat rate (MBtu/MWh)	6.04	6.04	6.04
natural gas CC-CCS*	investments ($/kW)	n/a	3750	3750
	fixed O&M ($/kW-yr)	n/a	18.2	18.2
	variable O&M ($/MWh)	n/a	9.9	9.9
	heat rate (MBtu/MWh)	n/a	9.07	9.07
natural gas combustion turbine	investments ($/kW)	645	645	645
	fixed O&M ($/kW-yr)	5.21	5.21	5.21
	variable O&M ($/MWh)	29.6	29.6	29.6
	heat rate (MBtu/MWh)	9.36	9.36	9.36
nuclear	investments ($/kW)	6100	6100	6100
	fixed O&M ($/kW-yr)	126	126	126
	heat rate (MBtu/MWh)	9.72	9.72	9.72
fuel**	coal ($/MBtu)	2.15	2.32	2.32
	natural gas ($/MBtu)	7.49	9.82	9.82
	uranium ($/MBtu)	0.8	0.85	0.85

* Carbon capture and sequestration technologies assumed to have a 90% capture rate

** Fuel prices indicated here are base fuel prices input to ReEDS, which has an endogenous fuel price elasticity for coal and natural gas

2.6. Storage Technologies

There are four storage technologies currently implemented in ReEDS: pumped hydro storage (PHS), compressed air energy storage (CAES), batteries and thermal storage in buildings. The battery chemistry assumed in the model—chosen on the basis of the current robustness of the technology and well-established and competitive costs—is sodium-sulfur. The cost/performance parameters for the storage technologies are in Table 19, below. Costs for each technology are for systems with eight hours of storage.

Table 19. Cost and Performance Characteristics for Storage Technologies

		capital costs ($/kW)	fixed O&M ($/kW-yr)	variable O&M ($/MWh)	round trip efficiency (%)	heat rate (MMBtu/MWh)
pumped hydropower storage	all years	2230	30.5	0	0.87	n/a
batteries	2010	4110	24.9	7.92	0.9	n/a
	2030	3590	24.9	7.92	0.9	n/a
	2050	3200	24.9	7.92	0.9	n/a
compressed air energy storage	all years	900-1200	11.5	1.53	1.25	4.42
thermal storage in buildings	2010	n/a	n/a	n/a	n/a	n/a
	2030	1900-2920	16.7	0	1	n/a
	2050	1590-2450	15.8	0	1	n/a

Source for PHS: red(source?), Batteries: (EPRI-DOE 2003), CAES: (Holst 2005)

CAES is not a pure storage technology; for the storage portion, off-peak electricity is used to charge the reservoir, in this case by pumping high-pressure air into an underground cavern (e.g., a salt dome). Upon discharging, however, the compressed air is mixed with natural gas and combusted before expanding it through a turbine to generate power. In effect, CAES is a hybrid technology that uses electrical-to-physical storage to power a highly efficient combustion turbine; the heat rate of a CAES plantis roughly half that of a traditional natural gas plant. Because there are two inputs (electricity and natural gas), it is difficult to create a single performance metric, so the table above includes both round-trip efficiency and heat rate. For every 0.72 MWh of electricity and 4.4 MMbtu of gas, the plant will provide 1 MWh of electricity.

ReEDS can choose to build storage either co-located with wind farms or sited at the load. In either case, the storage can be charged in ReEDS by either wind-generated electricity or electricity from the general grid. The primary advantage of co-locating with wind is the potential to save money by downsizing a long transmission line. (With a 100 MW wind farm, a 20 MW battery allows the developer to build a transmission line of only 80 MW without risking losing energy generated by the top 20 MW.) There is a trade-off in that the maximum capacity the combined wind-storage system can generate is then limited by the transmission line. Storage at the load does not allow downsized transmission, but the storage will always be able to discharge at full power. Storage at load also assists the movement of wind power to load centers by charging overnight when transmission lines are relatively free, rather than trying to move the power during peak hours when the lines are congested. Storage at the load also allows slightly more wind energy to be stored for the same storage capacity since transmission losses are incurred before the load-sited storage. Similarly, storage at the load site charged from the general grid does not incur transmission losses to and from a remote wind-sited storage facility.

There are 21 GW of utility-scale electric storage in use in the United States as of 2008, the vast bulk of which is PHS. A single 110 MW CAES plant operates in McIntosh, Alabama. For further expansion, the model restricts PHS to load-located only, assuming that the odds of finding appropriate hydrological features at many attractive wind sites are slim. Because much of the country has geological features appropriate to CAES caverns (e.g., aquifers, domal salt, or bedded salt), wind-located CAES is permitted. However, CAES of either type is restricted in regions without appropriate geology (Figure 9 shows where suitable geology exists). Batteries can be installed anywhere.

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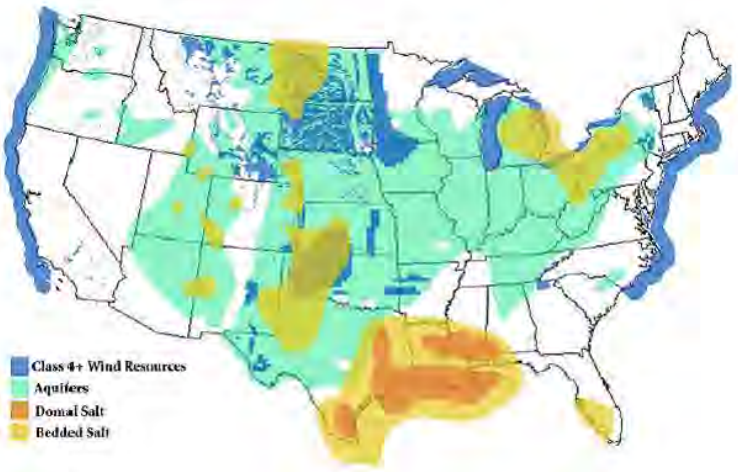


Figure 9. Areas with geology favorable to CAES, overlaid with class 4+ wind resource

Finally, the model has the ability to model thermal storage in buildings. Typically, this is ice storage used to shift the building peak load from peak summer periods (typically associated with high air-conditioning loads) to off-peak periods with cheaper electricity.

2.7. Transmission

Three types of transmission systems can be used to transport wind power around the country, existing grid, new lines, and in-region transmission. In the case of transmission, "existing" means in existence at the start of the model, in 2006.

It is assumed that 10% of the existing grid can be used for new wind or CSP capacity, either by improving the grid or by tapping existing unused capacity (DOE 2008). A GIS optimization determines the distance at which a particular wind farm will have to be built to connect to the grid (based on the assumption that the closest wind installation will access the grid first at the least cost). In this way, a supply curve of costs to access the grid is created for each class of wind in each region. Additionally, a pancake-type fee for crossing between balancing areas may be charged within the model. The supply curves described earlier are based on this type of transmission and the GIS optimization described here. In the near term, one can expect that most of the wind that is built will use the existing grid, but as higher penetration levels are reached, the existing grid will be insufficient and new wind installation will require construction of new transmission lines.

Existing transmission capacity is estimated using a database of existing lines (length and voltage) from Platts Energy Market Data (2006). This database is translated into a megawatt capacity as a function of kilovolt (kV) rating and length (Weiss and Spiewak 1998).

Regarding new lines, the model has the ability to build straight-line transmission lines between any of the 356 resource regions. The line is built exactly to the size necessary to transmit the desired megawatts and the cost of building that transmission line is accounted for in the model.

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In-region transmission: Within any of the 356 resource regions around the country, the model can build directly from a wind resource location to a load within the same region. A second GIS-generated supply curve is used within the model to assign a cost for this transmission.

A fourth type of transmission, used predominantly by conventional capacity and called general transmission, can be built as well. This is not frequently deployed because conventional capacity can generally be built in the region where it is needed, thereby obviating the need for new transmission.

To emulate large regional planning structures based on that of the Midwest ISO, there is essentially no wheeling fee between balancing areas used in the base case (although the model has the capability to model such a fee).

There are several transmission related assumptions in the model as indicated in the following table. Note that certain transmission issues are treated differently depending on the region that the line is in:

Table 20: Transmission Inputs

Variable	Cost (2009$)	Regions
line costs ($/MW-mile)	$1,480	WECC, TRE, SPP, FRCC
	$1,140	all other regions
regional line cost multipliers	3.56x	CA, NE, NY, east PJM
	1.58x	west PJM
substation costs ($/MW)	$10,700-$24,000	
intertie (AC-DC-AC) costs ($/MW)	$230,000	
grid interconnection costs ($/MW)	110000	
transmission losses	1% per 100 miles	

2.8. Federal and State Energy Policy

2.8.1. Federal Emission Standards

All emissions are point-source emissions from the plant only (not "life-cycle" emissions).
ReEDS has the ability to impose a national cap on CO2 emissions from electricity generation, or a CO2 emission charge (tax). Neither a carbon cap nor charge is implemented in the Base Case.
Emissions of SO2 are capped at the national level. The base case uses a cap that corresponds roughly to the 2005 Clean Air Interstate Rule (CAIR; EPA 2005a), replacing the previous limits established by the 1990 Clean Air Act Amendments. The CAIR rule divides the United States into two regions. ReEDS uses the EPA's estimate of the effective national cap on SO2 resulting from the CAIR rule. Table 21 provides the SO2 cap used in ReEDS. Because CAIR was struck down in the courts in 2008, we moved the ReEDS SO2 limits schedule back four years; we will update the limits as more information becomes available or as developments occur.

Table 21. National SO2 Emission Limit Schedule in ReEDS

	2003	2014	2019	2024	2034

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SO2 Cap (MTons)	10.6	6.1	5.0	4.3	3.5

Source: http://www.epa.gov/cair/charts

NO2 emissions are currently unconstrained in ReEDS. The NO2 cap based on the CAIR may be added, but the net effect on the overall competitiveness of coal is expected to be relatively small (EIA 2003). Also, adding a NO2 cap is complicated by the wide array of options available for NO2 control.

Mercury emissions are currently unconstrained in ReEDS. As of November, 2008, the Clean Air Mercury Rule (see http://www.epa.gov/camr/index.htm) is a cap-and-trade regulation, expected to be met largely via the requirements of CAIR. Control technologies for SO2 and NO2 that are required for CAIR are expected to capture enough mercury to largely meet the cap goals. As a result, the incremental cost of mercury regulations is very low and is not modeled in ReEDS (EIA 2003).

2.8.2. Federal Energy Incentives

Two federal tax incentives for renewable energy are included in the ReEDS base case as shown in Table 22

Table 22. Federal Renewable Energy Incentives

	Value	Notes and Source
Renewable Energy PTC	$21/MWh	Applies to wind. No limit to the aggregated amount of incentive. Value is adjusted for inflation to US$2006. Expires end of 2009.
Renewable Energy ITC	30%	Applies to CSP. Expires end of 2016.

2.8.3. State Energy Incentives

Several states also have production and investment incentives for renewable energy sources. The values used in ReEDS are listed in Table 23.

Table 23. State Renewable Energy Incentives

State	PTC ($/MWh)	ITC (%)	Assumed State Corporate Tax Rate (%)
Iowa	-	5.0	10.0
Idaho	-	5.0	7.6
Minnesota	-	6.5	9.8
New Jersey	-	6.0	9.0
New Mexico	10	-	7.0
Oklahoma	2.5	-	6.0
Utah	-	4.75	5.0
Washington	-	6.5	0.0
Wyoming	-	4.0	0.0

Investment and production tax credit data from IREC (2006) Tax rates from: http://www.taxadmin.org/fta/rate/corp_inc.html

2.8.4. Federal Renewable Portfolio Standards

A renewable portfolio standard (RPS) requires that a certain fraction of a region's energy be

derived from renewable sources. While there is no federal RPS in place (as of October, 2008) or in the ReEDS Base Case, ReEDS can accommodate a national RPS, with input values for fraction of energy to be provided by renewables, RPS start year, duration, and shortfall penalty.

2.8.5. State Renewable Portfolio Standards

A number of states have legislated RPS requirements, and states can put capacity mandates in place as an alternative or supplement to an RPS. A capacity mandate requires a utility to install or generate a certain fixed amount of renewable capacity or energy. Unless prohibited by law, a state might also meet requirements by importing electricity. The ReEDS Base Case enforces the legislated state standards listed in Table 24.

Table 24. State Renewable Portfolio Standards

State	RPS Start	Full Implementation	Assumed RPS (%)
Arizona	2001	2025	6.17
California	2003	2017	32.4
Colorado	2007	2015	19.4
Connecticut	2004	2010	1.3
Delaware	2007	2019	5.6
Illinois	2004	2013	6.2
Kansas	2006	2020	15.6
Massachusetts	2003	2009	19.5
Maryland	2006	2019	19.34
Minnesota	2002	2015	27.4
Montana	2008	2015	9.9
North Carolina	2008	2021	11.1
New Hampshire	2007	2025	23.3
New Jersey	2005	2021	24.9
New Mexico	2006	2020	15.2
Nevada	2003	2025	22.0
New York	2006	2015	20.9
Oregon	2002	2025	20.4
Pennsylvania	2007	2021	17.5
Rhode Island	2007	2019	15.8
Washington	2008	2020	12.7
Wisconsin	2001	2015	10.125

Notes:
1) RPS data as of Fall 2009. (IREC 2006)
2) RPS Start Year is the "beginning" of the RPS program. The RPS is ramped linearly to the full implementation year.
3) RPS Full Implementation is the year that the full RPS fraction must be met.

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APPENDIX F:

SOLAR ENERGY TECHNOLOGY OVERVIEW

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APPENDIX F:

SOLAR ENERGY TECHNOLOGY OVERVIEW

F.1 INTRODUCTION

Solar energy technology can be defined broadly as those activities, applications, or devices designed to harness energy from the sun to perform useful work. By that measure, humans have been devising and applying solar energy technology for centuries, beginning with the use of magnifying glasses and mirrors to concentrate the sun's rays to start fires and light ceremonial torches as early as the 7th century B.C. The first application of passive solar heating was in Roman bathhouses of the 1st through the 4th centuries A.D. The first solar electric or photovoltaic cell was produced in 1839, and the first solar water heater was manufactured in 1891. Photovoltaic technology was advanced in the United States in the 1950s, and the first telecommunications satellite, Telstar 1, was powered by photovoltaic panels in 1962. The first photovoltaic-powered residence was constructed in 1973; and a rapid expansion of solar energy technologies that began in the early 1980s continues today.[1]

This overview focuses only on the use of solar energy to produce electric power for utilities by using:

- Photovoltaics to convert the sun directly into electricity, and
- Concentrated solar power that creates steam to drive a conventional generator to produce electricity.

Other uses of solar energy include direct sunlight to heat and light living and working spaces and concentrated sunlight to heat water.

F.1.1 Scope of Overview

In recent years, technological advances, the rising costs of energy, as well as government regulations and incentives for renewable energy technologies, have increased interest in renewable energy technologies, including solar. This overview does not discuss all variations of energy-producing solar technologies that exist or that could be built. Instead, the focus is on two technology categories that are believed to hold the greatest potential for generating large

[1] For more information on the history of solar technology development, see *The History of Solar* online at http://www1.eere.energy.gov/solar/pdfs/solar_timeline.pdf. Accessed Jan. 1, 2009.

amounts of electricity that can be delivered to the nation's electric grid within the 20-year planning horizon of the Solar programmatic environmental impact statement (PEIS).[2]

These solar electric categories are

1. Concentrating solar power (CSP) (or solar thermoelectric), and

2. Photovoltaic (PV) (or solar electric).

(See the text box for naming conventions for solar energy technologies.)

Naming Conventions for Solar Energy Technologies

For the purpose of this PEIS, solar energy technologies designed to produce electrical power are placed in one of two categories: "solar thermal technologies" and "solar electric (or photovoltaic) technologies."

The first category comprises solar thermal technologies that create electrical power by using the sun's energy to capture and manipulate heat to produce steam to drive a conventional steam turbine/electric generator set (STG) or to power an external heat engine that produces mechanical energy to drive a generator. Typically some means of concentrating the incident solar energy is used to improve the efficiencies of thermal technologies, such as reflecting or concentrating mirrors. This category of technologies is commonly referred to as "concentrating solar power," or CSP.

The second category comprises solar cell technologies that create electrical power by directly converting the photons in sunlight to electricity. This is called photovoltaic (PV) technology because it capitalizes on the "photovoltaic effect," which is the ability of certain materials to produce a flow of electrons when excited by sunlight. PV is also referred to as "solar electric technologies."

Concentrating photovoltaics (CPV) are a variation of PV-based technologies. CPV uses concentrating devices to further increase the amount of sunlight exposure on each solar cell than the area of the cell would otherwise receive. Placing the emphasis on the concentrating aspects, some categorize CPV with solar thermal technologies that also utilize some concentrating feature and consider all of these as CSP. This PEIS, however, identifies CPV as a PV or solar electric technology, rather than a CSP. The CSP category is reserved for technologies that involve the conversion of solar thermal energy to electricity.

Hybrid solar facilities are classified in this report as facilities that get their electricity from a combination of solar thermal technology and fossil-fuel–fired (e.g., coal or natural gas) power-generating equipment.

Some solar technologies can be categorized by their ability to produce dispatchable power (i.e., power readily available at all times to the grid operator, achieved in most instances through the use of thermal storage systems) rather than by the way in which they interact with the sun. Although dispatchability is a desirable operational characteristic for utility-scale solar facilities, it does not distinguish the technology. So, while various options for improving a solar facility's dispatchability are discussed, dispatchability is not used in this report as a means to categorize technologies.

[2] Various feasibility studies have been performed to explore other energy-related applications for solar technology (e.g., the production of hydrogen through electrolysis of water, the production of process steam for industrial applications, or the use of solar-produced heat to support thermochemical reactions). All such applications are considered outside the scope of this PEIS.

Within the two major technology categories (CSP and PV), five broad categories are reviewed in this overview:

- CSP technologies
  - Parabolic trough and compact linear Fresnel reflector (CLFR)
  - Solar power tower
  - Solar dish engine

- PV technologies
  - Flat-plate PV
  - Concentrating PV

The scale at which any solar energy technology is used to produce electricity can vary greatly and depends on the intended end use of the power being produced. The scope of this PEIS is limited to those technologies (listed above) that can produce utility-scale electrical power on the order of 20 MWe[3] for connection to the nation's medium- and high-voltage electric transmission and distribution grids.

Solar energy technologies that generate electricity used locally to satisfy relatively minor power demands are known as distributed, isolated, or off-grid applications. Some small-capacity installations are not connected to the electric grid, while others, primarily PV systems on residences or commercial buildings in urban or suburban areas, have the ability to return excess or unneeded electricity to the local electric distribution grid.[4] All such applications are characterized as having relatively low power-generating capacities (on the order of hundreds of watts or kilowatts, up to a few megawatts, maximum), and although they can be very effective and efficient in the individual applications for which they were designed, they are not included in the scope of this PEIS.

One inherent limitation of solar energy technologies is that power can be produced only when the sun is shining. Furthermore, the rate at which power is produced is directly related to the intensity of the solar radiation (or insolation) reaching the solar collectors (see text box). Consequently, during cloudy periods or at night, power production is severely reduced or stops entirely. Depending on the location and the utility, this intermittency in power generation can result in instability of the electricity grid to which the solar power facility is connected. Two methods to address the lack of dispatchability and reliability inherent in solar power generation are available for some CSP facilities: (1) incorporating thermal energy storage (TES), which

[3] Arbitrarily, 20 MWe (net) is selected as the lower limit of utility-scale electrical power generated expressly for delivery to the grid. Obviously, the capacity of any solar energy facility is dependent on many factors and changes over the course of a day, a season, or a year regardless of its technology, geographic location, or design. The nominal capacity of 20 MWe (net) is understood to mean the peak power-generating capacity of the facility, expressed in watts as Wp minus all auxiliary, internal (parasitic) loads. In this document, MWe is used synonymously with MW (i.e., no thermal power [MWt] is discussed).

[4] The process of reverse power flow is known as net metering. Many states have adopted net metering policies that require utilities to purchase from or otherwise credit the customer for this reverse power. Net metering is available in 42 states and the District of Columbia. More details about state programs are available at http://apps3.eere.energy.gov/greenpower/resources/maps/netmetering_map.shtml. Accessed Jan. 5, 2009.

Insolation and Its Importance to Solar Technologies

Insolation is the solar radiation that reaches the earth's surface. It is typically represented as energy density and measured in units of watts per square meter (W/m^2) [joules/ft^2] per minute.

It represents the total electromagnetic energy contained in the incident sunlight. The sun's insolation is greatest over the equator—the more insolation, the higher the temperature. Factors that affect insolation are the angle of the sun, the distance between the sun and the earth, and the duration of daylight. A measure of insolation at any given location on the earth's surface must account for both daily and annual changes in the sun's angle of incidence. Changes in insolation levels over the course of the day are expressed as kilowatt hours per square meter per day (kWh/m^2 day). This daily average power-generating potential is a more meaningful number for estimating the potential of a location for solar power production. To account for variations in weather (cloud cover and airborne contaminants can both dramatically reduce solar energy reaching the ground), averaging insolation over many years provides a reliable number for estimating insolation potential for any given location.

The National Renewable Energy Laboratory (NREL) and National Aeronautics and Space Administration (NASA) maintain insolation data for the entire United States. (The NREL data sets can be accessed at http://www.nrel.gov/rredc/solar_resource.html. The NASA database can be accessed at http://eosweb.larc.nasa.gov/cgi-bin/sse/grid.cgi?uid=3030.) Computed in 2000, the 10-year insolation averages (expressed in $kWh/m^2 \cdot day$) for some locations within the study area of the PEIS are Los Angeles, California, 5.40; Phoenix, Arizona, 5.38; Las Vegas, Nevada, 5.30; Albuquerque, New Mexico, 4.97; and Salt Lake City, Utah, 4.53. The effect of latitude on variability of insolation values can be observed by reviewing the monthly average values for any location. For example, for Phoenix, values (in $kWh/m^2 \cdot day$) ranged from a low of 2.75 in December to a high of 7.7 in June, while for Anchorage, Alaska, values ranged from 0.12 to 4.58.

Solar technology designers must consider critical factors such as insolation and its variations over the time of day at a candidate location. Changes in insolation over time affect both the rate and the characteristics of the power being generated. These impacts can be overcome by applying devices that can reorient themselves to changing angles of incident sunlight, sophisticated system monitoring capabilities, and complex power conditioning equipment. However, these features increase initial installation and maintenance costs over a system's lifetime, so compromises are likely to be made that will influence the power-generating capacity of the resulting facility.

utilizes a system to store some of the heat captured in the solar field for delayed production of steam, and (2) combining the CSP facility with conventional fossil fuel–fired power-generating equipment, and using combined conventional steam turbine generators (STGs) and cooling systems. At this point in its development, TES is not practically available for CSP solar dish engines[5] or solar PV systems, because each uses fundamentally different mechanisms to produce electricity. Systems that incorporate TES are discussed for parabolic trough and power tower facilities in Section F.2.4.4. For informational purposes, the potential array of fossil fuel and parabolic trough or power tower hybrid systems is discussed in Section F.2.4.5, although the environmental impacts of the fossil fuel–fired portions of such combinations are not evaluated in this PEIS.

[5] However, U.S. Department of Energy (DOE)-funded research in TES includes development of TES applications for solar dish engines. See Section F.2.4.3 for details.

F.1.2 Organization of Overview

Sections F.2 and F.3 provide brief descriptions of each of the five technology categories addressed in this PEIS (parabolic trough [including CLFR], solar power tower, solar dish engine, flat-plate PV, and concentrating PV), including

- How each technology produces electricity and the major components that a facility would need to produce electricity at the utility scale;
- The current state of commercial solar technologies; and
- The environmental footprint of a utility-scale facility, identifying key resource demands.

Some of the key resource demands are estimated by using parameters identified in currently proposed solar energy facility documentation. Information pertaining to design parameters for specific projects is meant to be representative of technologies with the greatest potential to generate utility-scale solar energy over the next 20 years. The facilities described in this appendix are in various stages of certification, and the parameters are subject to change. The parameters included in this overview were initially drawn from project applications, and have been revised to reflect data current as of February 2010.

Solar facilities also will need to connect to the electricity transmission grid. A discussion of required activities for transmission line construction and associated considerations is provided in Section F.4.

F.2 CONCENTRATING SOLAR POWER (CSP) TECHNOLOGIES AND FACILITIES

F.2.1 Basic Types of CSP Facilities

CSP has historically been called solar thermal electric or thermoelectric power since all variations are designed to convert the sun's energy to heat and then apply that heat in various ways to produce electricity. CSP technologies are distinguished by three basic design architectures for reflecting and concentrating solar energy:

1. Line-focus systems that concentrate solar energy along a line-shaped receiver, typically an oil-filled pipe positioned at the focus of parabolically shaped reflectors (parabolic trough systems) or along the focus of a parallel array of nearly flat mirrors acting as concentrators (the CLFR);
2. Point-focus systems that concentrate solar energy to a point receiver by means of flat-plate mirrors focusing reflected light on a receiver located at the top of a centrally located tower (solar power tower systems); and

3. Point-focus systems that use a parabolic-shaped reflector dish to focus the sun's energy on a point receiver/external heat engine/generator located at the focal point of the dish (solar dish engine systems).

To produce heat, all CSP technologies utilize direct normal insolation (DNI) only. That is, they use sunlight that directly strikes the reflecting/concentrating surface, rather than global insolation, which includes sunlight that has been refracted or diffused by clouds, airborne dusts, or the ground. Thus, for optimal performance, the reflective surfaces of CSP technologies must track the sun so that they reflect its rays to a line or point focus over the course of the day, and reflectors and/or concentrators must exhibit good optical characteristics.[6]

Parabolic trough and solar power tower CSP systems typically utilize a heat transfer fluid (HTF) (usually synthetic oil in the case of parabolic trough facilities and molten salt in the case of power tower facilities) to transfer the heat generated at the solar collectors to a heat exchanger, where steam is produced to drive a conventional STG. The CLFR system dispenses with the HTF, making steam directly at the solar field for delivery to the STG. The power block of a solar thermal facility containing the STG and other related power-generating and power management equipment is virtually identical in both form and function to the power block of fossil fuel and nuclear power plants that also use steam to produce electricity. The solar dish engine is unique among CSP technologies in that it uses the sun's heat not to produce steam but to expand a gas against a piston, generating mechanical energy that drives an electric generator or alternator. Although all CSP systems rely on their ability to collect and concentrate the sun's energy and convert it to heat, point-focus systems such as solar power towers and solar dish engines can attain greater degrees of concentration of the sun's energy than can troughs. By using different working fluids and power cycles, these systems generally operate at higher temperatures and higher efficiencies than parabolic troughs. Nevertheless, among CSP technologies, parabolic trough facilities have enjoyed the greatest degree of development and utility-scale application to date.

One thermal electric technology does not involve production of steam; this technology uses organic Rankine cycle (ORC) turbines coupled to conventional generators. Instead of accepting steam from a remote source, ORC turbines use heat to boil an organic working fluid contained in the reservoir of a closed system, allowing the resulting hot expanding vapors of the working fluid to drive the turbine-generator set. In doing so, the working fluid loses sufficient thermal energy to return to its liquid state and, after further cooling, is returned to its reservoir,

[6] To ensure optimal year-round performance, reflecting surfaces must remain precisely perpendicular to the sun's DNI over the course of both the day (azimuth tracking) and the year (elevation tracking). Virtually every grid-connected utility-scale CSP facility can be expected to have at least single-axis, and more likely dual-axis, tracking capability. Either of two methods of dual-axis tracking can be used: (1) azimuth-elevation tracking, which rotates the dish in a plane parallel to the earth's surface over the course of the day, and up and down to reflect the changing position of the sun in the sky with the seasons, and (2) polar tracking, which rotates the dish about an axis that is parallel to the earth's rotational axis at a constant rate of 15º per hour, matching the earth's rotation, and then simultaneously rotates the dish about the declination axis (perpendicular to the polar axis) at a rate of 0.0016º per hour (approximately ± 23.5º over the course of a year). Reorienting the reflecting surface by either tracking method is typically accomplished by means of electric motors or hydraulic actuators, either system being computer-controlled and preprogrammed against the facility's specific location.

allowing the process to repeat. ORC turbines enjoy many industrial applications, recovering otherwise wasted heat and converting it to electrical power or mechanical energy. They offer a number of advantages, including: the ability to produce power from relatively minor sources of heat; minimal internal corrosion issues due to the absence of water; thermal efficiencies as high as 85%; and extended mechanical life due to relatively slower rotational speeds compared to conventional STGs. Perhaps most importantly for CSP applications in water-deprived locations, ORC turbines require substantially less water than do conventional STGs. However, to date, ORCs have been applied only in relatively low-power situations.

An option to increase the reliability of power production for parabolic trough and power tower technologies is to use some form of energy storage. Many energy storage technologies exist; examples include storage as chemical energy in storage batteries (a chemical or galvanic battery) or as potential energy in compressed air (a pneumatic battery). However, these energy storage options are impractical and/or inefficient for adaptation to CSP facilities. TES options are technically feasible and efficient additions to parabolic trough and power tower CSP facilities. TES has been demonstrated in power towers (see Section F.2.3 on Solar One and Solar Two) and is currently being built into the Andasol 1 plant in Spain.[7] TES is also a feature of the proposed Ivanpah Solar Electric Generating System (ISEGS) power tower proposed for construction in California (see Section F.2.3.2). Because solar dish engine systems do not produce steam, they cannot be easily hybridized with TES, but unique adaptations are nevertheless currently being studied. Adding TES capabilities allows a portion of the heat generated during periods of greatest insolation to be diverted to storage for later use rather than being used immediately to produce electricity.[8] Simple sodium and potassium nitrate salts with high heat capacities have been found to act as excellent heat storage media. While TES capability is technically feasible, the unresolved issue is whether TES can be implemented cost effectively in a utility-scale CSP facility. Details about TES applications to solar facilities are provided in Section F.2.4.3.

F.2.2 Parabolic Trough Technologies

As noted above, parabolic trough CSP systems are the furthest along toward commercial application of any of the CSP technologies. There are numerous examples worldwide of operating commercial, utility-scale parabolic trough systems as well as numerous facilities proposed or in the design phase. A number of feasibility studies and component evaluation testing initiatives have been completed, and component and system performance assessments have been published on the basis of field experience. Although many engineering designs and performance issues have been settled, many others are still in need of further study and development, all for the purpose of improving the operability, reliability, and overall efficiency of parabolic trough technologies.

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7 See http://www.nrel.gov/csp/troughnet/pdfs/2007/martin_andasol_pictures_storage.pdf for details.

8 In many parts of the country (including the six-state study area of this PEIS), the daily peaks of electric demand occur in the early morning and early evening. In those circumstances, storage heat energy generated in the middle of the day when the sun's energy is most intense effectively allows a CSP facility to produce its greatest amounts of power over periods that coincide with those anticipated power load peaks.

F.2.2.1 Facility Components

F.2.2.1.1 Solar Field (Collectors, Mirrors, and Receivers). The distinguishing feature of parabolic trough systems is the solar field with its parabolically shaped collectors. Parabolic troughs utilize only sunlight's DNI or beam radiation; they do not use diffuse radiation. The optimum size of the solar field is determined by the strength of the DNI incident on the facility's location and the collective optical and thermal efficiencies of the collectors, mirrors, and receivers. Major components in the solar field include:

- Parabolically shaped linear collectors;
- Single-axis tracking structures; and
- Mirrors that collect, reflect, and concentrate the sun's energy at the linear receivers (absorber tubes) (see Figure F.2.2-1).

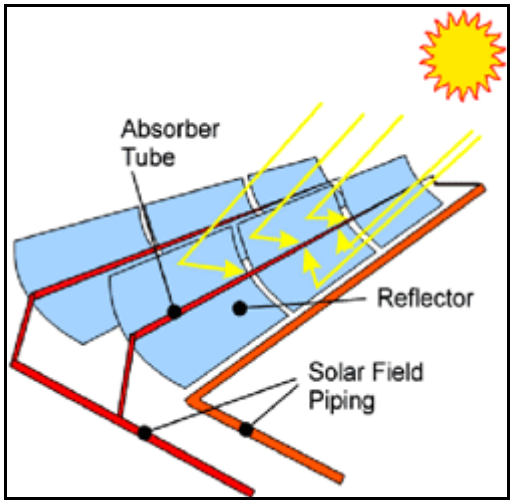


FIGURE F.2.2-1 Parabolic Trough Solar Collector Assembly (Source: NREL. Available at http://www.nrel.gov/csp/troughnet/solar_field.html. Accessed Sept. 4, 2008)

The collectors are structures to which the reflecting surfaces are attached, together with the apparatus that rotates the mirrors to maintain alignment with the sun.

Three basic collector designs have emerged: the Luz system, the Euro Trough, and the Solargenix system. The Luz system and its direct derivative, the Euro Trough, are constructed of galvanized steel and use torsion bars to maintain sufficient structural stiffness to oppose dynamic wind loading while maintaining alignment accuracy. The Solargenix system's support is constructed of aluminum and uses a lighter space frame design that is easier to erect and needs little to no alignment in the field.

The most efficient use of space typically consists of connecting individual collectors in north-to-south-oriented rows and allowing them to track the sun from east to west over the course of a day (Figure F.2.2-2). Sufficient space is left between the rows to allow for maintenance access and to prevent one row of collectors from shading the adjacent row during periods of low sun angles of incidence (at the beginning and end of each day).

The reflecting surfaces (the mirrors) in the solar field have traditionally been manufactured of low-iron, high-transmissivity silvered glass. More recent designs have involved laminated mirrors composed of thinner glass and formed to the parabolic shape of a collector's superstructure. To reduce production costs, rather than incorporating the parabolic shape of the mirror in one piece, collectors are made up of many small flat-plane mirrors, each specifically aligned to reflect light to the parabola's focus.



FIGURE F.2.2-2 Solar Field for the Florida Power and Light Parabolic Trough Facility Known as SEGS VI, Kramer Junction, California (In addition to CSP, the facility also includes a natural gas–fired turbine located in the facility's power block; see background right.) (Source: NREL. Available at http://www.nrel.gov/csp/troughnet/pdfs/32282.pdf. Accessed June 16, 2008)

The receiver (also sometimes called the absorber or the heat collection element [HCE]) is the tube positioned at the focus of each parabolic collector. A stainless steel tube containing the HTF is encased in a glass tube, and the annular space is maintained in a vacuum. To improve its thermal insulating properties, the steel tube is coated with "cermet," a surface treatment consisting of fine metal particles encased in a dielectric ceramic matrix that has a high absorptivity to solar energy and a low emissivity for the infrared spectrum to reduce thermal radiation losses from the receiver. The glass tube is typically constructed of low-iron glass and coated with an antireflection coating to maximize sunlight transmissivity and minimize reflective losses. The receivers of individual parabolic collectors are connected to receivers of adjacent collectors by means of flexible bellows, accommodating the differential thermal expansion between the glass envelopes and the steel tubes and allowing each collector and its receiver to move independently of adjacent collectors and receivers to remain precisely aligned with the sun.

The balance of system components for the solar field includes the collector foundations, tracking and alignment drive systems, and controllers. Given the latitudes at which utility-scale parabolic trough systems are likely to be located, ground freezing is typically not a major concern, so foundation designs are driven primarily by the weight and dynamic wind loading of each panel and the structural properties of indigenous soils and subsoils. Parabolic trough

systems use both electric motor and simple gear assemblies or hydraulics for tracking and alignment. Future designs may utilize either system. An individual controller that can be monitored remotely is integrated into a facility-wide supervisory control and data acquisition (SCADA) system. This device controls the tracking and alignment of each collector and monitors the condition of the vacuum and HTF levels in the receiver. However, it is likely that there would be an operating crew present at future utility-scale facilities, especially those located in remote locations.

F.2.2.1.2 Heat Transfer Fluids. All parabolic trough facilities designed and built in the United States have used an HTF to absorb heat from the collectors in the solar field and transfer it to a conventional steam heat exchanger.[9] Ideal HTF properties for solar energy applications are as follows:

- Thermal stability for extended periods of time at high temperatures (HTFs can be heated in the solar field to temperatures >750°F [400°C]);
- Eutectic point (the temperature at which both constituents simultaneously begin to solidify) is below the expected lowest ambient temperature at the facility location [ideally below 32°F (0°C)];
- Low vapor pressure (<1 atmosphere) and low viscosity at the maximum working temperature;[10]
- High heat capacity (the amount of heat energy required to raise the temperature of a specified volume by a specified interval, usually defined by convention as 1 gram of material raised 1 Centigrade degree);
- Little or no potential for thermal decomposition over extended periods of time (especially for organic HTFs);
- Compatibility with HTF containment and recirculation component materials; and
- Relatively low cost.

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9 Some research has been completed in Europe involving the direct production of steam by circulating a water/glycol mixture, rather than conventional synthetic oil HTF, through the HCEs (Valenzuela et al. 2004; Eck and Steinmann 2002; Zarza et al. 2002). Such a system would be less expensive to construct and simpler to operate since the steam heat exchanger is eliminated. However, although the system could be designed to produce superheated steam, providing even steam flow to the STG would be difficult during periods of fluctuating solar insolation (e.g., from passing clouds). No direct steam generation facilities are currently being studied or have been proposed for the United States; consequently, this option is not discussed further. However, a variation of the conventional parabolic trough system, the CLFR, does produce steam directly at the solar field. See Section F.2.2.2.1.

10 Low vapor pressure simplifies the design of storage and transfer equipment because it means that high temperature fluids are maintained at relatively low pressures. Because the fluid must circulate, low viscosity reduces the power required to accomplish that.

The material that has been used exclusively to date is a formulation of synthetic organic oils, sold commercially as Dowtherm A®, manufactured by Dow Chemical, or Therminol® VP1, distributed by Solutia, Inc. Both products are mixtures of diphenyl oxide (≈ 73.5%) and biphenyl (≈ 26.5%). Both formulations have been used successfully in CSP plants for many years. The mixture is ideal for CSP applications in regions with high insolation. However, over time (i.e., within the typical facility's 30- to 40-year design basis lifetime), the material has been shown to thermally decompose to produce hydrogen and other organic species such as benzene and dibenzofuran (Moens and Blake 2008). The hydrogen that forms has also been shown to permeate the stainless steel tube containing the HTF and move into the evacuated annular space between the stainless steel tube and the glass outer tube, thus reducing the thermal efficiency of the HCE. Consequently, it is necessary to either capture the hydrogen in special chemical sponges placed in the annular space or provide for the venting of hydrogen from the HTF as it is formed. Venting is typically selected as the simplest strategy for preserving the performance of the HCE and the HTF over the long term. Experience suggests that the extent of thermal decomposition of the HTF is minimal, and replacing the entire volume of HTF within the operating lifetime of a facility is not expected to be necessary.

Although commercial formulations of synthetic oils have predominated as HTFs in solar facilities, they have intrinsic drawbacks that could make them obsolete for application in advanced CSP technologies. Advanced CSP designs that provide higher degrees of solar concentration and function at higher operating temperatures may require alternative HTFs. Substantial research is ongoing to identify those alternatives. Organic salts, compounds composed of organic cations, and organic or inorganic anions that are liquids at expected ambient temperatures are all being investigated. Imidazolium salts have received the most attention (Moens et al. 2003). To date, research has established the effectiveness of imidazolium salts to temperatures of 570°F (300°C); however, some salts exhibited corrosive actions on system components. Mineral oils (paraffinic hydrocarbons) with operating temperature ranges from 14°F to 570°F (–10°C to 300°C) and silicone oils with operating temperature ranges from -40°F to 752°F (–40°C to 400°C) have also been investigated. Both have drawbacks: both can be made to burn, and silicone oils are expensive to produce. The same general physical and chemical properties desirable for HTFs also define excellent thermal storage media. Consequently, mixtures of inorganic nitrate salts similar to those now being used for long-term TES in some CSP facilities are also being considered as HTFs (Moens and Blake 2005). Current research direction appears to suggest that future CSP facilities may use the same material for both initial heat transfer from the solar field and long-term thermal storage. See Section F.2.4.3 for more details on thermal storage options.

Finally, although the choice of both HTF and TES media is based primarily on performance, the selection also involves cost, safety, and environmental considerations. Large, utility-scale CSP facilities with long-term TES capability can be expected to have substantial quantities of HTF and/or TES material present in their respective systems (hundreds of

thousands of gallons or more). Consequently, failures of those systems can lead to accidental releases or fires.[11]

F.2.2.2 Utility-Scale Parabolic Trough Facilities

The parabolic trough is the CSP technology with the greatest amount of field experience. Some of the first parabolic trough facilities in the world built to produce electricity are the Solar Energy Generating Systems (SEGS) I through IX facilities installed in three locations in the southern Mojave Desert in Southern California from 1985 through 1991.[12] The plants have a collective capacity of 354 MW and cover 1,600 acres (6.5 km^2). The five SEGS plants constructed at Kramer Junction, California, share some common central ancillary power production, steam cooling, and power plant management facilities. All the SEGS plants utilize Luz-style collectors and support Rankine cycle STGs.[13] SEGS I has a 3-hour TES capability. SEGS II through VII augment heat provided to the steam heat exchanger from the parabolic troughs with heat produced in a natural gas-fired boiler, while SEGS VIII and IX maintain a minimum temperature of HTF during plant downtime by means of a natural gas-fired heater as a way to facilitate (and shorten) cold start-up. Details on the SEGS plants are provided in Table F.2.2-1. The SEGS plants represent a relatively narrow range of Rankine cycle turbine capacities, from 13.5 MWe (gross) in SEGS I to a maximum of 89 MWe (gross)[14] in SEGS VIII and IX.

The Nevada Solar One facility is a parabolic trough plant that has been in operation since June 2007 (Acciona SA 2008). It is located about 40 mi southeast of Las Vegas and has a total facility size of 400 acres (1.6 km^2) (the solar fields encompass 300 acres [1.2 km^2]). Solar One has a maximum capacity of 75 MW and employs about 28 full-time workers during operations. The construction period for the facility was about 16 months. The power produced at the facility is delivered to the electric transmission grid and is sold to the Nevada Power Company and Sierra Pacific Power Company through long-term power purchase agreements.

The simplest configuration for a parabolic trough facility is one in which energy captured in the solar array is used only to produce electricity. It typically includes only the solar field and a conventional STG, together with necessary ancillary support equipment for each. The Beacon Solar Energy Project (BSEP), proposed to be constructed on approximately 2,012 acres (8.14 km^2) in eastern Kern County, California, represents such a "solar only" facility

[11] Fires are possible not only because of the presence of fluids that burn, but also because the materials are maintained at extreme temperatures and their contact with common combustible materials can result in spontaneous ignition of those materials.

[12] Parabolic trough facilities constructed as early as the mid- to late-1970s were originally built to provide industrial process steam rather than electricity.

[13] The Rankine cycle turbine is the type most commonly used in simple cycle thermoelectric plants that produce steam from the combustion of fossil fuels and is the likely choice for solar thermal applications.

[14] The maximum net power outputs of SEGS VIII and IX were limited by Federal Energy Regulatory Commission (FERC) and Public Utility Regulatory Policy Act (PURPA) requirements.

TABLE F.2.2-1 Solar Energy Generating System (SEGS) Parabolic Trough Plants

Plant Name	Location (California)	First Year of Operation	Net Output (MWe)	Solar Field Outlet Temperature (ºF/°C)	Solar Field Area (acres/km^2)	Efficiency (%)		Annual Output (MWh)	Hybrid Assist
						Solar Turbine	Fossil Fuel Turbine		
SEGS IX	Harper Lake	1991	80	734/390	120/0.49	37.6	37.6	256,125	HTF heater
SEGS VIII	Harper Lake	1990	80	734/390	115/0.47	37.6	37.6	252,750	HTF heater
SEGS VI	Kramer Junction	1989	30	734/390	47/0.19	37.5	39.5	90,850	Gas boiler
SEGS VII	Kramer Junction	1989	30	734/390	48/0.20	37.5	39.5	92,646	Gas boiler
SEGS V	Kramer Junction	1988	30	660/349	62/0.25	30.6	37.4	91,820	Gas boiler
SEGS III	Kramer Junction	1987	30	660/349	57/0.23	30.6	37.4	92,780	Gas boiler
SEGS IV	Kramer Junction	1987	30	660/349	57/0.23	30.6	37.4	92,780	Gas boiler
SEGS II	Daggett	1986	30	601/316	47/0.19	29.4	37.3	80,500	Gas boiler
SEGS I	Daggett	1985	13.8	585/307	21/0.08	31.5	None	30,100	3-h TES

Sources: NREL TroughNet Parabolic Trough Solar Power Network Web site (http://www.nrel.gov/csp/troughnet/power_plant_data.html#solar_one, accessed May 28, 2008) and SDRREG (2005).

(Beacon Solar, LLC 2008). The BSEP will produce power by using only the heat generated in the solar field, except for brief periods of cold start-up when two natural gas boilers will be operated. This facility will have a nominal electrical output of 250 MWe. An Application for Certification (AFC) for the BSEP was filed with the California Energy Commission (CEC) on March 14, 2008, and accepted as complete by CEC on May 5, 2008.[15] Commercial operation is planned to begin in late 2011. The CEC released its Final Staff Assessment (FSA) on October 22, 2009. The FSA is an evaluation of the BSEP application that presents the commission's analysis and recommendations. In its application, Beacon Solar proposed a wet-cooling system that would draw its water from fresh groundwater on-site wells, which is

[15] The complete AFC for BSEP is available electronically at http://www.energy.ca.gov/sitingcases/beacon/index.html. Accessed Jan. 5, 2009.

inconsistent with the State Water Resources Control Board and CEC water policies. The CEC is concerned with the water usage and its source and suggested alternatives for Beacon's consideration. Alternatives include a shift to dry cooling or a different water source that uses degraded groundwater from off-site wells. Beacon Solar continued to support wet cooling, but agreed to use degraded water for its cooling system. In a status conference call on December 1, 2009, BSEP discussed its analysis of three different possible water use plans. However, BSEP continued to propose use of approximately 200 ac-ft/yr (247,000 m^3/yr) of fresh groundwater for processes including mirror washing and emergency usage. On January 12, 2010, CEC released a Proposed Conditions of Certification, which would allow 8 ac-ft/yr (9,870 m^3/yr) of on-site groundwater for potable water needs and 47 ac-ft/yr (58,000 m^3/yr) for emergency purposes. As of January 2010, the CEC had not approved the project's water source for construction and operations water needs, and the water source for BSEP remained unresolved (CEC 2009a).

Future utility-scale CSP facilities may also be hybrids that combine CSP technologies with conventional fossil fuel generation, including integrated solar combined-cycle (ISCC) systems, or even with energy generation technologies that use other renewable fuels, such as biomass. Section F.2.4.4 discusses the feasibilities of such hybrid systems and provides some examples of recently proposed hybrid systems. The environmental impacts of the fossil fuel–fired portions of such combinations are not evaluated in this PEIS.

F.2.2.2.1 Compact Linear Fresnel Reflector (CLFR). While the majority of feasibility studies and technology research, development, and demonstration (RD&D) for CSP focuses on improving overall efficiency through higher operating temperatures and improved dispatchability and reliability of the power being produced, one relatively new CSP technology approach involves changing the fundamental way in which the sunlight is captured and concentrated and its heat applied. Recent technology developments in both Germany and Australia have incorporated the use of a series of nearly flat reflecting surfaces aligned in a parallel arrangement to concentrate sunlight onto an insulated pipe containing water rather than conventional HTF, resulting in the direct production of steam (Figure F.2.2-3).[16]

Apart from the unique concentrating mechanism and the use of water in the HCE rather than conventional HTF, the remainder of the CLFR facility is the same as a conventional parabolic trough facility. CLFR-designed CSP plants offer the following advantages over conventional parabolic trough plants:

- CLFR reflecting mirrors are generally inexpensive to manufacture, and because the focal lengths of the mirrors used in CLFR plants are relatively small, the optical precision need not be as great as is needed for the comparatively more expensive parabolic mirrors.

[16] This technology earns its name from the fact that the parallel arrangement of reflectors behave very much like a Fresnel lens. See Section F.3.2.2 for discussions on a PV technology that employs a Fresnel-type concentrating lens.



FIGURE F.2.2-3 Compact Linear Fresnel Reflector (Source: DOE 2009)

- The nearly flat-plate reflectors in a CLFR plant offer numerous advantages, including:
  - Lower production costs over parabolically shaped reflectors because of less stringent curvature requirements;
  - Simplified installation and sun tracking; and
  - Reduced shadow interference between adjacent reflectors, allowing for closer spacing and, attaining equivalent solar heat capture in a smaller footprint, thus minimizing land use.

- Single-axis tracking of the mirrors simplifies design and deployment as well as maintenance.

- Wind loading issues are reduced due to the comparatively lower profile than conventional parabolic troughs.

- The direct production of steam simplifies plant design and reduces both capital and operation and maintenance (O&M) costs (through elimination of the HTF circulation and storage components) and allows for more rapid plant start-up

Once the steam is produced, downstream activities, as well as equipment associated with power generation and steam condensate management and recycling, are essentially the same as

for other parabolic trough facilities. Many aspects of CLFR technology are still under development. If the anticipated reduced costs can offset the reductions in performance over a trough collector and if CLFR facilities can operate at temperatures as high as 734°F (390°C), as does a conventional trough plant, they are likely to find a potential market in utility-scale power production.

No CLFR facilities were operating in the United States as of February 2010. Ausra CA II, LLC (doing business as Carrizo Energy, LLC) recently submitted an AFC to the CEC (Carrizo Energy, LLC 2007) for what would have been the first operating utility-scale CLFR facility– the Carrizo Energy Solar Farm (CESF), in San Luis Obispo County, California.[17] The proposed project was terminated in November 2009, but the application data is still assumed to be generally representative of this category of CSP technology.

F.2.2.2.2 Non-Steam-Based Power Turbine Options. Most CSP technologies utilizing a steam cycle have incorporated the use of conventional steam-driven turbines. However, some non-steam-based turbine options also exist. The Saguaro Solar Power Plant, a 1-MWe parabolic trough facility owned by Arizona Public Service, is currently operating in Red Rock, Arizona, using an ORC turbine-generator (Figure F.2.2-4).[18] Pentane rather than water is used as the working fluid in the Saguaro ORC. Spent pentane exiting the turbine is condensed and cooled with the use of a completely closed-loop, glycol-based water coolant heat exchanger. Other than the initial filling of the system with water-based coolant (which must be replaced periodically to control internal corrosion), the Saguaro facility consumes no water to produce electricity.

Various organic compounds can be used as HTFs in ORC turbines. Because of the relatively low boiling point [97ºF (36ºC)] of pentane, the Saguaro ORC turbine operates at relatively low temperatures compared to conventional steam turbines. However, pentane is also extremely flammable and has a relatively low autoignition temperature of 500ºF (260ºC), so its use introduces some fire risk. Selection of HTFs with higher boiling points and heat capacities relative to pentane but with less extreme (or no) flammability characteristics (e.g., synthetic oils or hydrofluorocarbon or perfluorocarbon commercial refrigerants) would allow for designs of ORC turbines with significantly higher power-generating capacities, along with reductions of concomitant risks from the working fluid. However, some alternative working fluids, while nonflammable, still have significant ozone depletion potential, although such would not be of environmental consequence unless the working fluid system developed a leak.

Field experience with ORC turbines in solar thermal power plants is limited, and ORC turbines have been used only in facilities with relatively small power outputs. Nevertheless, the Saguaro facility clearly demonstrates the technical applicability of ORC turbines at parabolic trough and power tower facilities. However, despite the intrinsic benefits of ORC turbines in arid

[17] The complete AFC for the CESF, as well as other documents related to the CEC review, are available at http://www.energy.ca.gov/sitingcases/carrizo/documents/index.html. Accessed Jan. 5, 2009.

[18] For details about the Saguaro Solar Power Plant, go to http://www.renewableenergyworld.com/rea/news/story?id=44696 and http://www.aps.com/_files/renewable/SP017SaguaroSolarTrough.pdf. Accessed Jan. 5, 2009.

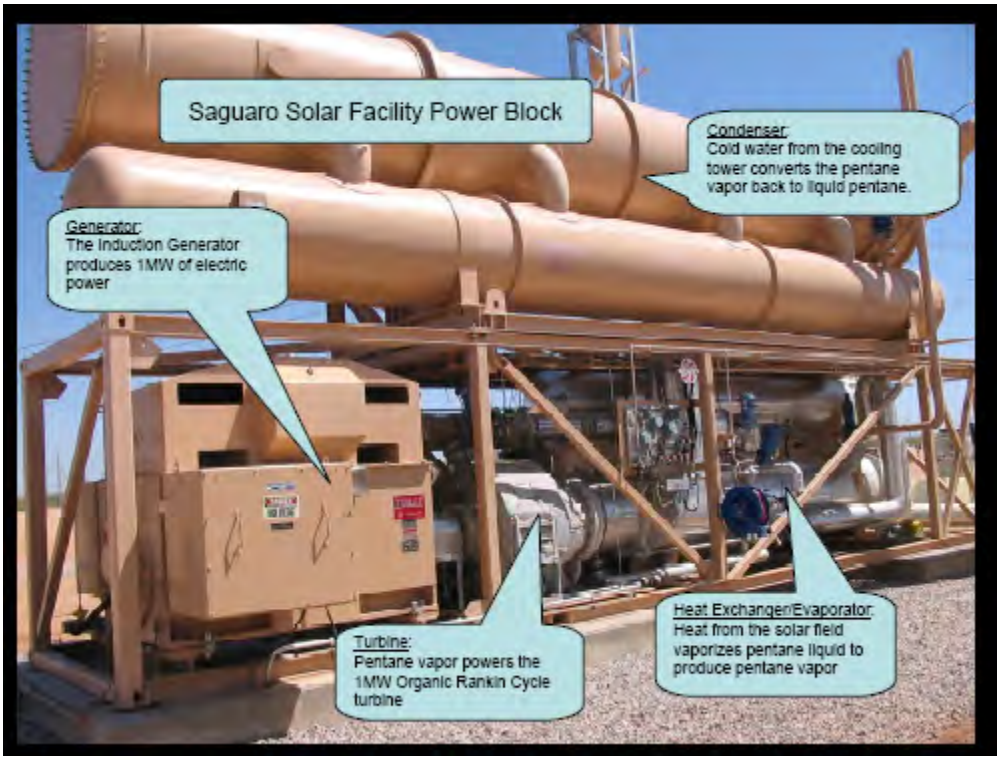


FIGURE F.2.2-4 Power Block of the Saguaro Solar Facility Showing a 1-MWe Pentane Organic Rankine Cycle Turbine (Courtesy of Arizona Public Service. Reprinted with permission. Available at http://www.aps.com/_files/renewable/SaguaroSolarFacilityPowerBlock.pdf. Accessed Aug. 6, 2008)

environments where cooling water is scarce, their limited application to date in utility-scale solar facilities as well as the lack of their inclusion in recently proposed facilities would appear to indicate that ORC turbines will likely not predominate or even come into widespread use in utility-scale solar facilities in the near term.

F.2.2.3 Optimizing the Size and Design of Parabolic Trough Facilities

Various RD&D initiatives addressing all aspects of parabolic-trough facility design and operation are complete or under way. The quality of the solar resource continues to be the largest determinant of overall CSP facility performance and the levelized cost of energy (LCOE)[19] that it can provide. Nevertheless, improvements in individual components that will also contribute to overall improved performance are contemplated. Using the SEGS VI plant as a baseline reference, the San Diego Regional Renewable Energy Group (SDRREG) anticipates the following changes in individual component efficiencies or plant parameters for plants built in 2012 (SDRREG 2005):

[19] Levelized cost of energy (also sometimes called the levelized cost of electricity) is the cost of the energy-generating system including all of the costs over its lifetime (initial investment, O&M, cost of fuel, and cost of capital).

- Optical efficiency increase from 53.3% to 72%;
- Receiver thermal efficiency increase from 72.9% to 86.3%;
- Piping thermal efficiency increase from 96.1% to 97.0%;
- Storage thermal efficiency increase from 99.4% to 99.7%[20];
- Power plant efficiency increase from 35% to 39.2%;
- Electric parasitic load increase from 82.7% to 92.9%;
- Power plant availability decrease from 98% to 94%; and
- Annual solar-to-electric efficiency increase from 10.6% to 17.1%.

Although data from the SEGS plants (see Section F.2.2.2) provide valuable field experience for virtually all aspects of parabolic trough facility design and operation, they do not define the ideal parabolic trough plant size and configuration.[21] Many configurations and sizes of parabolic trough facilities are possible. A study commissioned by the U.S. Department of Energy's (DOE's) NREL explored the advantages, disadvantages, and probable configurations of large-scale parabolic trough power plants in an effort to approximate the most preferred size and configuration (Kelly 2006a). The study sought to identify the preferred plant size, that is, those engineering dimensions and power-producing capacities that represent a favorable balance among maximum capture of economies of scale, parasitic losses, and capital and operational costs such that overall system efficiencies and economies are realized and the LCOE produced is minimized.

Using utility- and industry-accepted models and parameters and published performance characteristics of major components, Kelly (2006a) determined the preferred sizes for parabolic trough facilities with and without TES. The major parameters evaluated in that study included Rankine cycle STG frame sizes and performance characteristics,[22] steam conditions, steam feedwater system, solar field size and geometries, HTF pumping costs and pressure losses, TES systems, steam cooling systems, and other parasitic losses associated with fluid transfers (HTF, steam/condensate, cooling water [in wet recirculating systems—see Section F.2.4.2], and molten salt [in TES systems—see Section F.2.4.3]), land acquisition and labor costs, as well as capital and operational costs. Major conclusions of the study include the following:

[20] Solar VI did not have thermal storage. Instead, the reference case is a hypothetical parabolic trough with 6-hour TES using 2007-era technologies.

[21] The ideal plant size and configuration is one that captures the maximum economies of scale for all components and aspects of plant operation while minimizing construction and operation/maintenance costs and parasitic losses (auxiliary loads that must be subtracted from the gross plant output).

[22] STGs are available in discrete frame sizes, with the number of stages, turbine blade lengths, and inlet and outlet steam pressures dictating the power-production capacity of available variants within each frame size.

- For parabolic trough plants using Therminol HTF with molten salt TES, a capacity of 200 MWe is likely to be the upper limit for the most economic plant. Multiple equipment items for the HTF and TES systems for larger plants, as well as the Rankine cycle STGs approaching their maximum efficiency of 38%, argue against any further increases in plant size.

- For parabolic trough plants using Therminol HTF without TES, the largest economical plant size is 250 MWe. At this plant size, HTF system efficiencies are maximized, and Rankine cycle STGs have attained their highest efficiencies.[23]

While the Kelly (2006a) study did not specifically evaluate plants that use inorganic HTFs in place of synthetic oils, the author notes that because inorganic salt HTFs allow the solar field to operate at higher temperatures, the maximum plant size would likely be in the range of 250 MWe to 300 MWe for plants with TES and 350 MWe for plants without TES.

A study published by SDRREG (2005)[24] demonstrated important design relationships for components of parabolic trough facilities utilizing TES: provided that a large enough solar field is selected and that the ideal ratio of solar multiple to hours of TES capacity is maintained, designers can create facilities with varying TES capacities while maintaining a competitive LCOE. This conclusion provides important flexibility in establishing Power Purchase Agreements (PPAs) that guarantee that the solar facility can produce power during periods of peak demand in the load centers it supports, regardless of whether those periods coincide with the times of maximum DNI. Figure F.2.2-5 demonstrates the relationships between LCOE, hours of TES, and the solar multiple of a hypothetical plant.[25,26] However, it is also important to note that CSP facilities with TES capability are able to produce power during peak loads, irrespective of insolation over those periods. This makes that power more valuable to transmission system operators and may result in a somewhat higher cost of electricity for consumers.

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[23] Importantly, the maximum sizes of 200 MWe and 250 MWe for plants with and without TES, respectively, do not reflect the dispatchability of either plant. So, while the maximum preferred size of a parabolic trough plant with TES is less, its dispatchability, and thus its value as a source of power to the grid, is significantly greater than that of the plant without TES.

[24] An appendix to this study, from which the data cited below were derived, was produced by NREL.

[25] The solar multiple reflects the ratio of the size and heat-generating capacity of the solar field to the amount of heat needed for the facility to operate at its peak power rating. A facility with a solar field only large enough to supply the amount of heat needed to produce steam and generate power at the facility's peak power rating is said to have a solar multiple of 1.0. If the solar field of such a facility were expanded to double its heat-producing capacity, the facility would have a solar multiple of 2.0. Such "excess" heat could then be directed to TES applications and used at a later time to produce steam and power. As a practical matter, most CSP plants would be designed with solar multiples greater than 1.0 even when no TES features were present. This would allow a portion of the solar field to be taken out of service for maintenance or repair without compromising the facility's ability to deliver power at its nameplate power rating.

[26] The values represented in Figure F.2.2-5 were derived by using the NREL Solar Advisor model. Details on that model are available at https://www.nrel.gov/analysis/sam/download.html. Accessed Jan. 5, 2009.

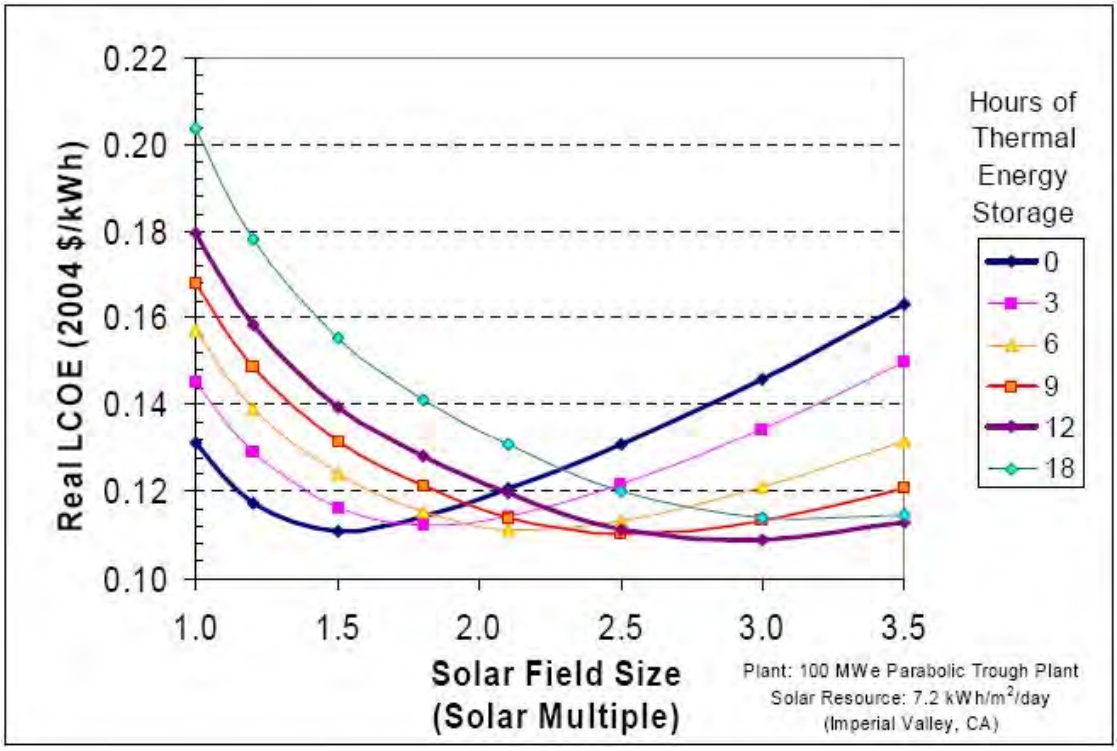


FIGURE F.2.2-5 Relationship between Solar Multiple and Levelized Cost of Energy for Parabolic Trough Facilities with Various TES Capacities (Source: NREL, as cited in SDRREG 2005)

Another parameter that can be used in defining an optimal parabolic trough plant configuration is the facility's capacity factor, or the percentage of time that the plant can produce power at its design basis. Here, again, the facility's solar multiple and TES capacity together play critical roles, offering designers flexibility in maximizing the capacity factor of a parabolic trough plant. The SDDREG study also explored the relationships among solar multiple, TES, and capacity factor. The results of that analysis are shown in Figure F.2.2-6.[27] As shown in that figure, a facility with a solar multiple of 3.5 and a TES capacity of 18 hours can provide nameplate levels of power more than 60% of the time. Increasing the capacity factor greatly improves the value of the solar plant as a source of reliable and dispatchable grid-connected power. However, increases in both the solar field size and TES capacity required to accomplish that will increase capital and O&M costs.

[27] As with the values in Figure F.2.2-5, the values in Figure F.2.2-6 were derived using the NREL Solar Advisor Model. The model is available at https://www.nrel.gov/analysis/sam/download.html. Accessed Jan. 5, 2009.

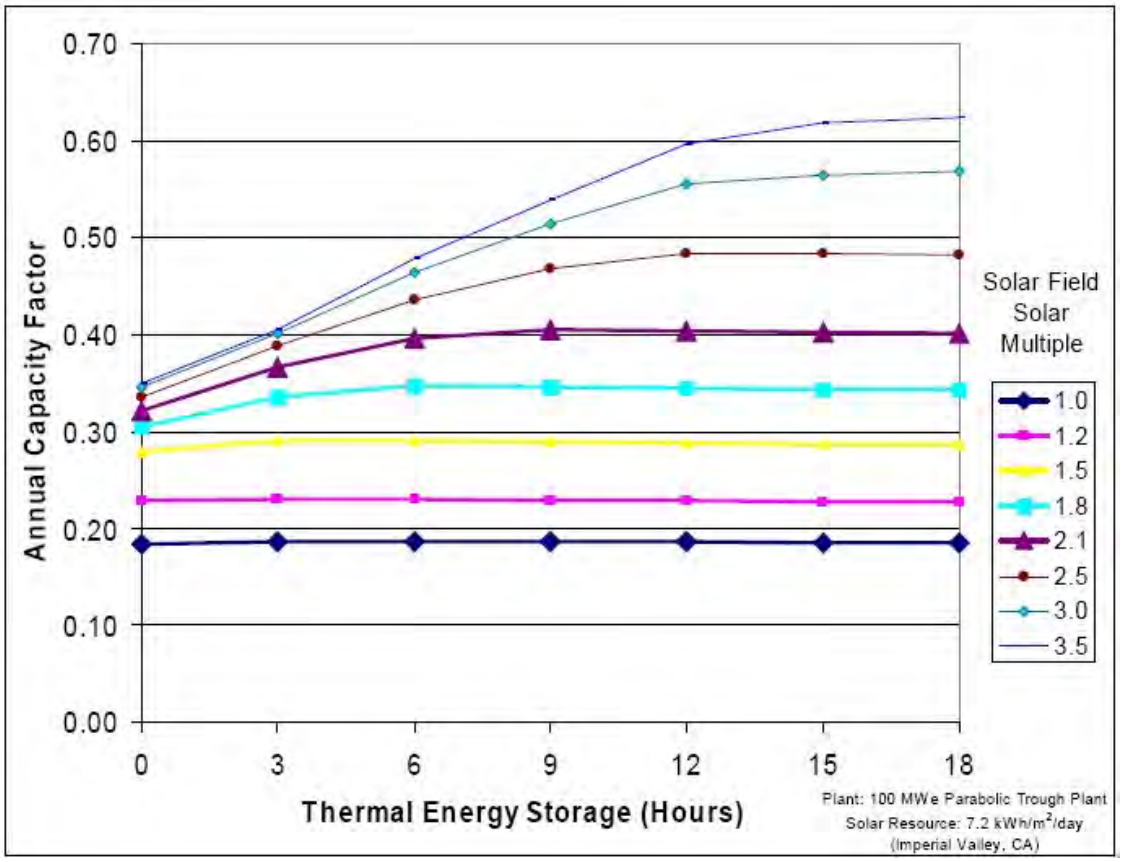


FIGURE F.2.2-6 Relationships among Solar Multiple, TES, and Capacity Factor for Parabolic Trough Facilities (Source: NREL, as cited in SDRREG 2005)

F.2.2.4 Engineering Parameters and Resource Requirements for Parabolic Trough Facilities

To support an environmental impact analysis of utility-scale parabolic trough facilities, it is necessary to define representative engineering parameters and resource requirements. This section presents these data for (1) a typical 250-MWe parabolic trough facility with 3 hours of TES,[28] (2) a proposed 250-MWe "solar only" parabolic trough facility, and (3) a proposed 177-MWe CLFR facility. These data are considered representative of similarly sized utility-scale parabolic trough facilities, although they may not anticipate parameters and requirements for future proposed facilities.

Engineering parameters for a hypothetical 250-MWe parabolic trough facility with TES were estimated by Kelly (2006a). Those parameters and dimensions that most directly relate to environmental impact are presented in Table F.2.2-2.

[28] Section F.2.4.3 provides a detailed description of various TES options.

TABLE F.2.2-2 Critical Parameters of a Hypothetical 250-MWe Parabolic Trough Facility with 3-Hour TES

Parameter	Quantity	Notes
Structures and Improvements		
Clear and grub	1,048 acres (4.2 km^2)	Applies to the entire facility
Excavations (site-wide)	38,487 yd^3 (29,443 m^3)	Foundations, footings, buried piping, and controls
Backfill and compaction (site-wide)	11,762 yd^3 (8,998 m^3)	Foundations, footings, buried piping, and controls
On-site roads—grading	25,600 yd^2 (21,427 m^2)	Does not include access road(s)
On-site roads—8-in. base	4,200 yd^3 (3,213 m^3)	Does not include access road(s)
On-site roads—3-in. asphalt	16,700 yd^2 (13,978 m^2)	Does not include access road(s)
On-site roads—6-ft shoulders	7,200 yd^2 (6,026 m^2)	Does not include access road(s)
Site perimeter fence	28,500 ft (8,687 m)	Assumed 10-ft chain link
Evaporation pond—grading	49,300 yd^2 (41,264 m^2)	Steam and cooling water blowdown
Evaporation pond—clay lining	36,400 yd^3 (27,846 m^3)	
Maintenance/warehouse building	6,000 ft^2 (558 m^2)	
Control/electrical/administration building	4,000 ft^2 (317 m^2)	
Security/gatehouse	150 ft^2 (14 m^2)	
Nitrogen storage vessel	3	Horizontal, cylindrical tank, 14-ft diameter, 51 ft long
Cold salt storage tank	3	Vertical cylindrical tank, 102-ft diameter × 46-ft height
Hot salt storage tank	3	Vertical cylindrical tank, 104-ft diameter × 46-ft height
Oil-to-salt heat exchangers	24	Straight shell, U-tube, 42,400 ft^2 heat transfer area each
Nitrogen-to-air heat exchanger	1	Finned tube, forced draft heat exchanger 50 ft^2 (4.6 m^2) bare tube area, 650 ft^2 (60.4 m^2) finned tube area, 0.75 brake horsepower (bhp) electric fan
Cold salt pumps	3	Extended shaft turbine pump, 1,750 bhp motor
Hot salt pumps	3	Extended shaft turbine pump, 1,750 bhp motor
Solar field	492 acres (1.99 km^2)	Parabolic troughs
HTF	1,228,000 gal (4,648 m^3)	Solutia Therminol VP-1
Tanks (only major tanks listed)		
Fuel oil storage (diesel emergency generator)	1	5,000 gal (19 m^3), horizontal, double-walled fiberglass, underground
Diesel generator day tank	1	200 gal (0.76 m^3), horizontal, carbon steel Above ground with concrete catch basin
Sludge thickener	1	3,000 gal (11.4 m^3), cone bottom, open top carbon steel with plastic lining and internals, 7-ft, 6-in. diameter × 10-ft high

TABLE F.2.2-2 (Cont.)

Parameter	Quantity	Notes
Tanks (Cont.)		
Sulfuric acid storage	1	6,000 gal (22.7 m^3), horizontal cylindrical, carbon steel 7-ft diameter × 21-ft long
Caustic soda storage	1	3,500 gal, (13.2 m^3) horizontal cylindrical, carbon steel 5-ft diameter × 23 ft, 6 in.
Soda ash storage bin	1	10,000 lb (4,540 kg) capacity, vertical cylindrical
Quick lime storage bin	1	9,600 lb (4,350 kg) capacity, vertical cylindrical
Steam-turbine generator lube oil	1	10,000 gal (37.9 m^3)
Cooling towers	1	Wet, mechanical draft, 135,000 gpm (511 m^3/min) water circulation, 9 cells, 1 fan/cell, 101 to 80°F @ 104°F dry bulb/ 68°F wet bulb

Source: Kelly (2006a).

In comparison, the critical engineering and environmental resource requirements of the proposed 250-MWe "solar only" BSEP facility, described in Section F.2.2.2, include the following (Note: changes to project parameters that occurred as a result of the CEC's FSA [Section F.2.2.2] are reflected in brackets and italics (e.g., *[6 acres]*):

- Power generation and fuel consumption
  - Nominal capacity: 250 MWe (gross)
  - Capacity factor (annual): 26.5%
  - Estimated annual power production: 600,000 MWh/yr
  - Parasitic load: 11%
  - Estimated natural gas consumption: 36,000 MMBtu/yr

- Facility size
  - Total footprint: 2,012 acres (8.1 km^2)
  - Solar array: 1,244 acres (5.0 km^2)
  - Power block: 22 acres (0.09 km^2)

- Solar array
  - Single-axis tracking parabolic trough
  - Total reflected area: >494 acres (>2 km^2)
  - HTF: Therminol™ VP-1
  - HTF temperature: 740°F (394°C)

- Power block and ancillary equipment
  - STG and support equipment (1)
  - Water-cooled condenser (1)
  - Natural gas boilers (2) to aid in cold start-up and prevent freezing of HTF
  - Wet recirculating cooling with mechanical draft cooling tower
  - Emergency fire-water pump engine and diesel fuel tank
  - Diesel-fueled generator for emergency alternating current (AC) power
  - Batteries for emergency direct current (DC) power
  - Evaporation ponds (3), double-lined, 8.3 acres (0.03 km^2) *[2 acres (0.01 km^2)]* each; 25 acres (0.1 km^2) *[6 acres (0.02 km^2)]* total

- Tanks
  - Raw water: 2,840,000 gal (10,751 m^3) (vertical, field erected)
  - Treated water: 2,350,000 gal (8,896 m^3) (vertical, field erected)
  - Demineralized water: 150,000 gal (568 m^3) (vertical, field erected)
  - Sodium hydroxide (steam water treatment): 7,500 gal (28 m^3)
  - Sulfuric acid (steam water treatment): 10,000 gal (38 m^3)
  - Lubricating oil and diesel fuel: various sizes, largest <1,200 gal (4.5 m^3)

- Transmission line: 230 kV, 3.5 mi (5.6 km)

- Water requirements and management
  - Source: off-site groundwater wells *[on-site groundwater wells]*
  - Consumption: average flow, 990 gpm (3.8 m^3/min); peak flow, 4,054 gpm (15.3 m^3/min) *[no update on this parameter was given in the October 2009 FSA]*
  - Zero-discharge evaporation ponds for cooling tower blowdown disposal
  - Estimated consumptive use: 1,600 ac-ft/yr (1.97 million m^3/yr) (1,388 ac-ft/yr [1.71 million m^3/yr])
  - Consumptive uses include wet, recirculating steam cycle cooling, miscellaneous industrial processes, mirror washing, and potable and sanitary uses

- Construction (includes natural gas connector pipeline and transmission line)
  - Project construction period: 25 months
  - Peak construction workforce: 836
  - Average construction workforce: 477

Critical engineering parameters and environmental resource demands for the proposed CLFR CESF facility, described in Section F.2.2.2.1, include the following:

- Nominal capacity: 177 MWe (net); 230-kV interconnect voltage

- Anticipated construction period: 35 months

- Typical operating periods: 13 h/day, 4,765 h/yr

- Overall plant size: 640 acres (2.6 km^2); additional 380-acre (1.5-km^2) construction laydown area

- Buildings and major structures
  - Control/administration building: 3,000 ft^2 (279 m^2), 40 ft (12 m) high
  - STG building: 10,000 ft^2 (930 m^2), 60 ft (18.3 m) high
  - Air-cooled condensers (2): 55,000 ft^2 (5,120 m^2) footprint, 115 ft (35 m) high
  - Water treatment facility: 300 ft^2 (28 m^2), 20 ft (6.1 m) high
  - Warehouse/shop building: 11,250 ft^2 (1,046 m^2), 20 ft (6.1 m) high
  - Fire water pump building: 1,000 ft^2 (93 m^2) by 15 ft (4.6 m) high
  - Blowdown tank (vertical) (29,000 gal [110 m^3]): 12 ft (3.7 m) diameter by 25 ft (7.6 m) high
  - Condensate tank (horizontal) (20, 000 gal [76 m^3]): 10 ft (3.0 m) diameter by 26 ft (7.9 m) long by 20 ft (6.1 m) high
  - Raw fire water tank (vertical) (450,000 gal [1,703 m^3]): 56 ft (17 m) diameter by 28 ft (8.5 m) high
  - Service water tank (vertical) (150,000 gal [568 m^3]): 36 ft (11 m) diameter by 19 ft (5.9 m) high
  - Decimalized water tank (vertical) (40,000 gal [151 m^3]): 17 ft (5.2 m) diameter by 28 ft (8.5 m) high

- Solar field: 618 acres (2.5 km^2)
  - 195 CLFR "lines:" each 90 ft (27.4 m) wide by 1,268 ft (387 m) long by 5 ft (1.5 m) high and each consisting of 10 mirrors reflecting sunlight to a linear Fresnel lens that focuses heat on a stationary steam tube

- Internal roadways: 7 mi (11 km)

- High perimeter fencing: 10 ft (3.0 m)

- Steam production: 2.52 million lb/h (1.14 million kg/h) at 720 psia (49.6 bar)

- Water demands (based on 4,765 h/yr of operation):
  - Average daily water consumption (for various maintenance processes and steam cycles): 18,500 gal (70 m^3)
  - Average annual water consumption: 21.8 ac-ft (26,890 m^3), based on average annual conditions of 95°F (35°C) at 100% load for 4,745 h/yr with mirror washing 250 days/yr
  - All water supplied by on-site well

F.2.3 Solar Power Tower Technologies

Although power tower technology shares many characteristics with parabolic trough technology, it has distinct differences. Parabolic reflectors of a parabolic trough facility act as line concentrators, focusing the sun's heat on a corresponding segment of an HTF-filled tube. All

of the power tower's nearly flat plate reflectors[29] (known as heliostats) work collectively as point concentrators, focusing the sun's heat on a central point at the top of a centrally located tower. Two large-scale research and demonstration facilities, the 10-MW Solar One facility near Barstow, California, and Solar Two, a retrofit of Solar One that incorporated molten salt storage, were operated in the United States from 1982 to 1997 and produced more than 38,000 MWh of electricity. Both plants proved the viability of tower technology. Furthermore, Solar Two, which at one point operated continuously at nameplate rating for 7 days, demonstrated the value of molten salt TES when combined with power tower technology to greatly improve the dispatchability of electricity from power towers.

Only one power tower facility with a power capacity of greater than 10 MW is currently operational in the world: PS10 in the Solucar Solar Park in Spain. PS10 consists of a central 377-ft (115-m) tower and 624 heliostats that focus the sun's radiation onto the uppermost part of the tower. Each heliostat has a reflecting surface area of 1,291 ft^2 (120 m^2) for a total reflecting surface area of 807,605 ft^2 (75,000 m^2). The facility has a nameplate rating of 11 MWe using only the solar field to produce steam. That rating can be augmented by as much as 12% to 15% with the introduction of a natural gas boiler to increase steam production. A companion plant, PS20, which has twice the power capacity, was scheduled to be commissioned in 2008.[30]

The heliostats' central point focus is a receiver positioned at the top of a tower that is at the center of an array of heliostats.[31] Depending on the number and positioning of the heliostats and the insolation available, the heat transfer medium at the receiver can be heated to as high as 1,050°F (565.5°C) (see DOE 2009).[32] Once the sun's reflected and concentrated heat is captured, the downstream activities of producing steam and subsequently using that steam in a Rankine cycle STG are essentially identical to those activities in a parabolic trough facility. A conceptual power tower facility with molten salt TES is shown in Figure F.2.3-1. An aerial photograph of the Solar Two facility in Barstow, California, is shown in Figure F.2.3-2.

[29] Heliostats have a slight curvature. The amount of curvature dictates the focal length of the reflector. For power towers, the focal lengths of the reflectors (the distance from the reflector to the point at the top of the tower on which the heliostats are focused) is much greater (on the order of tens or even hundreds of feet) than the focal length of a typical parabolic trough facility, where the focus of the reflector is the HCE, which is only a few feet from the reflecting surface.

[30] Details on PS10 and PS20 are available at http://www.abengoasolar.com/sites/solar/en/. Accessed Jan. 5, 2009.

[31] Heliostats need not completely surround the tower; however, a recently proposed power tower facility incorporates such a 360° array—see Sections F.2.3.2 and F.2.3.3.

[32] This temperature can be attained only in a power tower facility with molten salt TES. Power tower facilities that store heat as steam operate at lower temperatures. For example, the PS10 facility in Spain operates at a steam temperature of 450°F (232°C) (and a pressure of 500 pounds per square inch [psi]).

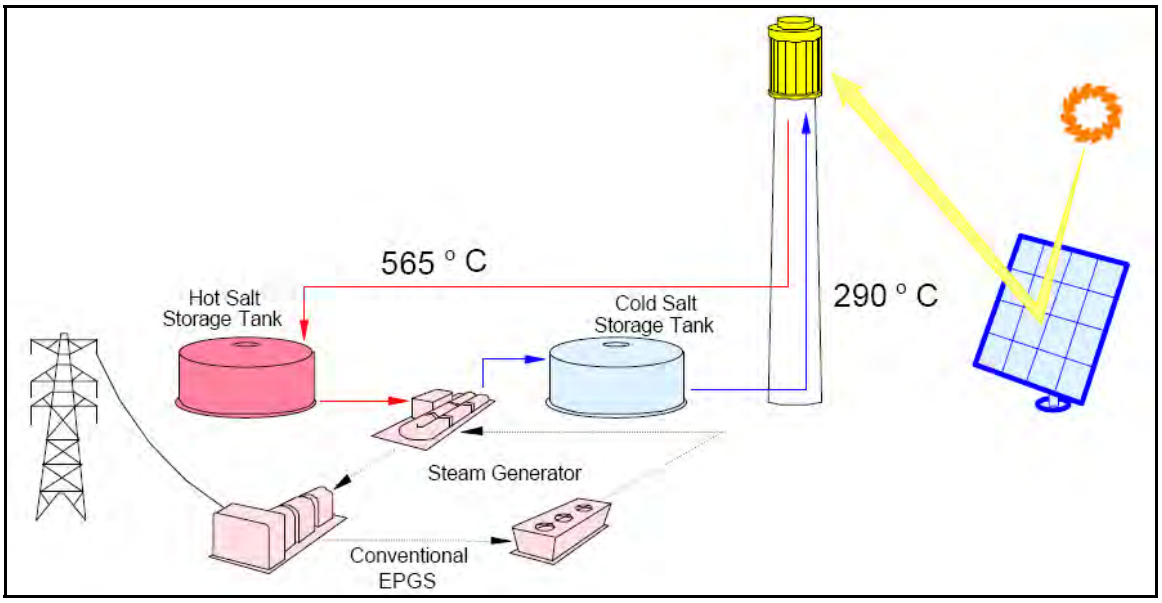


FIGURE F.2.3-1 Schematic of a Power Tower Facility with Two-Tank Molten Salt Storage (Depiction of the Solar Two facility) (Source: Sandia National Laboratory. Available at http://www1.eere.energy.gov/solar/pdfs/kolb.pdf. Accessed June 19, 2008)

F.2.3.1 Facility Components

F.2.3.1.1 Solar Field: Mirrors and Receivers. The solar field of a power tower facility consists of individual slightly curved heliostats capable of single-axis or dual-axis sun tracking and that are aimed at the receiver at the top of the centrally located tower. The receiver is simply a container holding the HTF, which, in the case of the only commercial power tower facility built to date, has been water/steam. However, as discussed above, feasibility studies suggest that a power tower design utilizing a molten salt mixture identical to the medium used for parabolic trough TES (see Sections F.2.3.2 and F.2.3.3) could be used as both an HTF and a TES medium in a power tower. The molten salt would be capable of producing steam immediately or storing heat for later steam production. (See Section F.2.4.3 for additional discussions on TES options.)

F.2.3.1.2 HTFs in Current and Future Power Towers. To date, only water has been used as an HTF in commercial power tower plants. However, because of the high concentrating ratios provided by the numerous heliostats, power tower facilities are nevertheless capable of generating receiver temperatures of more than 1,000°F (537°C). For example, the proposed ISEGS is capable of providing superheated steam at 1,004°F (540°C) and 2,030 psi (140 bar) to its STGs. (See Section F.2.3.2 for details.) Future power towers may use molten salt as both an HTF and a TES medium and may be capable of generating even higher receiver temperatures, allowing for the production of supercritical rather than subcritical steam, which

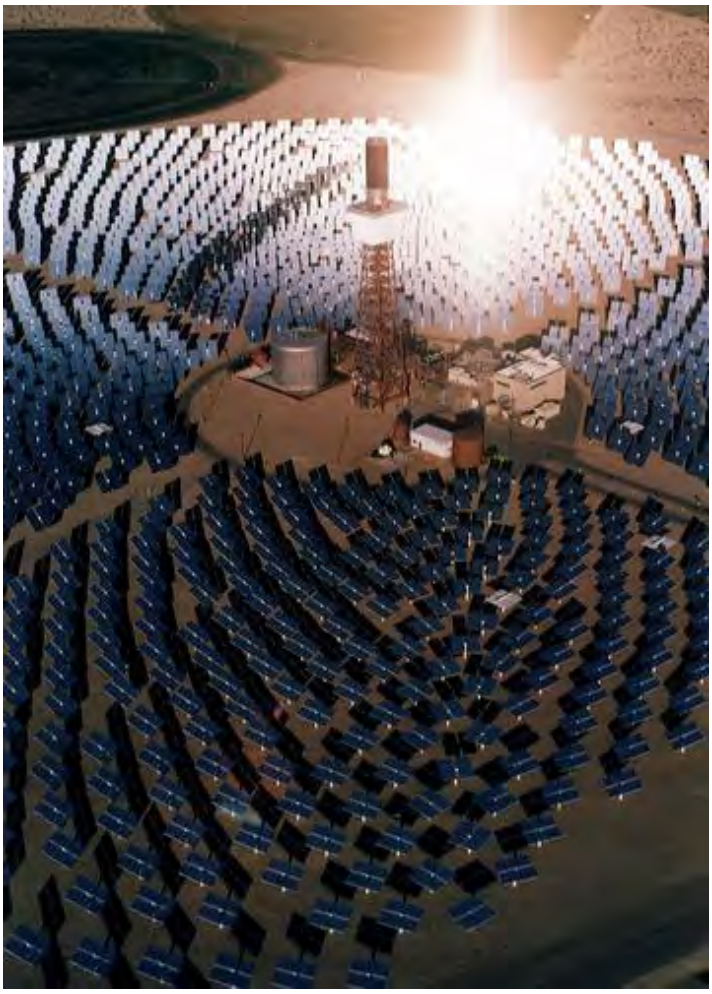


FIGURE F.2.3-2 Solar Two, CSP Power Tower Facility in Daggett, California (Source: NREL Photo #01701. Photo Credit: Sandia National Laboratory. Available at http://www.nrel.gov/data/pix/searchpix.cgi?getrec=10135024&display_type=verbose&search_reverse=1. Accessed July 2, 2008)

would result in higher operating efficiencies for the STGs.[33] However, no actual power tower facilities have been designed to produce supercritical or ultra supercritical steam, and the ISEGS proposes to use water as its HTF and have only 1 hour of TES capability (stored as steam).

[33] "Supercritical" and "subcritical" define the thermodynamic state of the water in the steam cycle. In supercritical steam-generating units, the steam cycle pressure is maintained above water's critical point so that there is no distinction between water's liquid and gaseous phases and the steam behaves as a homogenous supercritical fluid. The supercritical point for water is 22.1 MPa (approximately 3,207 psi). Supercritical steam generators offer numerous advantages over their subcritical counterparts, including higher thermal efficiencies and greater flexibility in changing loads. Finally, ultra supercritical steam-generating plants, operating at steam conditions as high as 4,500 psi and 1,112°F, are operational in Denmark and Japan; however, none is currently operating in the United States.

The use of molten salt HTF would result in special design and operating demands. For example, the circulation pumps would need to be constructed of materials compatible with the salt and would need to be designed to withstand the expected higher operating temperatures. Preventive maintenance to preempt corrosive deterioration of salt management systems, heat tracing on all transfer piping to ensure that the salt's temperature stays above its eutectic point, and supplemental heating during down periods to shorten cold start-up periods might be required, all of which would create an increased parasitic load for the facility.

F.2.3.2 Utility-Scale Power Tower Facilities

As noted above, the ISEGS is a proposed utility-scale power tower facility that, if approved, will be located near the Ivanpah Dry Lake in San Bernardino County, California, on land administered by the U.S. Department of the Interior (DOI) Bureau of Land Management (BLM).[34] An AFC (BrightSource Energy, Inc. 2007) for ISEGS was submitted to the CEC on August 28, 2007, and deemed complete by the CEC on October 31, 2007.[35] The FSA and Draft Environmental Impact Statement (CEC 2009b) was published on November 4, 2009.[36] Project parameters were changed during the CEC's evaluation of the AFC and are reflected in brackets and italics (e.g., *[270 MWe]*) in the requirements listed below. Changes in design optimization were made in response to data requests from CEC to the applicant and mostly include reduction in the number of heliostats, increased heliostat surface area, movement of project boundaries, and reduction in the number of power towers. On February 11, 2010, BrightSource submitted a Biological Mitigation Proposal that would reduce impacts to biological and visual resources. The mitigated ISEGS 3 configuration includes further reduction in the project footprint, number of heliostats, and number of towers. It also results in a capacity reduction to ISGES 3 from a nominal 200 MWe to 170 MWe (CEC 2010).

The ISEGS facility is proposed to be built in three phases. ISEGS 1 and ISEGS 2 will each have a nominal rating of 100 MWe, while ISEGS 3 will be rated at 200 *[170]* MWe, for a total facility capacity of 400 *[370]* MWe. Each phase will be capable of independent operation, and each will be supported by a natural gas boiler that will shorten cold start-up times. Some functions of facility operation will be centralized to support all three ISEGS phases while minimizing the environmental footprint of the facility.

[34] Project approved. Updated information will be included in the Final PEIS.

[35] The complete AFC for the ISEGS, as well as documents related to the CEC review, are available at http://www.energy.ca.gov/sitingcases/ivanpah/documents/index.html. Accessed Jan. 5, 2009.

[36] The complete FSA and Draft Environmental Impacts Statement are available at http://www.energy.ca.gov/2008publications/CEC-700-2008-013/FSA/. Accessed Nov. 20, 2009.

F.2.3.3 Engineering Parameters and Resource Requirements for Power Tower Facilities

To support an environmental impact analysis of utility-scale power tower facilities, it is necessary to define representative engineering parameters and resource requirements. This section presents these data for the proposed ISEGS facility described in Section F.2.3.2. These data are considered to be representative of similarly sized utility-scale power tower facilities, although they may not anticipate parameters and requirements for future proposed facilities.

Salient engineering parameters and environmental resource requirements for the ISEGS facility include the following (Note: changes to project parameters that occurred during the CEC's evaluation of the AFC are reflected in brackets and italics):

- Power ratings
  - ISEGS 1 and ISEGS 2: 100 MWe each *[ISEGS 1: 120 MW; ISEGS 2: 125 MW]*
  - ISEGS 3: 200 MWe *[ISEGS 3: 125 MW]*

- Land area
  - ISEGS 1 and ISEGS 2: 850 acres (3.4 km^2) each *[914 acres (3.7 km^2) and 1,097 acres (3.7 km^2), respectively]*
  - ISEGS 3: 1,660 acres (6.7 km^2) *[1,227 acres (7.4 km^2)]*
  - Total facility (ISEGS 1, 2, and 3 plus shared facilities): 3,400 acres (13.8 km^2) *[3,582 acres (16.5 km^2)]*

- Towers and heliostat arrays
  - Towers: three *[one]* each for ISEGS 1 and 2, four *[one]* for ISEGS 3
  - Tower heights: 312 ft (95 m) for ISEGS 1 and 2, 459 ft (140 m) for ISEGS 3 *[459 ft [140 m] for ISEGS 1, 2 and 3]*
  - Heliostats (each): 7.2 ft (2.2 m) high, 10.5 ft (3.2 m) wide, 75.6-ft^2 (7.04-m^2) reflection surface area (an overall height of 12 ft [3.6 m])
  - Heliostat arrays: 68,000 each for ISEGS 1 and ISEGS 2 *[53,500 for ISEGS 1, 60,000 for ISEGS 2]*, 136,000 *[60,000]* for ISEGS 3

- Air-cooled condensers for each steam cycle

- Natural gas boiler for each tower
  - Used to shorten cold start-up times and sustain power outputs during brief cloudy/stormy periods
  - Heat-generating capacity no more than 5% of the heat supplied by the heliostats
  - Operation no more than 4 h/day
  - Average boiler usage of less than 1 h/day

- Water
  - Source: on-site well
  - Consumption (mirror washing, miscellaneous industrial processes, potable use): <100 ac-ft/yr (123,350 m^3/yr) total for all three plants

- Construction period: 48 months (all phases with some overlap)

- Employment
  - Construction: 959 total jobs (averaging 474 over entire construction period)
  - Operation: 90 full-time employees

F.2.4 Common Systems and Hybrid Systems for Parabolic Trough and Power Tower Facilities

F.2.4.1 Power Plant Systems

Although the mechanisms for producing steam are different for parabolic trough and power tower facilities, the downstream power-generating activities of both technologies are essentially identical. The power plant system, sometimes referred to as the power block, is defined as that portion of the facility at which electrical power is generated. In typical parabolic trough and power tower facilities that generate electricity from only solar energy, the power block includes the (1) steam heat exchanger at which steam is produced, (2) STG that produces electricity, and (3) electrical equipment contained in a substation where the electrical power is converted to AC, transformed to the appropriate voltage, conditioned, and otherwise synchronized for delivery to the bulk electrical grid to which the solar facility is connected. All components of the power block from the steam condenser downstream are virtually identical in form and function to the components composing the power blocks of a conventional fossil fuel thermal power plant.

Superheated steam from the heat exchanger drives a Rankine cycle STG. Leaving the STG, the spent steam is condensed in a standard condenser, and condensate is returned to the heat exchanger via condensate and feedwater pumps after appropriate chemical treatment. Heat absorbed by the steam condenser can be rejected by a variety of cooling systems (see Section F.2.4.2).

The balance of plant for the power block typically includes a SCADA system to monitor and control plant operations, the various pumps and piping systems by which HTF and steam water are circulated, air compressors, the steam condenser, the chemical treatment equipment used to condition the steam condensate before recycling, and the cooling system used to reject heat from the steam condenser (including chemical treatment equipment when cooling water is recirculated). Much of this equipment is likely to be housed in a central operations building. Warehouse and shop buildings are also likely to be present. Also typically present are diesel-fueled emergency generators and/or storage batteries to provide power during power failures for

safe shutdown of AC and DC internal plant loads. Raw water for steam cycle and cooling-water makeup and for firefighting can also be expected to be stored on-site. Tanks for steam condensate, deionized water, steam cycle treatment chemicals, and process wastewater, and an HTF reservoir are also likely to be present.

F.2.4.2 Cooling Systems

All CSP systems that produce steam must also be able to condense and recycle that steam. Information provided in this section is therefore applicable to both parabolic trough and power tower facilities. Because the efficiency of a Rankine cycle STG is governed in large part by the pressure and temperature of the steam both entering and leaving the turbine, the steam condensing/cooling system directly affects overall facility performance.[37] Steam condensation is the single greatest water demand associated with electrical power generation utilizing a steam cycle. A 100-MW parabolic trough facility using a Rankine cycle STG with recirculating wet cooling is estimated to require about 750 ac-ft/yr (925,110 m^3/yr) of water (Dahle et al. 2008). Such cooling systems (see Section F.2.4.2.1) can be expected to account for approximately 90% of that water volume (through evaporation and drift), with another 8% consumed in maintenance of the chemical quality of both the steam water and the cooling water before recycling (e.g., through replacement of blowdown water),[38] and 2% consumed in plant maintenance (e.g., for parabolic trough plants, primarily associated with regular washing of the mirrors).

Rejecting heat through condensation of steam from the steam cycle by means of a recirculating wet-cooling system is technically feasible for CSP facilities. However, the principal mechanism for heat rejection in a recirculating wet-cooling system is evaporation of some portion of the cooling water; approximately 1 pound (0.12 gal at 70°F) of water is lost to evaporation for each pound of steam condensed (Kelly 2006b). In a power plant with a nominal rating of 80 MWe operating at a capacity factor of 27%, this rate of evaporative loss can amount to approximately 5.33 ac-ft/yr (6,575 m^3/yr) (Kelly 2006b). Because the ideal location for a solar facility is often in arid or semiarid desert environments where water availability is limited, controlling consumptive uses of water is critical not only to the performance but also to the very viability of the facility.

Because steam condensation represents the greatest consumptive use of water in parabolic trough and power tower plants, the cooling system becomes a critical design element, especially for facilities sited in water-deprived areas. Four basic cooling system options exist for

[37] It has been estimated that for parabolic trough facilities, for every 1ºF rise in temperature of steam condensate leaving the condenser, power production is decreased by approximately 1% (Kutscher et al. 2006).

[38] To remove suspended solids and to control scale, bacterial growth, corrosion, and a variety of other problems in systems that recirculate water, a certain amount of the water is periodically removed and replaced. When the quality of the replacement water source is high, blowdown can account for as little as 1% of the total volume of water in the system. However, poor-quality replacement water can require blowdowns of as much as 20% of the system volume. In most cases, the makeup water is treated to meet prescribed quality and performance factors before being introduced into the system.

thermoelectric power plants: (1) once-through (or open-loop) wet cooling, (2) recirculating (also known as closed-loop) wet cooling, (3) dry cooling, and (4) hybrid wet/dry cooling. The use of once-through wet-cooling systems for thermoelectric power plants can reasonably be expected to be confined to locations with plentiful surface water supplies (e.g., coastal areas and locations adjacent to rivers, lakes, or reservoirs). On average, once-through cooling systems can be expected to withdraw between 400 and 600 gpm (1.5 and 2.3 m^3/min) for every megawatt of power produced in a conventional steam cycle power plant (EPRI 2004a). Because once-through cooling systems are obviously not compatible with arid environments and are not likely to be selected as the cooling system for either parabolic trough or power tower facilities being developed in the six-state study area of this PEIS, they are not discussed further.[39]

The following sections discuss the cooling systems that would be used by either parabolic trough or power tower facilities in the PEIS study area and the water requirements for each.[40]

F.2.4.2.1 Wet-Cooling Systems. The most common cooling system employed in thermoelectric power plants is known as the wet recirculating system, or the wet closed-loop system. Although the wet closed-loop cooling system is not entirely closed, the majority of the water in the system is retained and recirculated, allowing the system to withdraw substantially less water than a once-through system. Spent steam leaving the STG is directed to a water-cooled condenser where it is cooled before being recycled in the steam cycle. Heated cooling water rejects the heat it absorbed from the condenser at a cooling tower where it is allowed to interact with a counterflow or crossflow of ambient air. Two variants of the closed-loop cooling tower are in use: the mechanical draft tower, where fans direct a flow of ambient air against cooling water cascading over a series of plates, and the natural draft cooling tower, where the flow of ambient air is produced not by fans but by simple convection that causes the air to rise up a tower counter to cascading cooling water. Some portion of the water evaporates into the atmosphere, taking heat energy away from, and thus cooling, the remaining water in the cooling loop. Some smaller fraction of water is also lost through drift, where droplets of water are actually entrained in the counterflow of air and exhausted to the atmosphere. Both cooling tower designs have essentially the same water demands. Although specific cooling system designs, operating conditions, and circumstantial factors (including climatic conditions) all can affect the overall efficiency of a wet-cooling system, it can be reliably anticipated that between 10 and 15 gal (0.038 and 0.057 m^3) of water will be lost per minute to evaporation and drift for every

[39] Recent amendments to Sections 316(a) and (b) of the federal Clean Water Act and National Pollutant Discharge Elimination System (NPDES) regulations make it highly unlikely that once-through cooling systems will be used in any new utility-scale power-generating facility.

[40] While the steam cycles and cooling system options are the same for parabolic trough and power tower facilities, power tower facilities can operate at substantially higher temperatures than parabolic trough facilities. Substantially more heat can be recovered than would be necessary to produce saturated steam. This excess heat can be used to support the TES system, or it can be used to produce supercritical or even ultra supercritical steam. At this time, no power tower facilities have been built or proposed that would use supercritical or ultra supercritical steam, so the impacts of these technologies on cooling system design and operation are not discussed further.

megawatt of electrical power produced using conventional STGs (CEC 2002).[41] This typically equates to a loss of 1% to 2% of the total volume of water present in the cooling loop to evaporation and would translate to an ongoing water replacement need (i.e., water consumption rate) of 10 to 15 gpm (0.038 to 0.057 m^3/min)/MWe (600 to 900 gal [2.27 to 3.41 m^3]/MWh) being produced.

Evaporation and drift represent water consumption mechanisms associated with wet closed-loop cooling, the volumes of which must be replaced. Over time, as water evaporates at the cooling tower, the dissolved solids content of the remaining water increases, as does the potential for scale and for the growth of biological organisms. Consequently, recirculating cooling water is treated to reduce the potential for scale formation (i.e., the precipitation of dissolved solids, which will reduce cooling tower efficiency), and biocides and/or chlorine are added to control the growth of biological organisms, especially algae.[42] To further control the chemical quality of the water, a small portion typically is removed as "blowdown" in each recirculation cycle. The amount of water removed through blowdown depends on many factors, including the initial quality of the water introduced into the cooling cycle. A reliable estimate is that for a wet closed-loop cooling system recirculating water at 500 gpm (1.89 m^3)/MWe, approximately 2 gpm (0.008 m^3/min)/MWe of cooling water will be removed through blowdown (CEC 2002).

DOE (2009) reports that parabolic trough plants using wet closed-loop cooling can be expected to withdraw about 800 gal (3.03 m^3)/MWh (780 gal [2.95 m^3] of which is consumed by evaporation at the cooling tower and the amount required to replace blowdown, and 20 gal [0.076 m^3] of which is used for noncooling-related activities such as mirror washing). In comparison, with the use of similar closed-loop cooling systems, a solar power tower facility would use 600 gal (2.27 m^3)/MWh; conventional coal-fired or nuclear power plants can be expected to withdraw as much as 500 gal (1.89 m^3)/MWh of electricity; and a combined-cycle natural gas plant[43] would use 200 gal (0.76 m^3)/MWh. Solar dish engine facilities that require water only for mirror washing and other maintenance functions consume 20 gal (0.076 m^3)/MWh. A detailed analysis of the performance metrics of wet closed-loop cooling systems for CLFR facilities has not been completed. However, it is expected that cooling water demands will be slightly higher than for similarly sized parabolic trough plants because of the

41 Of this amount, most is lost to evaporation. Cooling towers equipped with modern drift eliminators can substantially reduce the amount of water lost to drift and are typically designed to reduce drift losses to 0.002% of the circulating water flow or less.

42 The use of chlorine in treating recirculating cooling water has been investigated for its potential to cause the formation of trihalomethanes by interactions with organic matter in the water, especially in open-loop wet-cooling systems where organic matter in the form of airborne insects is introduced. Trihalomethanes are generated, however, because power plants typically chlorinate their cooling water only a few times a day to maintain adequate biological control. The rate at which trihalomethane generation occurs in freshwater cooling systems is slight and thought to represent only negligible health impacts on exposed workforce personnel (EPRI 2004b).

43 A combined-cycle natural gas plant would be expected to consist of a combustion turbine generator operating in conjunction with heat recovery steam generators (HRSGs). See Section F.2.4.5 for additional details.

CLFR's expected lower operating temperatures and lower thermal efficiencies (i.e., greater amounts of heat rejected per MWe produced).[44]

F.2.4.2.2 Dry-Cooling Systems. Dry-cooling (or air cooling) systems can be either direct or indirect in their design. Direct dry-cooling systems function by directing a flow of ambient air across condenser tubes through which the spent steam from the STG is circulated. Indirect dry-cooling systems introduce a closed cooling-water loop that accepts heat from the spent steam in a closed condenser and then ultimately rejects that heat to the atmosphere in an air-cooled condenser (i.e., radiator). With dry-cooling systems, overall water consumption is reduced by as much as 90% over conventional wet-cooling systems because both evaporation and drift at the wet closed-loop cooling tower are eliminated. However, plant-wide consumptive uses of water are not completely eliminated with conversion to dry cooling of steam. Other ongoing uses include replacing steam cycle blowdown, general plant maintenance activities (including regular washing of solar collectors), and potable consumption. Collectively, however, these other consumptive uses would be equal to no more than 10% to 15% of the consumptive uses in wet-cooling systems and can be expected to average 80 gal (0.30 m^3)/MWh of electricity produced (depending on local conditions and cooling system design). EPRI (2004a) estimates that a 350-MW coal-fired plant would realize a water savings of approximately 6,400 ac-ft/yr (~2 billion gal/yr) (7.9 million m^3/yr) in switching from wet closed-loop cooling to dry cooling. Likewise, a 500-MW natural gas combined-cycle plant would realize savings of 2,800 ac-ft/yr (~ 900 million gal/yr) (3.5 million m^3/yr).

Although dry-cooling systems require considerably less water than do wet-cooling systems, they have shortcomings. For example, capital costs are higher, as are auxiliary power loads (parasitic power losses). Because dry-cooling system efficiencies increase with increasing temperature differentials between the materials being cooled and the cooling agent, dry-cooling systems operating in desert environments where the ambient air temperature is generally high can be expected to have lower cooling efficiencies than wet-cooling systems operating at the same locations.[45] Such lower system efficiencies are expected to be most apparent on the hottest days when electrical demand is highest and the plant can be expected to be operating at capacity (DOE 2009). Such lower cooling system efficiencies ultimately translate to a net power loss.[46] (See Section F.2.4.2.4 for additional discussion on performance penalties from dry-cooling systems.)

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[44] Although all the water consumption values cited in this paragraph are believed to be generally representative, it is important to note that water consumption from wet open-loop cooling systems is location dependent, with the overall performance of the cooling system influenced by many factors, especially including, climatic conditions of average ambient air temperatures and relative humidities.

[45] Wet-cooling system efficiencies are also dependent on the temperature differentials (between incoming cooling water and counterflowing ambient air), albeit to a much lesser degree.

[46] This power reduction reflects not only the lower thermal efficiencies of the cooling system, but also the higher parasitic load of fans used in dry, air-cooled systems compared to fan loads of wet recirculating systems of equivalent capacity.

F.2.4.2.3 Combined Wet/Dry Cooling Systems. Combined wet/dry cooling systems may provide an acceptable alternative in desert environments where water is scarce. Such systems contain both the conventional wet-cooling tower and a dry-cooling surface condenser that can be placed either in parallel or series arrangements. In series, spent steam is first sent to the dry-cooling system and then further cooled in the wet system. In the parallel arrangement, distribution of spent steam from the STG to either cooling system is at the discretion of the plant operator. In either configuration, hybrid wet/dry cooling systems would represent somewhat higher internal loads than a simple wet recirculating system, and this higher load would translate into a loss in net power production. DOE estimates that over a range of possible wet/dry cooling configurations, water savings can range from 80% to 90% (over conventional wet recirculating cooling) with net power losses from 2% to 10% (DOE 2009).[47] Ostensibly, dry cooling would be used most of the time; however, during very hot periods when dry cooling efficiency is at its lowest and parasitic load is highest, more spent steam would be sent to the wet-cooling system. Although the initial capital costs of such a dual system are obviously higher, as are the maintenance and operating costs, the flexibility that such a system offers may prevent significant decreases in overall power-generating efficiency and output during high-demand periods while still staying within the constraints of limited water availability.

A unique family of variants to combination wet/dry cooling is known as enhanced air cooling or "evaporative enhancement." In such a system, a fine mist of water is sprayed into the airstream that is directed toward a dry-cooling surface condenser. Alternatively, cooling air is passed through a wet media filter placed ahead of the condenser, or water is "deluged" onto the surface of the condenser as ambient air is directed over it. In desert environments where the relative humidity of the ambient air is low and the temperature is well above the dew point, the water quickly evaporates, effectively cooling the air in the airstream to an extent proportional to the amount of water introduced. Drawbacks for such water-enhanced dry systems include the following:

- Increased capital investments;
- Higher parasitic loads for fans (especially for wet media filters that introduce significant pressure drops, which fans must overcome);
- Scaling (especially for condenser deluge systems that use water with high concentrations of dissolved solids); and
- Increased maintenance costs.

Furthermore, an increase in internal loads also represents a loss in net power output. Nevertheless, water savings can be dramatic. Figures F.2.4-1, F.2.4-2, and F.2.4-3 depict enhanced spray, enhanced wet media, and enhanced deluge wet/dry cooling systems.

[47] The range of net power loss expected reflects primarily variations in cooling system efficiencies as a result of ambient conditions of temperature and humidity. In the desert Southwest, efficiencies of wet-cooling systems are high due to relatively high ambient temperatures and low relative humidity. However, the high ambient temperatures tend to decrease the efficiencies of air-cooled condensers.

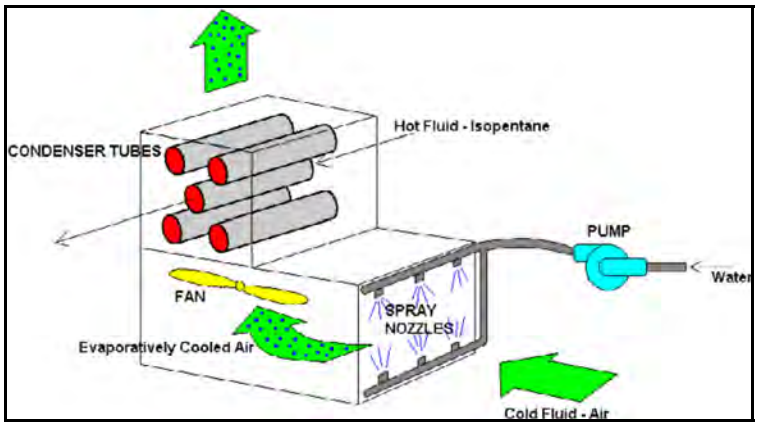


FIGURE F.2.4-1 Enhanced Spray Wet/Dry Cooling (Source: Kutscher et al. 2006)

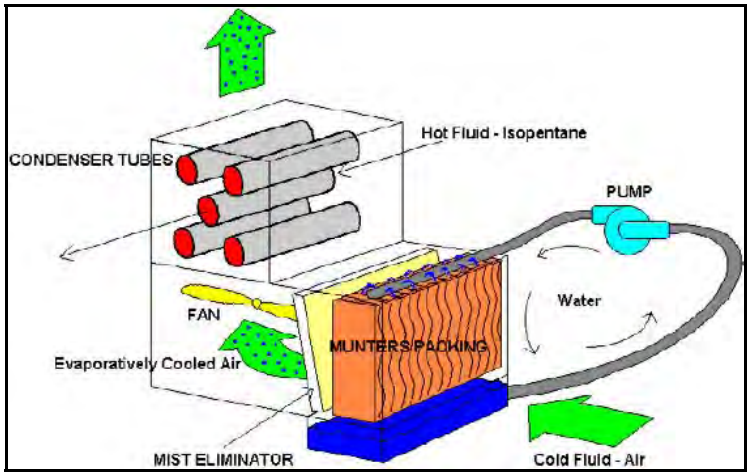


FIGURE F.2.4-2 Enhanced Wet Media Wet/Dry Cooling (Source: Kutscher et al. 2006)

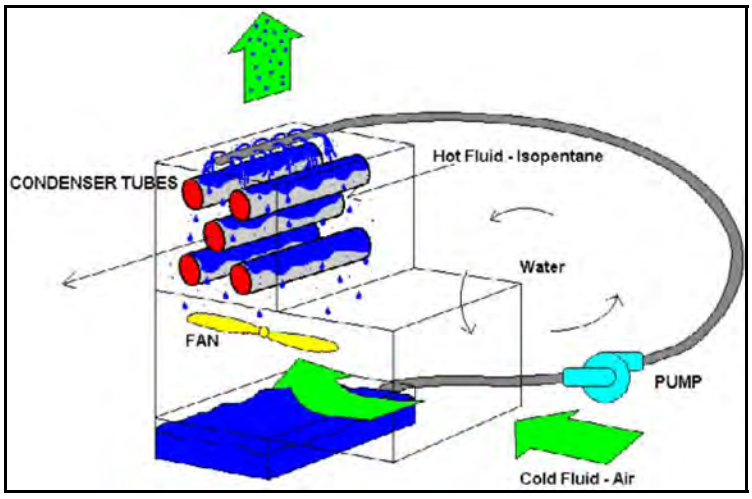


FIGURE F.2.4-3 Enhanced Deluge Wet/Dry Cooling (Source: Kutscher et al. 2006)

F.2.4.2.4 Performance Penalties Resulting from Alternative Cooling Systems. The various alternatives to conventional wet closed-loop cooling discussed above all result in reductions in the amount of water needed for cooling to support a thermoelectric facility. In that regard, they all deserve consideration as substitutes to wet closed-loop cooling in a solar thermoelectric facility located in arid, water-deprived areas. Further, because the performance of these systems is maximized in the ambient conditions typical in arid environments (ambient air with low relative humidity), they offer ideal alternatives to conventional wet closed-loop cooling. However, all such alternative cooling systems come with a performance penalty in the form of a net loss of power production capability. In general, alternative cooling systems have lower thermal efficiencies than wet closed-loop systems, even in climatic conditions where their performance is optimal. Such lower efficiencies result in higher steam condensate temperatures, higher back pressures at the steam turbine, and lower steam turbine efficiencies. Additionally, higher parasitic loads for some alternative cooling systems further contribute to net power losses.

DOE (2009) reports that the net electric power output of a trough plant using air cooling would drop by 4.5% to 5% and that of a solar power tower facility would drop by 1.3% over equivalent plants using wet closed-loop cooling. Performance penalties actually increase during the hottest periods of the day, periods that are likely to coincide with highest electricity demand (primarily for air conditioning). During the hottest 1% of the day, the performance penalties for parabolic trough and power tower facilities using dry cooling would increase to 17.6% and 6.3%, respectively.[48] However, increasing the size of the solar field and the resulting increase in steam production could offset any net power loss associated with a switch to dry cooling.

Performance penalties for wet/dry cooling systems are somewhat less dramatic. A facility using a typical wet/dry system can realize a 50% reduction in water consumption (compared to a wet closed-loop cooling system) while suffering only a 1% drop in net power production. That same facility can be designed to save as much as 85% of water consumption with only a 3% drop in net power production (DOE 2009). Kutscher et al. (2006) estimate net power losses from misting or wet media cooling systems and from deluge systems at 40 kWh/1,000 gal (3.79 m^3) of water used and 60 kWh/1,000 gal (3.79 m^3) of water used, respectively. Further, the savings in water consumption as well as the net power loss suffered can both be influenced by the manner in which wet/dry cooling systems are operated. For example, diverting more of the steam cooling responsibilities to the wet-cooling system during the hottest hours of the day could significantly reduce the net power loss that would be experienced if all the cooling demands were met by the dry-cooling mode during those periods. Pursuing such operating flexibilities, facility operators could expect to reduce total water usage by 80% to 90% while suffering net power losses in the range of 2% to 10%, depending on local conditions and cooling system designs and operating flexibilities.

[48] The performance penalty for compact linear Fresnel reflector facilities has not yet been established, but is estimated to be somewhat higher than that for parabolic trough facilities because of their somewhat lower operating temperatures (DOE 2009).

F.2.4.3 Thermal Energy Storage Options

A "solar-only" facility using either parabolic trough or power tower technology would be simple to construct and operate and would offer numerous environmental advantages, including few to no emissions of air pollutants during operation.[49] However, it would be capable of producing power at its nameplate rating only when the DNI matches its design basis. During periods of reduced DNI or at night, power production would be greatly reduced or stopped entirely. Nevertheless, utility-scale facilities of such a design are feasible and have recently been proposed (see Section F.2.2.2.1). For grid-connected facilities, this lack of dispatchability greatly reduces the value of power from such solar-only facilities.

Adding TES capabilities to a parabolic trough or power tower facility[50] greatly increases the dispatchability and reliability of the plant as a source of grid-connected power and can also improve the facility's overall power-generating capacity. TES can increase the capacity factors of parabolic trough or power tower facilities from 25% to more than 70% (NREL 2008a). (The capacity factor is the percentage of time over which useful amounts of power are produced.) The decision to construct a facility with TES requires a fundamental change to the design basis.

Although many materials could serve as heat storage media, a eutectic mixture of molten salt, typically a binary mixture of 60% sodium nitrate [$Na(NO_3)$] and 40% potassium nitrate [$K(NO_3)$], has been the subject of the majority of investigations and feasibility studies. A mixture of 48% calcium nitrate [$Ca(NO_3)_2$], 7% sodium nitrate, and 45% potassium nitrate, available commercially as Hitex XL®, has also been investigated.[51]

Both direct and indirect TES designs involving molten salt have been conceptualized. In the direct design, the conventional synthetic oil HTF is replaced with molten salt, circulated between the solar field and a storage facility consisting of one or two tanks, and subsequently circulated between its storage location and a conventional steam heat exchanger. In the indirect design, the solar field continues to use a conventional synthetic oil HTF to transfer heat from the

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[49] Depending on anticipated weather conditions at the selected location, a "solar-only" plant may also use a natural gas- or propane-fired heater to heat the HTF when ambient temperatures are expected to fall below its eutectic point. Such a heater may also be used to preheat the HTF to aid in rapid plant start-up. Also, chemicals used in the treatment of recirculated cooling water may be emitted from the cooling tower in minor amounts as drift (see Section F.2.4.2).

[50] Although most RD&D on TES has been directed toward its application for parabolic trough facilities, research indicates that analogous TES applications to power tower facilities would, in many cases, be equally feasible.

[51] Many other technological approaches to TES have been identified, including storing heat in a concrete block buried beneath the solar field (through which hot HTF would circulate), and storing heat in the form of pressurized hot water in underground formations below the solar energy facility (where it would "flash" into steam as its pressure is relieved, bringing it to the surface through a recovery well). For details, see http://www.nrel.gov/csp/troughnet/pdfs/tamme_concrete_storage.pdf and http://www.sciam.com/article.cfm?id=sunny-outlook-sunshine-provide-electricity&page=1; accessed Jan. 5, 2009. Both technologies are currently undergoing development, but neither has been proposed for commercial application and, consequently, neither is discussed further here. The DOE is also funding various RD&D projects for CSP, including many involving development of low-cost TES technologies. For details, see http://www.energy.gov/news/6562.htm; accessed Jan. 5, 2009.

solar field to molten salt in storage.[52] During those periods when DNI is reduced or has stopped entirely, the molten salt is used to produce steam that is directed to the STG for uninterrupted power production.

The primary advantage provided by TES is the ability to produce power (in many cases, at or near the facility's nameplate rating) during periods of less-than-ideal insolation, including during nighttime hours. Since many electricity load peaks occur in early morning or early evening hours, adding this ability to a facility greatly enhances its value as a source of utility-scale power. A second equally important advantage can also be realized when molten salt replaces conventional HTF: the facility can operate at a higher temperature range (842°–932°F [450°–500°C]) than the typical operating temperature of a plant using synthetic oil HTF (740°F [393°C]). This, in turn, allows the Rankine cycle STG to improve in efficiency from 37.6 to 40%, thus increasing the overall power-generating capacity of the facility with virtually no change to the footprint of the solar field and minimal changes to the overall facility footprint.

Adding TES capability greatly affects the configuration and size of the solar field. Without a TES element, a facility would be expected to have a solar field only large enough to supply the amount of heat needed to produce steam and generate power (under anticipated peak insolation and meteorological conditions) at the facility's peak power rating.[53] Such a facility is said to have a solar multiple of 1.0 (see also Section F.2.2.3). Facilities with TES capability must be able to generate more heat than would be required to meet nameplate ratings, with the extra heat being that which is stored in the TES. Such facilities will invariably have larger solar fields with solar multiples proportional to the amount of heat expected to be delivered to the TES, generally a factor of how many hours the facility would be capable of delivering power at nameplate rating without concurrent insolation.

Practical limitations exist as to the length of time heat can be stored in molten salt systems. At the current stage of technology development, most feasibility studies identify 6-hour storage (i.e., sufficient to provide full-load power for as long as 6 hours) as the practical upper limit. The molten salt can be stored in one tank (also known as a thermocline) or in two tanks (a hot tank and a cold tank). Each storage configuration is supported by its own unique configuration for circulating the molten salt between its storage location and the STG and for replacing the heat lost in steam generation with heat recovered from the solar field.

Figure F.2.4-5 (below, in Section F.2.4.4) provides an example schematic of a parabolic trough–TES system. It has been estimated that a parabolic trough facility with 6 hours of molten salt storage, operating at a nominal salt temperature of 842°F (450°C) and using a two-tank storage configuration, can reduce the LCOE as much as 14.2% (and more than 20% when using a thermocline storage configuration) compared to a state-of-the-art conventional parabolic trough

[52] Although replacing the synthetic oil HTF with molten salt without also adding storage capacity for molten salt is technically feasible, early studies concluded that using molten salt as an HTF without also including the ability for its use as a long-term TES medium was not economical (Kearney et al. 2004).

[53] As a practical matter, solar fields in commercial utility-scale solar-only facilities can be expected to be somewhat larger than what would be required to meet nameplate power expectations, allowing some of the field to be isolated and shut down for maintenance and repair without compromising the facility's power capacity.

facility without TES (see Section F.2.2.3). Even greater improvements to overall facility efficiencies and even greater reductions in LCOE could be realized if the engineering challenges of operating the molten salt system at even higher temperatures could be overcome.

The most salient engineering and O&M issues associated with the use of molten salt TES include the following:

- The higher freezing points of molten salt eutectic mixtures over conventional HTFs (248°F to 428°F [120°C to 220°C] for binary and ternary salt formulations, respectively, versus 60°F [15°C] for conventional synthetic oil HTF) require additional design considerations to prevent salt freezing in transfer piping.

- There is greater potential heat loss in receivers and transfer piping due to higher operating temperatures.

- The corrosive action of molten salts on their containment and circulation systems and components requires modifications involving more resistant materials, which are more expensive.[54]

- The overall higher operating temperatures may require alternative components in the salt transfer and storage systems (e.g., flexible connections between individual receivers and transfer pumps may need to be built to closer tolerances and with alternative materials to operate at higher temperatures for extended periods).

- To improve cold start-up times and avoid potentially damaging temperature gradients throughout the system (thermal stresses), some mechanism for preheating the HTF in the solar field may be necessary.

- Heating of transfer piping and storage containers may be necessary in the event of the failure and long-term inoperability of the salt circulation system, resulting in higher parasitic loads and possibly air pollutant emissions if the heat source involves combustion of fossil fuels.

- There are higher parasitic loads related to transfer pumping of molten salt versus less viscous synthetic oil HTF.

- There is a 50% increase in O&M costs and O&M manpower requirements (NREL 2004).

[54] Although the pure nitrate salts are expected to be only minimally corrosive, the presence of contaminants, such as chloride and perchlorates, and water, can greatly enhance the salt's corrosive properties.

Various options have been identified to successfully address these and other engineering issues.[55] However, all such solutions increase the complexity of the facility. This is reflected in increased capital costs and O&M costs, and a reduction in overall plant capacity due to an increase in parasitic load. Nevertheless, feasibility studies have shown that these extra costs and considerations do not devalue the option more than the value added from TES incorporation (Kearney et al. 2004).

Although the initial focus of TES technology development has been limited to investigating its applicability to parabolic trough and power tower facilities, the Solar Energy Technologies Program (SETP) of the DOE's Office of Energy Efficiency and Renewable Energy (EERE) is working to expand TES options for solar energy facilities. In addition to supporting a variety of initiatives aimed at reducing the overall costs and improving the overall thermal efficiencies of traditional TES systems and applications, thereby lowering the cost of energy TES-equipped facilities can produce, the SETP is directing research into development of advanced HTFs. Such advanced systems include, for example, the use of phase change materials (PCMs) (i.e., materials whose physical state changes as they absorb heat) and nanofluids as a thermal storage media. Novel applications of TES, for example, use of TES at solar dish engine facilities, are also being investigated. [56]

F.2.4.4 Solar/Fossil Fuel and Solar/Renewable Fuel Hybrid Systems

Hybrid facilities combining solar energy technologies with conventional fossil fuel technologies or other renewable energy technologies can greatly improve the dispatchability and reliability of the power being produced. Many combinations coupling CSP technologies with power-producing technologies that use other forms of energy are technically feasible. These hybrid systems could include integration with new or existing coal-fired power plants or with other renewable technologies that involve thermoelectric generation (e.g., geothermal and biomass combustion).[57] The most likely hybridizations, however, would couple parabolic trough or power tower[58] CSP with either a natural gas–fired combustion turbine generator (CTG) working in combination with heat recovery steam generators (HRSGs), and/or a natural gas–fired boiler that can augment steam produced by the solar field.

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[55] For example, continuous circulation of the salt HTF throughout the night, or use of an auxiliary natural gas-fired heater or electric heat tracing tape on the transfer piping, can prevent salt freezing.

[56] For additional details on this as well as other ongoing TES R&D projects, see the DOE Solar Energy Technologies Program Web site at http://www1.eere.energy.gov/solar/pdfs/csp_funding_prospectus_2008.pdf.

[57] Nuclear power is also classified as thermoelectric. However, hybrids between solar CSP and nuclear power plants, while technically feasible, are impractical and not likely to materialize. Although excellent geothermal resources exist within the six-state study area near high-value solar resources, no such combination of technologies has yet been proposed. Although arid desert areas that are most likely to have the best solar resources would not be expected to be near significant biomass resources, one facility combining solar thermal and biomass thermoelectric technologies has been proposed for a desert region of California.

[58] Although both parabolic trough and power tower CSP plants lend themselves equally well to hybridization with other thermoelectric generating technologies, only hybrids involving parabolic troughs have been proposed or built to date.

Combustion turbines do not produce steam but instead drive a turbine with high-temperature, high-pressure gases generated through the combustion of fossil fuels, typically natural gas. Consequently, their use does not increase steam condensate cooling water demand. However, CTGs do use water to cool the inlet combustion air that has been compressed to high pressure before being introduced into the combustion zone of the turbine.[59] When the exhaust gas leaving the turbine is exhausted directly to the atmosphere, the CTG, known as a simple- or single-cycle CTG, operates at an efficiency of about 35% to 38%. Because the gases exhausted from a CTG still possess a considerable amount of heat energy, CTGs are often used in conjunction with HRSGs that can use latent heat in the exhausted gases to produce additional steam. By comparison, Rankine cycle turbines can operate at overall efficiencies as high as 40%. Brayton cycle turbines equipped with HRSGs can reach efficiencies as high as 80%.[60] Combined-cycle power plants involve the simultaneous but independent operation of both Rankine cycle and Brayton cycle turbines (coupled, in most instances, with HRSGs).[61]

Conceptually, many combinations of steam-generating technologies can be combined with parabolic trough or power tower technologies and CTGs to result in ISCC facilities.[62] In such configurations, the solar field would be capable of producing steam and/or providing some heat energy to the bottoming cycle of the fossil fuel combined-cycle plant STGs. Figures F.2.4-4 and F.2.4-5 demonstrate two of the most likely hybridizations: a parabolic trough plant combined with a natural gas-fired boiler, both feeding an STG, and an ISCC facility hybridizing a parabolic trough solar plant with a natural gas-fired CTG and HRSG, respectively.

While solar dish engines can be operated in parallel with any thermoelectric generating technology, the advantages of such combinations are minimal since very little of each technology can utilize shared equipment. Such hybrids, therefore, would represent nothing more than collocation of two fundamentally different technologies that actually create a complex facility with respect to O&M because of their disparate natures. The dish engine itself does have a hybridization option, however, in that it can be modified to run on conventional fuels, essentially

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[59] A CTG's performance relies on mass flow of inlet air. High ambient temperatures, combined with additional heating of inlet air due to compression, reduce the density (and thus mass flow) of turbine inlet air. Spraying water into the inlet air stream, which allows evaporative cooling to take place, restores the mass air flow and avoids loss of turbine performance. Cooling inlet air by introducing a fine spray of water is known as "fogging" and can represent the third-largest consumptive use of water in a combined-cycle power plant. Typically, as much as 125 to 160 gal (0.47 to 0.61 m^3) of water is used for every megawatt-hour of power produced by the CTG, operating at design conditions (Maulbetsch and DiFilippo 2006).

[60] The efficiencies being measured here are the conversion of heat energy to electricity.

[61] Brayton cycle turbines working in conjunction with HRSGs are also combined-cycle plants. Combined-cycle plants can also function as cogeneration (Co-Gen) plants in which a fraction of the steam produced is used for industrial processes rather than power generation. Co-Gen plants are considered outside the scope of this PEIS.

[62] A combined-cycle power plant is one that uses two or more different thermodynamic cycles to produce power. Most commonly, a conventional STG operating on the principles of a Rankine thermodynamic cycle is operated simultaneously with a CTG that operates in accordance with a Brayton thermodynamic cycle. Also, CTGs operating alone are sometimes referred to as simple cycle, but when working in conjunction with HRSGs that use the heat contained in the CTG's exhaust to produce steam, the system is also sometimes referred to as a combined cycle.

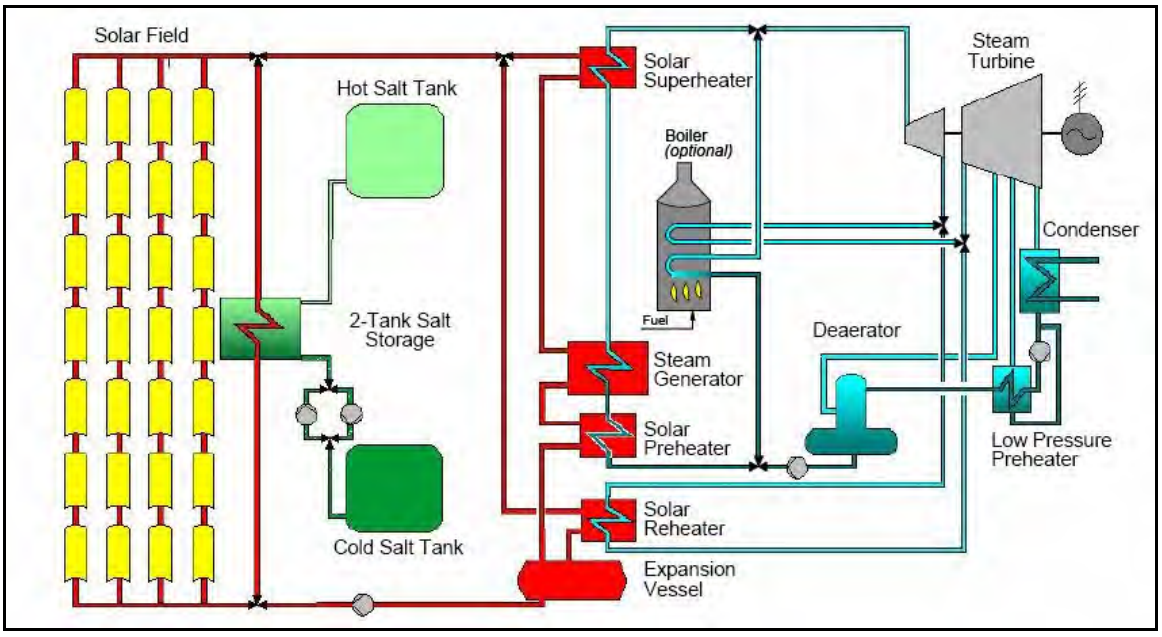


FIGURE F.2.4-4 Process Flows for a Typical Parabolic Trough Power Plant with Two-Tank TES Operating in Conjunction with a Natural Gas-Fired Boiler (Source: NREL, as presented in SDRREG 2005)

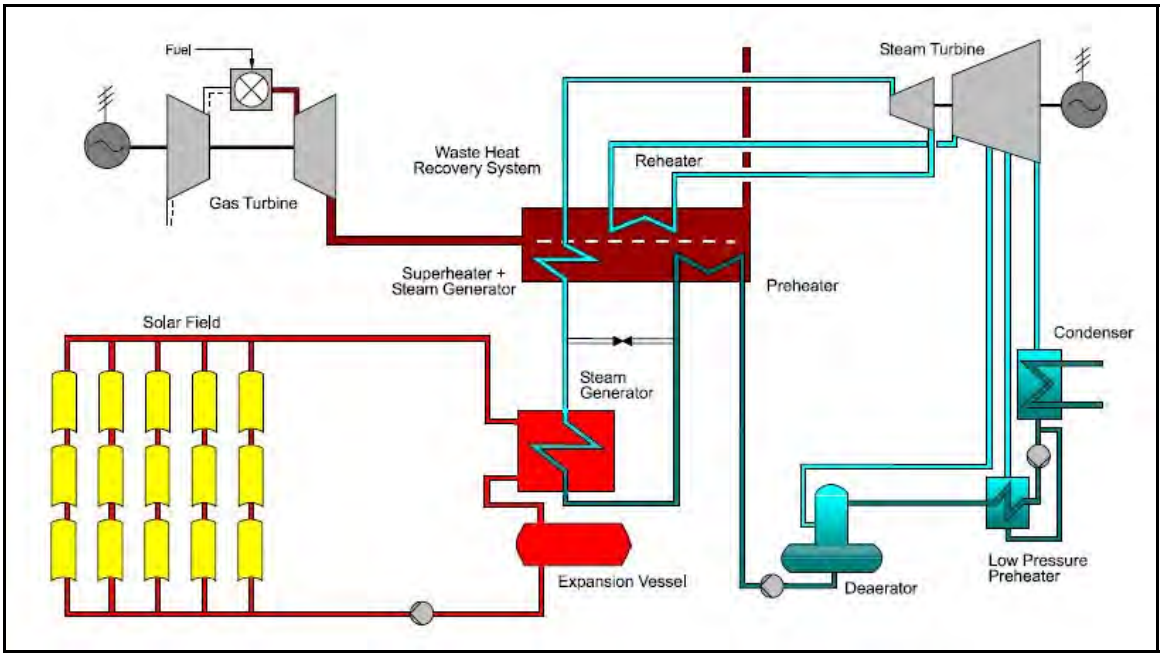


FIGURE F.2.4-5 Process Flows for an Integrated Solar Combined Cycle (ISCC) Facility Combining a Parabolic Trough Plant with a CTG and HRSG (Source: NREL, as presented in SDRREG 2005)

converting a Stirling-type heat engine into a conventional internal combustion engine (ICE) similar to the type used in today's vehicles. Any of these dual-fuel systems would allow undiminished power production during short periods of less than ideal solar intensity or power production after sunset (albeit, perhaps at a somewhat diminished rate). However, although technically feasible, no such utility-scale hybrids have been built or proposed.

Most hybridizations are designed to enhance both the power-generating capacity and the dispatchability of the solar facility. One hybrid, however, addresses only the facility's dispatchability. That hybrid configuration involves adding a natural gas- or propane-fired heater not to produce additional steam but to maintain a minimum temperature for the HTF during periods of low DNI and at night. Such a feature would shorten the amount of time after sunrise or stormy/cloudy periods before the solar facility was again capable of producing sufficient steam to generate utility-scale amounts of electricity.[63] Because most regions experience high load demands in the early morning hours, features that can shorten the effective start-up time of the solar facility increase its value as a reliable and more dispatchable power source. In comparison to configurations in which a natural gas boiler is used to produce additional steam, fuel consumption by such HTF heaters is substantially less.

The rate of water consumption for hybrid parabolic trough facilities can be greatly affected by the operation of the non-solar power-producing equipment. Boilers that provide supplemental steam have steam-cooling demands commensurate with the character and amount of steam they produce and other factors relating to the designs and efficiencies of their steam cycles. CTGs do not require steam condensate cooling since they do not produce steam, but they do require water to cool the compressed air introduced at the inlet to function at their highest performance levels. For example, in a hybrid plant where equal amounts of power are produced by the solar field and the CTG, water consumption per megawatt is reduced by something less than half. Hybridizing solar with a natural gas-fired boiler producing steam with the same characteristics as the steam produced by the solar field, however, is likely to have little to no effect on the overall water-per-megawatt consumption rate.

As discussed in Section F.1.1, the environmental impacts of the fossil fuel-driven portions of such hybrid facilities are not evaluated in this PEIS. However, additional background information on the numbers and types of such existing and proposed facilities is given here to provide a broad understanding on the status of hybrid solar development.

A hybrid facility combining parabolic trough technology with two natural-gas-fired CTGs, two HRSGs, and one STG, the Victorville 2 Hybrid Power Project, has been proposed for the vicinity of Victorville, in San Bernardino County, California (Inland Energy, Inc. 2007). An AFC was submitted to the CEC on February 28, 2007. The project was approved on July 16, 2008.[64] Although many combinations of CSP technology with fossil fuel power-generating

[63] An HTF heater would not increase water demand but would result in emissions of criteria pollutants. However, to the extent that a solar facility so equipped could come on line sooner in the day, possibly replacing a fossil fuel- generating facility, the net result could be a reduction in criteria pollutants.

[64] The complete AFC and other related documents are available at http://www.energy.ca.gov/sitingcases/victorville2/documents/applicant/afc/. Accessed Jan. 5, 2009.

technology are possible, the Victorville 2 Hybrid Power Project is considered to be representative of most future ISCC-type facilities.

The Victorville 2 Hybrid has a nameplate rating of 570 MW, 520 MW of which originates from the heat generated by combustion of natural gas and only 50 MW of which originates from heat captured in a collocated parabolic trough facility. The engineering parameters and environmental resource requirements for this facility, therefore, reflect profiles more closely associated with fossil fuel–fired power plants than with parabolic trough plants, even though some of the major components associated with the steam cycle (including steam condensation and cooling systems) serve both the solar and nonsolar portions of the plant.

F.2.5 Solar Dish Engine CSP[65]

The solar dish engine is unique among CSP technologies; it relies on DNI but generates electricity through the action of an external heat engine rather than steam production. The system consists of a parabolically shaped reflector/concentrator, a receiver located at the mirror's point focus, an external heat engine, and an induction generator or alternator. The reflector concentrates incident solar energy onto a receiver, which, in turn, transfers heat to a "working gas" (most typically hydrogen or helium) contained in a sealed system known as an external heat engine.[66] As this working gas is superheated,[67] its increasing pressure drives a piston, producing mechanical power that drives an induction generator in each dish's power conversion unit to produce electricity. Individual dish engines have been designed with power-generating capacities of 0.025 to 0.050 MW.

The heat engine most typically used in solar dish engines is called a Stirling-type engine, named after the 19th-century minister who first applied the thermodynamic principles of the Carnot cycle to his patented design for an engine that produced mechanical work from an external heat source. Various reflector and receiver designs for the Stirling dish engine have been developed over the years, including one-, two-, and four-piston designs for the engine itself (Stine and Diver 1994; Mancini 1997).

Although no utility-scale solar dish engine facilities are currently in operation in the United States,[68] development efforts are ongoing, including at DOE's Sandia National

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65 Only a cursory review of relevant aspects of solar dish engine technology is provided here. For more information, see http://www.osti.gov/bridge/basicsearch.jsp. Accessed Jan. 5, 2009.

66 In 1824, Nicholas Carnot first proposed his hypothetical external heat engine that was based on thermodynamic principles that control the behavior of a gas in a sealed system that is receiving heat from an external source (the Carnot cycle).

67 As high as 1,452°F (790°C), according to DOE (2009).

68 Recently, a PPA was negotiated between SES and San Diego Gas and Electric for power to be produced at a 750-MW facility composed of SES-designed Stirling dish engines. SES submitted an AFC for its facility to CEC on June 30, 2008 (SES Solar Two, LLC 2008). The entire AFC is available at http://www.energy.ca.gov/sitingcases/solartwo/documents/applicant/afc/index.php. Accessed Jan. 5, 2009.

Laboratories, in which a solar dish engine designed by Stirling Energy Systems (SES) recently attained the highest overall sunlight to electricity conversion efficiency of 31.25%.[69] Figure F.2.5-1 shows SES Stirling dish engines undergoing development and testing in Albuquerque, New Mexico. Figure F.2.5-2 shows the major components of the SES dish engine assembly.

F.2.5.1 Dish Engine Facility Components

F.2.5.1.1 Concentrators/Reflectors.[70] Early versions of the reflector used in solar dish engines were fabricated with conventional silver-backed glass mirrors. Now, reflectors are typically constructed of glass or plastic onto which aluminum or silver has been applied to either

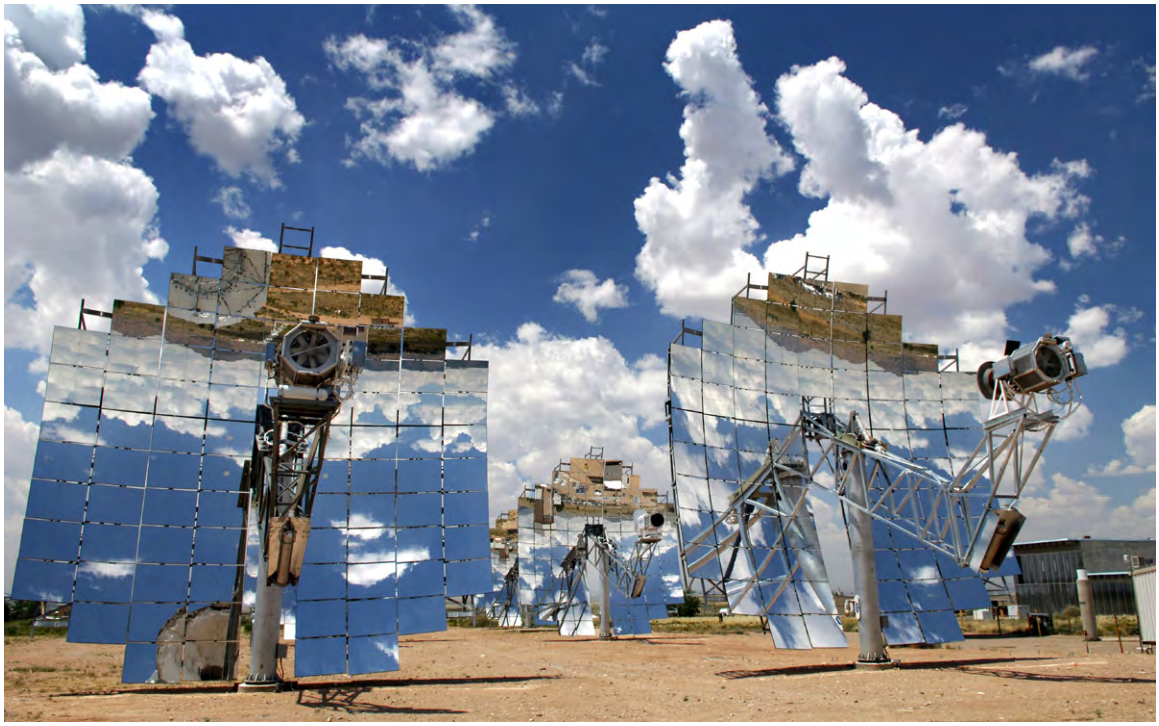


FIGURE F.2.5-1 Stirling Dish Engines at the Stirling Energy Systems Test Facility in Albuquerque, New Mexico (Credit: Randy Montoya. Source: Sandia National Laboratory. Available at http://www.sandia.gov/news/resources/releases/2008/solargrid.html. Accessed April 16, 2008)

69 For information on research involving solar dish engine research, see http://www.nrel.gov/csp/troughnet/pdfs/2007/liden_ses_dish_stirling.pdf. Accessed Jan. 5, 2009.

70 In this overview, the term "reflector" means a device that reflects (i.e., redirects) but does not concentrate incident sunlight. Conversely, a "concentrator" may comprise a number of reflecting devices that each, depending on orientation, reflect incident sunlight to a common point or line, thus causing a concentration or increase in solar insolation intensity at that point or along that line.

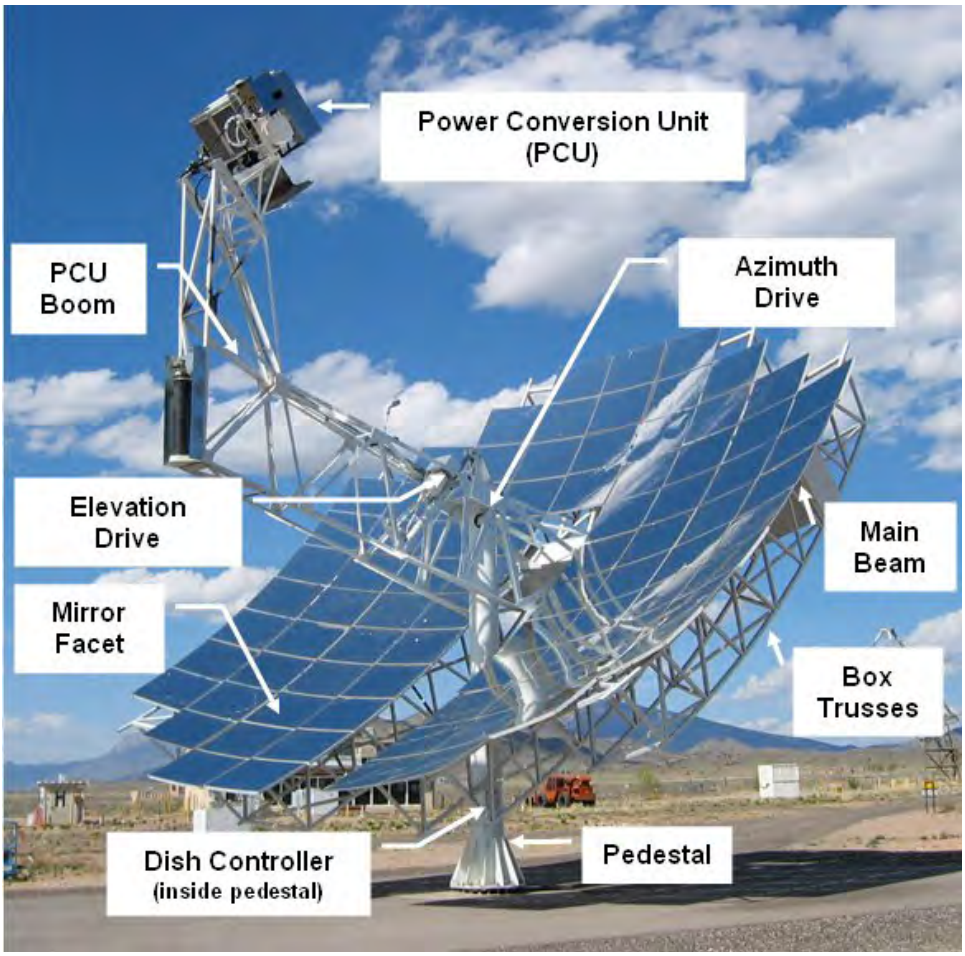


FIGURE F.2.5-2 Stirling Dish Engine Manufactured by Stirling Energy Systems (Reprinted with permission. Available at http://www.energy.ca.gov/sitingcases/solartwo/documents/applicant/afc/volume_01/MASTER_Section%201.0.pdf. Accessed July 17, 2008)

the back or front side (a back-surface or second-surface mirror). More recently, to further reduce production costs without sacrificing focusing accuracy, the parabolic shape of the reflector was attained through the use of multiple, spherically shaped mirrors rather than through a single continuous reflecting surface cast in the parabolic profile. In the latest advancement, the parabolic reflecting surface can be created through the use of flexible reflective membranes stretched across a rigid support and forced to assume the desired shape through the application of pressure or the creation of a vacuum between the reflective membrane and a second membrane stretched across the properly shaped support frame behind the reflective membrane.

Because the receiver is located in a fixed position relative to the reflecting surface, sunlight incident on the reflector will always be reflected precisely on the receiver. However, to attain maximum DNI capture efficiency, high-performing Stirling dish engine facilities capable of producing utility-scale power can be expected to have dual-axis tracking capability.

F.2.5.1.2 Receivers. The parabolic surface of the concentrator dish is capable of precisely reflecting incident sunlight to a point. However, because the sun's rays incident on the reflector are not precisely parallel (although far away, the sun is still not truly a point source), reflections onto the receiver are diffuse, with intensity decreasing exponentially with distance from the focal point of the reflector. Typically, the receiver is fitted with an aperture through which reflected sunlight enters the heavily insulated cavity, with the aperture being just large enough to admit most of the slightly diffuse reflected light. Reflected light strikes the absorber portion of the receiver that contains the working fluid (typically hydrogen gas). Minor variations in the receiver's design have been developed to ensure even heating of the working fluid with changing sunlight conditions. Because they operate at extremely high temperatures, receivers place special demands on design and material selection and can often represent a significant portion of the overall cost of a solar dish system. Further, the required high efficiency of the heat exchange that takes place at the receiver dictates precise fabrication controls and the use of materials that do not deform at high temperatures over time.

F.2.5.1.3 Stirling Engines. The Stirling engine is one of many designs that qualify as external heat engines, devices that can receive heat from an external source and convert it to mechanical work. The Stirling engine shares many functional similarities with the ICE. The power of an ICE derives from the rapid expansion of gases resulting from the controlled detonation of a gasoline (or diesel or ethanol)/air mixture in the engine's combustion chamber. In the Stirling engine, the power results not from any combustion of fuel, but from the heating and rapid expansion of a working gas by an external source of heat, in this case, the sun.

Although the thermodynamic efficiency of an external heat engine is theoretically very high, capabilities of real-world engines are limited by the temperature limitations of the materials used in their construction and by efficiency losses due to friction in the mechanical components of the engine. The Stirling engine operates at working gas temperatures between ≈1,100 to 1,470ºF (650 to 800ºC) and with projected overall efficiency as high as 40%.[71] Various designs have been advanced for the internal mechanical workings of the Stirling engine. The most typical design, a kinematic engine, involves a power piston that is acted upon by the expanding working gas being mechanically connected to a rotating output shaft, which in turn is connected to an integrated alternator or generator. Multiple piston arrangements are also possible. Figure F.2.5-3 provides a schematic of a Stirling-type engine most likely to be used in solar applications.

Although any gas, including air and nitrogen, can be used as a working gas in a Stirling engine and yield the same overall thermodynamic efficiencies, none can match the power-producing capability of hydrogen or helium. Hydrogen or helium is much preferred not only for high energy densities but also for desirable chemical and physical properties, such as low viscosities, high heat transfer capabilities, chemical and thermal stabilities under typical operating conditions, and thermodynamic efficiencies. Although hydrogen exhibits somewhat

[71] In February 2008, Sandia and SES jointly announced that a CSP research facility utilizing a Stirling dish engine recorded a new record for sunlight-to-electricity conversion efficiency of 31.25%, topping the previous (1984) record of 29.4%. See http://www.sandia.gov/news/resources/releases/2008/solargrid.html. Accessed Jan. 5, 2009.

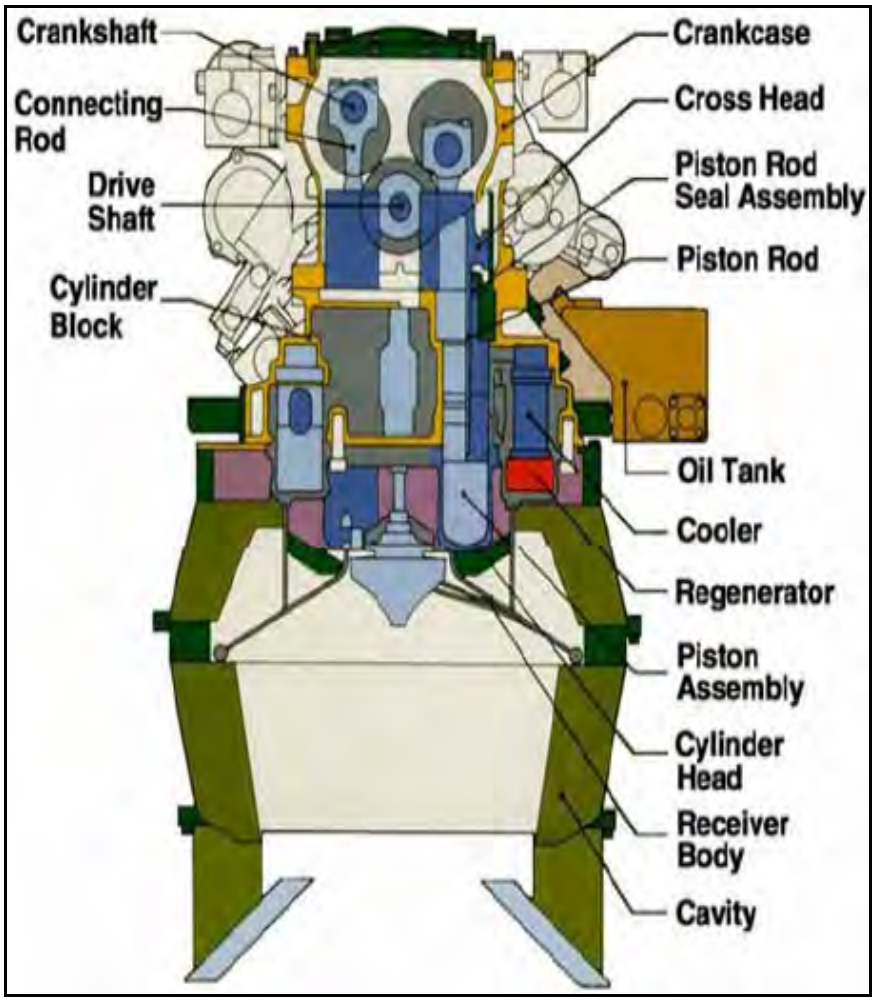


FIGURE F.2.5-3 Schematic of a Stirling-Type External Heat Engine (Courtesy of Stirling Energy Systems. Available at http://www.nrel.gov/csp/troughnet/pdfs/2007/liden_ses_dish_stirling.pdf. Accessed July 18, 2008)

better thermodynamic properties and results in overall better engine efficiencies, it creates more material incompatibility issues than does helium and introduces an additional safety hazard because of its flammable and explosive properties. More critical for hydrogen is its permeability through common metallic components and gasket materials, especially at the relatively high pressures (720 to 2,900 psi) (5 to 20 MPa) at which dish engines operate to maximize their power outputs. Operating experience to date suggests that hydrogen is likely to leak from its expansion chamber at a rate of less than 200 ft^3/yr (5.7 m^3/yr) (SES Solar Two, LLC 2008).[72]

[72] However, the amount of hydrogen working gas in an individual dish engine is quite small, and the engine is not considered to represent a significant fire or explosion hazard, nor would leakage of hydrogen from a Stirling engine constitute a significant fire or explosion hazard. In commercial applications, to ensure continuous operability, the engine would be supported externally by a compressed gas cylinder of hydrogen (most probably a 195-ft^3 [5.5-m^3] "k" cylinder) to replace any hydrogen that leaks from the receiver body.

However, permeability problems in future versions of the Stirling engine can be overcome by replacing components made of common steels with more expensive stainless steels, aluminum, or ceramics. Over the long term, hydrogen exhibits additional incompatibilities with engine components, causing metal embrittlement and ultimately component failure.

Although temperature extremes maximize the efficiency with which the working gas can convert heat energy into mechanical work, uncontrolled heat on the moving parts of the engine can result in premature wear, degradation of the lubricating oil, or wholesale failure. Consequently, high-efficiency Stirling engines are often also equipped with cooling devices. Typically, these consist of either a fan directing a flow of ambient air across critical engine components or the use of a circulating glycol-based, closed-loop coolant/external radiator system functionally identical to the cooling system used in an automobile.

Although waste engine heat must be managed, no Stirling dish engine hybrid designs have been advanced that would couple these engines with conventional fossil fuel-driven thermoelectric power-generating equipment. Likewise, no feasibility studies have explored harvesting the rejected heat from a Stirling engine to support cogeneration of process steam or as the first step in a coincident thermal storage system.

As with any mechanical device, Stirling engines are subject to wear and must receive regular maintenance and occasional refurbishment. The typical design basis for Stirling engines employed in solar dish systems includes a 20-year lifetime (40,000–60,000 hours of operation for engines operating at latitudes and areas ideal for solar technologies) before major refurbishment. Moving parts are subject to frictional wear similar to that which occurs in conventional ICEs. Lubricating oils must be changed periodically, although at somewhat greater intervals than oils in ICEs. Unless leakage occurs, the working gas is unchanged over time and needs neither servicing nor replacement over the expected useful life of the engine.

Unlike other CSP plants that produce steam to support a centrally located STG, each individual Stirling dish engine supports its own power conversion unit, which consists of an induction generator. The induction generator is fundamentally different from the synchronous generators typically found in STGs and CTGs. However, the induction generator is ideally suited for Stirling dish engine application because, unlike synchronous generators, the induction generator can produce power over a wide range of rotational speeds of its central shaft.

To date, no hybrid facilities have been proposed that would combine solar dish engines with other types of power-generating technologies in an effort to improve the dispatchability of the dish engine's power. Combining the solar dish engine with any technology utilizing a steam cycle would be impractical and offer very little advantage since the mechanisms by which such steam-based technologies produce electricity have little in common with the solar dish engine's power-generating technology. DOE is funding preliminary studies to investigate the feasibility of recovering heat from an operating Stirling-type dish engine for storage in a TES system by using thermally stable phase-changing salts.[73] As with all solar technologies, electrochemical energy

[73] For additional details on this as well as other ongoing TES R&D projects, see the DOE Solar Energy Technologies Program Web site at http://www1.eere.energy.gov/solar/pdfs/csp_funding_prospectus_2008.pdf.

storage through the use of deep cycle batteries is technically available for dish engine facilities; however, no practical applications of battery storage at dish engine facilities currently exist.

F.2.5.2 Utility-Scale Dish Engine Facilities

Various solar dish systems have been built around the world with a combination of heat engine and concentrator designs from various manufacturers. As noted above, no utility-scale solar dish engine facility is operational in the United States; however, there is a proposal to build the Imperial Valley Solar Project (formerly named SES Solar Two), in Imperial County, California, on both BLM-administered and privately owned land.[74] An AFC was submitted to the CEC on June 30, 2008 (SES Solar Two, LLC 2008). A supplement to the AFC was filed on June 12, 2009 (SES Solar Two, LLC 2009) that addressed changes to the water and hydrogen supply. The hydrogen supply for the project was changed from off-site reformation of natural gas to on-site production from electrolysis, which would reduce environmental impacts of hydrogen tank deliveries. In its application, the developer proposed to meet its water needs by using treated water from a nearby raw water canal. An estimated 33 ac-ft/yr (40 million m^3/yr) of water would be needed for mirror washing and drinking water. In the first set of data requests, the CEC asked for more information on the reliability of the proposed water supply and the source of backup water. In response to the data request, the CEC was provided with a supplement, which changed the primary water source to reclaimed water from a water treatment facility.[75]

F.2.5.3 Engineering Parameters and Resource Requirements for Dish Engine Facilities

The engineering parameters and environmental resource requirements of the proposed Imperial Valley facility include the following (Note: changes to project parameters that were provided in the June 2009 supplement to the AFC are reflected in brackets and italics, e.g., *[300 MW]*):

- Nominal capacity: 750 MWe developed in two phases (300 MW Phase 1 and 450 MW Phase 2)
- Total land area: 6,500 acres (26.3 km^2)
- On-site roads (maintenance access, paved): 25.2 mi (42.6 km); 138 acres (0.56 km^2)
- On-site roads (perimeter roads, unpaved): 11.2 mi (18 km); 16.2 acres (0.07 km^2)

[74] Project approved. Updated information will be included in the Final PEIS.

[75] The complete AFC and documents related to CEC's review are available at http://www.energy.ca.gov/sitingcases/solartwo/documents/applicant/afc/index.php. Accessed Jan. 5, 2009.

- Main industrial area: 14.4 acres (0.058 km^2)

- Additional buildings: 14.4 acres (0.058 km^2)

- Main electrical substation: 5.2 acres (0.0^2 km^2)

- Construction
  - Laydown areas (2): 100 acres (0.4 km^2) and 11 acres (0.045 km^2)
  - Period (both phases): 40 months
  - Dish engine foundations: metal pipe, hydraulically driven into the ground or set in concrete, depending on extant soil and subsurface conditions
  - Workforce: varies from 101 to a maximum of 731 individuals

- Solar concentrator dish and engine
  - 25-kW capacity each
  - 38 ft (11.6 m) high, 40 ft (12.2 m) wide
  - Sunlight-to-electricity conversion efficiency: 31.25%
  - 12,000 solar dish engines in Phase 1
  - 18,000 solar dish engines in Phase 2

- Employment (fully developed 750-MW facility): 164 full-time individuals

- Water
  - Source: nearby canal *[reclaimed water from a wastewater treatment facility]*
  - Demands (mirror washing, miscellaneous industrial processes) *[hydrogen production]*: 33 ac-ft/yr (40,706 m^3/yr)
  - On-site storage (raw water for firefighting and industrial uses): 175,000 gal (662 m^3)

- Dielectric oil (transformers, switches, other electrical equipment): 50,000 gal (189 m^3)

- Lubricating oil (present in each Stirling engine, site-wide total): 108,333 gal (410 m^3)

- Hydrogen (present in each Stirling engine, site-wide total): 50,000 ft^3 (1,416 m^3) (On-site hydrogen generation system (by electrolysis) with distribution to each Stirling Engine [1,065 cf/h])

- Ethylene glycol coolant (present in each Stirling engine, site-wide total): 110,000 gal (416 m^3)

- Gasoline (storage tank for refueling on-site maintenance vehicles): 5,000 gal (19 m^3)

- Diesel fuel (storage tank for emergency generator): 5,000 gal (19 m^3)

F.3 PHOTOVOLTAIC (PV) TECHNOLOGIES

F.3.1 Overview of PV Technologies

F.3.1.1 PV Effect, Semiconductors, and the Solar Cell

PV technologies are fundamentally different from other technologies currently being used to produce electricity. The heart of PV technology is the solar cell that is capable of generating electricity by a physical process known as the photovoltaic effect. French physicist Edmund Becquerel discovered the photovoltaic effect in 1839 when, during experiments with electrolytic cells, he noticed that certain materials were capable of generating small amounts of electric current when exposed to sunlight. Materials exhibiting these unique properties are known as semiconductors. An overview of how semiconductors work is provided below to aid in understanding the function of solar cells and the overall design and power-generating capacity of PV systems.

Metals like copper and iron share a unique physical property: in their solid form, the bonding electrons (electrons in each atom's outermost shells) that hold the atoms together are relatively free to move about in the metallic crystalline lattice and are easily displaced by other electrons introduced into the lattice. Because electricity is the flow of electrons, this property allows metals to act as excellent conductors of electrical current. Atoms such as carbon, silicon, and germanium in their pure crystalline forms hold all their bonding electrons tightly in covalent bonds and resist or impede the flow of electrical current, acting instead as insulators. However, introducing minute amounts of impurities (called dopants) can result in dramatic changes in behavior. Silicon, the earth's second most abundant material (after oxygen), was one of the first materials used to manufacture semiconductors and still predominates as one of the major constituents of semiconductors produced today.

Two types of dopants can be introduced to create semiconductors: negative-type (N-type) and positive-type (P-type). Atoms such as phosphorus or arsenic have five electrons in their outmost shell. Crystallizing a mixture of silicon with a few atoms of phosphorus or arsenic results in a crystal lattice in which one bonding electron of each phosphorus or arsenic atom has nothing to bond with and is thus relatively free to be displaced. Because electrons have a negative charge, the material is known as an N-type semiconductor. Unlike pure silicon, this material conducts electricity, although not as efficiently as would a pure metal; thus it is referred to as a "*semi*conductor." Doping silicon with atoms having only three electrons in their outermost shell (e.g., boron or gallium) results in "holes" in the crystalline lattice (i.e., spaces that are deficient in electrons). Resulting materials are also capable of acting as semiconductors, not by being a source of electrons, but by accepting electrons introduced from outside the crystalline lattice. Such materials are identified as P-type semiconductors.

By themselves, neither N-type nor P-type semiconductors are very remarkable or have much practical application. However, in combination, they can produce electric current. The simplest configuration of a solar cell combines an N-type semiconductor with a P-type

semiconductor, creating an interface or junction where the two meet. Some portion of the energy in sunlight striking this semiconductor pair is absorbed by the "extra" electrons in the N-type semiconductor that are not engaged in bonding. In their excited energy state, those electrons are free to escape from the semiconductor's crystalline lattice and be replaced by other electrons from outside the N-type crystalline lattice. At the same time, the "holes" of electron deficiency in the P-type semiconductor are ready to accept electrons. In combination, an electric field is established at the junction of the semiconductor pair that can provide a flow of current when that field is connected to a load (i.e., an electrical device that can receive the flow of electrons to perform useful work). The N-type semiconductor provides a source of electrons to the load, while the "holes" in a P-type semiconductor realign to receive electrons from the load, thus completing the circuit (Figure F.3.1-1).

A wide variety of materials exhibit semiconductor properties. Among the many semiconductor materials that have been used for solar cells are silicon, copper indium diselenide, cadmium telluride, gallium indium phosphide, and gallium arsenide. Selection of the appropriate semiconductor material for solar energy applications is based on the semiconductor's physical and electronic properties:

- Its degree of crystallinity, which controls its sunlight-to-electricity conversion efficiency;

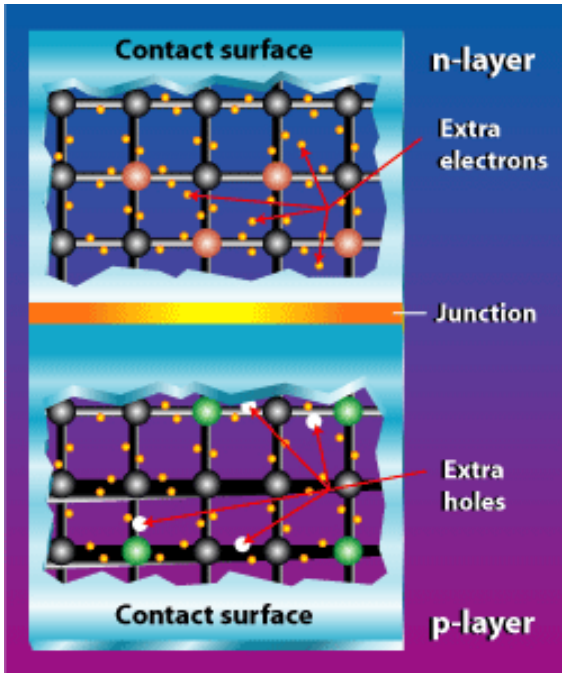


FIGURE F.3.1-1 Depiction of the PV Effect (Source: DOE/EERE. Available at http://www.eere.energy/gov/solar/photoelectric_effect.html)

- The amount of sunlight that can be absorbed by a given thickness of material (its absorptivity);

- The range of wavelengths in the sun's light spectrum that can be absorbed (the band gap);

- More practical factors, such as the cost of production (primarily reflected in the cost and availability of raw materials, some of which are quite rare); and

- The complexity of the manufacturing process.

Band gap is the most critical and most influential property in the design of solar cells. Electrons in any semiconductor's crystalline lattice can exist only at discrete energy levels, with the lowest energy level available for any of an atom's bonding or valence electrons known as the valence band. The next higher energy level available, representing an electron capable of moving freely through its crystalline lattice, is known as the conductance band. Only electrons that exist in their conductance band energy level are available to produce electric current. The difference in these two energy levels is known as the band gap. Sunlight is composed of photons or packets of different energy levels. Only those photons having energy approximately equal to a semiconductor's band gap energy (Eg) can be absorbed by the crystalline lattice of a semiconductor to move valence electrons to their conductance band. Incident photons with less energy pass through the semiconductor materials without moving any valence electrons. Photons with greater energy also are absorbed and can move a valence electron, but the excess energy is essentially wasted; this energy is manifested not as additional electric potential but as heat, which, if not properly controlled, can significantly reduce the performance and longevity of a solar cell.

Solar cells composed of only one semiconductor pair (and thus only one band gap) have a practical limit to their conversion efficiency of no more than about 30%, since they can capture and efficiently use only a small portion of the sun's complete light energy spectrum. Under real-world conditions, solar cells made from single-crystal silicon can exhibit efficiencies of only about 10%, but such cells are relatively inexpensive to produce and so they are predominantly used in off-grid applications with relatively low power demands.[76]

The efficiency with which a solar cell can convert incident light energy to electrical potential also depends on whether its semiconductors have direct or indirect band gaps. Indirect band gaps use some of the incident energy to first create vibrations in the crystalline lattice, making only the remaining energy available for exciting a valence electron into its conductance band. Direct band gap semiconductors are, therefore, much preferred. They are typically composed of Group III elements of the periodic table, primarily aluminum, gallium, or indium combined with elements from Group V, such as nitrogen, phosphorus, or arsenic. Further, changing the relative proportions of these elements within the crystalline lattice allows the designer to create semiconductors with different Eg values.

[76] However, recent advances in silicon solar cell technology have led to the development of thin-film silicon-based solar cells. Such solar cells are now being used in grid-connected, utility-scale PV systems.

The challenge for designers of utility-scale PV systems is to create a solar cell that absorbs the maximum amount of incident sunlight and converts it most efficiently to electrical potential. This is typically done by stacking semiconductors responsive to photons of different energy together in a multijunction solar cell "sandwich," installing conductive metal grids above and below to carry current from and to the solar cell, and encasing the entire assembly in glass or transparent plastic to prevent contamination (e.g., from airborne dusts, oxygen, humidity), limit deterioration due to weather, and protect against incidental damage. In a typical arrangement, the semiconductor pair having the highest Eg is uppermost in the sandwich, followed by semiconductors with decreasing Eg values. In some cases, especially where the uppermost semiconductor is highly reflective (e.g., crystalline silicon), an antireflective coating is applied to the top of the cell to minimize reflection of incident light, which can reduce overall cell efficiency.

Solar cells composed of two semiconductors can theoretically capture as much as 50% of the incident solar flux (Wu et al. 2002). Researchers at DOE's Lawrence Berkeley National Laboratory have identified a family of semiconductors composed of gallium indium and nitrogen, differing only in relative proportions of each element, that are photoelectronically active throughout the entire solar spectrum. A solar cell composed of all these semiconductors could theoretically capture as much as 86% of solar energy.

Although it is hypothetically possible to capture 100% of the sun's light energy by simply stacking enough semiconductors together with Eg values collectively spanning the entire electromagnetic spectrum of sunlight, in practice there are limits. The reduced opacity of multijunction cells, optical losses due to reflection or refraction, as well as the complexity and cost of production have limited multijunction solar cells to a maximum of three or four semiconductor pairs and a real-world efficiency limit of 70%. Even so, multijunction solar cells greatly increase the overall energy-producing efficiency of a solar cell and are ultimately the choice for utility-scale PV systems. An example of a multijunction solar cell is depicted in Figure F.3.1-2.

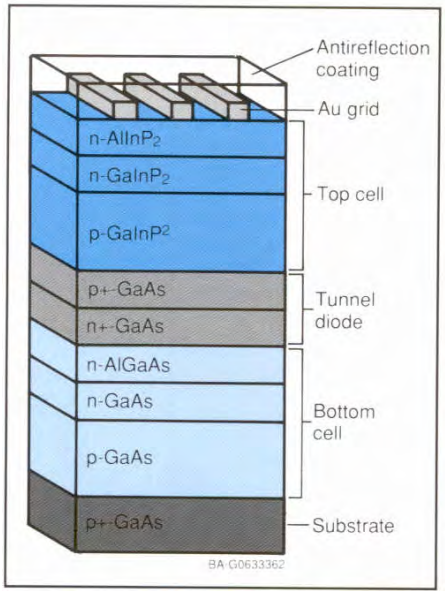


FIGURE F.3.1-2 Multijunction Solar Cell (Source: NREL. Available at http://www.nrel.gov/docs/legosti/old/16319.pdf)

F.3.1.2 Solar Cell Fabrication

Fabrication of solar cells involves a variety of complex processes, each requiring precisely controlled, scrupulously clean environments. Although fabrication activities are outside the scope of this PEIS because they would occur at remote manufacturing locations and not at the PV installations being considered, some background information is given here to assist in understanding the design and performance of PV facilities.

Solar cell fabrication is a major cost item for PV technologies. Semiconductors can be constructed of single crystals, semicrystals, polycrystals, or even amorphous materials and thin films. Each type offers unique advantages and disadvantages in both manufacturing and performance. In single-crystal semiconductors, all the atoms in the electrically active portion are precisely aligned. Although growing single-crystal cells is a delicate process,[77] their electrical performance is generally excellent. Semicrystalline or polycrystalline cells have active portions composed of many single crystals or grains, randomly arranged. Although such cells are less expensive to produce, this random arrangement of atoms creates potential for a reduction in electrical performance. In amorphous solar cells, atoms exist in totally random arrangements. Careful control of fabrication conditions can result in amorphous solar cells with good solar energy conversion efficiencies. Nevertheless, most amorphous solar cells, typically composed of silicon, have been used in low-power devices, and until recently, amorphous solar cells have not been considered for utility-scale PV systems. Now, many operating utility-scale PV facilities utilize amorphous thin-film silicon PV materials. Likewise, utility-scale PV facilities proposed for the United States would likely use thin-film amorphous silicon PV materials. (See Sections F.3.2.4 and F.3.3 for additional information on the types of solar cells being used or proposed for utility-scale PV facilities.)

Recent electronics industry advances have resulted in the production of thin-film semiconductors that also have PV applications. Thin-film solar cells comprise exceedingly thin layers of semiconductors stacked on top of each other. They can be made from a wide variety of semiconducting materials in both polycrystalline and amorphous forms. Production costs are dramatically reduced for thin-film solar cells. Because the entire thin film behaves monolithically, fabrication is substantially simplified over conventional solar panels that comprise many individual cells that must be precisely aligned and electrically interconnected to form a panel. The manufacturing process for thin-film solar cells is readily adaptable to creating thin films of various sizes and even building thin-film solar cells on flexible substrates such as thin plastic.

F.3.1.3 PV System Design Considerations

Regardless of their solar energy conversion efficiencies, individual solar cells (excluding thin-film solar cells) are quite small in their active area (i.e., the photoelectrically active portion exposed to sunlight) and produce minimal amounts of electricity (on the order of one or two watts at most). Consequently, applications of PV technology necessarily involve the use of many interconnected solar cells in a module. Various modules combine to make a solar panel, and panels are combined to create subarrays or arrays (Figure F.3.1-3). Modular design allows many arrangements of solar panels and relatively straightforward expansions of a PV facility's capacity. The nature of the solar cell used and the manner in which individual solar cells are interconnected allow the designer to attain critical electrical performance targets. Each solar cell produces only DC power. Connecting crystalline solar cells in series allows for the voltages

[77] Single crystals are typically grown in cylindrical shapes that are sliced to create wafers of various thickness (semiconductor material with poor absorptivity requires a thicker wafer to perform adequately), which may be further shaped into squares to allow for more efficient packing in a solar panel.

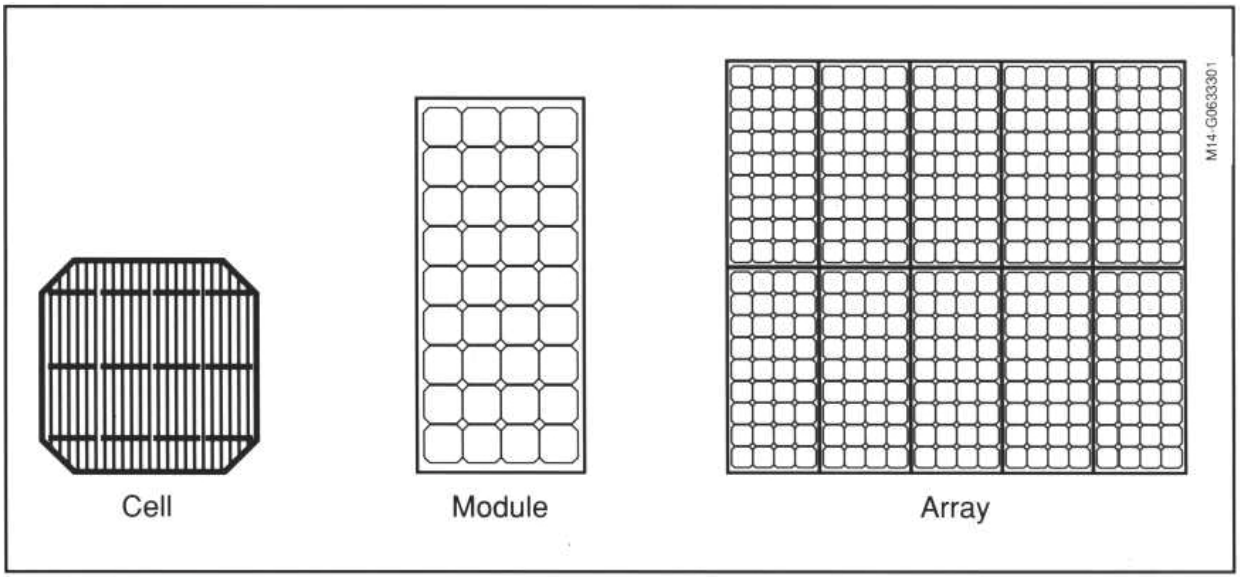


FIGURE F.3.1-3 PV Cells, Modules, and Arrays (Solar cells are incorporated into a module, and modules can be arranged in an array. Sometimes a panel of several modules is preassembled in a factory to reduce installation time and costs in the field.) (Source: NREL. Available at http://www.nrel.gov/docs/legosti/old/16319.pdf. Accessed Jan. 5, 2009)

produced by each cell to be additive while the current (in amperes) produced remains the same. Parallel connections allow for additive current across the interconnected cells without an increase in voltage.

For large PV systems connected to the grid, both voltage and current need to be controlled; thus both methods of interconnection are used. Cells within a module are connected in series to increase voltage, while modules in a panel are interconnected in parallel to increase amperage or in series to increase voltage. In practice, the method of interconnection is critical to overall performance. Reliability over time and over a wide range of environmental conditions, especially changes in ambient temperature, increases the criticality of cell interconnections.

Thin-film solar cells offer a distinct advantage with respect to reliable connectivity. While other solar cells are interconnected with metallic grids or wires, thin films convey their current through thin layers of electrically conductive metal oxides such as tin oxide, indium tin oxide, or zinc oxide. All oxides used for this purpose can be easily applied during fabrication by the use of essentially the same molecular deposition methods as used to deposit the thin films of semiconductor materials. In addition to overcoming many of the difficulties in installing and maintaining solar panels interconnected by metal grids, thin-film oxide conductors are all highly transparent to incident light (i.e., their presence does not affect overall solar cell performance by blocking, reflecting, or refracting incident light) and offer very little resistance to the flow of current. Once installed on their substrate as a continuous film, thin-film solar panels can create individual solar cells, interconnected (through the oxide film) in the manner necessary to meet module voltage and current requirements.

A wide variety of PV materials have been identified as having potential application in solar cells. Manufacturing costs and worldwide availability of raw materials used in the production of compound semiconductors, combined with the relatively inexpensive production costs and widespread availability of silicon-based semiconductors, have been major controlling factors in the type of PV material applied in photoelectric facilities. In 2000, the distribution of photocell material in use included polycrystalline silicon, 47.54%; single-crystal silicon, 35.17%; amorphous silicon, 8.30%; ribbon silicon, 3.50%; thin-film silicon, 0.26%; and others, less than 1% (Summers and Radde 2004).

Efficiency of conversion of photons to electricity has steadily increased without concomitant increases in costs. The use of concentrating lenses in combination with compound semiconductors and precise dual-axis tracking has resulted in observed efficiencies of 32.3% (Summers and Radde 2004). Using a triple-junction solar cell composed of gallium indium phosphide and gallium indium arsenide to split the solar spectrum into three equal parts, researchers at NREL reported a 40.8% efficiency concentrator cell in 2008 (NREL 2008b).

Overall efficiency still varies considerably among candidate PV materials. Most PV modules sold today are single-crystal or polycrystalline silicon. Likely semiconductor materials for future grid-connected central PV facilities include thin-film cells composed of both amorphous and polycrystalline silicon as well as a wide variety of compound semiconductor materials such as cadmium telluride (CdTe), copper indium gallium diselenide, and materials constructed of alloys of Group III elements (e.g., aluminum, gallium, and indium) and Group V elements (e.g., nitrogen, phosphorus, and antimony).

The candidate PV materials that will be deployed in large utility-scale PV systems will be determined by a combination of many factors, including module efficiency, manufacturing costs, reliability, installation costs, and O&M costs. The efficiency of the PV cells is important, but it will not be the only factor under consideration.

F.3.2 Types of PV Technologies and Facilities

PV technologies can be placed in two types of systems, flat-plate systems and concentrating systems. Flat-plate systems all utilize solar modules whose designs allow sunlight to directly strike the solar cells, without benefit of any light-concentrating or -focusing device. They are further differentiated by the orientation of their solar modules as being either fixed or tracking. CPV systems use concentrating or reflecting devices to effectively increase the amount of light energy that strikes the high-performance solar cells. CPV systems also require the use of tracking devices to take full advantage of their high-performance solar cells. Solar cell materials and design, and the design and orientation of solar modules and arrays, are the chief differentiating factors among PV facilities. Beyond these factors, the components that compose the remainder of the PV facility (the balance of the system) are quite similar across all PV technologies.

F.3.2.1 Flat-Plate Systems (Nonconcentrating)

In the simplest PV systems, the solar cells are arranged in flat modules or flat plates and no other components otherwise concentrate the sunlight before it strikes the solar cell. The flat modules are placed in a fixed position to capture the maximum amount of sunlight, typically pointing the module to the sun's expected midday position and adjusting the tilt of the module to maximize the annual energy production.[78] Once a tilt angle is established, the module's position does not change throughout the lifetime of the facility. The tilt angle can be chosen to maximize the annual energy production or for a specific season such as summer. The costs for design, construction, and maintenance of fixed, flat-plate systems are typically the lowest of all PV system designs.

In more sophisticated systems, flat-plate modules are mounted on motorized devices that track the sun's movement across the sky on one or two axes. Single-axis tracking follows the sun's diurnal path (i.e., east to west over the course of a day), and dual-axis tracking additionally follows the sun's seasonally changing paths (i.e., changes to the sun's altitude above the horizon over the course of a year). Tracking capability adds complexity and cost to the mounting devices and to the systems that control them. Maintenance costs also increase over fixed flat-plate PV systems. However, more energy can be produced, which should offset the additional costs of a tracking system.

Not all tracking flat-plate PV systems utilize dual-axis tracking. Changes in the sun's seasonal position are most pronounced in the northern latitudes of the northern hemisphere. For PV facilities located in southern latitudes, the seasonal difference in the sun's altitude is slight, and the loss of insolation due to divergence of the module's tilt angle from a precisely perpendicular orientation to incident light does not justify the cost and complexity of dual-axis tracking. Figure F.3.2-1 shows both a fixed-tilt flat-plate PV system with single-axis tracking (foreground) and a dual-axis tracking CPV system.

Also shown in Figure F.3.2-1 is the typical height difference between a fixed-tilt nonconcentrating PV system and a dual-axis tracking CPV system. A horizontal single-axis tracking flat-plate PV system is about the same height as a fixed flat-plate system (10 ft [3 m] or less).

F.3.2.2 Concentrating PV (CPV)

CPV systems differ from flat-plate PV systems by integrating a light-concentrating or light-focusing device ahead of the solar cells to effectively increase the amount of sunlight striking the photoelectrically active portion of the solar cell without actually increasing its area. If the amount of the sun's energy reaching a simple solar cell is defined as "one sun," then equipping that solar cell with a 10-fold concentrating device means that "10 suns" are now reaching the solar cell (Figure F.3.2-2). And because the conversion efficiencies of most solar

[78] In practice, both directly incident sunlight and diffuse sunlight (i.e., reflected from clouds, the ground surface, and surrounding objects) are captured by nonconcentrating flat panel PV systems.



FIGURE F.3.2-1 A Utility-Scale Flat-Plate PV System at the Prescott, Arizona, Airport Operated by Arizona Public Service Company (This system incorporates flat-plate nonconcentrating solar panels [foreground] and concentrating flat-plate solar panels [background].) (Credit: Arizona Public Services; Source: NREL 2010)

cells actually increase with increasing intensity of incident light (at a fixed temperature), the cell is now capable of producing slightly more than 10 times the amount of electricity. With the use of various devices that provide reflection and refraction, sunlight can be concentrated along a line or at a point (see Figure F.3.2-3) by means of a Fresnel lens.[79] A highly reflective parabolic surface can concentrate light along a line, while both mirrors lining the inside surface of a dish and a relatively inexpensive Fresnel lens can serve as point concentrators and, when arranged in a row, as line concentrators.

With current technology, as much as 300-fold increases in insolation (referred to within the industry as the concentration ratio) reaching the solar cell can be accomplished. Three concentration regimes are generally recognized: low concentration (concentration factors from 2 to 10 suns), medium concentration (from 10 to 60 suns), and high concentration (more than 100 suns) (Goetzberger and Hoffmann 2005). Although individual solar cells in a flat plate can be modified by fitting each with a concentrating lens to create CPV systems, space and cost

[79] The Fresnel lens was invented by French physicist Augustin-Jean Fresnel and was first used in lighthouses in the early 1800s. The desirable optical characteristics of the Fresnel lens, a very large aperture and relatively short focal length, are consequences of its being constructed of numerous curved lenses arranged in concentric circles (or Fresnel zones) rather than being constructed in one piece. Each zone is at a slightly different angle to incident light so that all zones focus light to the same point, resulting in magnification of the light's intensity. Advantages of such construction include comparatively low cost of production (compared to conventional one-piece lenses) and substantial weight savings when the lenses are made of acrylic rather than glass.

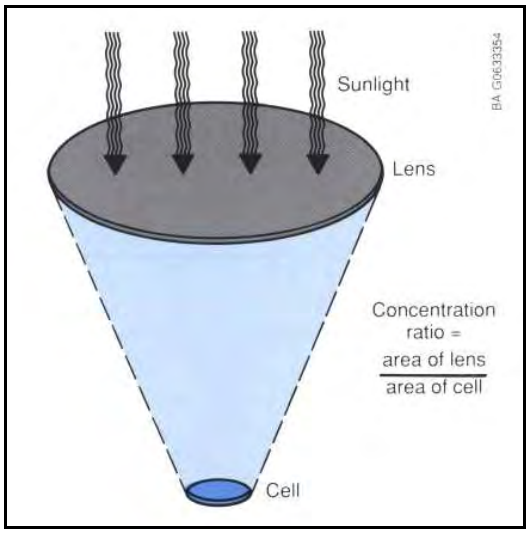


FIGURE F.3.2-2 Concentration Ratio for a Circular Lens (The ratio can also be defined for a linear parabolic reflector or a circular parabolic reflector. Greater tracking accuracy is required for higher concentration ratios.) (Source: NREL. http://www.nrel.gov/docs/legosti/old/16319.pdf. Accessed Jan. 5, 2009.)

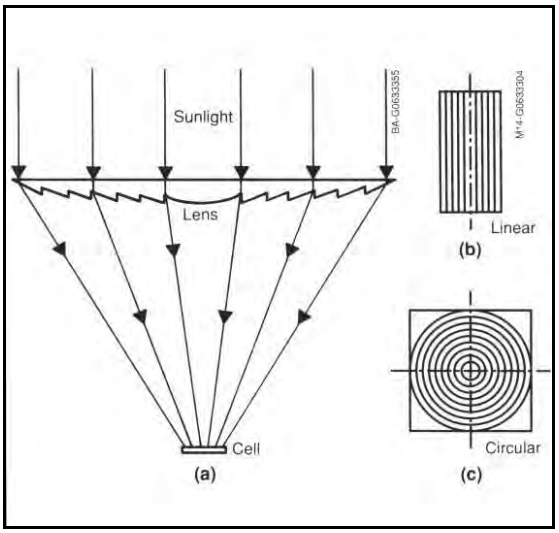


FIGURE F.3.2-3 Fresnel Lens Concentrator (Fresnel lenses can be circular or linear.) (Source: NREL. http://www.nrel.gov/docs/legosti/old/16319.pdf. Accessed Jan. 5, 2009)

considerations have resulted in the development of various other configurations. These include using a common concentrating device in a convex orientation above a conventional flat-plate solar module, lining the surface of a concave dish with reflecting devices and placing the solar cell at the focal point of the dish, or placing solar cells at the top of a tower that is surrounded by reflecting devices arrayed on the ground, all aiming at the solar cells.

A variety of concentrating devices provide a wide range of power magnification, from as low as 10- to 20-fold increases to well over 500-fold.[80] However, CPV systems must use high-performance cells to capture higher degrees of sunlight concentration. Typical choices include cells constructed of alloys of Group III elements (e.g., aluminum, gallium, and indium) and Group V elements (e.g., nitrogen, phosphorus, and antimony), along with crystalline silicon. Such cells have exhibited solar energy conversion efficiencies of 28% with direct solar irradiance and as high as 36% when incorporated into CPV systems (Dahle et al. 2008). Further, alignments between incident light, the concentrating lens, and the solar cell are critical in CPV systems because even a slight misalignment will likely result in a precipitous drop in system performance. CPV systems, therefore, must use dual-axis tracking to realize their full potential throughout daylight hours and throughout the year.

[80] At the current stage of CPV technology development, a 500× magnification is the practical limit. That degree of magnification requires the PV panel to be supported by an extremely precise tracking device to realize its fullest potential.

NREL, together with its commercial and academic partners, is currently conducting research on CPV technology. The High-Performance PV Project[81] has already demonstrated a high-performance CPV solar cell with a sunlight-to-electricity conversion efficiency of 37.3%. Replacing nonconcentrating solar panels composed of 25% efficient silicon cells with these high-performance CPV cells can result in an energy production increase of 50%, which may equate to a reduction in energy costs of as much as 33%. Research is still needed, however, to lower the cost of CPV cell production while increasing its reliability and efficiently and addressing some coincident negative effects of sunlight concentration, such as increased heat.

Figure F.3.2-1 showed a PV facility installed at the Prescott, Arizona, airport that uses both flat-plate PV and CPV technologies. Figures F.3.2-4 and F.3.2-5 show flat- plate and dish configurations of CPV, respectively, while Figure F.3.2-6 shows a CPV system that uses parabolic trough line concentrators.

Although CPV systems can produce as much as 30% more energy than fixed flat-plate systems having the same total illuminated area (Dahle et al. 2008), primarily because of the tracking feature and not necessarily the concentrating feature, there are drawbacks. Both production costs and maintenance costs are higher for CPV than for conventional flat-plate PV. The necessary commitments to high-performance (and more expensive) solar cells and precise dual-axis tracking also add to development and installation costs and introduce additional maintenance obligations throughout the facility's life. High-performance solar cells provide no tangible advantage over less expensive counterparts unless their performance is matched by the



FIGURE F.3.2-4 Fresnel Point Concentrators Positioned above Flat-Plate PV Solar Panels at Arizona Public Service's Solar Test and Research (STAR) Center, Tempe, Arizona (This unit can produce 20 kW of electricity.) (Credit: W. Timmerman. Source: NREL. Photo #08992. Available at http://www.nrel.gov.data/pix/searchpix.html. Accessed April 15, 2008)

[81] Additional information on the High-Performance PV Project is available at http://www.nrel.gov/pv/highperformancepv/. Accessed Jan. 5, 2009.

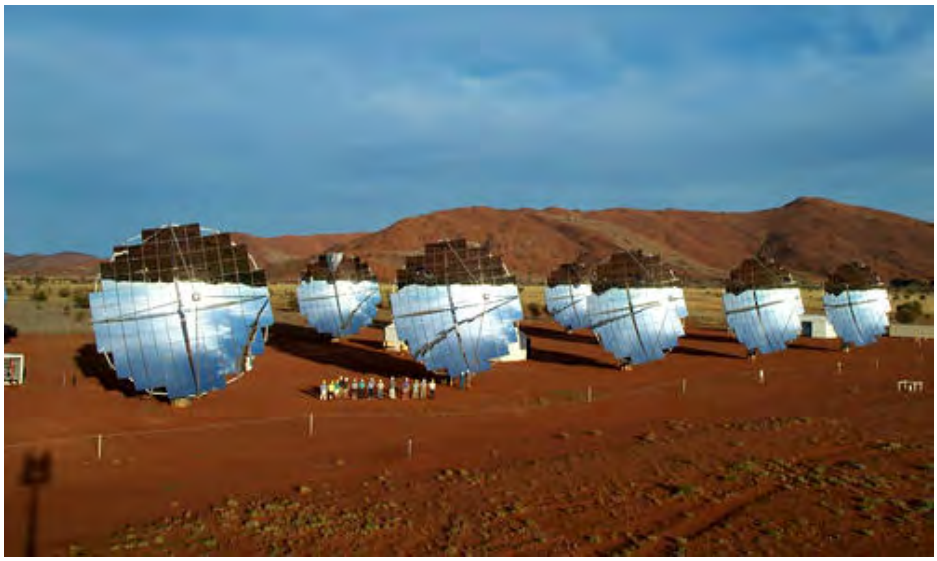


FIGURE F.3.2-5 25-kW CPV Dish at Alice Springs, Australia (The solar panels are positioned at the focal points of each of the dishes by four support arms that also serve to provide support for electrical cables and water lines for cooling jackets.) (Credit: R. McConnell. Source: NREL. Photo #13736. Available at http://www.nrel.gov/data/pix/Jpegs/13736.jpg. Accessed April 15, 2008)



FIGURE F.3.2-6 CPV System Using Parabolic Trough Line Concentrators (This 480-kilowatt-peak (kWp) research facility is operated by the University of Madrid, Spain.) (Source: NREL. Photo #13744. Available at http://www.nrel.gov/data/pix/. Accessed Jan. 5, 2009)

quality of the reflecting mirrors or the concentrating lenses that deliver sunlight to them. Both mirrors and lenses must be kept clean to perform at their best, which is often a significant commitment in desert areas that have periods of high concentrations of airborne dusts.[82]

Concentrating sunlight also concentrates heat. Solar cells are not responsive to heat and do not convert heat to electricity. Instead, the heat must be controlled to prevent solar cell deterioration or loss of solar cell performance, reliability, and longevity. Higher levels of light magnification may therefore require more aggressive cooling than simple inexpensive passive systems can provide. As magnification and heating rise, so will the cost and complexity of the cooling system that are required.[83] Cooling system designs can have tremendous variation and include a variety of HTFs.

Concentrators have been applied in only a few utility-scale systems. One such proposed facility, the Victorian Project in Australia, will have a 154-megawatt-peak (MWp)[84] capacity (see Section F.3.2.4). A number of smaller, non-utility-scale CPV projects have been installed, many of them by a company called Solar Systems in Australia. These systems range in capacity from 40 kWp to 288 kWp, and most of them augment local diesel generation (Kinsey et al. 2006; Solar Systems undated a–d). One small CPV system with a capacity of 75 kWp has been installed at the Clark Generating Station, a 740-MW gas-fired power plant in Nevada (Edwards 2006).

F.3.2.3 PV Facility Balance of System

The basic balance of system components for a typical PV facility and their function are shown in Table F.3.2-1. The most critical component from the perspective of the transmission grid operator is the power conditioning system (PCS). PV cells produce DC electricity. That power must be converted to AC and conditioned before a connection from the PV facility can be safely made. One item of PCS equipment unique to PV facilities is a DC-AC inverter that converts the initially produced DC current to AC. Modern-day inverters use solid-state technology and typically operate at efficiencies higher than 90%. The remaining equipment in the PCS is functionally identical to power conditioning and management equipment found at any thermoelectric power plant but has special design features to accommodate the unique character

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82 Over the long term, abrasive airborne particulates can also damage the surfaces of mirrors and lenses, further reducing their performance.

83 Passive cooling systems may be as simple as adding cooling fins at strategic locations to enhance the solar cell assemblies' ability to dissipate heat to their surroundings through radiation cooling. Active cooling systems can range from forced air flow across the solar cell assembly to simple water circulation between the solar cell assembly and a remote heat exchanger to more sophisticated systems using HTFs such as synthetic oils, ethylene glycol solutions, brines, conventional refrigerants (including ozone-depleting chemicals), or HTFs with even higher heat exchange potentials, such as anhydrous ammonia. Active cooling systems also introduce additional maintenance costs as well as the potential for release of coolants to the environment in the event of system failure.

84 Megawatt-peak (MWp) and kilowatt-peak (kWp) are measures of the peak output of a given PV system.

TABLE F.3.2-1 Balance of System Components for PV Facilities

Component	Function	Notes
Electrical cables	Deliver power from individual PV module assemblies to a PCS within the facility and then to a grid.	Often buried below ground for security against storm damage.
Solar module mounting assemblies (fixed plate)	Secure solar modules at the appropriate angle to incident sunlight, sometimes also including line-concentrating or point-concentrating devices.	Often of complex designs to adjust for land surface slopes and irregularities; constructed of suitable materials to resist the vagaries of weather over the lifetime of the facility.
Solar module tracking assemblies	Change the orientation of the solar module assembly over the course of the day and year to maximize incident solar radiation (typically using electric motors or hydraulic systems).	Both single-axis and dual-axis tracking systems are used. Trackers require firm footings (piles, pylons) in the ground.
Cooling system/ passive/air cooled	Dissipate heat from solar module assemblies using convection cooling.	Typically necessary only on CPV systems. Not needed in all locations.
Cooling system/ active/air cooled	Dissipate heat from solar module assemblies using forced air flow by means of electric fans.	Typically necessary only on CPV systems.
Cooling system/ active/liquid cooled	Dissipate heat from solar module assemblies using liquid coolants circulated between the solar panel assembly and a remote heat exchanger by electrically powered pumps.	May be necessary for CPV systems with high light-concentration ratios.
SCADA systems	Remotely monitor system performance, control solar module assembly tracking features (when equipped), engage or disengage hybrid system components, monitor power conditioning, and make adjustments to operating parameters in response to upset or changing conditions.	Typically consisting of various solid-state monitoring and control devices, remotely controlled switches and motors, and communication systems (telephone, optic cable, radio, microwave) connecting the facility with a remote control center.
Power conditioning equipment (PCS)	Convert the DC electricity produced at the solar modules to AC with inverters. Transformers are used to step up the voltage, and electronics are used to synchronize the phase of the current before connecting it to the transmission grid.	Typically, many strategically located PCSs would be required. Each PCS would also be equipped with various switches, capacitors, and other electrical devices designed to protect the reliability of the transmission grid.

TABLE F.3.2-1 (Cont.)

Component	Function	Notes
Module cleaning system	Keep surfaces of the solar cells free of dust. Systems can be manual (e.g., spraying from water trucks) or built in.	To avoid scale build-up on the hot PV module's surface, water used for cleaning must be demineralized before use. Recovery of wash solutions may or may not be practical, depending on arrangements of the PV modules.
Grounding system	Provide personnel safety, lightning protection, reduction of static charge buildup, and electrical surge protection.	Typically composed of strategically placed copper grounding rods or metallic grounding nets buried beneath the ground surface.
Drainage system	Remove rain and cleaning water from site via trenches and/or pipes.	

of the power. Importantly, all PCSs are equipped with devices that can sense grid-destabilizing events and faults and automatically disconnect the PV facility from the grid.

F.3.2.4 Utility-Scale PV Facilities

Utility-scale PV power plants are a new and rapidly developing technology. Among the 25 largest operational plants worldwide, ranging in capacity from 5 to 20 MWp, only six were connected to their respective power grids before 2007. Total installed capacity increased from 186 MWp in 2006 to 489 MWp at the end of 2007. Lenardic (2008a) summarizes information about PV power plants greater than 200 kWp. Seventy percent of these plants are ground mounted; 29% roof mounted; and 1% integrated into buildings. Europe has 81% of the worldwide solar power capacity; the United States, 14%; Asia, 4%; and the rest of the world, less than 1%. The industry is developing rapidly, and the United States, Germany, Spain, Italy, and Korea all have utility-scale projects under construction.

Table F.3.2-2 provides information about utility-scale PV power plants with a peak capacity of at least 10 MWp. Plants scheduled for completion in 2008 or beyond are included in the table along with several proposed facilities. Except for the proposed Victorian Project (Australia), which will use CPV technology, all the listed plants use flat-plate PV systems.

In recent years, interest in utility-scale PV in the United States has risen sharply, and numerous utility-scale PV facilities have been proposed, most in southern California. One such facility has been proposed to be built on the Carrizo Plain in San Luis Obispo County, California, by Topaz Solar Farms, LLC (formerly a wholly owned subsidiary of OptiSolar, Inc., a California-based manufacturer of thin-film amorphous silicon PV modules, now owned by First Solar). It is one of a number of similarly sized facilities proposed for construction in various

TABLE F.3.2-2 Summary Information for Existing and Proposed Utility-Scale PV Plants

Plant Name	Location	Capacity (MWp)	Annual Power Produced (MWh)	Plant Area acres (km^2)	Solar Modules		Notes[a]
					Number	Area (m^2)	
Victorian Project[b]	Australia	154	270,000	NA	62,976	NA	• Proposed • 500× solar concentration technology • Components: 19,250 heliostats, 246 receivers • Phase 1 commissioning expected in 2010; phase 2 in 2013
Kings River Conservation District Solar Plant[c]	California	80	NA	NA	NA	NA	• Proposed in Fresno County • Construction over 3 yr: 10 MWp in 2009, 30 MWp in 2010, 40 MWp in 2011
Topaz Solar Farm	California	550	NA	6,200 (25)	NA	NA	• Proposed in San Luis Obispo County • Construction scheduled to begin in 2010 • Thin-film silicon cells • In a June 2009 revision to the CUP, the plant area was changed to 5,200 acres (21.5 km^2)
Moura Energy Station[d]	Portugal	62	88,000[e]	321 (13)	>376,000	130 ha (320 acres)	• Under construction • Two-stage construction: 42 MWp in 2008, 20 MWp in 2009 • Mounting for first phase: 190,000 panels (32 MWp) fixed and 52,000 (10 MWp) on single-axis trackers

1

TABLE F.3.2-2 (Cont.)

Plant Name	Location	Capacity (MWp)	Annual Power Produced (MWh)	Plant Area acres (km^2)	Solar Modules		Notes[a]
					Number	Area (m^2)	
Solarpark Waldpolenz[f]	Germany	24	40,000	272 (1.1)	550,000	400,000	• First year of operation 2007; planned expansion in 2009 will increase plant capacity to 40 MWp • Thin-film modules, no tracking • Operating lifetime of at least 20 yr and probably 30–40 yr
Parque Fotovoltaico Abertura Solar[g]	Spain	23	NA	440 (1.8)	NA	NA	• Planned start of operation: 2008 • 2,000 h/yr sun • Very flat land • 11-month construction time • 200 individual 100-kW plants each with 600 PV panels, one tracker, one inverter, one transformer, and additional infrastructure • 200 single-axis trackers: 5,000 tons of galvanized steel, 26,000 holes drilled, 22,222 yd^3 (17,000 m^3) of concrete for vertical supports • Rainwater drainage: 7.5 mi (12 km) of channels/trenches and 0.2 mi (350 m) of piping • 14×10^6 L (16,293 m^3) of water storage for fire control • 48,390 ft^2 (4,500 m^2) of revegetation • Control center and substation occupying 3,230 ft^2 (300 m^2)

TABLE F.3.2-2 (Cont.)

Plant Name	Location	Capacity (MWp)	Annual Power Produced (MWh)	Plant Area acres (km^2)	Solar Modules		Notes[a]
					Number	Area (m^2)	
Parque Solar Hoya de Los Vicentes[h]	Spain	23	42,000[e]	247 (1)	120,000	NA	• Planned start of operation: 2008 • Continual breeze keeps panels cool
Solarpark Calaveron[i]	Spain	21	40,000	247 (1)	96,000	NA	• Planned start of operation: Jan. 2008 • Polycrystalline modules
Planta Solar La Magascona[j]	Spain	20	NA	247 (1)	120,000	NA	• Planned start of operation: 2008 • 200 100-kW solar plants each with 600 PV panels • Operating lifetime of 30 yr
Solarpark Beneixama[k]	Spain	20	30,000	124 (0.5)	100,000	NA	• Planned start of operation: Sept. 2007 • Polycrystalline modules • 1-yr construction time; 80 employees at different times
SinAn Power Plant[l]	Korea	19.6	27,000	400 (1.6)	109,000	600,000	Planned start of operation: May 2008
Almeria PV Park[m]	Spain	15.4	24,000	NA	91,000	300,000	Under construction
Nellis Air Force Base[n]	Nevada	14.2	30,100	141 (0.57)	72,416 200-W modules 5,891,328 cells	NA	• First operation: Dec. 2007 • 26 weeks construction time; 200 workers • 5,821 trackers, 18 transformers, 54 inverters, 1,051 mi (1,691 km) of power cable • See text for additional information

TABLE F.3.2-2 (Cont.)

Plant Name	Location	Capacity (MWp)	Annual Power Produced (MWh)	Plant Area acres (km^2)	Solar Modules		Notes[a]
					Number	Area (m^2)	
Planta Solar de Salamanca[o]	Spain	13.8	NA	89 (0.36)	70,000	NA	• First operation: Sept. 2007 • Three separate arrays on-site
Solarpark Lobosillo[p]	Spain	12.7	NA	NA	83,000	NA	• First operation: Sept. 2007 • First phase of 60-MWp project • 140 100-kW systems
Parque Solar Fotovoltaico Villafranca[q]	Spain	12	NA	NA	NA	NA	• Planned start of operation: 2008 • 13 “solar farms or gardens,” including the largest, Huerta Solar Monte Alto, below • Each park has multiple owners and contains 5–11 kW individual panels and trackers
Solarpark Gut Erlasee[r]	Germany	12	14,000	77	NA	NA	• First year of operation: 2006
Serpa PV Power Plant[s]	Portugal	11	NA	60	52,000	NA	• First operation: March 2007 • On south-facing hillside • Single-axis tracking • At least 25-yr lifetime • 7-month construction period

TABLE F.3.2-2 (Cont.)

Plant Name	Location	Capacity (MWp)	Annual Power Produced (MWh)	Plant Area acres (km^2)	Solar Modules		Notes[a]
					Number	Area (m^2)	
Solarpark Pocking[t]	Germany	10	10,750	26	57,600	75,000	• First operation: Dec. 2005 • Single-axis tracking • 3 separate systems at locations in close proximity • Individual 1.67 MWp solar modules • 4 rows of panels with aluminum supporting structures; substructure length of about 10.3 mi (16.5 km) • Panel foundations fixed with 8,112 “earth bolts” • 24 400-kVA inverters and 4 1,600-kVA inverters
Parque Solar de Zuera[u]	Spain	9.9	NA	52	47,000	NA	• Planned start of operation: 2008 • 90 individual 110-kWp solar modules Approximately 350 construction workers
Huerta Solar Monte Alto[v]	Spain	9.5	14,000	51	52,706 modules	NA	• First year of operation: 2006 • Built on hilly terrain • 899 solar structures, 864 with automated solar tracking, remainder fixed and adapted to topography • 18.6 mi (30 km) of ditches for electrical conduits, 55.9 mi (90 km) of pipes, 7,843 yd^3 (6,000 m^3) of concrete, 3.9 mi (6.3 km) of bore holes (number not specified) for trackers

TABLE F.3.2-2 (Cont.)

Plant Name	Location	Capacity (MWp)	Annual Power Produced (MWh)	Plant Area acres (km^2)	Solar Modules		Notes[a]
					Number	Area (m^2)	
Planta Solar Villa de Canas[w]	Spain	9.5	NA	NA	NA	NA	• Planned start of operation: Feb. 2008 • 7 months to construct

a Information in this table was compiled in mid-2008 and reflects project status at that time.

b Solar Systems (undated a).

c RED (2008a).

d The Guardian (2005); Now Public (2008).

e MEI (2007).

f juwi group (2007).

g RED (2008b).

h Luzentia Solar Promotion (undated a,b).

i RenewableEnergyWorld.com (2008).

j SPG Media Limited (2007a,b).

k City Solar AG (undated).

l Project Finance Magazine (2008).

m RED (2008c).

n Nellis Air Force Base (undated); Nellis Air Force Base (2006).

o KYOCERA (2007).

Footnotes continued on next page.

TABLE F.3.2-2 (Cont.)

[p] Ecostream (2006).

[q] Lenardic (2008b).

[r] The Solarserver (2007).

[s] Marsden (2007); SPG Media Limited (2008a).

[t] SPG Media Limited (2008b); PowerLight (2005); The Solarserver (2008).

[u] Foro-Industrial (2008).

[v] Professor of ESO (2007); Lenardic (2008b).

[w] RED (2008a).

Source: Lenardic (2008b).

NA = not available.

areas of southern California and is likely representative of utility-scale PV facilities that will be built within the next 20 years.

Because PV technologies are not thermoelectric facilities and do not require water to support a steam cycle, operators proposing such facilities in California are not required to obtain an AFC from the CEC regardless of nameplate power rating; such facilities are instead required to obtain a conditional use permit (CUP) from the county in which they are located. On July 18, 2008, Topaz Solar Farms submitted an application for a CUP (DRC2008-00009) to San Luis Obispo County (Topaz Solar Farms, LLC 2008).[85] In April 2009, Optisolar, Inc. merged with First Solar, Inc. and the applicant switched its proposed PV technology to thin-film solar modules manufactured by First Solar. On June 25, 2009, Topaz Solar Farms, LLC submitted a revised CUP application that supersedes the July 18, 2008, application (Topaz Solar Farms, LLC 2009).[86] Changes to project parameters from the technology shift include reduced water requirements and decreased land area.

F.3.2.5 Hybrid PV Systems

Various options are available for constructing hybrid facilities involving PV technology. As was shown in Figure F.3.2-1, combining flat-plate PV systems with CPV systems is already being practiced. Likewise, the use of modules composed of different solar materials and different PV flat-plate designs in the same facility is equally feasible. However, while such options may improve overall operability or power-producing capacity, they do nothing to improve the "dispatchability" of the facility's power and thus do not significantly improve the value of the facility as a utility-scale power source. Because PV technologies do not produce steam, their hybridization with conventional thermoelectric technologies is not easily or efficiently accomplished. While it is possible to co-locate PV solar with conventional thermoelectric generation, except for the physical juxtaposition, there is really no "integration" of the two technologies. Also, because PV is not a thermal-based technology, including TES systems with PV facilities is not feasible. However, PV technologies would be suited for hybridization with energy storage in batteries for delayed delivery to the grid.[87] PV could also be adapted to generate alternative energy supplies (e.g., hydrogen through the electrolysis of water). To date, no such PV hybrids have been proposed for utility-scale PV facilities.

[85] The entire CUP application can be viewed at http://www.slocounty.ca.gov/planning/environmental/EnvironmentalNotices/optisoloar/Optisolar_App_Submit.htm. Accessed July 14, 2009.

[86] The entire revised CUP application can be viewed at http://www.slocounty.ca.gov/planning/environmental/EnvironmentalNotices/optisoloar/topaz6-09.htm. Accessed December 1, 2009.

[87] Although batteries have been used in conjunction with small-scale distributed PV systems (DOE 2008), the technology is not considered viable for utility-scale systems at this time.

F.3.2.6 Water Demands of Utility-Scale PV Facilities

PV facilities are fundamentally different in their approach to producing electricity than CSP plants. All CSP plants produce steam to drive a conventional STG and, as a consequence, require substantial amounts of water to condense that steam so that it can be recycled. There are additional miscellaneous water demands associated with the operation of a CSP plant to support activities such as routine washing of reflectors and/or concentrators and various routine plant maintenance and cleaning activities. PV plants have similar water demands for activities such as solar panel washing and routine plant cleaning and maintenance. However, because they do not produce steam, the water demands for PV plants are substantially less than those for CSP plants of equivalent power capacity.

Although solar cells interact with the sun's photons of light energy and not its heat, they do nevertheless get hot from their exposure to the sun. Although heat can cause deterioration of a solar cell, reducing its performance and shortening its useful life, most solar cell applications are able to adequately control heat by simple convection cooling of the panels. Recent developments of concentrating devices to increase the effective area of the solar cells have introduced the potential need to install more aggressive heat rejection features. Although there is no expectation that wet closed-loop cooling systems would ever be required, any of the dry or wet/dry cooling hybrids discussed in Sections F.2.4.2.2 and F.2.4.2.3 could be adapted to CPV facilities. Less elaborate variants of those cooling technologies that could provide adequate levels of heat rejection might include forced-air cooling of individual panels or installation of completely closed cooling systems that reject heat by blowing an ambient air stream across a radiator. Such closed systems would be similar to automobile cooling systems and utilize the same glycol-based aqueous coolants. Even so, such closed systems would require only a fraction of the water required by wet closed-loop cooling systems, and the water would need only infrequent replacement to control corrosion of the cooling system's components. In areas where even this relatively small amount of water would be difficult to obtain, closed cooling systems recirculating organic-based HTFs similar to those used in ORC turbines might also be used.

F.3.3 Engineering Parameters and Resource Requirements for PV Facilities

To support an environmental impact analysis of utility-scale PV facilities, it is necessary to define representative engineering parameters and resource requirements. This section presents those data for the proposed Topaz Solar Farm facility described in Section F.3.2.4. The data presented were extracted from that facility's application for a CUP.[88] They are considered representative of similarly sized utility-scale PV facilities, although they may not anticipate parameters and requirements for future proposed facilities.

[88] Topaz Solar Farms, LLC, submitted a revised CUP Application in June 2009. The entire revised application can be viewed at http://www.slocounty.ca.gov/planning/environmental/EnvironmentalNotices/optisoloar/topaz6-09.htm. Accessed December 1, 2009.

The critical engineering dimensions and resource needs for the Topaz Solar Farm PV facility include the following (Note: changes to project parameters associated with the revised CUP application are reflected in brackets and italics below):

- Nominal power capacity: 550 MW total (210 MW Phase 1, 340 MW Phase 2, construction initiated 4 years after Phase 1 completed)

- Project size: 6,200 acres (25.1 km^2) (5,300-acre [21.5-km^2] study area; 4,200-acre [17-km^2] ultimate project perimeter), including four *[two]* 10-acre (0.041-km^2) *[6-acre (0.024-km^2]* temporary material staging areas to support construction, all within facility boundaries

- Expected project life: 30 years

- Technology: Thin-film amorphous silicon PV *[thin-film PV modules]*

- Solar field
  - 12 PV modules/block, 5 acres (0.02 km^2)/block, 500 kW(AC)/block
  - Each PV block served by pad-mounted inverter and transformer, 20 ft × 10 ft × 8 ft high (6 m × 3 m × 2.4 m) (1,100 devices for the entire facility)
  - Each module 3.28 ft × 1.64 ft (1 m × 0.5 m), 15º tilt, maximum elevation 3 ft (0.9 m) above grade
  - Module rows separated by 5 ft (1.5 m) to prevent shading and provide access for maintenance
  - *[550 1-MW arrays, consisting of groups of modules called tables]*
  - *[45 modules per table; 6.5 acres (0.026 km^2) per table]*
  - *[10 tables per MW]*
  - *[Each table 6 ft × 60 ft (1.83 m × 18.29 m), 1.5 ft (0.46 m) high at front end, 5 ft (1.52 m) high at rear end]*
  - *[Arrays will be separated by 20-ft (6.1-m) access corridors]*

- Central electrical substation: 5acres (0.020 km^2) *[6 acres (0.024 km^2)]*, 8-ft (1.5-m) high perimeter fence

- Two-acre O&M facility (two double-wide trailers) and employee parking

- Water sources and requirements
  - Sources: on-site wells
  - Requirements, construction phase
    - Fugitive dust control: 7,200 gal/day (27.2 m^3/day), 8.0 ac-ft/yr (9.868 m^3/yr)
    - Concrete manufacturing (temporary on-site batch plant at each of four construction staging areas, 300,000 yd^3 [229,500 m^3]) total: 12,000 gal/day (45.4 m^3/day), 13.4 ac-ft/yr (16,036 m^3/yr)
    - Sanitary uses: 3,750 gal/day (14.2 m^3/day), 4.2 ac-ft/yr (5,026 m^3/yr)

    - Other (initial PV panel washing): 960 gal/day (3.63 m^3/day), 1.1 ac-ft/yr (1,316 m^3/yr)
    - Total, construction: 23,910 gal/day (90.5 m^3/day), 26.7 ac-ft/yr (31,951 m^3/yr) *[expected to use 20 ac-ft/yr, a maximum of 43,000 gal/day (163 m^3/day)]*
  - Requirements, operations phase
    - Sanitary uses: 160 gal/day (0.61 m^3/day), 0.2 ac-ft/yr (247 m^3/yr) *[less than 100 gal/day (0.38 m^3/day)]*
    - Panel washing (once/year): 2,900 gal/day (11 m^3/day), 3.3 ac-ft/yr (4,070 m^3/yr) (requires no water for electricity generation or for cleaning modules)
    - *[35 gal/day (0.13 m^3/day) for Solar Energy Learning Center]*
    - Total, operations: 3,060 gal/day (11.58 m^3/day), 3.5 ac-ft/yr (4,317 m^3/yr) *[135 gal/day (0.51 m^3/day)]*

- Wastewater: on-site septic system, <1,500 gal/day (5.7 m^3/day) during construction, 50 gal/day (0.2 m^3/day) *[135 gal/day (0.51 m^3/day)]* during operation

- Workforce:
  - Construction: 250 *[400]* workers (daily average over a 3-year construction period)
  - Operation 10 *[15]* workers (daytime shift only, 24-h security presence)

- Transportation impacts, 3-year construction period:
  - 60 *[58]* vehicle trips/day for workforce commute
    - Shuttle buses for workers (10 *[18]* @ 20 workers each)
    - 50 *[40]* individual worker vehicles
  - Deliveries: 85 vehicle trips/day
  - Construction vehicles: 135 *[420]* will remain on-site throughout construction period, none operated on public roads

- Transportation impacts, 30-year operation period:
  - 8 *[13]* vehicles/day with 1.5 *[approximately 1]* workers/car for workforce commute
  - Deliveries, 4 *[7]* vehicles/day

F.4 TRANSMISSION LINES AND GRID INTERCONNECTIONS

F.4.1 General Information Regarding the Transmission Grid

This PEIS addresses the potential impacts of the construction and operation of transmission lines to connect solar energy facilities to the main high-voltage electric transmission grid. It is assumed that the maximum distance of transmission line construction required for any

individual solar facility would be 25 mi (40 km). This section provides additional information on the major components of high-voltage transmission lines and the potential environmental impacts associated with their construction and operation. The primary factors influencing the design and performance of transmission lines are also briefly discussed. Site-specific impacts of transmission lines (e.g., impacts on specific species and habitats) are not addressed in this section.

Information presented here was taken primarily from a Technical Memorandum published by Argonne National Laboratory (Argonne 2007) and from the recently published *Final Programmatic Environmental Impact Statement, Designation of Energy Corridors on Federal Land in the 11 Western States* (DOE and DOI 2008b). Those documents, both of which are available electronically at http://corridoreis.anl.gov, provide more in-depth information on these topics.

The North American electric system includes power generation, storage, transmission, and distribution facilities in Canada, United States, and northern Mexico (Baja Norte). The high-voltage transmission grid comprises three main interconnected regions: the Eastern Interconnection, Western Interconnection, and Electric Reliability Council of Texas (ERCOT) Interconnection. The Western Interconnection serves 12 western states (including all six states within the scope of this PEIS), the Canadian provinces of Alberta and British Columbia, and Baja Norte, Mexico.

Within each interconnection, all electric utilities are interconnected and operate synchronously; that is, the generators are operated such that the peak voltage from all generators occurs simultaneously. Voltage from AC generators varies over time following a sine wave, reaching a peak or a minimum 60 times per second (60 Hz). If all the power contributions from generators were not "in phase," the voltage from one would cancel some of the voltage from others. Ensuring synchronicity is essential to the transmission grid's reliability and function. Consequently, each line segment connecting a generating facility to the transmission grid is supported by substations located either at the generator's facility or at the "point of injection" (or both) that accomplish the necessary power modifications. In addition to ensuring proper phase, transformers are present to adjust voltage to match the grid or to provide for efficient transfer of power to the point of injection. Circuit breakers are present to disconnect the facility should upset conditions occur, and at solar PV facilities inverters are present to convert the direct current produced at the solar panels to alternating current.

F.4.2 Providing for Transmission Grid Reliability and Stability

The Federal Energy Regulatory Commission (FERC) is the primary federal regulatory authority overseeing electric transmission and is responsible for ensuring the reliability of the electricity transmission grid. To further ensure system reliability, the Energy Policy Act of 2005 authorized the creation of an independent, international Electric Reliability Organization (ERO) and directed FERC to establish rules for EROs as well as a process for certification. In

July 2006, FERC approved the North American Electric Reliability Corporation (NERC) as the authorized ERO for the United States.[89]

NERC's mission is to promote reliability of the bulk electricity transmission systems (i.e., electricity transmitted at 100 kV or greater) that serve North America. To achieve that and in collaboration with all segments of the electric power industry, NERC develops and enforces FERC-approved reliability standards; monitors the bulk power system; assesses future adequacy; audits owners, operators, and users for preparedness; and educates and trains industry personnel. Reliability standards provide for the reliable performance of the North American bulk electric systems without causing undue restrictions or adverse impacts on competitive electricity markets.[90] To ensure consistency in the manner in which individual generating facilities are granted access to the transmission grid and to ensure that such interconnections do not jeopardize the stability of the grid, FERC has also developed a generator interconnection procedure and published a model interconnection agreement, both required to be used for generating facilities with nameplate ratings greater than 20 MW.[91]

NERC is composed of Regional Reliability Councils (RRCs), each responsible for bulk transmission within its assigned geographic area. The transmission grid segments within the six states addressed in this PEIS are under the control of the Western Electricity Coordinating Council (WECC). WECC is authorized to promulgate regional reliability standards (that must be approved by NERC and FERC)[92] to develop regional reliability criteria or planning standards that complement the NERC reliability and planning standards, or to establish consistent procedures for ensuring compliance with NERC standards among all WECC transmission system participants. Together, the NERC and WECC reliability standards dictate the design and capabilities of transmission system components, the dimensions and conditions of rights-of-way (ROWs), the configurations and capabilities of switchyards and substations, and the monitoring and operating parameters and controls of transmission line segments and interconnections.

F.4.3 Transmission Line Components

As discussed above, reliability standards, together with the characteristics and amount of power expected to be delivered, control every aspect of a solar facility's interconnection to the

89 More information on NERC can be found at the NERC Web site, available athttp://www.nerc.com.

90 Currently, there are 94 FERC standards and 185 NERC standards addressing reliability of all facets of bulk electricity transmission, including design, planning, operations, infrastructure and cyber security, communication, coordination, and operational safety. All NERC reliability standards can be accessed electronically at http://www.nerc.com/files/Reliability_Standards_Complete_Set_2009Feb25.pdf.

91 Both the interconnection procedure and agreement can be found at the FERC Web site, available at http://www.ferc.gov/industries/electric/indus-act/gi/stnd-gen.asp). See also, FERC Order No. 2003, issued March 5, 2004, available electronically at http://www.ferc.gov/industries/electric/indus-act/gi/stnd-gen/order2003-a.pdf.

92 As of January 2009, FERC has approved eight WECC reliability standards, which can be accessed electronically at http://www.ferc.gov/industries/electric/indus-act/reliability/WEC-standards.asp.

grid, from the type and size of the electrical devices and controls required at substations, to the design, configuration, and dimensions of line components, to the width of the ROW and the manner in which it is maintained. The more critical components of interconnections are discussed below.

F.4.3.1 Tower Specifications and Construction

The towers support the conductors and provide physical and electrical isolation for energized lines. Voltage; the type, number, weight, and size of conductors (wires) to be supported (typically, three conductors for each circuit present); as well as the safe separation distances that must be maintained among energized conductors, towers, and ground obstructions to prevent faulting, combine to dictate tower specifications with respect to size, geometry, construction materials, and tower spacing. ROW circumstantial factors such as ground slope, surface and subsurface conditions, wind loading, and weather extremes such as snow and ice can impose additional requirements on the specifications of towers, their spacing, and their foundation requirements. At 500 kV, the material of construction is generally steel, although aluminum and hybrid construction, which uses both steel and aluminum, have also been used.[93] The weight of the tower varies substantially with height, duty (e.g., straight run or change in direction, river crossing), material, number of circuits, and geometry, and can range from 8,500 to 235,000 lb (3,856 to 106,594 kg). The basic function of the tower is to isolate conductors from their surroundings, including controlling the extent of their sag and slope over the expected operating temperature range. Clearances are specified for phase-to-tower, phase-to-ground, and phase-to-phase. For example, phase-to-tower clearance for 500 kV ranges from about 10 to 17 ft (3 to 5 m), with 13 ft (4 m) being the most common specification. These distances are maintained by insulator strings and must take into account possible swaying of the conductors. The typical phase-to-ground clearance is 30 to 40 ft (9 to 12 m). This clearance is maintained by setting the tower height, controlling the line temperature to limit sag, and controlling vegetation and structures in the ROW. Typical phase-to-phase separation is also 30 to 40 ft (9 to 12 m) and is controlled by tower geometry and line motion suppression.[94]

Myriad designs exist for towers, all of which can be placed into one of two general categories: lattice type or monopole. Regardless of their appearance, towers must safely support energized conductors. The voltages at which the conductors are maintained dictate the clearances that must be maintained between each conductor and other conductors, the tower, and ground

[93] Solar facilities with capacities in the hundreds of megawatts (as is the case with the majority of existing and proposed facilities) could be served by a transmission interconnection operating at substantially less voltage (even as low as 40 kV or 69 kV), and it is likely that solar facility interconnections will operate at such lower voltages. The discussion references requirements and dimensions for a 500-kV line (the highest voltage of any existing segment within the six-state study area) as a way of demonstrating a worst-case condition that could exist for a transmission line interconnection.

[94] Other factors critical to tower and transmission line performance, such as insulator design, lightning protection, and conductor motion suppression, do not introduce additional environmental impact factors and are not discussed here.

obstructions. Those clearances dictate the physical dimensions of the towers and the necessary minimum dimensions of the operating ROW.

Tower erection involves clearing the construction area (typically as much as 80,000 ft^2 [7,432 m^2] and an adjacent tower assembly area (100 by 200 ft [30 by 61 m]) of vegetation. Creating level ground for lifting equipment is required. In general, construction ROW widths can be as much as twice the ROW width needed for safe operation. Excavation, concrete pouring, and pile driving are required to establish foundations, some of which can extend as deep as 40 ft (12 m). Each foundation may require as much as 10 yd^3 (8 m^3) of reinforced concrete. In most instances, ready-mixed concrete is delivered to the site by commercial vendors; however, at particularly remote or rugged sites, special tactics may be employed such as delivery of the concrete by helicopter or creation of a temporary concrete batch plant near the ROW. Monopole towers utilize a single reinforced-concrete foundation, formed either as a solid cylinder or in the shape of a donut. Lattice-type towers require somewhat less substantial foundations for each of their four legs.

Towers can reach to heights of 150 ft (46 m) and widths of 75 ft (23 m). To ensure adequate clearances of conductors to ground interferences, operating ROW widths could approximate twice the width of the tower. Tower spacing on level ground without special concerns for wind or ice loading on power cables would be 1,000 to 1,200 ft (305 to 366 m) for lattice towers and 800 ft (244 m) for monopole towers. Radical changes in grade (e.g., crossing a deep valley or hilly terrain) or anticipated wind and ice can greatly reduce tower spacing or require the installation of exceptionally tall towers to maintain acceptable slope of the conductors between towers or clearances of conductors to ground.

Tower erection also involves the creation of access roads with specifications (grade, turning radius, width, and weight limits) sufficient to handle large, heavy tower components, earthmoving equipment, tower erection equipment, and maintenance equipment. Laydown areas would also be created for temporary storage of tower components (typically 3 acres [0.01 km^2] in size and roughly every 10 mi [16 km] along the ROW). Tower construction can result in the loss of some vegetation, increased potential for wind- and water-induced soil erosion, impacts on surface waters from increased sediment loads, and possible impacts on groundwater from exceptionally deep foundation excavations. Most tower construction-related impacts are of short duration, however, and best management practices have been developed to minimize, if not completely mitigate, most impacts. Additional ROWs established for construction are typically returned to their natural state once construction is complete.

F.4.3.2 Conductor Specification and Installation

Transmitting electrical power over a long distance is not an efficient proposition. Even materials considered excellent conductors of electrical current offer some resistance to current flow. Resistance is typically manifested as heat.[95] Power losses as high as 10% can result.

[95] Some power is also lost due to corona discharge, the ionization of oxygen molecules in the ambient air surrounding a high-voltage conductor.

Various strategies have been pursued to eliminate or at least reduce line loss. Because electrical power (expressed in watts, kilowatts, or megawatts) is the product of voltage times current and since the amount of power lost to heat is proportional to the amount of current being transferred, transmitting electrical power at the highest possible voltage minimizes transmission losses due to heat. Alternatively, a variety of conductor compositions and constructions are currently in use to meet a variety of specific requirements. Although the ideal conductor material is one exhibiting the best electrical conductance properties, the selection of conductor materials typically represents a compromise balancing performance, cost, and weight factors. Because of its weight and cost, copper is typically replaced by aluminum, which offers greater strength-to-weight ratios than copper but only 60% of the electrical conductivity of copper. Aluminum-steel composites are also in widespread use. Most recently, ceramic fibers in a matrix of aluminum have been used, offering high strength even at the elevated temperatures that often result from high current flows during peak power demand periods.

Conductor specifications dictate tower design, specification, and spacing. Regardless of the materials selected, conductor installation is a formidable task, and conductor stringing requires substantial land areas beyond the operating ROW for the staging and operation of installation equipment. A temporary construction ROW would be required to accommodate at least two cable-pulling areas, each about 150 by 250 ft (46 by 76 m). As with tower erection areas and laydown areas, conductor-pulling areas would be returned to their native state after installation is complete.

F.4.3.3 Switchyards and Substations

To minimize power losses over long-distance transfers, existing high-voltage transmission lines in the study area are typically maintained at voltages as high as 500,000 volts (500 kV), substantially greater than the voltage at which power from a solar facility is initially produced. Consequently, the collective purpose of all the equipment in a substation is to condition the power being produced to be compatible with the power present on the grid in both voltage and phase and to provide for immediate isolation of the solar facility from the grid during upset or emergency conditions. For electrical as well as fire safety, substations are typically kept completely free of vegetation, and the area is covered in gravel to promote drainage. Individual pieces of equipment rest on concrete pads or are mounted on metal superstructures. Much of the equipment is filled with as much as hundreds of gallons of dielectric fluids[96] that provide electrical insulation as well as heat dissipation. Although spills or leaks are possible, most equipment is sealed by the manufacturer and remains sealed throughout its operating life. In addition, some designs allow the outer shell of the device to provide secondary containment of any leaked fluids. Solar facilities with nameplate ratings of hundreds of megawatts can be expected to have one or more power-conditioning areas, each comprising anywhere from 2 to 10 acres (0.01 to 0.04 km^2).

[96] Oils containing polychlorinated biphenyls (PCBs) were once common dielectric fluids. However, modern-day equipment is free of PCBs and instead contains synthetic or mineral-based oils. Some equipment contains a gaseous dielectric material, sulfur hexafluoride.

F.4.3.4 Rights-of-Way (ROWs) and Access Roads

A ROW is a passive but critical component of a transmission line. It provides a safety margin between the high-voltage lines and surrounding structures and vegetation. The ROW also provides a path for ground-based inspections and access to transmission towers and other line components if maintenance or repairs are needed. Failure to maintain an adequate ROW can result in dangerous situations, including ground faults.

A ROW generally consists of native vegetation or plants selected for favorable growth patterns (slow growth and low mature heights). However, in some cases, access roads constitute a portion of the ROW and provide more convenient access for repair and inspection vehicles.

ROW widths are dictated primarily by the width of the towers being installed, which in most instances is directly proportional to the highest voltage of the circuits present. In some instances, ROW widths are artificially large to allow for avoidance of potentially sensitive or problematic areas along the path. Table F.4.3-1 shows the range of minimum ROW width reported by U.S. utilities for various line voltages (for one line of towers). The number of companies reporting each width provides an indication of the most common size ranges.

TABLE F.4.3-1 Minimum ROW Widths

Voltage (kV)	Range of Widths (ft)[a]	No. of Companies Reporting
<230	<50	51
	51 to 125	41
	>125	7
230	<75	40
	76 to 125	36
	>125	30
345	<75	6
	76 to 125	36
	>125	30
500	<125	4
	126 to 175	21
	>175	13

[a] For distance in meters, multiply by 0.3048.

Source: FERC (2004).

Access roads will be required; some will be temporary roads constructed only to support certain construction activities, while others will remain throughout the operating life of the transmission line and provide access to the ROW for ground-based inspections and vehicles and equipment needed for maintenance, repairs, or replacements of components. Terrain and overall length of the interconnection line segment may require multiple access roads. Road specifications are dictated by the equipment and vehicles that will use them. In most instances, access roads will enjoy separate ROWs, typically 12 to 14 ft (3.7 to 4.2 m) wide (together with a temporary construction ROW of an additional 3 ft [1 m] along either side of the road). Circumstantial factors will dictate road construction techniques, including special techniques required to cross streams, wetlands, or especially rugged terrain. Roads are likely to be finished in gravel to provide for all-weather access. Access roads that provide primary access to the ROW or to substations may have a more permanent pavement. In most instances, pre-existing roads would be sufficient for the task of transporting equipment, components, and construction vehicles to the ROW. However, in some instances modifications would be required. For example, bridges may need to be strengthened or load height clearances extended, and pathways over water courses may need to be widened and fortified.

F.4.3.5 Additional Structures

For some long-distance transmission line construction projects, additional facilities such as maintenance or repair facilities, material storage areas, administrative buildings, and operational control centers would also be constructed. However, it is not likely that any such facilities would be necessary for the grid interconnection segments being discussed here, and if they are, they would likely be the responsibility of the transmission system operator and not the solar facility operator.[97] It is more likely that at some point along its route, the transmission interconnection segment from a solar facility would share the ROW with a similar segment from another solar facility. Multiple, independent transmission lines sharing a ROW create some unique issues associated both with construction and with operation. Designs would be amended to provide adequate spacing between lines to prevent interferences or emergencies on one line from cascading to the second line. Agreements would be required among the parties involved to establish liability limits and assign responsibility for each aspect of ROW maintenance. Coordination of construction- and operation-related activities would also be addressed to prevent adverse impacts on safe operation of either line.

F.4.3.6 Hazardous Materials and Wastes

The hazardous materials used during construction of transmission lines consist primarily of fluids (lubricating oils, hydraulic fluids, glycol-based coolants, and battery electrolytes) needed to perform primary maintenance on construction vehicles and equipment. Most such materials would be present in portable containers of 55-gal (208-L) capacity or less. Some equipment cannot be easily moved (e.g., exceptionally large lifting cranes that are transported in pieces and assembled on-site, or bulldozers used for initial clearing), which may require the establishment of temporary fueling facilities consisting of portable aboveground tanks holding diesel fuel and/or gasoline.

Compressed gas cylinders of welding and cutting gases such as oxygen and acetylene and modest amounts of cleaning solvents, paints, and corrosion control coatings would also be present. Portable sanitary facilities would also be brought to the construction site. Finally, pesticides used for initial clearing of construction areas, and later in the ongoing maintenance of the ROW, may be present. At associated substations, much of the electrical equipment would be filled with dielectric fluids or gases. However, except in the case of major malfunctions that result in arcing or leaks, these dielectric materials would not be expected to require replacement, and no waste dielectrics typically result from routine operation. At the decommissioning of the

[97] The best solar resources are concentrated in relatively small geographic areas; some of these areas, however, are remote and devoid of existing high-voltage transmission line infrastructure. Nevertheless, for the purpose of this discussion, it is assumed that interconnection transmission line segments would be no more than 25 mi (40 km) in length. This assumption is supported by the existence of state initiatives, such as the Renewable Energy Transmission Initiative (RETI) in California, that seek to facilitate development of renewable energy resources in remote areas by establishing the necessary transmission infrastructure in those areas. Additional details on RETI can be found on the California Energy Commission's Web site at http://www.energy.ca.gov/reti/documents/index.html. It is further expected that similar initiatives may be pursued in other states within the study area where concentrations of renewable resources exist.

transmission line, very large electrical equipment may need to be drained before being relocated, however.

The majority of construction-related wastes are associated with vehicle and equipment maintenance. These wastes are likely to be containerized and briefly stored at the construction area before being removed to off-site treatment or disposal areas. Special arrangements may be necessary for disposition of very large quantities of vegetation resulting from ROW clearing in some locations. The expected relatively short length of transmission line interconnections suggests that, even in remote areas, there will be no need to establish employer-provided housing for the construction workforce.

Except for pesticides used in ROW maintenance, virtually no hazardous materials would be required during the operating period of the transmission line and related substations, and no operation-related wastes would be generated unless major repairs or replacements are required.

F.4.3.7 Transmission Line Operation and Maintenance

Transmission lines require very little attention and intervention during normal operation. Periodic visual inspections are conducted by driving or walking the ROW or through aircraft flyovers. Inspection frequencies are dictated largely by experience with similar lines operating in similar environments. Table F.4.3-2 shows typical inspection frequencies.

TABLE F.4.3-2 Number of Companies Reporting Various Inspection Frequencies

Frequency	Aerial	Ground
More than twice a year	25	7
Semiannual	34	22
Annual	46	76
Biennial	6	6
Every 3 years	1	6
Less than every 3 years	3	2.5
As needed	8	1
Did not report	38	7

Source: FERC (2004).

In rare instances, inspectors may need to climb the towers when close inspections are required to verify the conditions of critical components. ROW vegetation maintenance is conducted in accordance with a preapproved plan. Maintenance may include periodic tree and bush trimming or applications of pesticides, or both. As with inspections, the frequency of ROW maintenance activities is dictated by circumstances and experiences.

Substations and switchyards are also inspected regularly, typically at a higher frequency than the transmission line. Arcing in transformers may require periodic replacement of the dielectric fluids. Replacements of bushings (ceramic insulators that isolate energized wires from the metallic cases of electrical equipment or from the metal superstructures to which they are attached) may also be necessary. Depending on configuration and function, personnel may need to visit the substation or switchyard to make changes to the routing of power.

During the expected operating lifetime of a transmission line, voltage upgrades, introductions of additional circuits or "double circuits,"[98] repairs, or replacements of conductor segments or insulators may all require the reintroduction of heavy equipment of the type used for initial construction. Depending on where such activity occurs, original construction access roads and clearings that were remediated after completion of construction may need to be re-established (together with the necessary amendments to the ROW lease). The impacts of such repairs, upgrades, or refurbishments would be similar to those incurred during initial construction. Likewise, upgrades may also involve replacements of equipment at substations or switchyards.

F.4.3.8 Transmission Line Decommissioning

The expected lifetime of a transmission line is indefinite. It is more likely that the line will undergo upgrades (including replacements of conductors or towers, or both) or the introduction of additional circuits than be abandoned. However, in the event a transmission line segment is abandoned, decommissioning would involve removal of all permanent structures. On the other hand, subsurface foundations may be allowed to remain if their removal would create more disruption than their retention. Virtually all major components, towers, and conductors are likely to remain serviceable and could be reconditioned for similar application on another transmission line segment. Equipment at substations or switchyards is also likely to be appropriate for reinstallation in other parts of the transmission grid or have recycling options. Some large pieces of equipment may need to be drained of their dielectric fluids before removal and transport. Failing that, recycling options would likely exist for all major components. In most areas of the ROW, remediation involves simply allowing native vegetation to re-establish itself. Where all-weather access roads have been removed or where decommissioning activities have resulted in bare soil, fast-growing, noninvasive species may be planted to provide interim erosion control until native vegetation can be re-established.

[98] Rather than the addition of a new, independent circuit, a double circuit may be installed. New conductors having electrical continuity with existing conductors would be installed adjacent to those conductors. This doubling of conductors allows for the transfer of the same or even greater amounts of current without causing any of the conductors to exceed their thermal limits. Double circuits are often installed when the existing circuit is at its current carrying capacity (i.e., at the thermal limits of the conductors); the circuit's capacity, however, may still be insufficient to meet forecasted peak load demands.

F.5 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this PEIS. It is likely that at the time of publication of this PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this PEIS.

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APPENDIX G:

TRANSMISSION CONSTRAINT ANALYSIS

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APPENDIX G:

TRANSMISSION CONSTRAINT ANALYSIS

The study area for this programmatic environmental impact statement (PEIS), "Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States," is located within the Western Interconnection, the electricity grid overseen by the Western Electricity Coordinating Council that serves the states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming; part of west Texas; the Canadian provinces of Alberta and British Columbia; and a small portion of northern Mexico in Baja California. The feasibility of developing any electricity-generating project within the Western Interconnection is determined, in part, by whether or not the project can secure access to the transmission grid. The extent and pace of solar energy development in the six-state study area will be affected by the Western Interconnection's existing transmission capacity and future expansions of its system.

As discussed in Section 1.3.6, as part of this PEIS, the U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) considered designating additional electricity transmission corridors on BLM-administered lands to facilitate utility-scale solar energy development. The extent to which the lack of transmission system access could impede solar energy development in the areas that are suitable for utility-scale solar energy development was analyzed to determine whether corridor designation was needed to support solar energy development. Specifically, the analysis identified which areas within the six-state study area are greater than 25 mi (40 km) from an existing transmission line or designated corridor. This transmission analysis only considered the locations of existing transmission lines and designated corridors and did not look at the available capacity on existing lines (i.e., the analysis assumed lines could be upgraded, if needed). Areas exceeding the 25-mi (40-km) threshold were determined to be constrained by the lack of transmission system access, or "transmission constrained," on the basis of the assumption that the process of siting and constructing a transmission line over greater distances could be both cost- and time-prohibitive. Once the constrained areas were identified, the BLM assessed the extent to which lands proposed to be available for right-of-way (ROW) application under the solar energy development program alternative, including the proposed solar energy zones (SEZs), were constrained by the lack of transmission access. For those lands that fell within the constrained areas, the BLM also assessed the conditions contributing to those constraints. On the basis of this analysis, the BLM decided to not include designations of additional transmission corridors on BLM-administered lands in the scope of this PEIS.

This appendix presents general information about the existing transmission grid in the PEIS study area, proposed new transmission lines, and designated corridors. It also presents the results of the transmission constraint analysis, including state-specific maps showing the constrained areas.

G.1 TRANSMISSION ACCESS CONSIDERATIONS

Access to adequate transmission capability directly affects the technical and financial feasibility of solar resource development areas. Several aspects of transmission linkages can influence the economic viability and favorability for potential solar development sites. These aspects fall under the general headings of proximity, capacity, and timing of new transmission and energy development. The sections that follow in this appendix briefly address these aspects of transmission access in the six-state study area.

Proximity to transmission lines is an important factor because costs are typically high for spanning significant distances with new transmission ROWs and new lines. Capacity is important because even if a solar development area is in close proximity to existing lines, adequate capacity must exist on those lines to transmit the solar-generated power to load areas. Timing is important in cases where planned additions of new lines or augmentations of existing lines may provide adequate transmission services for future dates of operation.

The North American Electric Reliability Corporation (NERC) is the primary organization that oversees planning activities of the electric power industry in the United States. In terms of planning efforts and perspectives, NERC's 2009 Long-Term Reliability Assessment (NERC 2009) provides an overview of the 10-year (i.e., 2009 to 2018) needs and plans for transmission systems in the United States. Transmission planning efforts in the west can be summarized as satisfying adequacy requirements as established by NERC guidelines, but with a major new emphasis on coordination between electrical areas within, and adjacent to, the region.

Because of geographic characteristics, load topography, and the way grid systems have evolved, transmission systems in the western United States tend to be characterized by greater "radial" connectivity, like spokes of a wheel, as compared with more "networked" connectivity (higher connectivity between all supply and demand points) that typifies systems in the eastern half of the United States. Networked grids offer reliability advantages over radial systems, and areas in the west are planning additional lines to improve reliability and reduce congestion issues.

A quote from NERC's 2009 Long-Term Reliability Assessment is representative of current objectives in the entire area: "The goal … is to collaborate in the planning, coordination, and implementation of a robust transmission system between Arizona, southern Nevada, Mexico, and southern California that is capable of supporting a competitive, efficient, and seamless west-wide wholesale electricity market while meeting established reliability standards" (NERC 2009). To accomplish this goal, planning efforts are looking to add significant numbers of new transmission links to existing grids.

The following sections provide a brief description of existing systems, current congestion areas, planned new lines, and designated transmission corridors. All of these elements play a role in assessing the implications of existing and planned transmission capabilities on the delivery of solar resources to areas of demand.

G.1.1 Existing Transmission Lines

Figure G-1 illustrates routings for existing transmission lines with ratings of 69 kilovolts (kV) or greater within the PEIS six-state study area. Different line weights indicate line voltages for alternating current (AC) lines in categories of 69 to 230 kV, 230 to 344 kV, 345 to 499 kV, 500 to 734 kV, and direct current (DC) interties (1,000 kV).[1] The total length for all existing lines of 69 kV or higher in the study area is approximately 100,000 circuit miles.

G.1.2 Transmission Congestion

Figure G-2 highlights the existing transmission lines currently encountering constrained flows due to line capacity limits. These constrained lines have little to no excess available capacity to transfer additional electricity above that which they already transfer. As a result, these particular lines offer very limited capabilities for conveying any additional power generation from new electricity-generating sources, such as solar energy projects, to demand areas.

These limitations are not necessarily absolute, in that some incremental power flows can often be achieved. However, time-of-day and seasonal limitations can render any incremental flows less valuable. The times when these constrained lines may be capable of transmitting more power are typically times when demands for power are lower. However, off-peak times when incremental transmission capabilities may be possible over the constrained lines, typically coincide with times that solar generation is not available (e.g., nighttime).

G.1.3 Proposed Transmission Lines

In addition to showing existing lines and the constrained segments, Figure G-2 shows the approximate pathways of new transmission lines currently under construction or proposed in the western United States. While the pathways for existing lines are charted with some degree of accuracy in Figure G-2, the pathways for proposed lines are more notional. In general, the proposed lines are depicted as simple point-to-point connections defined on the basis of the origin and destination endpoints that are associated with the announced plans for each line.

From detailed listings in NERC's 2009 Long-Term Reliability Assessment (NERC 2009), plans for new transmission lines represent nearly 150 lines, with planned service dates ranging from 2010 to 2018. Because transmission lines often cross state boundaries, it is difficult to give precise tallies of lines for each state. However, in very general terms, there are approximately 75 new lines proposed for Arizona–New Mexico–Southern Nevada, with expected start-up dates ranging from 2010 to 2018; approximately 35 lines planned for California, with dates of 2010 to 2017; approximately 10 lines planned for Utah for 2010 to 2011; and about 15 proposed lines for Colorado for 2010 to 2013.

[1] Although AC lines with voltages ranging from 735 to 999 kV exist in the United States, there are none in the six-state study area at this time.

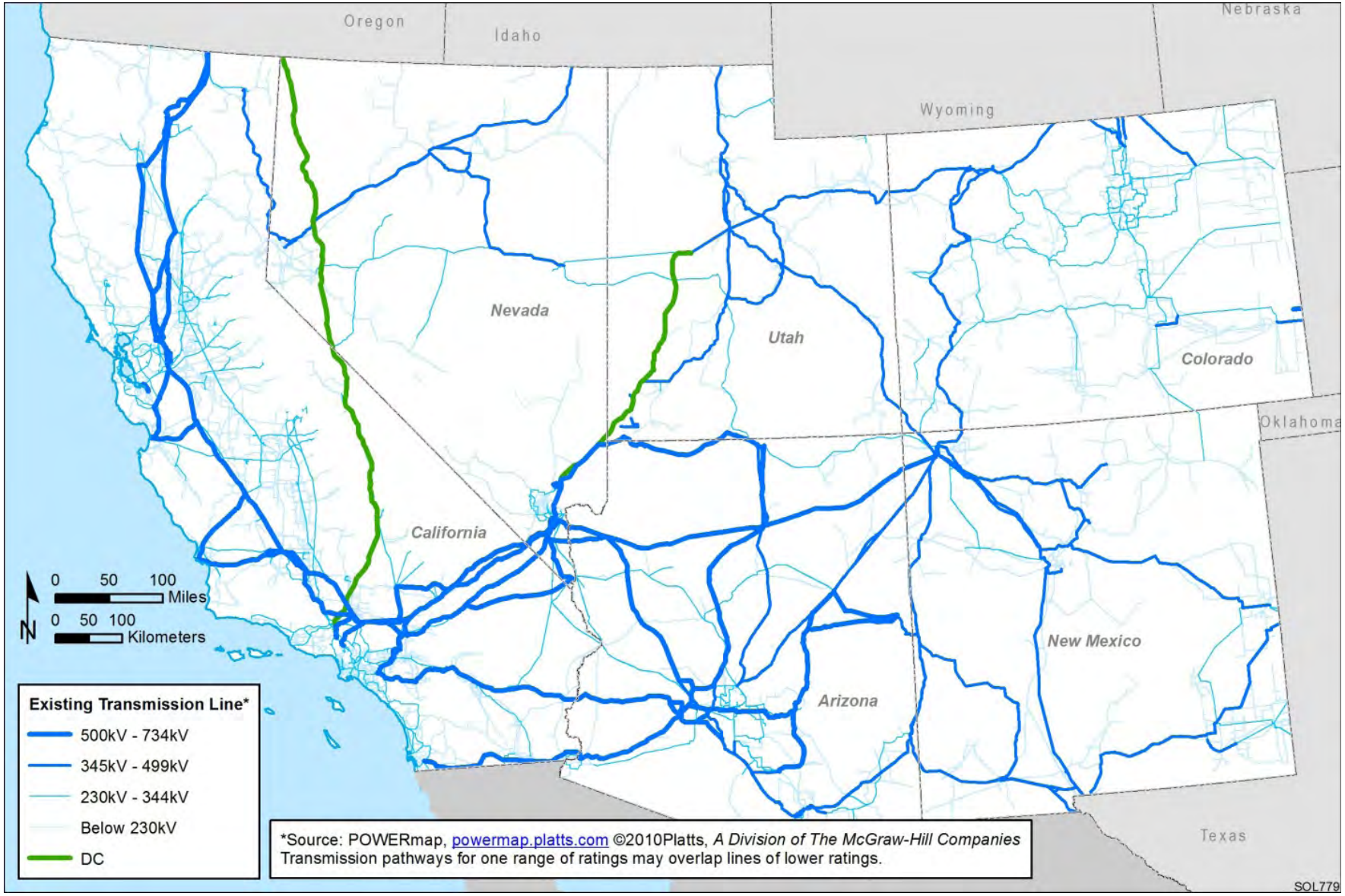


FIGURE G-1 Existing Transmission Lines in the PEIS Study Area with Ratings of 69 kV or Higher

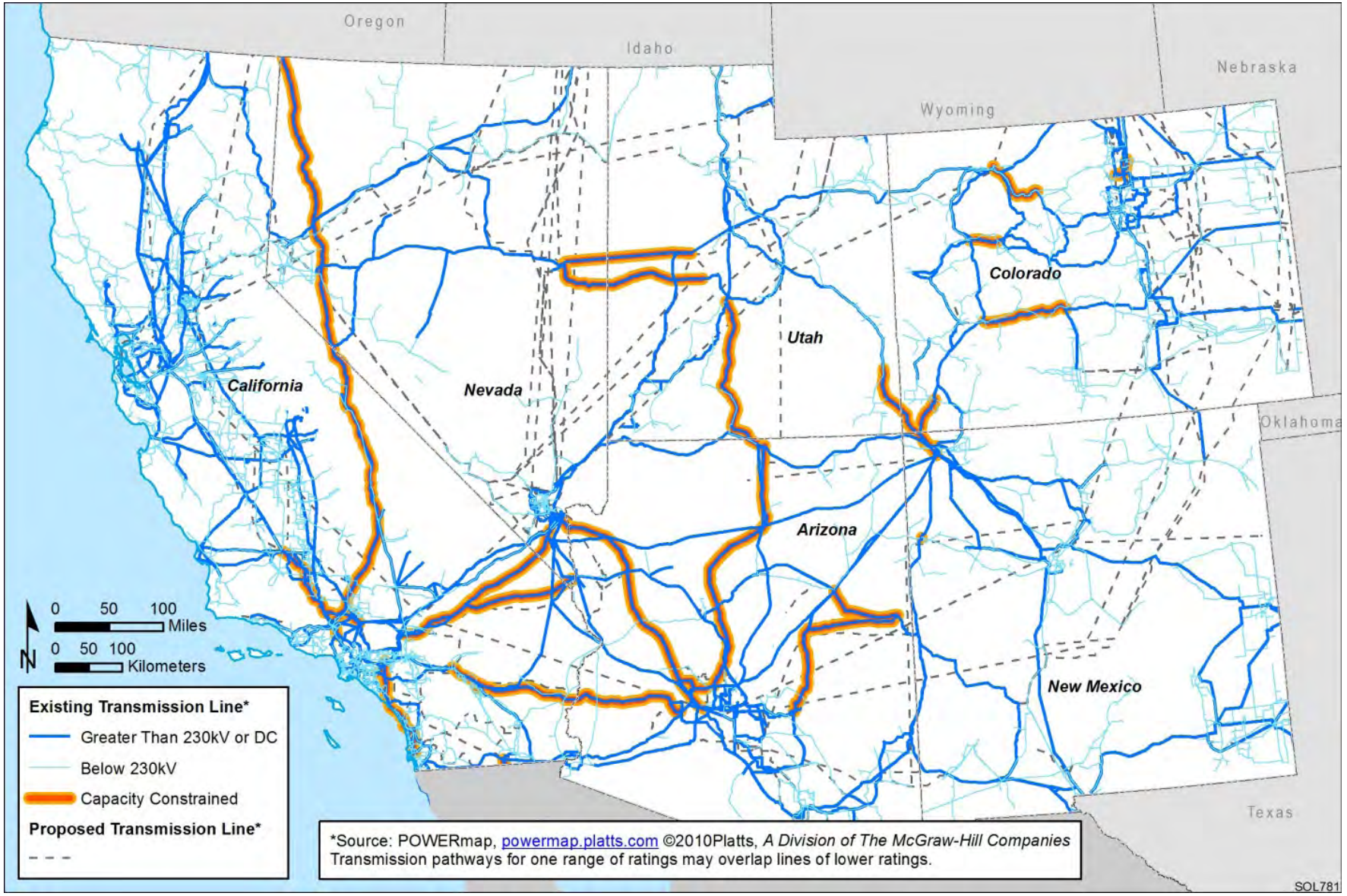


FIGURE G-2 Existing, Constrained, and Proposed New Transmission Lines in the PEIS Study Area with Ratings of 69 kV or Higher

For the Arizona–New Mexico–Southern Nevada area, proposed lines represent a total of more than 3,000 new circuit miles. About 1,400 of these circuit miles are relatively firm planned additions; the other 1,600 are at the "conceptual" stage of planning. The conceptual stage indicates that a project is less advanced in terms of permitting, land acquisition, and other required steps leading up to construction and service. However, conceptual plans represent serious intentions for new transmission capabilities, and these plans are submitted to NERC from each electrical planning region.

For California, proposed lines represent nearly 4,700 circuit miles of additional transmission capabilities. Conceptual planned additions represent approximately 3,300 circuit miles of the total, and about 1,400 circuit miles are more advanced in the planning and implementation process.

Utah is located in an area where 30% of the planned additions are relatively firm, and 70% are at the conceptual stage. Colorado is in a region where virtually all of the planned additions are relatively firm (i.e., almost no additions in "conceptual" category).

Figure G-2 illustrates that there is not a one-to-one correspondence between constrained lines and proposed transmission lines. In some cases, the proposed additions do follow pathways of constrained lines, but in other cases, proposed lines follow new pathways. This observation does not represent an inconsistency, because congestion relief can often be effectively achieved by adding new pathways to the grid. This is especially true for more "radial" systems as typified in the western states. New links lead to a greater level of networked connectivity, and greater flexibility in delivering power from generation sources to various demand areas.

G.1.4 Designated Corridors

Environmental issues and other siting considerations often present barriers to the development of new transmission lines. Some of the key issues and considerations include potential impacts on individual animal and plant species and their habitats, cultural and historic resources, visual resources, and specially designated areas (e.g., parks, monuments, recreation areas). Other siting issues relate to topography, the location of surface water bodies and drainages, land use and ownership, and the location of other infrastructure (e.g., pipelines, roads, and railways).

To proactively address these types of issues and considerations, federal agencies have engaged in comprehensive planning efforts to designate energy transport corridors across federal lands. Such corridors are designated pathways that the agencies have determined to be most appropriate for the location of energy transmission infrastructure, including electricity transmission lines. The corridors are sited specifically to avoid, as much as possible, sensitive resources, land use conflicts, and extreme terrain while maximizing the opportunities to connect energy development areas with demand centers and support development of the existing transmission system. The designation of corridors is expected to streamline reviews and approvals of specific transmission projects crossing federal lands.

Section 368 of the Energy Policy Act of 2005 (Public Law 109-58) required federal agencies to engage in transmission corridor planning (see Section 1.6.2.1). As a result of this mandate, the BLM, U.S. Department of Energy (DOE), U.S. Forest Service (USFS), and U.S. Department of Defense (DoD) prepared a PEIS to evaluate the designation of energy corridors on federal lands in 11 western states, including the six states evaluated in this study (DOE and DOI 2008). The BLM and USFS issued Records of Decision to amend their respective land use plans to designate numerous corridors. In addition to this west-wide initiative, a number of BLM field offices have similarly designated corridors across BLM-administered lands in the study area in local land use plans.

Figure G-3 shows the corridors designated as a result of Section 368 along with BLM locally designated corridors in the six-state study area. For reference, Figure G-3 also shows existing transmission lines, proposed new lines, BLM-administered lands proposed to be available for ROW application, and BLM's proposed SEZs.

G.2 TRANSMISSION CONSTRAINT ANALYSIS FOR BLM-ADMINISTERED LANDS

As discussed previously, BLM's analysis of the extent to which the lack of transmission access could constrain solar energy development on BLM-administered lands proposed to be available for ROW application entailed (1) the identification of lands that were greater than 25 mi (40 km) from an existing transmission line or designated corridor, and (2) for those lands within these constrained areas, the conditions contributing to the constraints. The types of contributing conditions that were evaluated included surrounding land ownership, terrain, and the potential for proposed transmission lines to alleviate the constraints.

Table G-1 lists the amount of acres considered to be constrained by the lack of transmission access in each field or district office, along with the percentage of the total lands proposed to be available for ROW application within that office. Figures G-4 through G-9 show the areas within each state identified as transmission constrained, along with the location of the BLM-administered lands proposed to be available for ROW application, the proposed SEZs, and land ownership. As shown in these figures, some portion of the lands that would be available for ROW application fall within constrained areas in each state, except Colorado. None of the proposed SEZs are located within constrained areas.

The following sections describe the extent of transmission access constraints in each state with respect to the lands proposed to be available for ROW application. In all cases, the BLM determined it did not need to designate additional corridors. A number of reasons factored into these determinations, most of which had some applicability to each of the constrained areas. The reasons for not designating additional corridors to the constrained areas include the following:

- In most instances, except in Utah (see the following discussion), the areas constrained by the lack of transmission access make up a relatively small percentage of the lands proposed to be made available for ROW application.

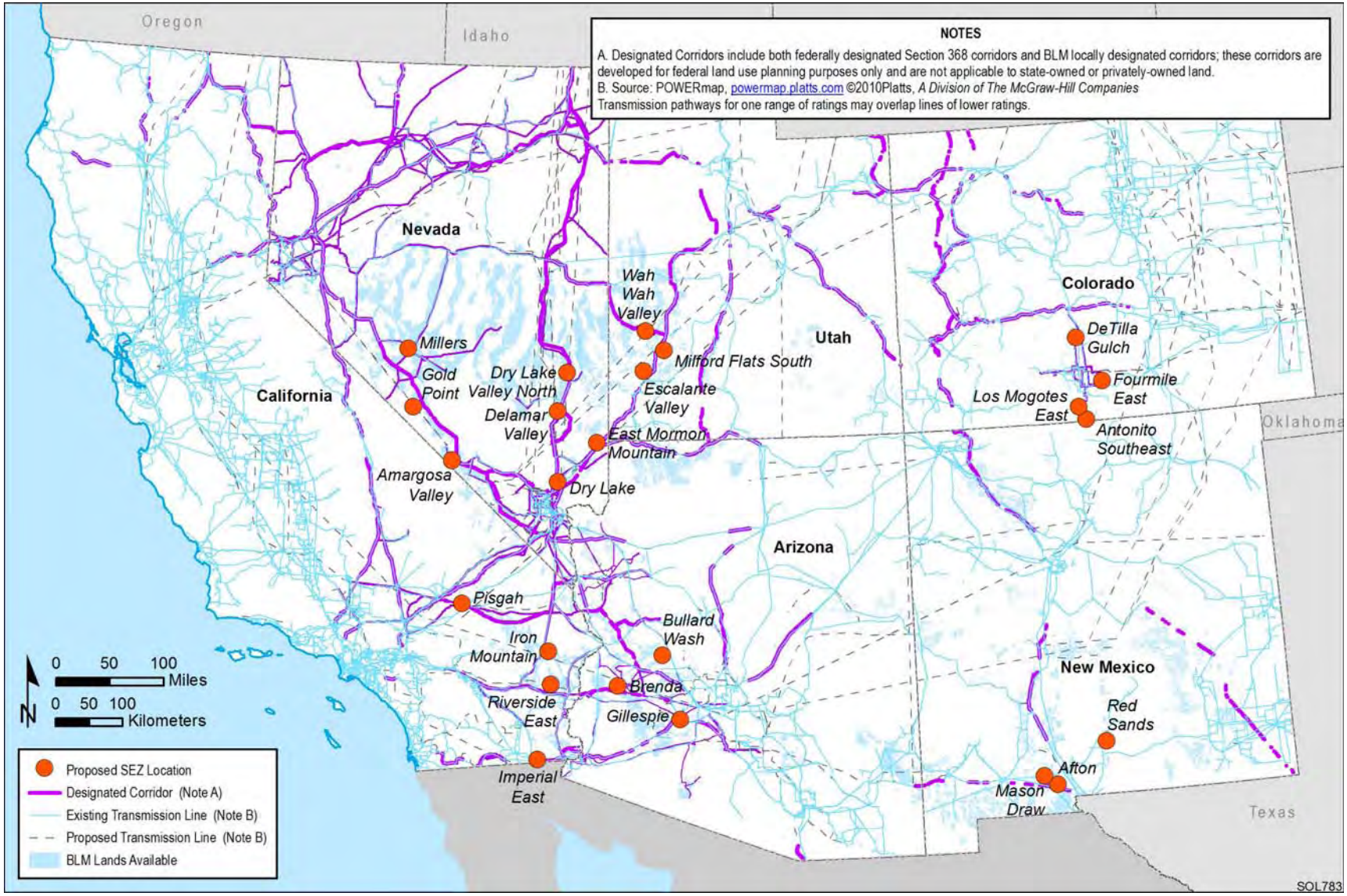


FIGURE G-3 Existing Transmission Lines, Proposed New Lines, and Designated Corridors in Relation to BLM-Administered Lands Proposed To Be Available for ROW Application, Including Proposed SEZs

TABLE G-1 Amount of Lands Available for ROW Application under the Solar Energy Development Program Alternative That Are Constrained by the Lack of Transmission Access[a]

Field/District Office	Total Acres Proposed To Be Available	Acres Constrained by Transmission Access	Percentage Constrained by Transmission Access
Arizona			
Arizona Strip	906,507	99,147	10.94
Hassayampa	338,445	0	
Kingman	625,777	0	
Lake Havasu	536,993	0	
Lower Sonoran	555,328	0	
Safford	709,824	2,127	0.30
Tucson	136,024	0	
Yuma	677,046	0	
Total	4,485,944	101,275	2.26
California			
Bakersfield	337	0	
Barstow	359,871	11,596	3.22
Bishop	95,509	0	
El Central	221,533	0	
Needles	667,447	0	
Palm Springs-South Coast	408,077	0	
Ridgecrest	13,769	0	
Total	1,766,543	11,596	0.66
Colorado			
Columbine	363	0	
Del Norte	9,869	0	
Dolores	9,042	0	
Gunnison	3,124	0	
La Jara	76,831	0	
Royal Gorge	10,755	0	
Saguache	38,088	0	
Total	148,072	0	
Nevada			
Battle Mountain	4,028,449	131,743	3.27
Carson City	863,456	91	0.01
Ely	3,327,761	181,790	5.46
Southern Nevada	789,823	640	
Winnemucca	74,561	0	0.08
Total	9,084,050	314,264	3.46
New Mexico			
Carlsbad	257,828	8,192	3.18
Farmington	364,575	0	
Las Cruces	1,792,899	25,807	1.44

TABLE G-1 (Cont.)

Field/District Office	Total Acres Proposed To Be Available	Acres Constrained by Transmission Access	Percentage Constrained by Transmission Access
New Mexico (Cont.)			
Rio Puerco	287,054	13,780	4.80
Roswell	722,150	63,887	8.85
Soccoro	633,472	126,112	19.91
Taos	10,346	0	
Total	4,068,324	237,778	5.84
Utah			
Cedar City	804,181	54,817	6.82
Fillmore	928,283	0	
Kanab	23,572	0	
Moab	1,210	0	
Monticello	85,722	16,732	19.52
Richfield	122,646	120,563	98.30
St. George	8,608	0	
Total	2,028,222	192,112	9.47
Total	21,581,154	857,025	3.97

[a] Lands potentially constrained by transmission access include those lands within the lands proposed as being available for ROW application that are greater than 25 mi (40 km) from existing AC transmission lines with a voltage of 69 kV or greater, local transmission corridors described in BLM land use plans, and corridors crossing federal lands designated under Section 368 of the Energy Policy Act. Totals may be off due to rounding. To convert to km^2, multiply acres by 0.00405.

- The constrained areas typically are adjacent to other proposed available lands. Solar energy development on those adjacent lands would result in the development of additional transmission infrastructure in the vicinity of the constrained lands which would, in turn, be likely to alleviate the constraints.

- Proposed transmission lines in the six-state study area, if constructed, would alter the results of the constraint analysis. Many of the constrained areas are located near proposed transmission lines as shown in Figure G-3.

- The constrained areas often are adjacent to, or separated from existing transmission lines, by lands not administered by the BLM. The BLM cannot designate corridors across lands it does not administer.

In Arizona, only 2.26% of the proposed available lands are considered to be constrained by transmission access. As shown in Figure G-4, most of these lands, 99,147 acres (401.2 km^2),

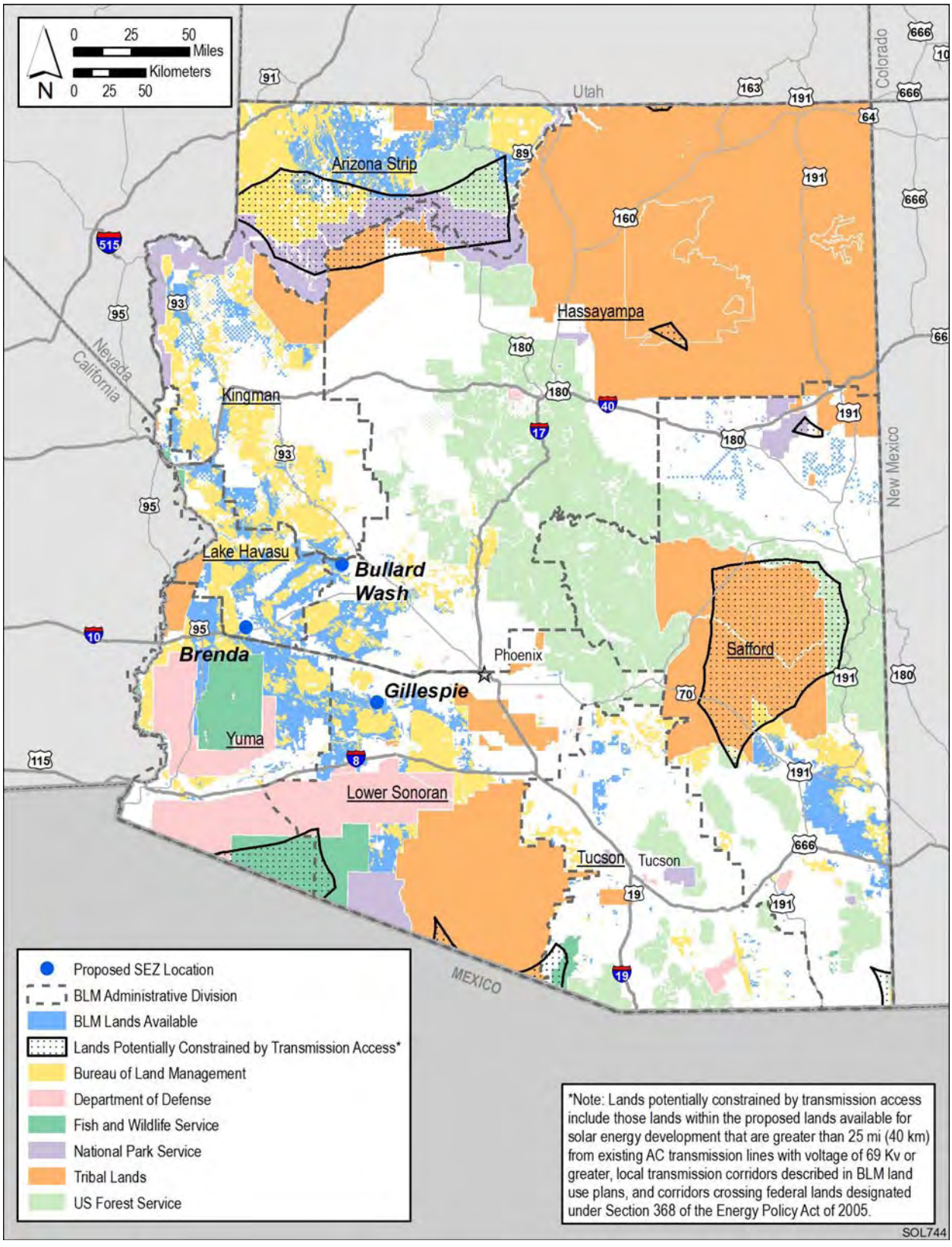


FIGURE G-4 Lands Potentially Constrained by the Lack of Transmission Access in Arizona



FIGURE G-5 Lands Potentially Constrained by the Lack of Transmission Access in California

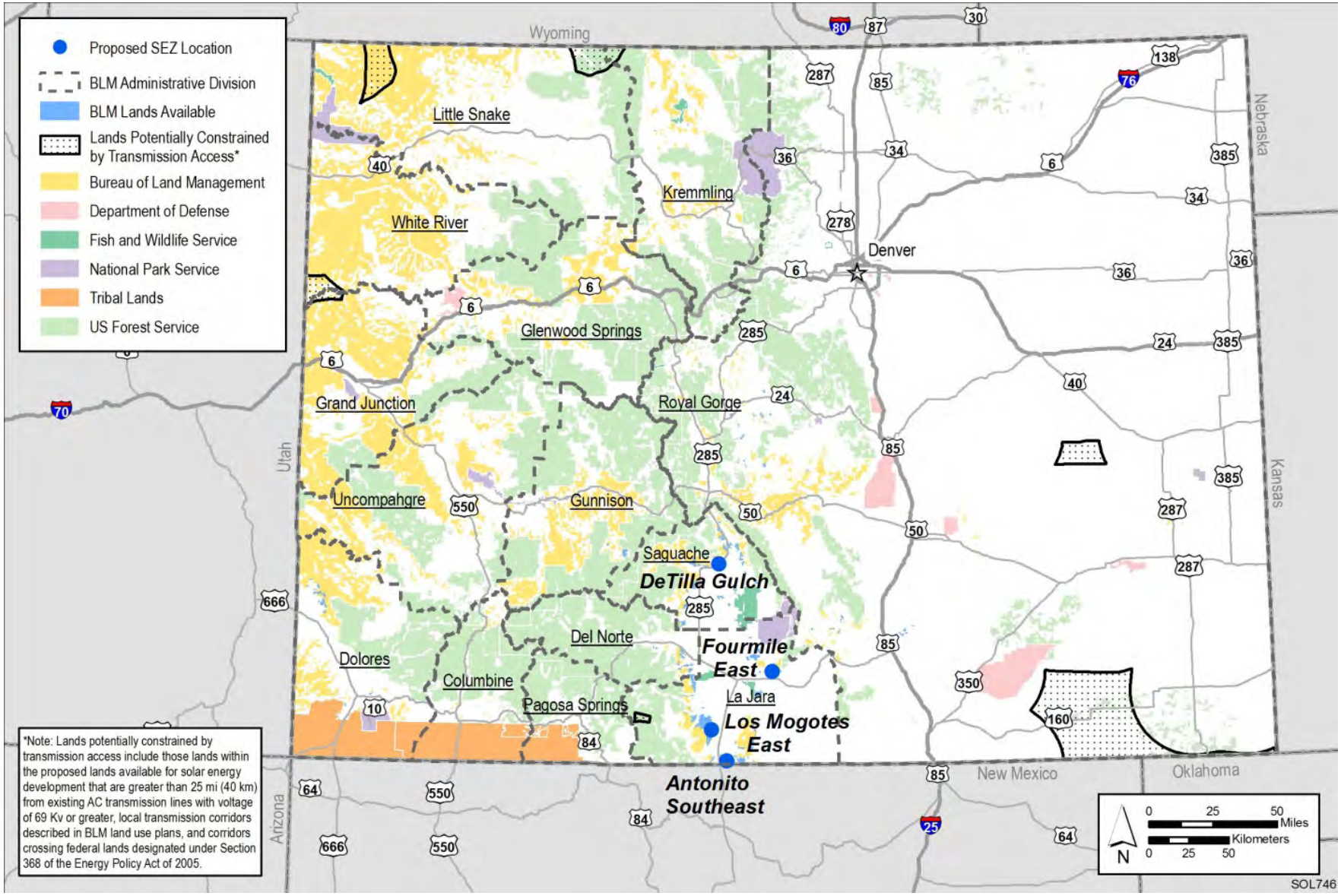


FIGURE G-6 Lands Potentially Constrained by the Lack of Transmission Access in Colorado

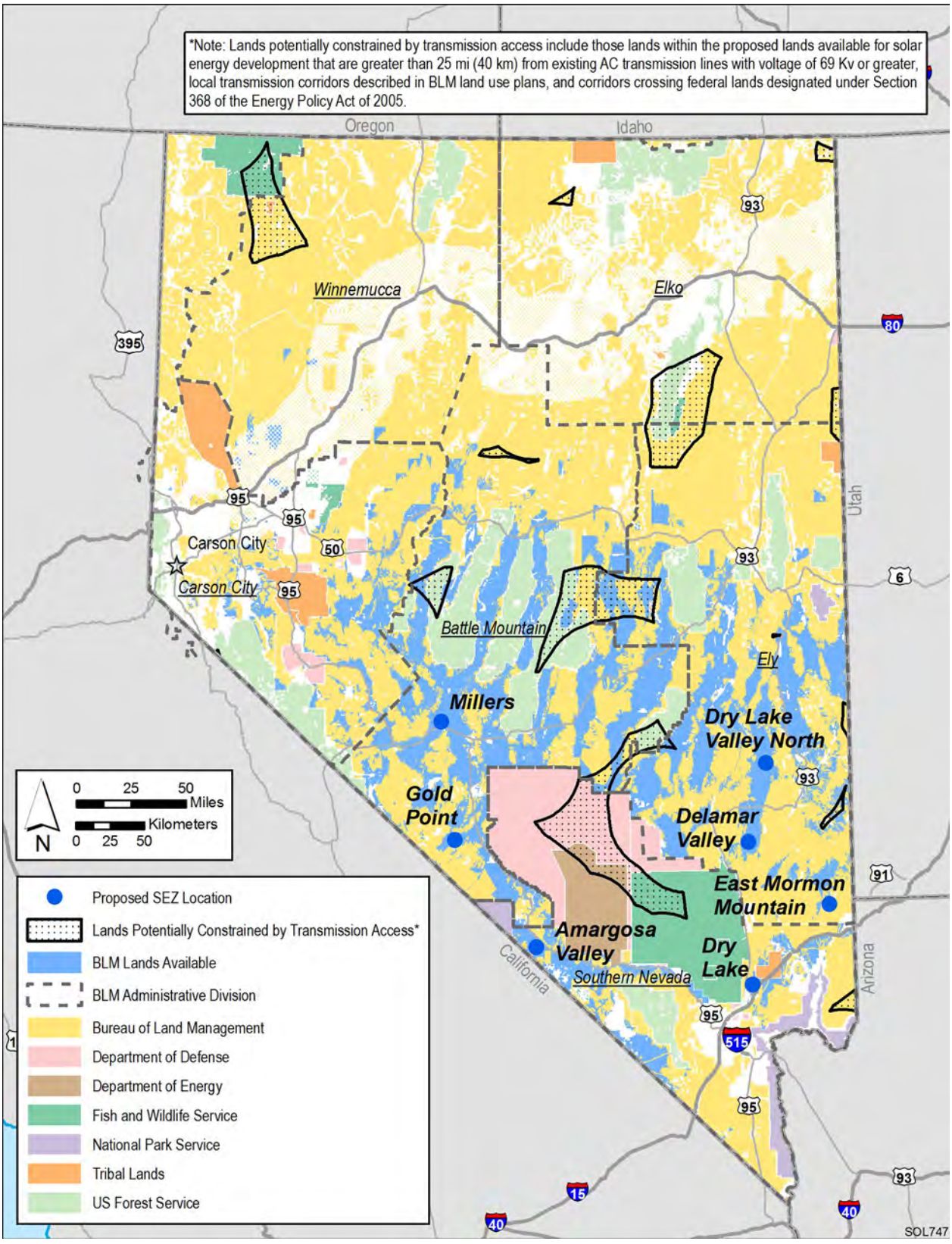


FIGURE G-7 Lands Potentially Constrained by the Lack of Transmission Access in Nevada

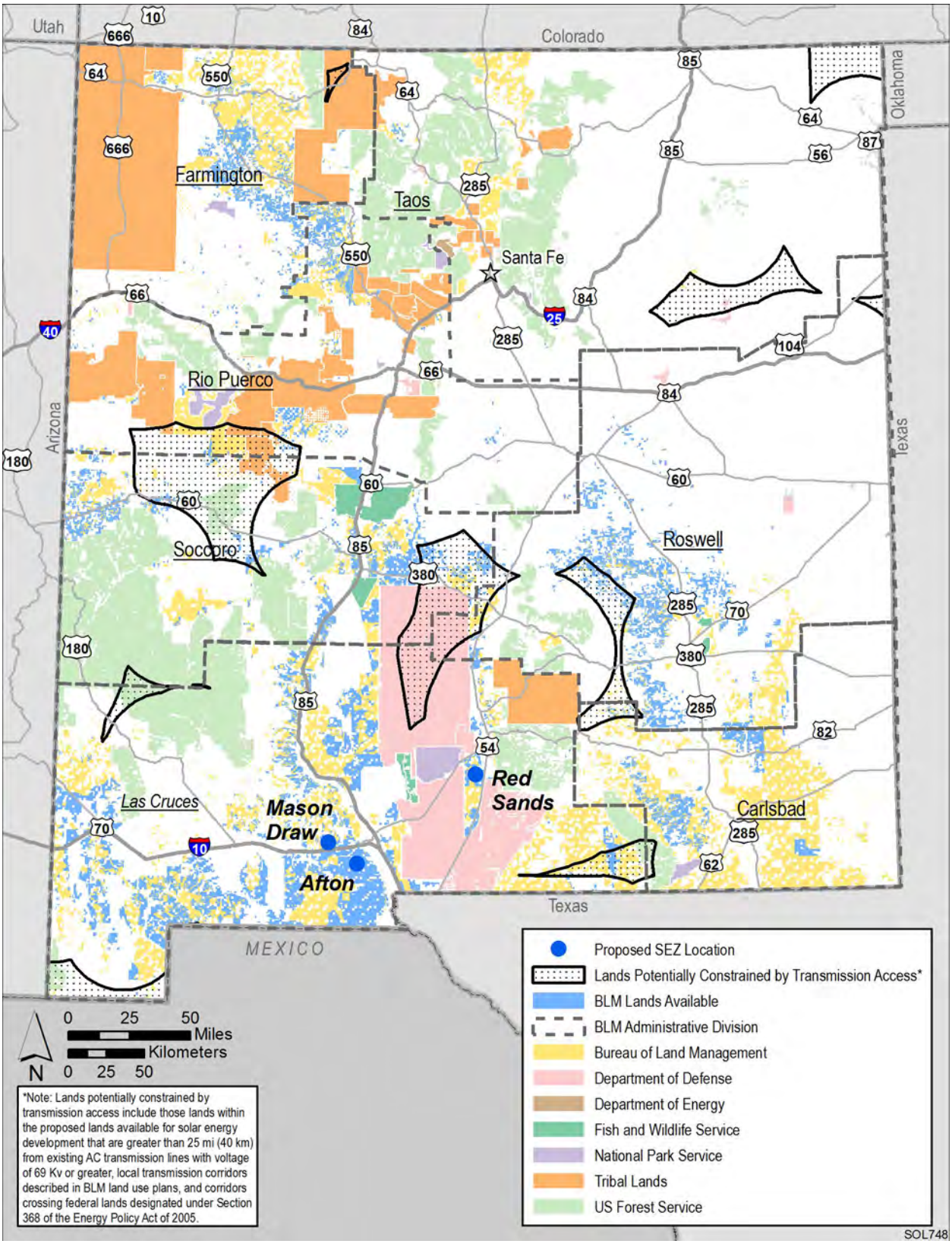


FIGURE G-8 Lands Potentially Constrained by the Lack of Transmission Access in New Mexico

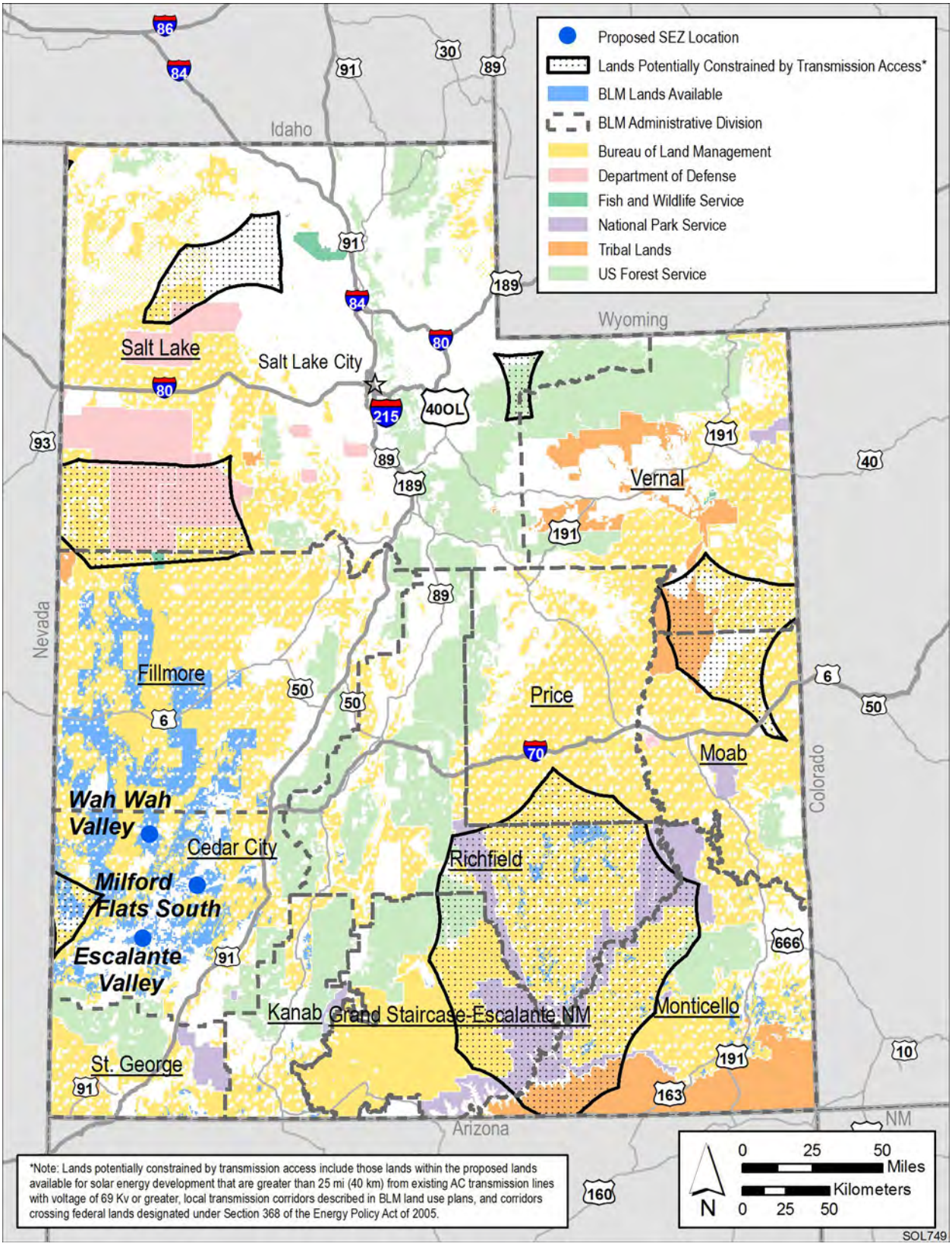


FIGURE G-9 Lands Potentially Constrained by the Lack of Transmission Access in Utah

are located in the Arizona Strip Field Office. Some of these constrained lands are located adjacent to or to the north of Grand Canyon National Park and the Lake Mead National Recreation Area. Smaller portions of constrained available lands are located in the Arizona Strip Field Office in an area situated between the Kaibab National Forest and the Navajo Indian Reservation and in the Safford Field Office.

In California, less than 1% of the proposed available lands are considered to be constrained by the lack of transmission access. As shown in Figure G-5, all of these lands, 11,596 acres (46.9 km^2), are located in the Barstow Field Office, adjacent to Death Valley National Park. These lands compose just over 3% of the proposed available lands in this field office.

In Colorado, none of the BLM-administered lands proposed to be available for ROW application are considered to be constrained by the lack of transmission access (Figure G-6).

In Nevada, at the state level, just over 3% of the proposed available lands are considered to be constrained by the lack of transmission access. As shown in Figure G-7, most of the lands that are constrained, are located in the Battle Mountain District Office (131,743 acres [553.1 km^2]) and the Ely District Office (181,790 acres [735.7 km^2]). Most of these lands are located near the Humboldt National Forest in an area of the state where the basin and range topography may limit transmission line construction.

In New Mexico, at the state level, less than 6% of the proposed available lands are considered to be constrained by the lack of transmission access. As shown in Figure G-8, the constrained lands are spread across many of the New Mexico field offices. The majority of these lands, 126,112 acres (510.4 km^2), are located in the Soccoro Field Office, and they compose almost 20% of the proposed available lands in that office. A number of new transmission lines have been proposed in New Mexico and, if constructed, they would reduce many of these transmission constraints (see Figure G-3).

Utah has the highest percentage of constrained lands. Statewide, more than 9% of the proposed available lands are constrained, with 120,563 acres (487.9 km^2) constrained in the Richfield Field Office, equal to more than 98% of the proposed available lands and 16,732 acres (67.7 km^2) in the Monticello Field Office, equal to almost 20% of the proposed available lands. As shown in Figure G-9, most of these lands are located in the general vicinity of Canyonlands National Park, Capitol Reef National Park, and the Glen Canyon National Recreation Area. This high density of park land is likely to impede transmission development in this area. The lack of proposed transmission lines in this region, as shown in Figure G-3, may be related to the presence of park lands.

G.3 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this PEIS. It is likely that at the time of publication of this PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this PEIS.

DOE and DOI (U.S. Department of Energy and U.S. Department of the Interior), 2008, *West-Wide Energy Corridor Programmatic Environmental Impact Statement, Designation of Energy Corridors on Federal Land in the 11 Western States,* DOE/EIS-0386, Final, Nov. Available at http://corridoreis.anl.gov/eis/guide/index.cfm.

NERC (North American Electric Reliability Corporation), 2009, *2009 Long-Term Reliability Assessment* 2009 – 2018, Princeton, N.J., Oct. Available at http://www.nerc.com/files/2009_LTRA.pdf.

APPENDIX H:

FEDERAL, STATE, AND COUNTY REQUIREMENTS POTENTIALLY APPLICABLE TO SOLAR ENERGY PROJECTS

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APPENDIX H:

FEDERAL, STATE, AND COUNTY REQUIREMENTS POTENTIALLY APPLICABLE TO SOLAR ENERGY PROJECTS[1]

H.1 AUTHORITIES

The tables that follow list the major federal and state laws, county ordinances, and Executive Orders that establish permits, approvals, or consultations that may apply to the siting, construction, operation, and decommissioning of solar energy and transmission line projects on U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) lands. The general application of these authorities and other regulatory considerations associated with such siting, construction, operation, and decommissioning are discussed in Chapter 3.

Tables H-1 through H-15 are divided into general environmental impact categories. The citations in the tables are those of the general authorities that govern the category. Under such authority, the lead federal or state agency may have promulgated implementing regulations that set forth detailed procedures for permitting and compliance. County zoning or land use ordinances may also contain specific requirements related to these impact categories.

The use of "NA" in the tables indicates that no specifically applicable ordinance was located.

Definitions of abbreviations used in the tables are provided here.

ACR	*Alamosa County Regulations (Colorado)*
ARS	*Arizona Revised Statutes*
CCC	*Clark County Code (Nevada)*
CRS	*Colorado Revised Statutes*
DACO	*Dona Ana County Ordinances (New Mexico)*
ICO	*Iron County Ordinances (Utah)*
LCC	*Lincoln County Code (Nevada)*
MCCI	*Municipal Code County of Imperial (California)*

[1] This list was compiled on January 6, 2010. Some federal, state, and county requirements may have changed since preparation of this PEIS.

NCC	*Nye County Code (Nevada)*
NMSA	*New Mexico Statutes Annotated*
NRS	*Nevada Revised Statutes*
OCO	*Otero County Ordinance (New Mexico)*
RCC	*Riverside County Code (California)*
SBCCO	*San Bernardino County Code of Ordinances (California)*
SC	*Saguache County (Colorado)*
UCA	*Utah Code Annotated*
USC	*United States Code*

TABLE H-1 Air Quality

Authority	Citation
Federal	• Clean Air Act (42 USC 7401 et seq.)
State	
Arizona	• Air Quality (ARS 49-401 et seq.)
	County
	Graham
	• NA
	La Paz
	• NA
	Maricopa
	• Air Rules (Maricopa County Air Quality Department, 100–310, 320–324, 330, 360–372, 510)
	Yavapai
	• NA
California	• California Global Warming Solutions Act of 2006 (*Health and Safety Code*, 38500 et seq.) • Air Resources (*Health and Safety Code*, 39000 et seq.)
	County
	Imperial
	• Rules and Regulations of the Imperial County Air Pollution Control District (Regulations I–XI)
	Riverside
	• NA
	San Bernardino
	• Air Quality (SBCCO, Title 8, Division 3, Chapter 83.01, Section 83.01.040)
Colorado	• Air Quality Control (CRS 25-7-101 et seq.)
	County
	Alamosa
	• NA
	Conejos
	• NA
	Saguache
	• NA

TABLE H-1 (Cont.)

Authority	Citation
State (Cont.)	
Nevada	• Air Pollution (NRS 445B.100 et seq.)
	County
	Clark
	• Air Quality and Environmental Management (CCC, Title 9, Chapter 9.08)
	Esmeralda
	• NA
	Lincoln
	• NA
	Nye
	• NA
New Mexico	• Air Quality (NMSA 74-2-1 et seq.
	County
	Dona Ana
	• Erosion Control Regulations (DACO, #194-2000)
	Otero
	• NA
Utah	• Air Conservation Act (UCA 19-2-101 et seq.)
	County
	Beaver
	• NA
	Iron
	• NA

1

TABLE H-2 Cultural Resources

Authority	Citation
Federal	• Native American Graves Protection and Repatriation Act (25 USC 3001 et seq.) • American Indian Religious Freedom Act (42 USC 1996 et seq.) • Archeological Resources Protection Act (16 USC 470(aa) et seq.) • Archeological and Historic Preservation Act (16 USC 469 et seq.) • Historic Sites, Buildings, and Antiquities Act (Historic Sites Act) (16 USC 461 et seq.) • Antiquities Act (16 USC 431 et seq.) • National Historic Preservation Act (16 USC 470 et seq.) • Theft and Destruction of Government Property (18 USC 641 et seq., 1361 et seq.) • Executive Order 11593, "Protection and Enhancement of the Cultural Environment," May 13, 1971 • Executive Order 13007, "Indian Sacred Sites," May 24, 1996 • Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments," November 6, 2000 • Executive Order 13287, "Preserve America," March 3, 2003
State	
Arizona	• Duties, board; partnership fund; State Historic Preservation Officer (ARS 41-511.04) • Arizona Historical Society; powers; officers; duties of board of directors (ARS 41-821 et seq.) • Historic Preservation (ARS 41-861 et seq.) • Archeological Discoveries (ARS 41-841 et seq.)
	County Graham • NA La Paz • NA Maricopa • NA Yavapai • NA
California	• Historical Resources (*Public Resources Code*, 5020 et seq.)
	County Imperial • NA Riverside • Historic Preservation Districts (RCC, Title 15, Chapter 15.72) San Bernardino • Cultural Resources Preservation (CP) Overlay (SBCCO, Title 8, Division 2, Chapter 82.12)

TABLE H-2 (Cont.)

Authority	Citation
State (Cont.)	
Colorado	• Historical, Prehistorical, and Archeological Resources (CRS 24-80-401 et seq.) • Unmarked Human Graves (CRS 24-80-1301 et seq.)
	County Alamosa • NA
	Conejos • NA
	Saguache • NA
Nevada	• Historic Preservation and Archeology (NRS 383.011 et seq.)
	County Clark • NA
	Esmeralda • NA
	Lincoln • NA
	Nye • NA
New Mexico	• Cultural Properties Act (18-6-3 NMSA 1978)
	County Dona Ana • NA
	Otero • NA
Utah	• History Development (UCA 9-8-102 et seq.) • Native American Graves Protection and Repatriation Act (UCA 9-9-102 et seq.)
	County Beaver • NA
	Iron • NA

1

TABLE H-3 Ecological Resources

Authority	Citation
Federal	• Fish and Wildlife Coordination Act (16 USC 661 et seq.) • Bald and Golden Eagle Protection Act (16 USC 668 et seq.) • National Wildlife Refuge System Administration Act (16 USC 668dd) • Migratory Bird Act (16 USC 703 et seq.) • Endangered Species Act (16 USC 1531 et seq.) • Wild Free-Roaming Horses and Burros Act (16 USC 1331 et seq.) • Executive Order 12996, "Management and General Public Use of the National Wildlife Refuge System," March 25, 1996 • Executive Order 13112, "Invasive Species," February 3, 1999 • Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds," January 10, 2001
State	
Arizona	• Powers and Duties (ARS 17-231 et seq.) • Taking and Handling of Wildlife (ARS 17-301 et seq.) • Wildlife Habitat Protection (ARS 17-451)
	County Graham • NA La Paz • NA Maricopa • NA Yavapai • NA
California	• Migratory Birds (*Fish and Game Code*, 355 et seq.) • Wildlife Conservation Law of 1947 (*Fish and Game Code*, 1300 et seq.) • Fish and Game Management (*Fish and Game Code*, 1500 et seq.) • Fish and Wildlife Protection and Conservation (*Fish and Game Code*, 1600 et seq.) • Native Species Conservation and Enhancement (*Fish and Game Code*, 1750 et seq.) • Conservation of Wildlife Resources (*Fish and Game Code*, 1800 et seq.) • Endangered Species (*Fish and Game Code*, 2050 et seq.) • Protected Reptiles and Turtles (*Fish and Game Code*, 5000 et seq.) • California Wilderness Preservation System (*Public Resources Code*, 5093.30 et seq.)
	County Imperial • NA Riverside • Stephens' Kangaroo Rat Study Areas (RCC, Title 15, Chapter 1504, Section 15.04.020 (G)) San Bernardino • Biotic Resources (BR) Overlay (SBCCO, Title 8, Division 2, Chapter 82.11)

TABLE H-3 (Cont.)

Authority	Citation
State (Cont.)	
Colorado	• Nongame and Endangered Species Conservation (CRS 33-2-101 et seq.) • Migratory Birds—Possession of Raptors—Reciprocal Agreements (CRS 33-1-115) • Protection of Fishing Streams (CRS 33-5-101 et seq.) • Nongame and Endangered Species Conservation (CRS 33-2-101 et seq.) • Colorado Natural Areas (CRS 33-33-101 et seq.) *County* Alamosa • NA Conejos • NA Saguache • Wildlife (SC, *Land Development Code*, Article XX)
Nevada	• Wildlife (NRS 501.003 et seq.) • Preservation of Endangered Species or Subspecies in County Whose Population Is 400,000 or More (NRS 244.386) *County* Clark • Incidental Take Permit: Compliance with the Endangered Species Act (CCC, Title 30, Chapter 30.32, Section 30.32.050) Esmeralda • NA Lincoln • NA Nye • Desert Tortoise Zone of Preservation (NCC, Title 18, Chapter 18.12)
New Mexico	• Wildlife Conservation Act (17-2-46 NMSA 1978) • Endangered Plant Species (75-6-1 NMSA 1978) • Protection of Native New Mexico Plants (NMSA 76-8-1 et seq.) • Habitat Protection (17-6-1 NMSA 1978 et seq.) *County* Dona Ana • NA Otero • NA

TABLE H-3 (Cont.)

Authority	Citation
State (Cont.)	
Utah	• *Wildlife Resources Code of Utah* (UCA 23-13-1 et seq.)
	County
	Beaver
	• NA
	Iron
	• NA

1

TABLE H-4 Energy Projects

Authority	Citation
Federal	• Federal Power Act (16 USC 791a et seq.) • Public Utilities Regulatory Policies Act (16 USC 2601 et seq.) • Energy Policy Act of 2005 (Public Law 109-58) • Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," February 11, 1994 • Executive Order 13212, "Actions to Expedite Energy-related Projects," May 18, 2001
State	
Arizona	• Power Plant and Transmission Line Siting Committee (ARS 40-360 et seq.)
	County Graham • NA La Paz • NA Maricopa • NA Yavapai • NA
California	• Power Facility and Site Certification (*Public Resources Code*, 21000 et seq.) • Certificates of Public Convenience and Necessity (*Public Utilities Code*, 1001 et seq.)
	County Imperial • NA Riverside • NA San Bernardino • Energy Facilities (EN) Overlay (SBCCO, Title 8, Division 2, Chapter 82.24)
Colorado	• Local Government Regulation—Location, Construction, or Improvement of Major Electrical or Natural Gas Facilities—Legislative Declaration (CRS 29-20-108)
	County Alamosa • Regulations for Site Selection and Construction of Major Facilities of a Public Utility (ACR, Chapter 6) Conejos • NA Saguache • NA

TABLE H-4 (Cont.)

Authority	Citation
State (Cont.)	
Nevada	• Construction of Utility Facilities: Utility Environmental Protection Act (NRS 704.820 et seq.)
	County
	Clark County
	• NA
	Esmeralda County
	• NA
	Lincoln County
	• NA
	Nye County
	• NA
New Mexico	• Electric, Gas, and Water Utilities (NMSA 62-1-1 et seq.)
	County
	Dona Ana
	• NA
	Otero
	• NA
Utah	• Electric Power Facilities Act (UCA 54-9-101 et seq.) • Electricity Facility Review Board Act (UCA 54-14-101 et seq.)
	County
	Beaver
	• NA
	Iron
	• Solar Power Plants (ICO, Title 17, Chapter 17.33)

1

TABLE H-5 Floodplains and Wetlands

Authority	Citation
Federal	• Clean Water Act (33 USC 1344) • Rivers and Harbors Act of 1899 (33 USC 401 et seq.) • Executive Order 11988, "Floodplain Management," May 24, 1977 • Executive Order 11990, "Protection of Wetlands," May 24, 1977
State	
Arizona	• Floodplain delineation; regulation of use (ARS 48-3609)
	County Graham • NA
	La Paz • Floodplain Management (2006-01)
	Maricopa • Floodplain Regulations (Flood Control District of Maricopa County 2006 Revision)
	Yavapai • Flood Damage Prevention Ordinance
California	• Wetlands Preservation (Keene-Nejedly California Wetlands Preservation Act) (*Public Resources Code*, 5810 et seq.) • Cobey-Alquist Flood Plain Management Act (*Water Code*, 8400 et seq.)
	County Imperial • Flood Damage Prevention Program (MCCI, Title 9, Division 16)
	Riverside • Regulating Flood Hazard Areas and Implementing the National Flood Insurance Program (RCC, Title 15, Chapter 15.80)
	San Bernardino • Flood Plain Safety (FP) Overlay (SBCCO, Title 7, Division 2, Chapter 82.14)
Colorado	• Drainage of State Lands (CRS 37-30-101 et seq.) • Marsh Land (CRS 37-33-101 et seq.)
	County Alamosa • NA
	Conejos • NA
	Saguache • NA

TABLE H-5 (Cont.)

Authority	Citation
State (Cont.)	
Nevada	• Establishment, Use and Operation of Wetland Mitigation Bank (NRS 244.388)
	County
	Clark
	• NA
	Esmeralda
	• NA
	Lincoln
	• Flood Damage Prevention (LCC, Title 12)
	Nye
	• Flood Damage Prevention (NCC, Title 15, Chapter 15.12)
New Mexico	• Hazard Areas; Floodplain Permits; Land Use Control; Jurisdiction; Agreement (3-18-7(C) NMSA 1978)
	County
	Dona Ana
	• Flood Damage Prevention (DACO, #161-95)
	Otero
	• Flood Control (OCO 75-01)
	• Flood Damage Prevention (OCO, 78-01)
Utah	• Plan Preparation (UCA 10-9a-403)
	• Plan Preparation (UCA 17-27a-403)
	• Quality Growth Act of 1999 (UCA 11-38-101 et seq.)
	County
	Beaver
	• NA
	Iron
	• Flood Damage Prevention (ICO, Title 15, Chapter 15.12)

1

TABLE H-6 Groundwater, Drinking Water, and Water Rights

Authority	Citation
Federal	• Safe Drinking Water Act (42 USC 300(f) et seq.)
State	
Arizona	• Water Quality Control (ARS 49-201 et seq., 49-241 et seq., 49-255 et seq., 49-351 et seq., 45-151 et seq.) • Appropriation of Water (ARS 45-151 et seq.)
	County Graham • NA
	La Paz • NA
	Maricopa • *Maricopa Environmental Health Code*, Chapters I and V (Ordinance P-14)
	Yavapai • *Water Well Code*
California	• California Safe Drinking Water Act (*Health and Safety Code*, 116270 et seq.) • Water (*Water Code*, 1000 et seq.)
	County Imperial • Groundwater Management (MCCI, Title 9, Division 22) • Water Well Regulations (MCCI, Title 9, Division 21)
	Riverside • Water Wells (RCC, Title 13, Chapter 13.20)
	San Bernardino • Domestic Water Sources and Systems (SBCCO, Title 3, Division 3, Chapter 6) • Monitoring, Control, and Elimination of Pollutants into the Storm Drainage System (SBCCO, Title 3, Division 5)

TABLE H-6 (Cont.)

Authority	Citation
State (Cont.)	
Colorado	• Water Right Determination and Administration (CRS-37-92-101 et seq.) • Water Quality Control (CRS 25-8-101 et seq.)
	County Alamosa • NA
	Conejos • NA
	Saguache • Significant Groundwater Recharge Zones (SC, *Land Development Code*, Article XVIII)
Nevada	• Underground Water and Wells (NRS 534.010 et seq.) • Water Controls; Public Water Systems (NRS 445A.800 et seq.)
	County Clark • Water Approval (CCC, Title 24, Chapter 24.36)
	Esmeralda • NA
	Lincoln • Water Transfers (LCC, Title 9, Chapter 5)
	Nye • NA
New Mexico	• Compliance with the Federal Safe Drinking Water Act (74-1-12 NMSA 1978) • Water Rights in General (NMSA 72-1-1 et seq.) • Appropriation and Use of Surface Water (NMSA 72-5-1 et seq.) • Ground Water Storage and Recovery (NMSA 72-5A-1 et seq.) • Underground Waters (NMSA 72-12-1 et seq.)
	County Dona Ana • Water Ordinance (DACO, #211-04)
	Otero • NA

TABLE H-6 (Cont.)

Authority	Citation
State (Cont.)	
Utah	• Safe Drinking Water Act (UCA 19-4-101 et seq.) • Ground Water Recharge and Recovery Act (UCA 73-3b-101 et seq.) • Appropriation (UCA 73-3-1 et seq.) • Determination of Water Rights (UCA 73-4-1 et seq.) • Withdrawal of Unappropriated Water (UCA 73-6-1 et seq.)
	County Beaver • NA
	Iron • Drinking Water Source Protection (ICO, Title 13, Chapter 13.16)

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TABLE H-7 Hazardous Materials and Toxic Substances

Authority	Citation
Federal	• Hazardous Materials Transportation Act (49 USC 5101 et seq.) • Emergency Planning and Community Right-to-Know Act of 1986 (42 USC 11001 et seq.) • Oil Pollution Control Act (33 USC 2701 et seq.) • Pollution Prevention Act of 1990 (42 USC 13101 et seq.) • Comprehensive Environmental Response, Compensation, and Liability Act (42 USC 9601 et seq.) • Toxic Substances Control Act (15 USC 2605(e)) • Executive Order 12856, "Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements," August 3, 1993
State	
Arizona	• Emergency Planning and Community Right-to-Know Act (ARS 26-341 et seq.) • Transporting Hazardous Material; Violation; Classification (ARS 28-1523)
	County Graham • NA
	La Paz • NA
	Maricopa • NA
	Yavapai • NA
California	• Unified Hazardous Waste and Hazardous Materials Management and Regulatory Program (*Health and Safety Code*, 25404 et seq.) • Hazardous Materials Release Response Plans and Inventory (*Health and Safety Code*, 25500 et seq.) • Safe Drinking Water and Toxics and Enforcement Act of 1986 (*Health and Safety Code*, 25249.5 et seq.)
	County Imperial • NA
	Riverside • Disclosure of Hazardous Materials and Formulation of Emergency Response Plans (RCC, Title 8, Chapter 8.64)
	San Bernardino • NA

TABLE H-7 (Cont.)

Authority	Citation
State (Cont.)	
Colorado	• Implementation of Title III of Superfund Act (CRS 24-32-2601 et seq.) • Hazardous Substances (CRS 25-5-501 et seq.) • Pollution Prevention (CRS 25-16.5-101 et seq.)
	County Alamosa • NA
	Conejos • NA
	Saguache • NA
Nevada	• Regulation of Highly Hazardous Substances and Explosives (NRS 459.380 et seq.) • Handling of Hazardous Materials (NRS 459.700 et seq.)
	County Clark • Hazardous Materials (CCC, Title 30, Chapter 30.68, Section 30.68.070 and Title 13, Chapter 13.04, Section 13.04.480)
	Esmeralda • NA
	Lincoln • NA
	Nye • NA
New Mexico	• Hazardous Chemicals Information Act (74-4E-1 NMSA 1978 et seq.) • Hazardous Material Transportation (74-4F-1 NMSA 1978 et seq.)
	County Dona Ana • Identification and Disclosure of Chemical/Hazardous Inventory and Further Providing Guidelines for Emergency Management in the Event of Accidental Discharge of Chemical/Hazardous Material (DACO, #178-99)
	Otero • NA

TABLE H-7 (Cont.)

Authority	Citation
State (Cont.)	
Utah	• Hazardous Materials—Transportation Regulations (UCA 41-6a-1639) • Hazardous Materials Emergency—Recovery of Expenses (UCA 53-2-105)
	County
	Beaver
	• NA
	Iron
	• NA

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TABLE H-8 Hazardous Wastes

Authority	Citation
Federal	• Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act and the Hazardous Solid Waste Amendments of 1984 (42 USC 6901 et seq.)
State	
Arizona	• Hazardous Waste Disposal (ARS 49-901 et seq.)
	County
	Graham
	• NA
	La Paz
	• NA
	Maricopa
	• NA
	Yavapai
	• NA
California	• Hazardous Waste Control (*Health and Safety Code*, 25100 et seq.)
	County
	Imperial
	• NA
	Riverside
	• Hazardous Waste Control (RCC, Title 8, Chapter 8.60)
	San Bernardino
	• Hazardous Waste (HW) Overlay (SBCCO, Title 8, Division 2, Chapter 82.16)
	• Hazardous Waste Facilities (SBCCO, Title 8, Division 4, Chapter 84.11)
Colorado	• Hazardous Waste (CRS 25-15-101 et seq.)
	County
	Alamosa
	• NA
	Conejos
	• NA
	Saguache
	• NA

TABLE H-8 (Cont.)

Authority	Citation
State (Cont.)	
Nevada	• Disposal of Hazardous Waste (NRS 459.400 et seq.)
	County
	Clark
	• NA
	Esmeralda
	• NA
	Lincoln
	• NA
	Nye
	• Hazardous Waste Facilities (NCC, Title 8, Chapter 8.24, Article III)
New Mexico	• Hazardous Wastes (NMSA 74-4-1 et seq.)
	• Hazardous Waste Feasibility Studies (NMSA 74-4C-1 et seq.)
	County
	Dona Ana
	• NA
	Otero
	• NA
Utah	• Solid and Hazardous Waste Act (UCA 19-6-101 et seq.)
	County
	Beaver
	• NA
	Iron
	• Garbage Collection and Disposal (ICO, Title 8, Chapter 8.08)

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TABLE H-9 Land Use

Authority	Citation
Federal	• Federal Land Policy and Management Act of 1976 (43 USC 1701 et seq.) • Mineral Leasing Act (30 USC 181 et seq.) • Coastal Zone Management Act, as amended by Coastal Zone Reauthorization Amendments of 1990 (16 USC 1451 et seq.) • Wild and Scenic Rivers Act (16 USC 1271 et seq.) • National Trails System Act (16 USC 1241 et seq.) • National Park Service Organic Act (16 USC 1 et seq.) • Wilderness Act (16 USC 1311 et seq.) • Federal Land Exchange Facilitation Act (43 USC 1716) • Federal Land Transaction Facilitation Act (43 USC 2301 et seq.) • Farmland Protection and Policy Act (7 USC 4201) • Soil and Water Resources Conservation Act of 1977 (16 USC 2001 et seq.) • Oregon and California Grant Lands Act of 1937 (43 USC 1181 a, b, d–f) • An Act to Establish the Glen Canyons National Recreation Area in the States of Arizona and Utah (16 USC 460 dd)
State	
Arizona	• Public Lands (ARS 37-101 et seq.) • Administration of State and Other Public Lands (ARS 37-201 et seq.) • Acts of Congress Relating to State and Federal Lands (ARS 37-701 et seq.) • Natural Resource Conservation District (ARS 37-1001) • State Claims to Streambeds (ARS 37-1101) • Arizona Agricultural Protection Act (ARS 3-3301)
	County Graham • Comprehensive Plan
	La Paz • La Paz County Zoning Regulations
	Maricopa • Zoning (Ordinance P 18)
	Yavapai • Planning and Zoning Ordinance

TABLE H-9 (Cont.)

Authority	Citation
State (Cont.)	
California	• California Wild and Scenic Rivers Act (*Public Resources Code*, 5093.50 et seq.) • Coastal Resources and Energy Assistance (*Public Resources Code*, 35000 et seq.)
	County Imperial • Zoning Areas Established (MCCI, Title 9, Division 5)
	Riverside • Land Use (Ordinance # 348, Articles III and XVII, codified throughout RCC) • Light Pollution (RCC, Title 8, Chapter 8.80)
	San Bernardino • Abatement of Fire Hazards and Hazardous Trees (SBCCO, Title 2, Division 3, Chapter 3) • Land Use Zoning Districts and Allowed Land Uses (SBCCO, Title 8, Division 2)
Colorado	• Areas and Activities of State Interest (CRS 24-65.1-101 et seq.) • Local Government Land Use Control Enabling Act (CRS 29-20-101 et seq.) • County Planning (CRS 30-28-101 et seq.) • (Municipal) Planning and Zoning (CRS 31-23-101 e seq.)
	County Alamosa • Regulations for Development in Areas Containing or Having a Significant Impact upon Natural Resources of Statewide Importance (ACR, Chapter 5) • Alamosa County Zoning and Subdivision Regulations
	Conejos • *Land Use Code*
	Saguache • Industrial Development Requirements (SC, *Land Development Code*, Article IV.5)

TABLE H-9 (Cont.)

Authority	Citation
State (Cont.)	
Nevada	• Regulations for Use of Land (NRS 548.410 et seq.) • Planning and Zoning (NRS 278.010 et seq.)
	County Clark • *Unified Development Code* (CCC, Title 30)
	Esmeralda • NA
	Lincoln • Zoning (LCC, Title 13, Chapter 5) • Special Use Permits (LCC, Title 13, Chapter 8) • Cooperative Public Lands Management (LLC, Title 9, Chapter 1)
	Nye • Zoning (NCC, Title 17) • Comprehensive Land Use and Management: Plan for Federal and State Managed Lands within Nye County (Ordinance #380 to be codified as Title 7)
New Mexico	• Land Development Fees and Rights (NMSA 5-8-1 et seq.) • Land Use Easements (NMSA 47-12-1 et seq.) • Natural Lands Protection (NMSA 75-5-1 et seq.) • Rangeland Protection (NMSA 76-7B-1 et seq.) • Range Management Plans (NMSA 76-7C-1) • Zoning Regulations (NMSA 3-21-1 et seq.)
	County Dona Ana • Land Use Regulations and Zoning Ordinance (DACO, #158-95)
	Otero • NA
Utah	• Quality Growth Act (UCA 11-38-101 et seq.) • Environmental Institutional Control Act (UCA 19-10-101 et seq.) • Municipal Land Use, Development, and Management (UCA 10-9a-101 et seq.) • County Land Use, Development, and Management (UCA 17-27a-101 et seq.) • Critical Land Near State Prison: Definitions - Preservation as Open Land - Management and Use of Land - Restrictions on Transfer - Wetlands Development - Conservation Easement (UCA 23A-5-222)
	County Beaver • Zoning Ordinance
	Iron • Zoning (ICO, Title 17)

TABLE H-10 Noise

Authority	Citation
Federal	• Noise Control Act, as amended by Quiet Communities Act (42 USC 4901 et seq.)
State	
Arizona	• No specific primary statutory authority
	County
	Graham
	• NA
	La Paz
	• NA
	Maricopa
	• Noise (Ordinance P-23)
	Yavapai
	• NA
California	• Noise Control Act (*Health and Safety Code*, 46000 et seq.)
	County
	Imperial
	• Noise Abatement and Control (MCCI, Title 9, Division 7)
	Riverside
	• NA
	San Bernardino
	• Noise Hazard (NH) Overlay (SBCCO, Title 8, Division 2, Chapter 82.18)
	• Noise (SBCCO, Title 8, Division 3, Chapter 83.01, Section 83.01.080)
Colorado	• Noise Abatement (CRS 25-12-101 et seq.)
	County
	Alamosa
	• NA
	Conejos
	• NA
	Saguache
	• NA

TABLE H-10 (Cont.)

Authority	Citation
State (Cont.)	
Nevada	• Prevention of Excessive Noise (NRS 244.363)
	County
	Clark
	• Noise (CCC, Title 30, Chapter 30.68, Section 30.68.020)
	Esmeralda
	• NA
	Lincoln
	• NA
	Nye
	• NA
New Mexico	• No specific primary statutory authority
	County
	Dona Ana
	• NA
	Otero
	• Unreasonable Noise (OCO 96-10)
Utah	• No specific primary statutory authority
	County
	Beaver
	• NA
	Iron
	• Noises (ICO, Title 8, Chapter 8.20, Section 8.20.60)

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TABLE H-11 Paleontological Resources

Authority	Citation
Federal	• Paleontological Resources Preservation Act of 2009 (16 USC 470aaa et seq.) • Federal Land Policy and Management Act of 1976 (43 USC 1701 et seq.) • National Environmental Policy Act of 1969 (42 USC 4321 et seq.) • Federal Cave Resources Protection Act of 1988 (16 USC 4302 et seq.) • Archeological Resources Protection Act (16 USC 470(aa) et seq.) • Archeological and Historic Preservation Act (16 USC 469-469c) • Archeological and Paleontological Salvage Act (16 USC 305) • Organic Act of March 3, 1879 (20 USC 59) • Theft and Destruction of Government Property (18 USC 641 et seq, 1361 et seq.) • National Wildlife Refuge System Administration Act (16 USC 668dd) • Executive Order 11593, "Protection and Enhancement of the Cultural Environment," May 13, 1971
State	
Arizona	• Archeological Discoveries (ARS 41-841 et seq.) • State Museum Responsibilities Include Paleontological Resources (ARS 15-1631) • State Lands: Fossils Belong to the Mineral Estate (ARS 37-231)
	County Graham • NA La Paz • NA Maricopa • NA Yavapai • NA
California	• Archeological, Paleontological, and Historical Sites (*Public Resources Code*, 5097 et seq. and 30244) • State Lands: Fossils Belong to the Mineral Estate (*Public Resources Code*, 6407)
	County Imperial • NA Riverside • NA San Bernardino • Paleontologic Resources (PR) Overlay (SBCCO, Title 8, Division 2, Chapter 2.20)

TABLE H-11 (Cont.)

Authority	Citation
State (Cont.)	
Colorado	• Historical, Prehistorical, and Archeological Resources (CRS 24-80-401 et seq.) • Paleontological Resources Are Prehistorical Resources Reserved to the State (CRS 24-80-401)
	County Alamosa • NA
	Conejos • NA
	Saguache • NA
Nevada	• Preservation of Prehistoric and Historic Sites (NRS 381.195 et seq.) • Paleontological Sites Belong to the State and Are Protected (NRS 381.195-381.227, NRS 321.5977)
	County Clark • NA
	Esmeralda • NA
	Lincoln • NA
	Nye • NA
New Mexico	• Cultural Properties (NMSA 18-6-1 et seq.)
	County Dona Ana • NA
	Otero • NA
Utah	• Geological Survey (UCA 63-73 et seq.)
	County Beaver • NA
	Iron • NA

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TABLE H-12 Pesticides and Noxious Weeds

Authority	Citation
Federal	• Federal Insecticide, Fungicide, and Rodenticide Act (7 USC 136 et seq.) • Plant Protection Act (7 USC 7701 et seq.)
State	
Arizona	• Pesticide Contamination Prevention (ARS 49-301) • Pesticides (ARS 3-341 et seq.) • Pesticide Control (ARS 3-361 et seq.)
	County Graham • NA La Paz • NA Maricopa • NA Yavapai • NA
California	• Agricultural Chemicals, Livestock Remedies, and Commercial Feeds (*Food and Agriculture Code*, 12500 et seq.) • Weeds (*Food and Agriculture Code*, 7201 et seq.)
	County Imperial • Abatement of Weeds and Other Vegetation (MCCI, Title 9, Division 18) • Pesticide Controls (MCCI, Title 8, Chapter 8.60) Riverside • Hazardous Vegetation (RCC, Title 8, Chapter 8.56) San Bernardino • NA
Colorado	• Pesticide Act (CRS 35-9-101 et seq.)
	County Alamosa • NA Conejos • NA Saguache • NA

TABLE H-12 (Cont.)

Authority	Citation
State (Cont.)	
Nevada	• Control of Insects, Pests, and Noxious Weeds (NRS 555.005 et seq.)
	County
	Clark
	• NA
	Esmeralda
	• NA
	Lincoln
	• Weed Management Plan (LCC, Title 14, Chapter 6, Appendix E)
	Nye
	• NA
New Mexico	• Pesticide Control (NMSA 76-4-1 et seq.)
	• Noxious Weed Control (NMSA 76-7-1 et seq.)
	County
	Dona Ana
	• NA
	Otero
	• Refuse, Litter, Handbill and Weed Control and Burn (OCO, 91-04)
Utah	• Utah Pesticide Control Act (UCA 4-14-1 et seq.)
	County
	Beaver
	• NA
	Iron
	• NA

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TABLE H-13 Solid Waste

Authority	Citation
Federal	• Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act and the Hazardous Solid Waste Amendments of 1984 (42 USC 6901 et seq.)
State	
Arizona	• Solid Waste Management (ARS 49-701 et seq.)
	County
	Graham
	• NA
	La Paz
	• NA
	Maricopa
	• *Maricopa Environmental Health Code*, Chapters I & II (Ordinance P-14)
	Yavapai
	• NA
California	• Solid Waste Handling and Disposal (*Health and Safety Code*, 117575 et seq.) • Waste Management (*Public Resources Code*, 40000 et seq.)
	County
	Imperial
	• Solid Waste Management (MCCI, Title 8, Chapter 8.72)
	Riverside
	• Solid Waste Collection and Disposal (RCC, Title 8, Chapter 8.132)
	San Bernardino
	• Waste Management (SBCCO, Title 3, Division 3, Chapter 8)
Colorado	• Solid Waste Disposal Sites and Facilities (CRS 30-20-100.5 et seq.)
	County
	Alamosa
	• NA
	Conejos
	• NA
	Saguache
	• NA

TABLE H-13 (Cont.)

Authority	Citation
State (Cont.)	
Nevada	• Collection and Disposal of Solid Waste (NRS 444.440 et seq.)
	County
	Clark
	• Solid Waste Management (CCC, Title 9, Chapter 9.04)
	Esmeralda
	• NA
	Lincoln
	• Solid Waste Management (LCC, Title 10, Chapter 4)
	Nye
	• Solid Waste Management (NCC, Title 8, Chapter 8.24)
New Mexico	• Solid Waste Incineration (NMSA 74-8-1 et seq.) • Solid Waste Act (NMSA 74-9-1 et seq.) • Solid Waste Authority (NMSA 74-10-1 et seq.)
	County
	Dona Ana
	• Residential and Commercial Solid Waste Collection and Disposal (DACO, #230-07)
	Otero
	• NA
Utah	• Solid Waste Management Act (UCA 19-6-501 et seq.)
	County
	Beaver
	• NA
	Iron
	• NA

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TABLE H-14 Source Water Protection

Authority	Citation
Federal	• Safe Drinking Water Act (42 USC 300h et seq.)
State	
Arizona	• Aquifer Protection Permits (ARS 49-241 et seq.)
	County
	Graham
	• NA
	La Paz
	• NA
	Maricopa
	• NA
	Yavapai
	• NA
California	• Water Wells and Cathodic Protection Wells (*Water Code*, 13700 et seq.) • Water Supply Provisions (*Public Resources Code*, 116975 et seq.)
	County
	Imperial
	• NA
	Riverside
	• NA
	San Bernardino
	• NA
Colorado	• Water Quality Control (CRS 25-8-101 et seq.)
	County
	Alamosa
	• Regulations for Efficient Utilization of Municipal and Industrial Water Projects (ACR, Chapter 3)
	Conejos
	• NA
	Saguache
	• NA

TABLE H-14 (Cont.)

Authority	Citation
State (Cont.)	
Nevada	• Underground Water and Wells (NRS 534.010 et seq.)
	County
	Clark
	• NA
	Esmeralda
	• NA
	Lincoln
	• NA
	Nye
	• NA
New Mexico	• Ground Water Protection (NMSA 74-6B-1 et seq.)
	County
	Dona Ana
	• NA
	Otero
	• NA
Utah	• Water Quality Act (UCA 19-5-101 et seq.)
	County
	Beaver
	• NA
	Iron
	• Drinking Water Source Protection (ICO, Title 13, Chapter 13.16)

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TABLE H-15 Water Bodies and Wastewater

Authority	Citation
Federal	• Clean Water Act (33 USC 1251 et seq.)
State	
Arizona	• Water Quality Control (ARS 49-201 et seq.)
	County
	Graham
	• NA
	La Paz
	• NA
	Maricopa
	• *Maricopa Environmental Health Code*, Chapters I, II, IV, & V (Ordinance P-14)
	Yavapai County
	• NA
California	• Water Quality (*Water Code*, 13000 et seq.)
	County
	Imperial
	• NA
	Riverside
	• NA
	San Bernardino
	• NA
Colorado	• Water Quality Control (CRS 25-8-101 et seq.) • Water and Wastewater Treatment Plant Operations (CRS 25-9-101 et seq.)
	County
	Alamosa
	• NA
	Conejos
	• NA
	Saguache
	• NA

TABLE H-15 (Cont.)

Authority	Citation
State (Cont.)	
Nevada	• Water Pollution Controls (NRS 445A.300 et seq.)
	County
	Clark
	• Stormwater Systems Discharge (CCC, Title 24, Chapter 24.40)
	Esmeralda
	• NA
	Lincoln
	• NA
	Nye
	• Water Pollution (NCC, Title 8, Chapter 8.12)
New Mexico	• Water Quality (NMSA 74-6-1 et seq.)
	County
	Dona Ana
	• Wastewater Ordinance (DACO, #210-04)
	Otero
	• NA
Utah	• Water Quality Act (UCA 19-5-101 et seq.)
	County
	Beaver
	• NA
	Iron
	• Wastewater Pretreatment (ICO, Title 13, Chapter 13.08)

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APPENDIX I:

ECOREGIONS OF THE SIX-STATE STUDY AREA AND LAND COVER TYPES OF THE PROPOSED SOLAR ENERGY ZONES

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APPENDIX I:

ECOREGIONS OF THE SIX-STATE STUDY AREA AND LAND COVER TYPES OF THE PROPOSED SOLAR ENERGY ZONES

I.1 STUDY AREA ECOREGIONS

An ecoregion is defined as an area that has a general similarity of ecosystems and is characterized by the spatial pattern and composition of biotic and abiotic features, including vegetation, wildlife, geology, physiography, climate, soils, land use, and hydrology (EPA 2007a). Ecoregions of the United States as mapped and described by the U.S. Environmental Protection Agency (EPA) are presented here as the basis for describing visual resources and ecosystems at a general level. The Level III ecoregion classification includes 22 ecoregions covering the six-state study area (Figure I-1). Figures I-2 and I-3 show the lands that the U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) is proposing as being available for solar energy development under its solar energy development program and solar energy zone (SEZ) program alternatives, respectively (see Section 2.2.2), in relation to the Level III ecoregions. Ecoregions of each of the six states in the study area, along with lands available under both the solar energy development program alternative and SEZ program alternative, are shown in Figures I-4 through I-9. The ecoregion descriptions presented here were derived primarily from the EPA (2002), except where noted.

I.1.1 Coast Range

The Coast Range ecoregion is located along the coast of California and extends north into Oregon and Washington. Within the six-state study area analyzed in the "Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States" (Solar PEIS), this ecoregion is approximately 3,261,500 acres (13,199 km^2), and the elevation ranges from 0 to 3,947 ft (0 to 1,203 m). The topography of this ecoregion ranges from beaches and low terraces to steeply sloping capes and volcanic slopes. The original dominant types of vegetation were Sitka spruce and coastal redwood forests along the coast, with a mosaic of western red cedar, western hemlock, and seral Douglas-fir in the inland areas. The low Coast Range mountains support highly productive coniferous forests. The area is now widely managed for timber production, and it supports extensive plantations of Douglas-fir. Because of the high precipitation levels, there are numerous streams and rivers. High scenic values attract many recreationists. Logging, wildlife habitat, recreation, rural residential, urban residential, and commercial development are important land uses within the ecoregion. Neither the solar energy development program alternative (development alternative) nor the SEZ program alternative includes this ecoregion.

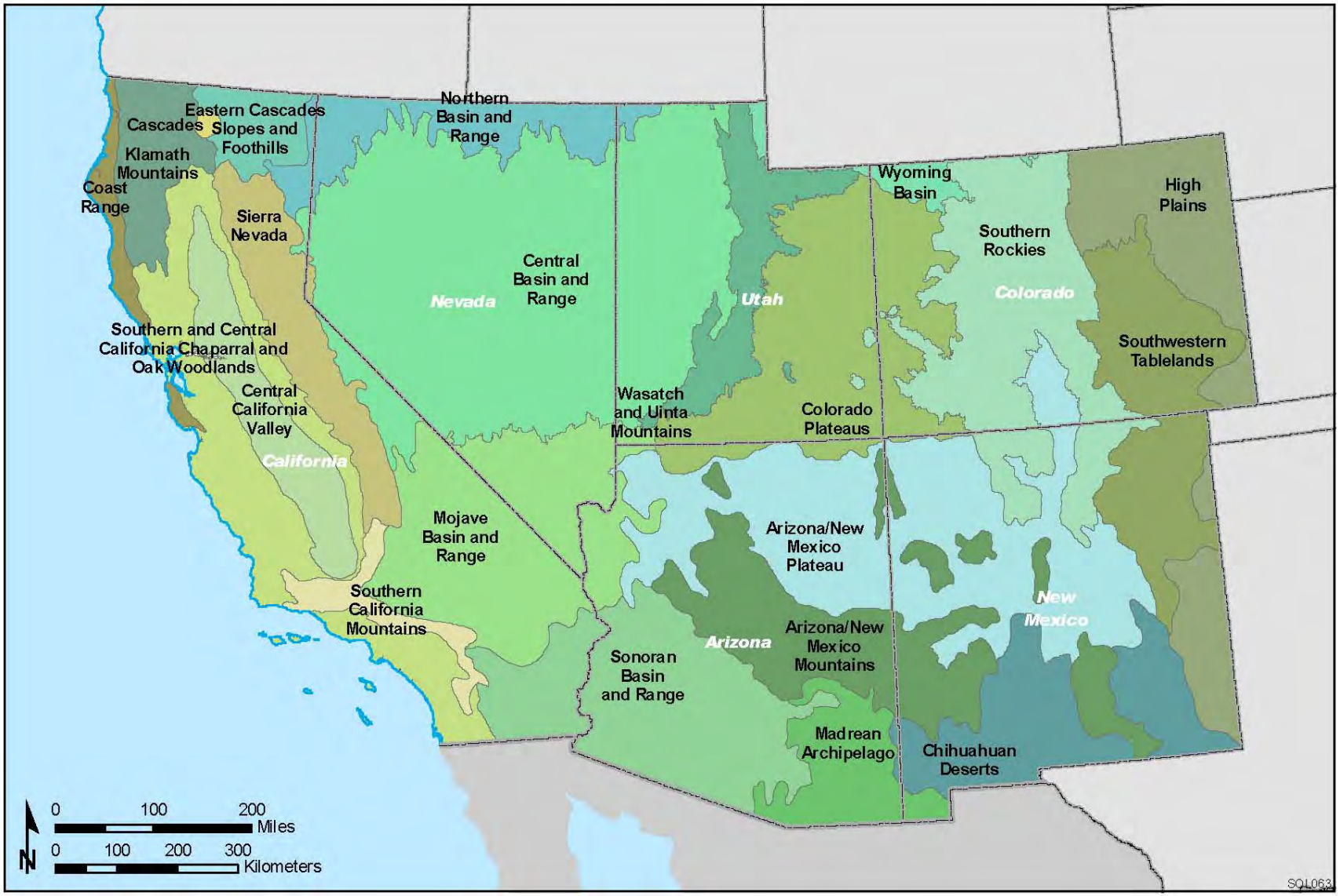


FIGURE I-1 Level III Ecoregions in the Six-State Study Area (Source: EPA 2007b)

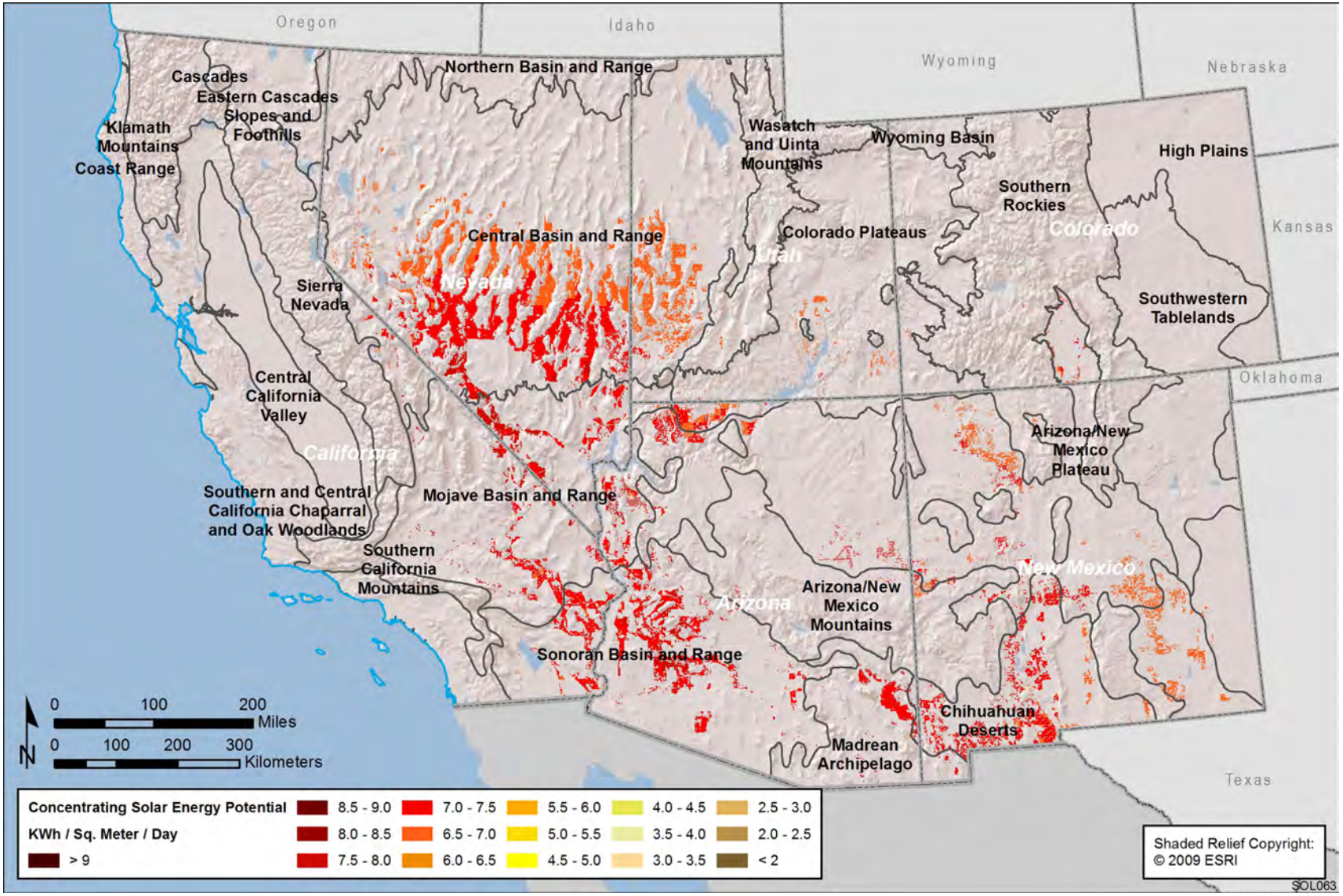
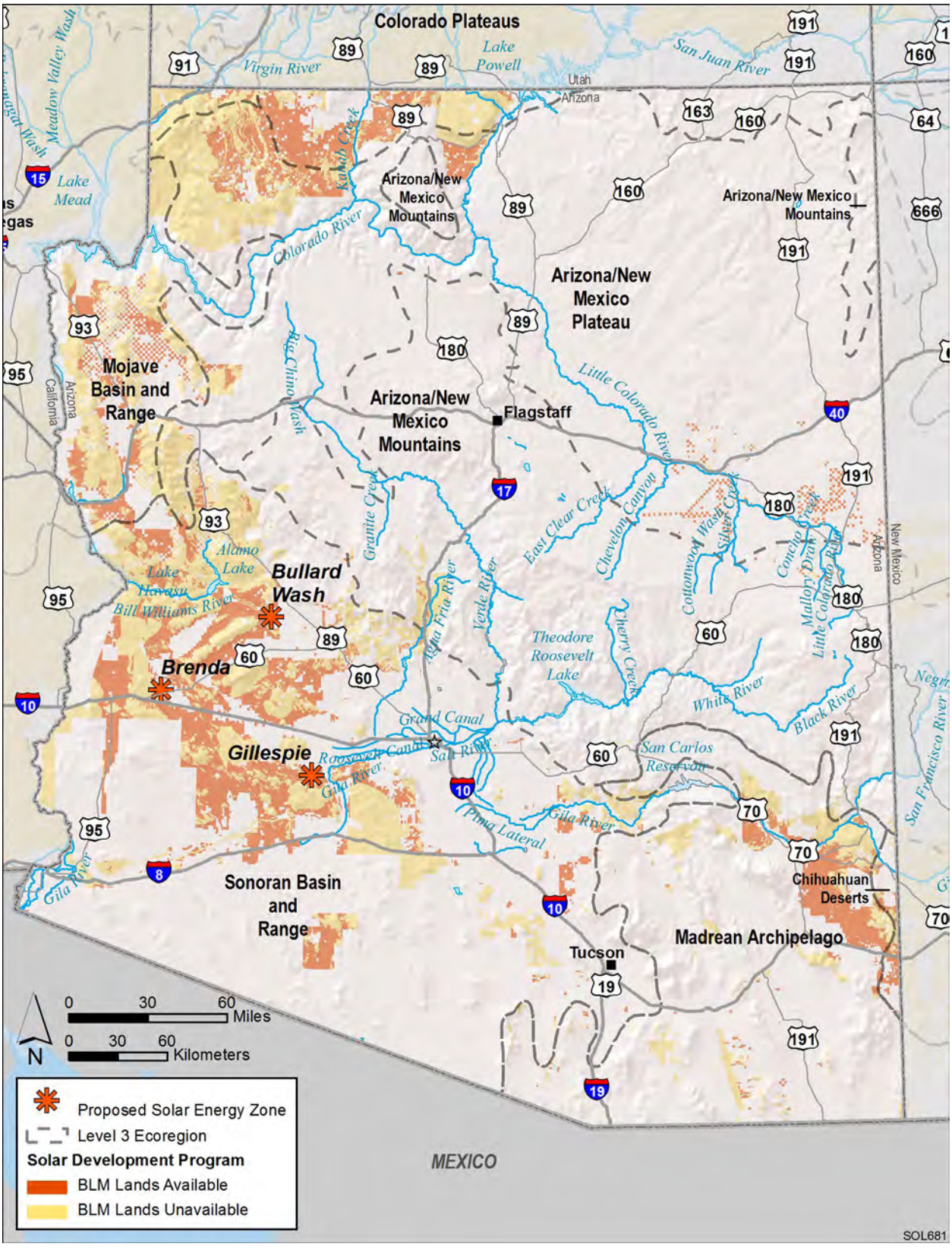


FIGURE I-2 BLM-Administered Lands Proposed To Be Available for Solar Energy Development and Associated Level III Ecoregions (Source: EPA 2007b)



FIGURE I-3 Level III Ecoregions and SEZs (Source: EPA 2007b)



1

2 **FIGURE I-4 Level III Ecoregions of Arizona and SEZs (Source: EPA 2007b)**



1

2 **FIGURE I-5 Level III Ecoregions of California and SEZs (Source: EPA 2007b)**

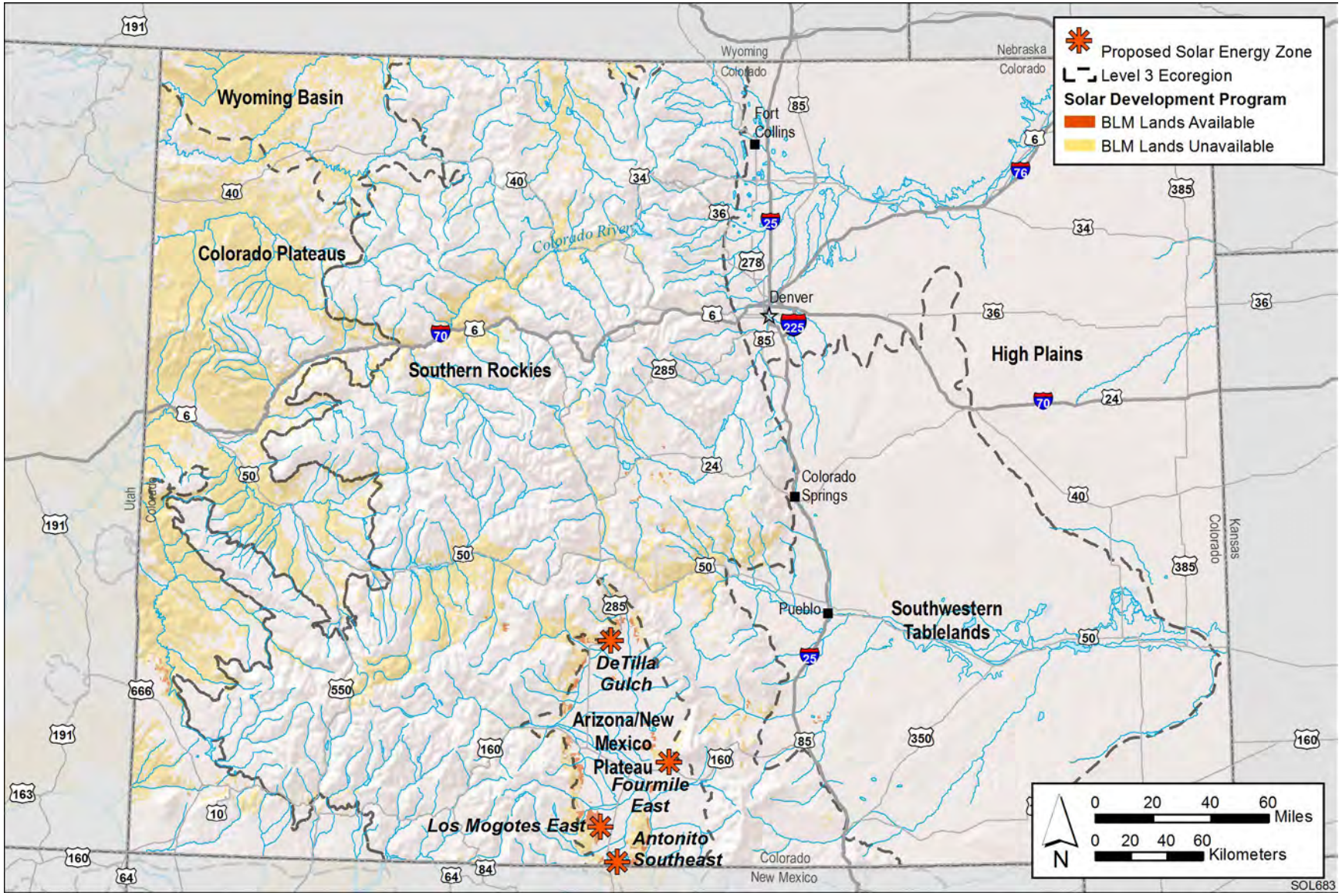
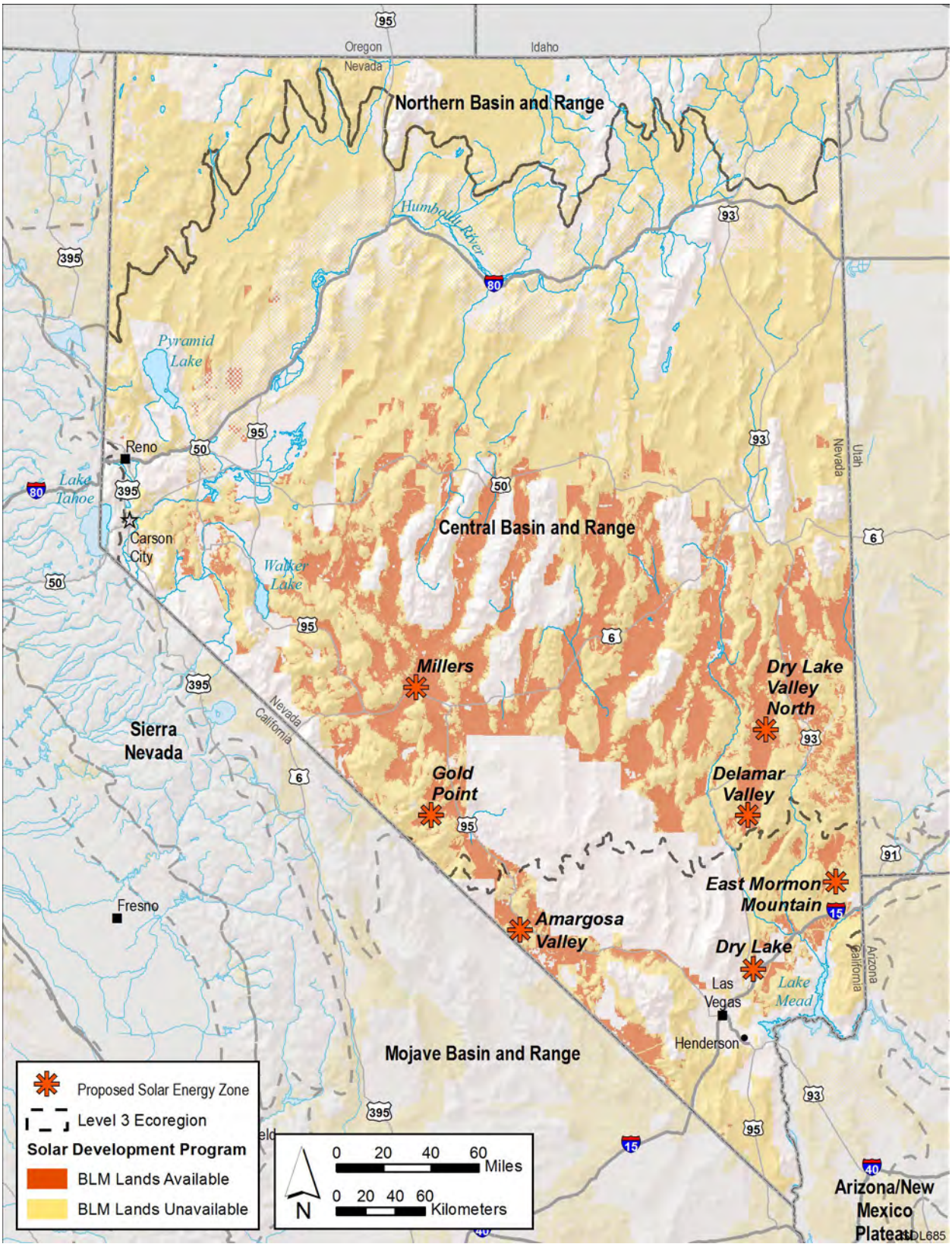


FIGURE I-6 Level III Ecoregions of Colorado and SEZs (Source: EPA 2007b)



1

2 **FIGURE I-7 Level III Ecoregions of Nevada and SEZs (Source: EPA 2007b)**

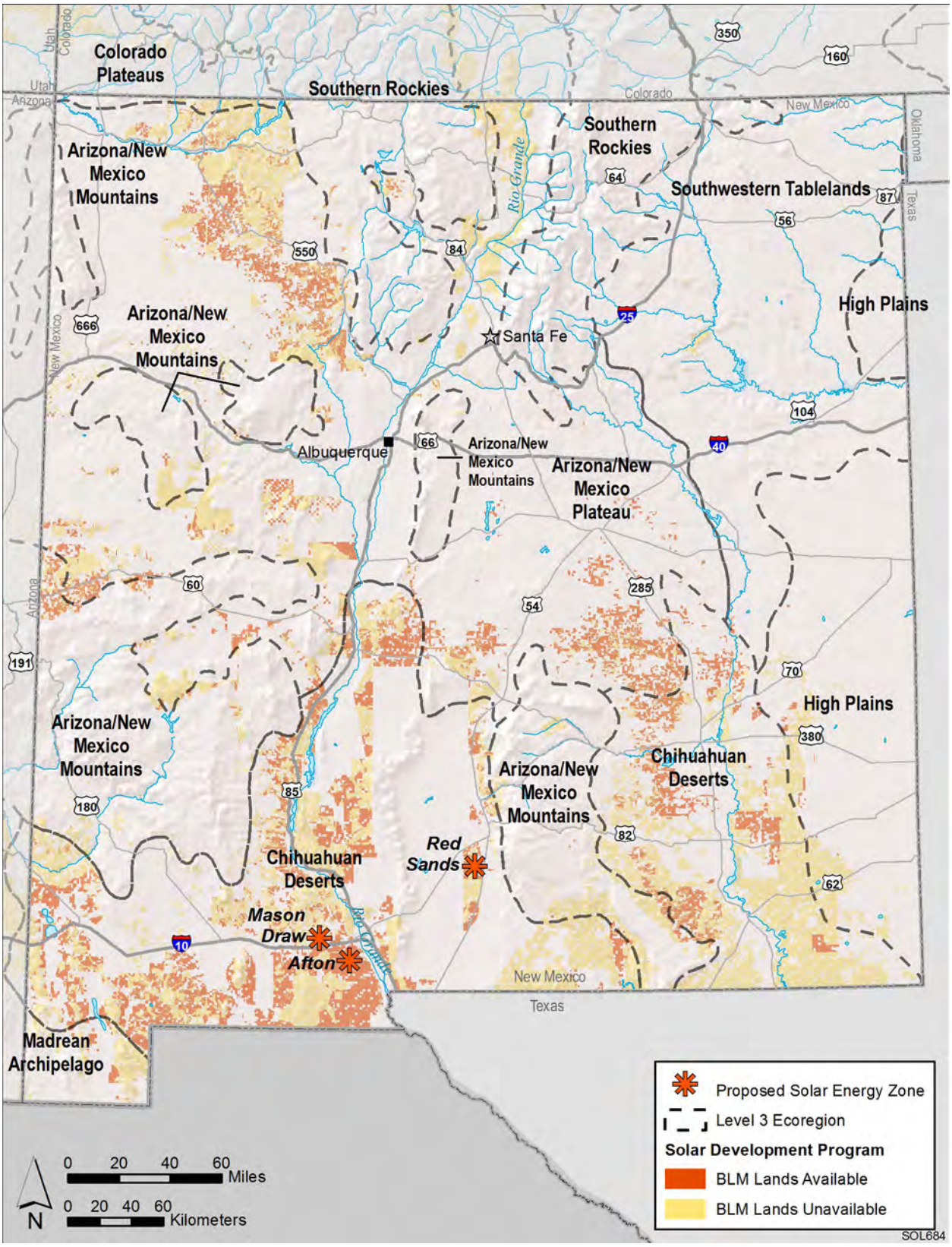


FIGURE I-8 Level III Ecoregions of New Mexico and SEZs (Source: EPA 2007b)

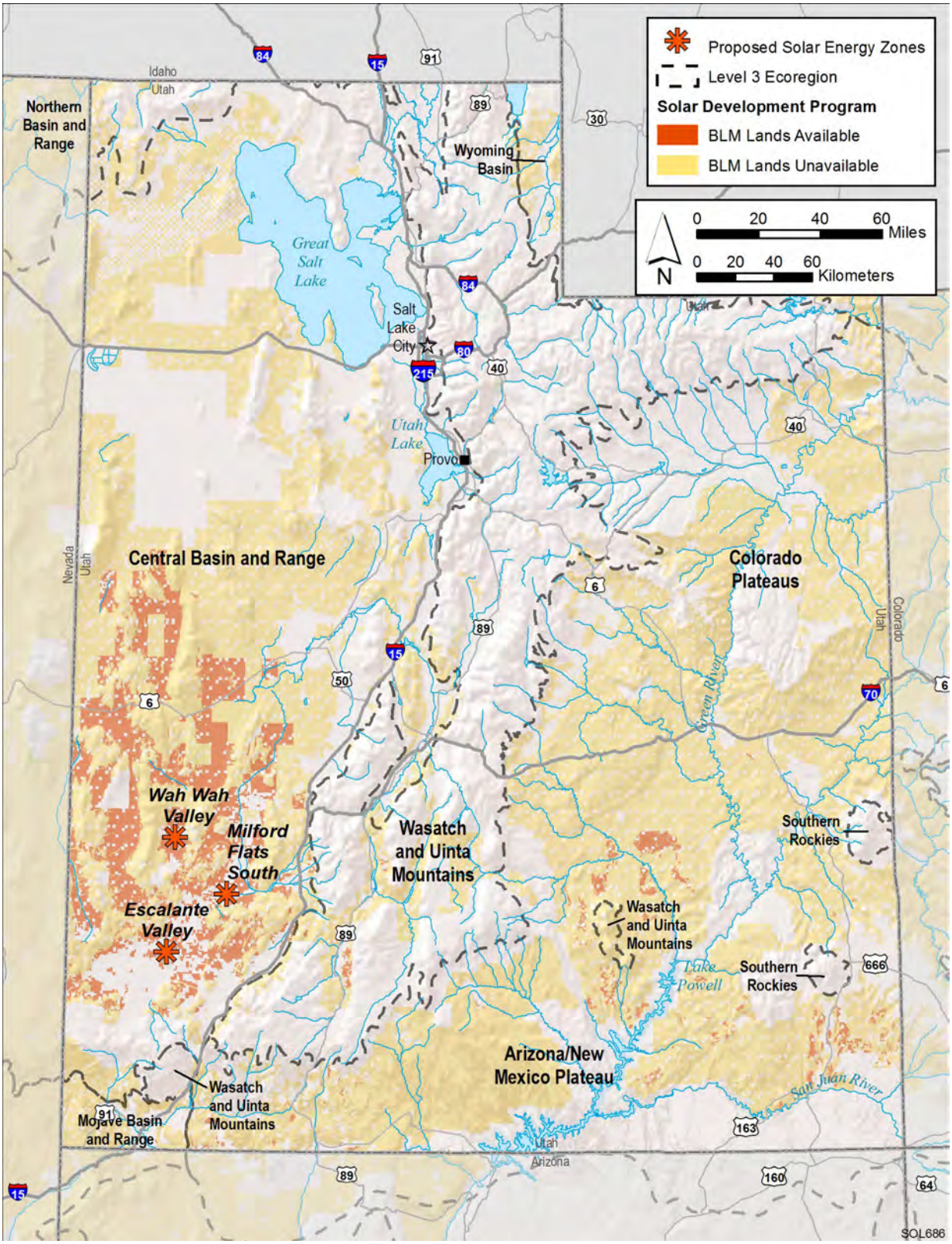


FIGURE I-9 Level II Ecoregions of Utah and SEZs (Source: EPA 2007b)

I.1.2 Cascades

The Cascades ecoregion occurs in California and extends north into Oregon and Washington. Within the six-state study area analyzed in the PEIS, the ecoregion is approximately 365,500 acres (1,479 km^2), and the elevation ranges from 2,989 to 12,747 ft (911 to 3,885 m). This mountainous ecoregion contains steep ridges and river valleys in the west and a high plateau in the east. The landscape includes westerly trending mountain ridges, steeply sloping mountains, and scattered lakes in glacial-rock basins, as well as glaciers and year-round snowfields on the highest peaks. It includes active and dormant volcanoes. The ecoregion's moist, temperate climate supports extensive coniferous forests, with subalpine meadows occurring at high elevations. Timber management and recreation are major land use activities. Neither the development program alternative nor the SEZ program alternative includes this ecoregion.

I.1.3 Sierra Nevada

The Sierra Nevada ecoregion is located almost entirely in California, except for a small portion in west–central Nevada. Within the six-state study area analyzed in the PEIS, the ecoregion is approximately 13,030,000 acres (52,729 km^2), and the elevation ranges from 827 to 13,596 ft (252 to 4,144 m). This deeply dissected ecoregion slopes gently down to the west and drops sharply on the eastern edge. The eastern portion has been strongly glaciated, and it is characterized by high mountain slopes, peaks, ridges, moraines, and lakes. Lower elevations support mostly ponderosa pine in the west and lodgepole pine in the east, with fir and spruce at higher elevations. Alpine conditions exist at the highest elevations. The Sierra Nevada ecoregion is famous for its scenic resources. In addition, its close proximity to San Francisco and other major urban areas leads to high levels of recreational use. Other land uses include logging, wildlife habitat, rangeland, and woodland grazing. The development program alternative includes 71 acres (0.29 km^2) of this ecoregion; the SEZ program alternative does not include this ecoregion.

I.1.4 Southern and Central California Chaparral and Oak Woodlands

The Southern and Central California Chaparral and Oak Woodlands ecoregion is located entirely within California and covers a sizable portion of the state. Within the six-state study area analyzed in the PEIS, the ecoregion is approximately 24,734,900 acres (100,099 km^2), and the elevation ranges from 0 to 7,166 ft (0 to 2,184 m). Open low mountains or foothills compose most of the region, with some irregular plains in the south. The ecoregion exhibits a Mediterranean climate of hot, dry summers and cool, moist winters. It supports mainly chaparral and oak woodlands vegetation. Grasslands occur at some lower elevations, and small stands of pine grow at higher elevations. Much of this region is grazed by domestic livestock; very little land has been cultivated. Numerous urban areas are found within the ecoregion, including Los Angeles, San Francisco, and San Diego. Neither the development program alternative nor the SEZ program alternative includes this ecoregion.

I.1.5 Central California Valley

The Central California Valley ecoregion is located entirely within California. Within the six-state study area analyzed in the PEIS, the ecoregion is approximately 11,368,000 acres (46,006 km^2), and the elevation ranges from 0 to 4,337 ft (0 to 1,322 m). The ecoregion is a flat, intensively farmed plain that has long, hot, dry summers and cool winters. Nearly half of the region is cropland, most of which is irrigated. The region once supported an array of prairies, oak-grass savannas, desert grasslands, riparian woodlots, and wetlands; however, human activities have affected most of the native plant communities (Olson and Cox 2001). Neither the development program alternative nor the SEZ program alternative includes this ecoregion.

I.1.6 Southern California Mountains

Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 4,427,900 acres (17,919 km^2), and the elevation ranges from 3 to 10,621 ft (1 to 3,237 m). The Southern California Mountains ecoregion occurs only in California. This ecoregion has a Mediterranean climate of hot, dry summers and cool, moist winters, but because of a higher elevation than adjacent ecoregions, it has slightly cooler temperatures and more moisture. Comparatively dense chaparral and oak woodlands are the predominant vegetation types, along with stands of ponderosa pine. Some grazing occurs, resulting in erosion in some areas. The development program alternative includes 439 acres (1.78 km^2) of this ecoregion; the SEZ program alternative does not include this ecoregion.

I.1.7 Eastern Cascades Slopes and Foothills

The Eastern Cascades Slopes and Foothills ecoregion is located in California and extends north into Oregon and Washington. Within the six-state study area analyzed in the PEIS, the ecoregion is approximately 5,100,000 acres (20,639 km^2), and the elevation ranges from 2,015 to 9,348 ft (614 to 2,849 m). This ecoregion, with a dry continental climate, lies in the rain shadow of the Cascade Mountains and supports open forests of ponderosa pine and some lodgepole pine. Plant communities in this ecoregion are adapted to frequent fires. Landscapes range from marshy basins to steeply sloped mountains and volcanic plateaus. The region also contains forests of white fir, sugar pine, and incense cedar; western juniper woodlands; and sagebrush steppe with low sagebrush, Wyoming big sagebrush, and bunchgrasses (Thorson et al. 2003). Important land uses include timber management, recreation, grazing, rural residential development, orchards, and cropping in valleys. Neither the development program alternative nor the SEZ program alternative includes this ecoregion.

I.1.8 Central Basin and Range

The Central Basin and Range is located in California, Nevada, and Utah. Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 76,238,900 acres (308,529 km^2), and the elevation ranges from 1,106 to 13,439 ft (337 to 4,096 m), but with

large portions between 4,000 and 9,000 ft (1,219 and 2,743 m). This internally drained ecoregion is characterized by a mosaic of xeric basins, scattered mountains, and salt flats. The topography is characterized by alternating basins and northerly trending mountain ranges. Shrub and shrub/grass communities, primarily Great Basin sagebrush and saltbush-greasewood, predominate on valleys, lower slopes, and alluvial fans, while juniper-pinyon woodland, mountain brush, and scattered western spruce-fir forests occur on higher elevation mountain slopes (EPA 2002; Bryce et al. 2003; Woods et al. 2001). Extensive, nearly flat alkaline or saline playas occur in this ecoregion, and tule marshes occur locally, especially along the Great Salt Lake (Bryce et al. 2003; Woods et al. 2001). The region is generally very sparsely populated but has some large urban areas on its periphery, including Carson City and Reno to the west and Salt Lake City to the northeast. Important land uses include rangeland, wildlife habitat, recreation, military reservations, logging, mining, and some irrigated farming. The development program alternative includes 10,274,956 acres (41,581.3 km^2) of this ecoregion; the SEZ program alternative includes 134,215 acres (543.149 km^2).

I.1.9 Mojave Basin and Range

The Mojave Basin and Range ecoregion is located in Arizona, California, Nevada, and Utah. Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 32,024,200 acres (129,598 km^2) in size, and the elevation ranges from –243 ft (–74 m) in Death Valley, California, to 10,909 ft (3,325 m). It has a warm, temperate climate with little precipitation and includes the Mojave Desert and scattered mountains (Holland et al. 2001; EPA 2002). The ecoregion is rich in endemic ephemeral plants. Creosotebush shrubland is the predominant natural vegetation. Mesquite, creosotebush, allscale, brittlebush, desert holly, and sagebrush are dominant species at low elevations (Holland et al. 2001); big sagebrush, blackbrush, Mormon tea, yellowbrush, galleta, Indian ricegrass, cheatgrass, and cholla are dominant at elevations of 3,000 to 5,000 ft (900 to 2,000 m); and pinyon, juniper, and oak woodlots dominate at elevations of 4,000 to 7,000 ft (1,000 to 2,000 m) (Woods et al. 2001; Bryce et al. 2003). The ecoregion includes the urban area of Las Vegas. Important land uses include rangeland, wildlife habitat, urban development, military bases, recreation, gravel operations, some pastureland, and some cropland. The development program alternative includes 2,547,519 acres (10,309.45 km^2) of this ecoregion; the SEZ program alternative includes 84,974 acres (343.88 km^2).

I.1.10 Wyoming Basin

The Wyoming Basin ecoregion occurs in Colorado and Utah, and it extends north into Wyoming, Idaho, and Montana. Within the six-state study area analyzed in the PEIS, the ecoregion is approximately 2,823,200 acres (11,425 km^2), and the elevation ranges from 5,942 to 9,538 ft (1,811 to 2,907 m). This ecoregion is a broad intermountain basin with rolling plains, mesas, terraces, scattered high hills, and low mountains (Chapman et al. 2006; Woods et al. 2001). The dominant vegetation types are arid grasslands and shrublands supporting bunchgrasses and sagebrush. Well-drained alluvial fans and foothills support sagebrush grasslands (Chapman et al. 2006). Wetlands supporting sedges, rushes, cattails,

and marsh grasses occur in poorly drained floodplains, alluvial fans, and terraces (Woods et al. 2001). Important land uses include oil and gas production, coal mining, grazing, and some irrigated farming. Neither the development program alternative nor the SEZ program alternative includes this ecoregion.

I.1.11 Wasatch and Uinta Mountains

The Wasatch and Uinta Mountains ecoregion occurs primarily in Utah and extends into Wyoming and Idaho. Within the six-state study area analyzed in the PEIS, the ecoregion is approximately 10,759,000 acres (43,539 km^2), and the elevation ranges from 3,645 to 12,921 ft (1,111 to 3,938 m). This ecoregion is composed of high mountains with narrow crests and valleys, bordered in some areas by dissected plateaus and open high mountains. Lower elevation semiarid foothills support pinyon-juniper woodlands, mountain mahogany-oak scrub, and maple-oak scrub; middle elevations support Douglas-fir forests, aspen parklands, ponderosa pine, and lodgepole pine; and Engelmann spruce, lodgepole pine, and subalpine fir occur at higher elevations (Woods et al. 2001). Alpine meadows are present above 11,000 ft (3,400 m). Land uses include timber production, seasonal range and livestock grazing, recreation, wildlife habitat, and oil production, with some irrigated farming in mountain valleys. The development program alternative includes 19,551 acres (79.120 km^2) of this ecoregion; the SEZ program alternative does not include this ecoregion.

I.1.12 Colorado Plateaus

The Colorado Plateaus ecoregion is located in Arizona, Colorado, and Utah, with a small portion in New Mexico. Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 32,581,700 acres (131,854 km^2), and the elevation ranges from 3,284 to 10,204 ft (1,001 to 3,110 m). This ecoregion is characterized by a rugged tableland topography, with large basins, ridges, spectacular canyons, and colorful geological formations. The ecoregion is heavily visited for recreational purposes. The higher elevations support extensive pinyon-juniper woodlands. Groundcover in these woodlands is sparse and consists of grama and other grasses, forbs, and shrubs, such as big sagebrush and alderleaf cercocarpus (Primm 2001). Lower areas contain saltbrush-greasewood shrublands, typical of hotter, drier areas. Land uses include livestock, some irrigated farming, recreation, mining, and gas and oil production. The development program alternative includes 1,165,623 acres (4717.112 km^2) of this ecoregion; the SEZ program alternative does not include this ecoregion.

I.1.13 Southern Rockies

The Southern Rockies ecoregion is located in Colorado, New Mexico, and Utah, and extends into Wyoming. Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 31,878,000 acres (129,006 km^2), and the elevation ranges from 5,187 to 13,777 ft (1,581 to 4,199 m). The ecoregion is characterized by high, steep, rugged mountains. Coniferous forest covers much of the region. The lowest elevations are generally grass- or shrub-covered.

Low to middle elevations support a variety of vegetation, including Douglas-fir, ponderosa pine, aspen, and juniper-oak woodlands. Middle to high elevations are predominantly coniferous forest. The highest elevations have alpine characteristics. Important land uses include timber management, recreation, hunting, wildlife habitat, grazing, mining, and oil production. The development program alternative includes 19,327 acres (78.214 km^2) of this ecoregion; the SEZ program alternative does not include this ecoregion

I.1.14 Arizona/New Mexico Plateau

The Arizona/New Mexico Plateau occurs primarily in Arizona, Colorado, and New Mexico, with a small portion in Nevada. Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 45,870,500 acres (185,632 km^2), and the elevation ranges from 2,165 to 11,949 ft (660 to 3,642 m). The ecoregion's landscapes include low mountains, hills, mesas, foothills, irregular plains, alkaline basins, some sand dunes, and wetlands. This ecoregion is a large transitional region between the semiarid grasslands to the east, the drier shrublands and woodlands to the north, and the lower, hotter, less vegetated areas to the west and south. Vegetation communities include shrublands with big sagebrush, rabbitbrush, winterfat, shadscale saltbush, and greasewood; and grasslands of blue grama, western wheatgrass, green needlegrass, and needle-and-thread grass (Chapman et al. 2006). Higher elevations may support pinyon pine and juniper forests. San Luis Lake is fed by regional groundwater and mountain streams. In Colorado, a high water table supports numerous ephemeral lakes, wetlands, springs, and flowing wells (Chapman et al. 2006). The ecoregion includes the urban areas of Santa Fe and Albuquerque. Important land uses include irrigated farming, recreation, rangeland, wildlife habitat, and some natural gas production. The development program alternative includes 2,038,581 acres (8,249.851 km^2) of this ecoregion; the SEZ program alternative includes 21,050 acres (85.186 km^2).

I.1.15 Arizona/New Mexico Mountains

The Arizona/New Mexico Mountains ecoregion occurs in Arizona and New Mexico. Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 26,782,700 acres (108,386 km^2), and the elevation ranges from 1,572 to 11,562 ft (479 to 3,524 m). It is characterized by low-elevation mountains that support vegetation indicative of dry, warm environments. Chaparral is common on lower elevations, while pinyon-juniper and oak woodlands are found on the lower and middle elevations. Open-to-dense ponderosa pine forests predominate at higher elevations, with forests of spruce, fir, and Douglas-fir in a few high-elevation areas. The ecoregion includes the urban area of Flagstaff, Arizona. Important land uses include timber production, livestock grazing, wildlife habitat, military use, and recreation. The development program alternative includes 160,550 acres (649.723 km^2) of this ecoregion; the SEZ program alternative does not include this ecoregion.

I.1.16 Chihuahuan Deserts

The Chihuahuan Deserts ecoregion occurs in Arizona and New Mexico. Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 19,108,000 acres (77,329 km^2), and the elevation ranges from 2,854 to 8,038 ft (870 m to 2,450 m). The broad basins and valleys of this ecoregion are bordered by sloping alluvial fans and terraces. The central and western parts of the region contain isolated mesas and mountains. Arid grassland and shrubland are the predominant vegetation types. The higher mountains, however, support oak-juniper woodlands. Important land uses include grazing, ranching, recreation, wildlife habitat, military reservations, and mining. The development program alternative includes 2,624,166 acres (10,619.63 km^2) of this ecoregion; the SEZ program alternative includes 113,052 acres (457.506 km^2).

I.1.17 High Plains

The High Plains ecoregion occurs in Colorado and New Mexico and extends north into Wyoming. Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 22,586,000 acres (91,404 km^2), and the elevation ranges from 2,979 to 6,992 ft (908 to 2,131 m). This ecoregion consists of smooth to slightly irregular plains. Blue grama-buffalo grass prairies dominate the natural vegetation in this region, which also includes sandsage prairie with sand sagebrush, rabbitbrush, sand bluestem, prairie sandreed, and Indian ricegrass (Chapman et al. 2006). Also occurring are bluestem-grama prairie and wheatgrass-bluestem-needlegrass prairie (Cook et al. 2001). Much of this ecoregion comprises cropland. The ecoregion includes the Denver, Colorado urban area. Other important land uses include grazing, oil and gas production, and gravel mining. The development program alternative includes 18,695 acres (75.656 km^2) of this ecoregion; the SEZ program alternative does not include this ecoregion.

I.1.18 Southwestern Tablelands

The Southwestern Tablelands ecoregion is located in Colorado and New Mexico. Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 21,610,000 acres (87,453 km^2), and the elevation ranges from 3,399 to 8,432 ft (1,036 to 2,570 m). This ecoregion is an elevated tableland that supports subhumid grassland and semiarid rangeland. The natural vegetation in this ecoregion is grama-buffalo grass, with mesquite-buffalo grass also occurring in the southeast portion. Midgrass prairie and open, low shrubs occur along the Canadian River. Juniper-scrub oak-grass savanna occurs on escarpment bluffs (Chapman et al. 2006). This ecoregion includes the urban area of Pueblo, Colorado. Land uses include grazing, dry and irrigated farming, and wildlife habitat, with increasing urban and residential development in some areas. The development program alternative includes 4,741 acres (19.19 km^2) of this ecoregion; the SEZ program alternative does not include this ecoregion.

I.1.19 Klamath Mountains

The Klamath Mountains ecoregion occurs in California and extends north into Oregon. Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 8,131,500 acres (32,907 km^2), and the elevation ranges from 577 to 8,268 ft (176 to 2,520 m). This ecoregion is physically and biologically diverse, with highly dissected, folded mountains; foothills; terraces; and floodplains. The vegetation is a mosaic of conifers and hardwoods. The valleys and foothills support grassland-savanna and grasslands with bunchgrass and wheatgrass, oak woodlands, oak savanna, Douglas-fir, ponderosa pine, madrone, and incense cedar (Thorson et al. 2003). Forests composed of tanoak, Douglas-fir, port orford cedar, and madrone occur on mountain areas. Seasonal ponds occur on mesa tops. Land uses include logging, grazing, crop and tree fruit production, recreation, rural residential development, mining, and some commercial development. Neither the development program alternative nor the SEZ program alternative includes this ecoregion.

I.1.20 Madrean Archipelago

The Madrean Archipelago ecoregion occurs in Arizona and New Mexico. Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 10,342,000 acres (41,851 km^2), and the elevation ranges from 2,129 to 10,250 ft (649 to 3,124 m). It consists of basins and ranges with medium to high local relief. Native vegetation in the basins is mostly grama-tobosa shrub-steppe. Oak-juniper woodland is the dominant vegetation type on the ranges; however, ponderosa pine is predominant at higher elevations. Land uses include livestock grazing, wildlife habitat, and some mining. The development program alternative includes 557,368 acres (2,255.59 km^2) of this ecoregion; the SEZ program alternative does not include this ecoregion.

I.1.21 Northern Basin and Range

The Northern Basin and Range ecoregion occurs in California, Nevada, and Utah, and it extends into Idaho and Oregon. Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 11,323,000 acres (45,824 km^2), and the elevation ranges from 4,200 to 9,961 ft (1,280 to 3,036 m). Landscapes include dissected lava plains, valleys, rocky uplands, rolling hills, alluvial fans, and scattered mountain ranges. Valleys and other mountainless areas support sagebrush steppe or saltbush communities, while juniper woodlands occur on rugged, stony uplands (Bryce et al. 2003; Woods et al. 2001). Some areas of sagebrush steppe support scattered ephemeral pools. Wetland communities of sedges, rushes, and marsh grasses; playas; and lakes also occur in this ecoregion. The dominant species on ranges at lower and middle elevations are Wyoming big sagebrush, black sagebrush, and cool season grasses, such as bluebunch wheatgrass and Idaho fescue. Douglas-fir, subalpine fir, mountain brush, and aspen groves are common at higher elevations, along with black sagebrush or mountain sagebrush, with open grassland on some ridge tops. Livestock grazing, recreation, mining, and wildlife habitat are important land uses, and there is some farming. Neither the development program alternative nor the SEZ program alternative includes this ecoregion.

I.1.22 Sonoran Basin and Range

The Sonoran Basin and Range ecoregion occurs in Arizona, California, and New Mexico. Within the six-state study area analyzed in the PEIS, this ecoregion is approximately 28,875,100 acres (116,854 km^2), and the elevation ranges from –243 to 6,569 ft (–74 to 2,002 m). This ecoregion includes the Sonoran Desert and scattered low mountains. The climate is slightly hotter than the Mojave Desert to the north. The potential natural vegetation of this arid ecoregion is predominantly creosotebush-bur sage with large areas of palo verde–cactus shrub and giant saguaro cactus. Land uses include grazing, agriculture, mining, and recreation. The development program alternative includes 3,140,682 acres (12,709.9 km^2) of this ecoregion; the SEZ program alternative includes 324,127 acres (1,311.70 km^2).

I.2 LAND COVER TYPES WITHIN THE POTENTIALLY AFFECTED AREAS OF THE PROPOSED SEZS

Land cover types, described and mapped under the Southwest Regional Gap Analysis Project, were used to evaluate plant communities in and near the SEZs. The following land cover descriptions are from USGS (2005).

Agriculture

An aggregated landcover type that includes both Pasture/Hay: areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle, where pasture/hay vegetation accounts for greater than 20 percent of total vegetation, and Cultivated Crops: areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards, where crop vegetation accounts for greater than 20 percent of total vegetation. Includes all land being actively tilled.

Apacherian-Chihuahuan Mesquite Upland Scrub

This ecological system occurs as upland shrublands that are concentrated in the extensive grassland-shrubland transition in foothills and piedmont in the Chihuahuan Desert. It extends into the Sky Island region to the west and the Edwards Plateau to the east. Substrates are typically derived from alluvium, often gravelly without a well-developed argillic or calcic soil horizon that would limit infiltration and storage of winter precipitation in deeper soil layers. *Prosopis* spp. and other deep-rooted shrubs exploit this deep soil moisture that is unavailable to grasses and cacti. Vegetation is typically dominated by *Prosopis glandulosa* or *Prosopis velutina* and succulents. Other desert scrub that may codominate or dominate includes *Acacia neovernicosa, Acacia constricta, Juniperus monosperma,* or *Juniperus coahuilensis*. Grass cover is typically low. During the last century, the area occupied by this system has increased through conversion of desert grasslands as a result of drought, overgrazing by livestock, and/or decreases in fire frequency. It is similar to Chihuahuan Mixed Desert and Thorn Scrub but is generally

found at higher elevations where *Larrea tridentata* and other desert scrub are not codominant. It is also similar to Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub but does not occur on eolian-deposited substrates.

Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe

This ecological system is a broadly defined desert grassland, mixed shrub-succulent or xeromorphic tree savanna that is typical of the Borderlands of Arizona, New Mexico, and northern Mexico [Apacherian region] but extends west to the Sonoran Desert, north into the Mogollon Rim, and throughout much of the Chihuahuan Desert. It is found on gently sloping bajadas that supported frequent fire throughout the Sky Islands and on mesas and steeper piedmont and foothill slopes in the Chihuahuan Desert. It is characterized by typically diverse perennial grasses. Common grass species include *Bouteloua eriopoda, Bouteloua hirsuta, Bouteloua rothrockii, Bouteloua curtipendula, Bouteloua gracilis, Eragrostis intermedia, Muhlenbergia porteri, Muhlenbergia setifolia, Pleuraphis jamesii, Pleuraphis mutica,* and *Sporobolus airoides,* succulent species of *Agave, Dasylirion,* and *Yucca,* and tall-shrub/short-tree species of *Prosopis* and various oaks (e.g., *Quercus grisea, Quercus emoryi, Quercus arizonica*). Many of the historical desert grassland and savanna areas have been converted, some to Chihuahuan Mesquite Upland Scrub (*Prosopis* spp.-dominated), through intensive grazing and other land uses.

Barren Lands Non-specific

(Rock/Sand/Clay)-Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits, and other accumulation of earthen material. Generally, vegetation accounts for less than 15% of total cover.

Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub

See Chihuahuan Mixed Desert and Thorn Scrub.

Chihuahuan Gypsophilous Grassland and Steppe

This ecological system is restricted to gypsum outcrops or sandy gypsiferous and/or often alkaline soils that occur in basins and slopes in the Chihuahuan Desert. Elevation range is from 1100-2000 m. These typically sparse grasslands, steppes, or dwarf-shrublands are dominated by a variety of gypsophilous plants, many of which are endemic to these habitats. Characteristic species include *Tiquilia hispidissima, Atriplex canescens, Calylophus hartwegii, Ephedra torreyana, Frankenia jamesii, Bouteloua breviseta, Mentzelia perennis, Nama carnosum, Calylophus hartwegii* (= *Oenothera hartwegii*), *Selinocarpus lanceolatus, Sporobolus nealleyi, Sporobolus airoides,* and *Sartwellia flaveriae*. This system does not include the sparsely

vegetated gypsum dunes that are included in North American Warm Desert Active and Stabilized Dune.

Chihuahuan Mixed Desert and Thorn Scrub

This widespread Chihuahuan Desert land cover type is composed of two ecological systems the Chihuahuan Creosotebush Xeric Basin Desert Scrub and the Chihuahuan Mixed Desert and Thorn Scrub. This cover type includes xeric creosotebush basins and plains and the mixed desert scrub in the foothill transition zone above, sometimes extending up to the lower montane woodlands. Vegetation is characterized by *Larrea tridentata* alone or mixed with thornscrub and other desert scrub such as *Agave lechuguilla, Aloysia wrightii, Fouquieria splendens, Dasylirion leiophyllum, Flourensia cernua, Leucophyllum minus, Mimosa aculeaticarpa* var. *biuncifera, Mortonia scabrella* (= *Mortonia sempervirens* ssp. *scabrella*), *Opuntia engelmannii, Parthenium incanum, Prosopis glandulosa,* and *Tiquilia greggii*. Stands of *Acacia constricta, Acacia neovernicosa,* or *Acacia greggii*-dominated thornscrub are included in this system, and limestone substrates appear important for at least these species. Grasses such as *Dasyochloa pulchella, Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua ramosa, Muhlenbergia porteri* and *Pleuraphis mutica* may be common, but generally have lower cover than shrubs.

Chihuahuan Mixed Salt Desert Scrub

This system includes extensive open-canopied shrublands of typically saline basins in the Chihuahuan Desert. Stands often occur on alluvial flats and around playas. Substrates are generally fine-textured, saline soils. Vegetation is typically composed of one or more *Atriplex* species such as *Atriplex canescens, Atriplex obovata,* or *Atriplex polycarpa* along with species of *Allenrolfea, Flourensia, Salicornia, Suaeda,* or other halophytic plants. Graminoid species may include *Sporobolus airoides, Pleuraphis mutica,* or *Distichlis spicata* at varying densities.

Chihuahuan Sandy Plains Semi-Desert Grassland

This ecological system occurs across the Chihuahuan Desert and extends into the southern Great Plains where soils have a high sand content. These dry grasslands or steppe are found on sandy plains and sandstone mesas. The graminoid layer is dominated or codominated by *Achnatherum hymenoides, Bouteloua eriopoda, Bouteloua hirsuta, Hesperostipa neomexicana, Pleuraphis jamesii, Sporobolus cryptandrus, Sporobolus airoides,* or *Sporobolus flexuosus*. Typically, there are found scattered desert shrubs and stem succulents such as *Ephedra torreyana, Ephedra trifurca, Fallugia paradoxa, Prosopis glandulosa, Yucca elata,* and *Yucca torreyi* that are characteristic of the Chihuahuan Desert.

Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub

This ecological system includes the open shrublands of vegetated coppice dunes and sandsheets found in the Chihuahuan Desert. Usually dominated by *Prosopis glandulosa* but includes *Atriplex canescens, Ephedra torreyana, Ephedra trifurca, Poliomintha incana,* and *Rhus microphylla* coppice sand scrub with 10–30% total vegetation cover. *Yucca elata, Gutierrezia sarothrae,* and *Sporobolus flexuosus* are commonly present.

Chihuahuan Succulent Desert Scrub

This ecological system is found in the Chihuahuan Desert on colluvial slopes, upper bajadas, sideslopes, ridges, canyons, hills, and mesas. Sites are hot and dry. Gravel and rock are often abundant on the ground surface. The vegetation is characterized by the relatively high cover of succulent species such as *Agave lechuguilla, Euphorbia antisyphilitica, Fouquieria splendens*, *Ferocactus* spp., *Opuntia engelmannii, Opuntia imbricata, Opuntia spinosior*, *Yucca baccata*, and many others. Perennial grass cover is generally low. The abundance of succulents is diagnostic of this desert scrub system, but desert shrubs are usually present. This system does not include desert grasslands or shrub-steppe with a strong cacti component.

Colorado Plateau Mixed Bedrock Canyon and Tableland

The distribution of this ecological system is centered on the Colorado Plateau where it is comprised of barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and open tablelands of predominantly sedimentary rocks, such as sandstone, shale, and limestone. Some eroding shale layers similar to Inter-Mountain Basins Shale Badland may be interbedded between the harder rocks. The vegetation is characterized by very open tree canopy or scattered trees and shrubs with a sparse herbaceous layer. Common species include *Pinus edulis, Pinus ponderosa, Juniperus* spp., *Cercocarpus intricatus*, and other short-shrub and herbaceous species, utilizing moisture from cracks and pockets where soil accumulates.

Colorado Plateau Mixed Low Sagebrush Shrubland

This ecological system occurs in the Colorado Plateau, Tavaputs Plateau, and Uinta Basin in canyons, gravelly draws, hilltops, and dry flats at elevations generally below 1800 m. Soils are often rocky, shallow, and alkaline. This type extends across northern New Mexico into the southern Great Plains on limestone hills. It includes open shrublands and steppe dominated by *Artemisia nova* or *Artemisia bigelovii* sometimes with *Artemisia tridentata* ssp. *wyomingensis* codominant. Semi-arid grasses such as *Achnatherum hymenoides, Aristida purpurea, Bouteloua gracilis, Hesperostipa comata, Pleuraphis jamesii*, or *Poa fendleriana* are often present and may form a graminoid layer with over 25% cover.

Colorado Plateau Pinyon-Juniper Woodland

This ecological system occurs in dry mountains and foothills of the Colorado Plateau region including the Western Slope of Colorado to the Wasatch Range, south to the Mogollon Rim, and east into the northwestern corner of New Mexico. It is typically found at lower elevations ranging from 1500–2440 m. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly, sandy loams to clay loam or clay. *Pinus edulis* and/or *Juniperus osteosperma* dominate the tree canopy. In the southern portion of the Colorado Plateau in northern Arizona and northwestern New Mexico, *Juniperus monosperma* and hybrids of *Juniperus* spp may dominate or codominate the tree canopy. *Juniperus scopulorum* may codominate or replace *Juniperus osteosperma* at higher elevations. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species include *Arctostaphylos patula, Artemisia tridentata, Cercocarpus intricatus, Cercocarpus montanus, Coleogyne ramosissima, Purshia stansburiana, Purshia tridentata, Quercus gambelii, Bouteloua gracilis, Pleuraphis jamesii,* or *Poa fendleriana*. This system occurs at higher elevations than Great Basin Pinyon-Juniper Woodland and Colorado Plateau shrubland systems where sympatric.

Developed, Medium–High Intensity

Developed, Medium Intensity: Includes areas with a mixture of constructed materials and vegetation. Impervious surface accounts for 50–79% of the total cover. These areas most commonly include single-family housing units. Developed, High Intensity: Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to 100% of the total cover.

Developed, Open Space–Low Intensity

Open Space: Includes areas with a mixture of some construction materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes. Developed, Low Intensity: Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20–49% of total cover. These areas most commonly include single-family housing units.

This system occurs in mountain ranges of the Great Basin and along the eastern slope of the Sierra Nevada within a broad elevation range from about 1220 m (4000 feet) to over 2135 m (7000 feet). This system often occurs as a mosaic of multiple communities that are tree-dominated with a diverse shrub component. The variety of plant associations connected to this system reflects elevation, stream gradient, floodplain width, and flooding events. Dominant trees may include *Abies concolor, Alnus incana, Betula occidentalis, Populus angustifolia, Populus balsamifera ssp. trichocarpa, Populus fremontii, Salix laevigata, Salix gooddingii,* and *Pseudotsuga menziesii*. Dominant shrubs include *Artemisia cana, Cornus sericea, Salix exigua, Salix lasiolepis, Salix lemmonii,* or *Salix lutea*. Herbaceous layers are often dominated by species of *Carex* and *Juncus*, and perennial grasses and mesic forbs such *Deschampsia caespitosa, Elymus trachycaulus, Glyceria striata, Iris missouriensis, Maianthemum stellatum,* or *Thalictrum fendleri*. Introduced forage species such as *Agrostis stolonifera, Poa pratensis, Phleum pratense,* and the weedy annual *Bromus tectorum* are often present in disturbed stands. These are disturbance-driven systems that require flooding, scour, and deposition for germination and maintenance. Livestock grazing is a major influence in altering structure, composition, and function of the community.

Great Basin Pinyon-Juniper Woodland

This ecological system occurs on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada. It is typically found at lower elevations ranging from 1600-2600 m. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Woodlands dominated by a mix of *Pinus monophylla* and *Juniperus osteosperma*, pure or nearly pure occurrences of *Pinus monophylla,* or woodlands dominated solely by *Juniperus osteosperma* comprise this system. *Cercocarpus ledifolius* is a common associate. Understory layers are variable. Associated species include shrubs such as *Arctostaphylos patula, Artemisia arbuscula, Artemisia nova, Artemisia tridentata, Cercocarpus ledifolius, Cercocarpus intricatus, Coleogyne ramosissima, Quercus gambelii, Quercus turbinella,* and bunch grasses *Hesperostipa comata, Festuca idahoensis, Pseudoroegneria spicata, Leymus cinereus* (= *Elymus cinereus*), and *Poa fendleriana*. This system occurs at lower elevations than Colorado Plateau Pinyon-Juniper Woodland where sympatric.

Great Basin Xeric Mixed Sagebrush Shrubland

This ecological system occurs in the Great Basin on dry flats and plains, alluvial fans, rolling hills, rocky hillslopes, saddles and ridges at elevations between 1000 and 2600 m. Sites are dry, often exposed to desiccating winds, with typically shallow, rocky, non-saline soils. Shrublands are dominated by Artemisia nova (mid and low elevations), *Artemisia arbuscula* (higher elevation), and may be codominated by *Artemisia tridentata* ssp. *wyomingensis* or *Chrysothamnus viscidiflorus*. Other shrubs that may be present include A*triplex confertifolia, Ephedra* spp., *Ericameria* spp., *Grayia spinosa, Lycium shockleyi, Picrothamnus desertorum, Sarcobatus vermiculatus,* and *Tetradymia* spp. The herbaceous layer is likely sparse and

composed of perennial bunch grasses such as *Achnatherum hymenoides, Achnatherum speciosum, Achnatherum thurberianum, Elymus elymoides,* or *Poa secunda*.

Hay/Pasture, Cultivated Crops

See Agriculture.

Inter-Mountain Basins Active and Stabilized Dune

This ecological system occurs in Intermountain West basins and is composed of unvegetated to moderately vegetated (<10–30% plant cover) active and stabilized dunes and sandsheets. Species occupying these environments are often adapted to shifting, coarse-textured substrates (usually quartz sand) and form patchy or open grasslands, shrublands or steppe composed of *Achnatherum hymenoides, Artemisia filifolia, Artemisia tridentata* ssp. *tridentata, Atriplex canescens, Ephedra* spp., *Coleogyne ramosissima, Ericameria nauseosa, Leymus flavescens, Prunus virginiana, Psoralidium lanceolatum, Purshia tridentata, Sporobolus airoides, Tetradymia tetrameres,* or *Tiquilia* spp.

Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland

This ecological system occurs on montane slopes and plateaus in Utah, western Colorado, northern Arizona, eastern Nevada, southern Idaho and western Wyoming. Elevations range from 1700 to 2800 m. Occurrences are typically on gentle to steep slopes on any aspect but are often found on clay-rich soils in intermontane valleys. Soils are derived from alluvium, colluvium, and residuum from a variety of parent materials but most typically occur on sedimentary rocks. The tree canopy is composed of a mix of deciduous and coniferous species, codominated by *Populus tremuloides* and conifers, including *Pseudotsuga menziesii, Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus contorta, Pinus flexilis,* and *Pinus ponderosa*. As the occurrences age, *Populus tremuloides* is slowly reduced until the conifer species become dominant. Common shrubs include *Amelanchier alnifolia, Prunus virginiana, Acer grandidentatum, Symphoricarpos oreophilus, Juniperus communis, Paxistima myrsinites, Rosa woodsii, Spiraea betulifolia, Symphoricarpos albus, or Mahonia repens*. Herbaceous species include *Bromus carinatus, Calamagrostis rubescens, Carex geyeri, Elymus glaucus, Poa* spp., and *Achnatherum, Hesperostipa, Nassella,* and/or *Piptochaetium* spp. (= *Stipa* spp.), *Achillea millefolium, Arnica cordifolia, Asteraceae* spp., *Erigeron* spp., *Galium boreale, Geranium viscosissimum, Lathyrus* spp., *Lupinus argenteus, Mertensia arizonica, Mertensia lanceolata, Maianthemum stellatum, Osmorhiza berteroi* (= *Osmorhiza chilensis*), and *Thalictrum fendleri*. Most occurrences at present represent a late-seral stage of aspen changing to a pure conifer occurrence. Nearly a hundred years of fire suppression and livestock grazing have converted much of the pure aspen occurrences to the present-day aspen-conifer forest and woodland ecological system.

In order to capture important habitat characteristics of an aspen-mixed conifer ecological system for vertebrate habitat modeling, SW ReGAP land cover mappers mapped patches of aspen-mixed conifer stands outside its normal range into the Southern Rocky Mountains. In the Southern Rocky Mountains, this system occurs as small to large patches of aspenmixed conifer woodland that could also be interpreted as seral stands within several Rocky Mountain conifer forest and woodland systems including: Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland, Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland, Rocky Mountain Lodgepole Pine Forest, Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland, Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland, and Rocky Mountain Ponderosa Pine Woodland.

Inter-Mountain Basins Big Sagebrush Shrubland

This ecological system occurs throughout much of the western United States, typically in broad basins between mountain ranges, plains and foothills between 1500 and 2300 m elevation. Soils are typically deep, well-drained, and non-saline. These shrublands are dominated by *Artemisia tridentata* ssp. *tridentata* and/or *Artemisia tridentata* ssp. *wyomingensis*. Scattered *Juniperus* spp., *Sarcobatus vermiculatus*, and *Atriplex* spp. may be present in some stands. *Ericameria nauseosa, Chrysothamnus viscidiflorus, Purshia tridentata,* or *Symphoricarpos oreophilus* may codominate disturbed stands. Perennial herbaceous components typically contribute less than 25% vegetative cover. Common graminoid species include *Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus, Festuca idahoensis, Hesperostipa comata, Leymus cinereus, Pleuraphis jamesii, Pascopyrum smithii, Poa secunda,* or *Pseudoroegneria spicata*.

Inter-Mountain Basins Big Sagebrush Steppe

This widespread matrix-forming ecological system occurs throughout much of the Columbia Plateau and northern Great Basin and Wyoming and is found at slightly higher elevations farther south. Soils are typically deep and non-saline, often with a microphytic crust. This shrub-steppe is dominated by perennial grasses and forbs (>25% cover) with *Artemisia tridentata* ssp. *tridentata, Artemisia tridentata* ssp. *xericensis, Artemisia tridentata* ssp. *wyomingensis, Artemisia tripartita* ssp. *tripartita*, and/or *Purshia tridentata* dominating or codominating the open to moderately dense (10-40% cover) shrub layer. *Atriplex confertifolia, Chrysothamnus viscidiflorus, Ericameria nauseosa, Tetradymia* spp., or *Artemisia frigida* may be common especially in disturbed stands. Associated graminoids include *Achnatherum hymenoides, Calamagrostis montanensis, Elymus lanceolatus* ssp. *lanceolatus, Festuca idahoensis, Festuca campestris, Koeleria macrantha, Poa secunda, and Pseudoroegneria spicata*. Common forbs are *Phlox hoodii, Arenaria* spp., and *Astragalus* spp. Areas with deeper soils more commonly support *Artemisia tridentata* ssp. *tridentata* but have largely been converted for other land uses. The natural fire regime of this ecological system likely maintains a patchy distribution of shrubs, so the general aspect of the vegetation is a grassland. Shrubs may increase following heavy grazing and/or with fire suppression, particularly in moist portions of the northern Columbia Plateau where it forms a landscape mosaic pattern with shallow-soil

scabland shrublands. Where fire frequency has allowed for shifts to a native grassland condition, maintained without significant shrub invasion over a 50- to 70-year interval, the area would be considered Columbia Basin Foothill and Canyon Dry Grassland.

Inter-Mountain Basins Cliff and Canyon

This ecological system is found from foothill to subalpine elevations and includes barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included is vegetation of unstable scree and talus slopes that typically occurs below cliff faces. Widely scattered trees and shrubs may include *Abies concolor, Pinus edulis, Pinus flexilis, Pinus monophylla, Juniperus* spp., *Artemisia tridentata, Purshia tridentata, Cercocarpus ledifolius, Ephedra* spp., *Holodiscus discolor*, and other species often common in adjacent plant communities.

Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland

See Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland.

Inter-Mountain Basins Greasewood Flat

This ecological system occurs throughout much of the western U.S. in Intermountain basins and extends onto the western Great Plains. It typically occurs near drainages on stream terraces and flats or may form rings around more sparsely vegetated playas. Sites typically have saline soils, a shallow water table and flood intermittently, but remain dry for most growing seasons. The water table remains high enough to maintain vegetation, despite salt accumulations. This system usually occurs as a mosaic of multiple communities, with open to moderately dense shrublands dominated or codominated by *Sarcobatus vermiculatus. Atriplex canescens, Atriplex confertifolia,* or *Krascheninnikovia lanata* may be present to codominant. Occurrences are often surrounded by mixed salt desert scrub. The herbaceous layer, if present, is usually dominated by graminoids. There may be inclusions of *Sporobolus airoides, Distichlis spicata* (where water remains ponded the longest), or *Eleocharis palustris* herbaceous types.

Inter-Mountain Basins Mixed Salt Desert Scrub

This extensive ecological system includes open-canopied shrublands of typically saline basins, alluvial slopes, and plains across the Intermountain western United States. This type also extends in limited distribution into the southern Great Plains. Substrates are often saline and calcareous, medium- to fine-textured, alkaline soils, but include some coarser-textured soils. The vegetation is characterized by a typically open to moderately dense shrubland composed of one or more *Atriplex* species such as *Atriplex confertifolia, Atriplex canescens, Atriplex polycarpa,* or *Atriplex spinifera*. Other shrubs present to codominate may include *Artemisia tridentata* ssp.

wyomingensis, Chrysothamnus viscidiflorus, Ericameria nauseosa, Ephedra nevadensis, Grayia spinosa, Krascheninnikovia lanata, Lycium spp., *Picrothamnus desertorum,* or *Tetradymia* spp. *Sarcobatus vermiculatus* is generally absent, but if present does not codominate. The herbaceous layer varies from sparse to moderately dense and is dominated by perennial graminoids such as *Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus* ssp. *lanceolatus, Pascopyrum smithii, Pleuraphis jamesii, Pleuraphis rigida, Poa secunda,* or *Sporobolus airoides*. Various forbs are also present.

Inter-Mountain Basins Montane Sagebrush Steppe

This ecological system includes sagebrush communities occurring at montane and subalpine elevations across the western United States from 1000 m in eastern Oregon and Washington to over 3000 m in the southern Rockies. In British Columbia, it occurs between 450 and 1650 m in the southern Fraser Plateau and the Thompson and Okanagan basins. Climate is cool, semi-arid to subhumid. This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. In general this system shows an affinity for mild topography, fine soils, and some source of subsurface moisture. It is composed primarily of *Artemisia tridentata* ssp. *vaseyana* (mountain sagebrush) and related taxa such as *Artemisia tridentata* ssp. *spiciformis* (= *Artemisia spiciformis*). *Purshia tridentata* may codominate or even dominate some stands. Other common shrubs include *Symphoricarpos* spp., *Amelanchier* spp., *Ericameria nauseosa, Peraphyllum ramosissimum, Ribes cereum,* and *Chrysothamnus viscidiflorus*. Most stands have an abundant perennial herbaceous layer (over 25% cover), but this system also includes *Artemisia tridentata* ssp. *vaseyana* shrublands. Common graminoids include *Festuca arizonica, Festuca idahoensis, Hesperostipa comata, Poa fendleriana, Elymus trachycaulus, Bromus carinatus, Poa secunda, Leucopoa kingii, Deschampsia caespitosa, Calamagrostis rubescens,* and *Pseudoroegneria spicata*. In many areas, frequent wildfires maintain an open herbaceous-rich steppe condition, although at most sites, shrub cover can be unusually high for a steppe system (>40%), with the moisture providing equally high grass and forb cover.

Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland

This ecological system occurs in hills and mountain ranges of the Intermountain basins from the eastern foothills of the Sierra Nevada northeast to the foothills of the Big Horn Mountains. It typically occurs from 600 m to over 2650 m in elevation on rocky outcrops or escarpments and forms small- to large-patch stands in forested areas. Most stands occur as shrublands on ridges and steep rimrock slopes, but it may occur as a small tree in steppe areas. This system includes both woodlands and shrublands dominated by *Cercocarpus ledifolius*. *Artemisia tridentata* ssp. *vaseyana, Purshia tridentata,* with species of *Arctostaphylos, Ribes,* or *Symphoricarpos* are often present. Scattered junipers or pines may also occur. *Cercocarpus ledifolius* is a slow-growing, drought-tolerant species that generally does not resprout after burning and needs the protection from fire that rocky sites provide.

Inter-Mountain Basins Playa

This ecological system is composed of barren and sparsely vegetated playas (generally <10% plant cover) found in the intermountain western United States. Salt crusts are common throughout, with small saltgrass beds in depressions and sparse shrubs around the margins. These systems are intermittently flooded. The water is prevented from percolating through the soil by an impermeable soil subhorizon and is left to evaporate. Soil salinity varies greatly with soil moisture and greatly affects species composition. Characteristic species may include *Allenrolfea occidentalis, Sarcobatus vermiculatus, Grayia spinosa, Puccinellia lemmonii, Leymus cinereus, Distichlis spicata,* and/or *Atriplex* spp.

Inter-Mountain Basins Semi-Desert Grassland

This widespread ecological system occurs throughout the intermountain western United States on dry plains and mesas, at approximately 1450 to 2320 m (4750–7610 feet) elevation. These grasslands occur in lowland and upland areas and may occupy swales, playas, mesatops, plateau parks, alluvial flats, and plains, but sites are typically xeric. Substrates are often well-drained sandy or loamy-textured soils derived from sedimentary parent materials but are quite variable and may include fine-textured soils derived from igneous and metamorphic rocks. When they occur near foothill grasslands they will be at lower elevations. The dominant perennial bunch grasses and shrubs within this system are all very drought-resistant plants. These grasslands are typically dominated or codominated by *Achnatherum hymenoides, Aristida* spp.*, Bouteloua gracilis, Hesperostipa comata, Muhlenbergia* spp., or *Pleuraphis jamesii* and may include scattered shrubs and dwarfshrubs of species of *Artemisia, Atriplex, Coleogyne, Ephedra, Gutierrezia,* or *Krascheninnikovia lanata*.

Inter-Mountain Basins Semi-Desert Shrub Steppe

This ecological system occurs throughout the intermountain western United States, typically at lower elevations on alluvial fans and flats with moderate to deep soils. This semi-arid shrub-steppe is typically dominated by graminoids (>25% cover) with an open shrub layer. Characteristic grasses include *Achnatherum hymenoides, Bouteloua gracilis, Distichlis spicata, Hesperostipa comata, Pleuraphis jamesii, Poa secunda,* and *Sporobolus airoides*. The woody layer is often a mixture of shrubs and dwarf-shrubs. Characteristic species include *Atriplex canescens, Artemisia tridentata, Chrysothamnus greenei, Chrysothamnus viscidiflorus, Ephedra* spp.*, Ericameria nauseosa, Gutierrezia sarothrae,* and *Krascheninnikovia lanata. Artemisia tridentata* may be present but does not dominate. The general aspect of occurrences may be either open shrubland with patchy grasses or patchy open herbaceous layer. Disturbance may be important in maintaining the woody component. Microphytic crust is very important in some stands.

Inter-Mountain Basins Shale Badland

This widespread ecological system of the intermountain western United States is composed of barren and sparsely vegetated substrates (<10% plant cover) typically derived from marine shales but also includes substrates derived from siltstones and mudstones (clay). Landforms are typically rounded hills and plains that form a rolling topography. The harsh soil properties and high rate of erosion and deposition are driving environmental variables supporting sparse dwarf-shrubs, e.g., *Atriplex corrugata, Atriplex gardneri, Artemisia pedatifida,* and herbaceous vegetation.

Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland

This ecological system extends from the Mojave Desert and Sierra Nevada across the central Great Basin to the central Wasatch and western Uinta mountains. These open woodlands are typically found on high-elevation ridges and rocky slopes above subalpine forests and woodlands. Site are harsh, exposed to desiccating winds with rocky substrates and a short growing season that limit plant growth. Parent materials include dolomitic, limestone, or granitic rocks. Occurrences can be found on all aspects but are more common on southwestern exposures on steep convex slopes and ridges between 2530 and 3600 m (8300–12,000 feet). Stands are strongly dominated by *Pinus flexilis* and/or *Pinus longaeva*. *Pinus monophylla* may be present in lower-elevation stands. If present, shrub and herbaceous layers are generally sparse and composed of xeric shrubs, graminoids, and cushion plants. Associated species may include *Antennaria rosea, Arenaria kingii, Artemisia tridentata, Cercocarpus intricatus, Chamaebatiaria millefolium, Cymopterus cinerarius, Elymus elymoides, Erigeron pygmaeus, Eriogonum ovalifolium, Festuca brachyphylla, Koeleria macrantha, Leptodactylon pungens, Ribes cereum,* or *Ribes montigenum.*

Inter-Mountain West Aspen-Mixed Conifer Forest and Woodland Complex

See Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland.

Introduced Riparian and Wetland Vegetation

See Invasive Southwest Riparian Woodland and Shrubland.

Introduced Upland Vegetation–Annual and Perennial Grassland

See Invasive Annual Grassland and Invasive Perennial Grassland.

Introduced Upland Vegetation–Annual Grassland

See Invasive Annual Grassland.

Introduced Upland Vegetation–Perennial Grassland and Forbland

See Invasive Perennial Grassland and Invasive Perennial Forbland.

Invasive Annual and Biennial Forbland

Areas that are dominated by introduced annual and/or biennial forb species such as: *Halogeton glomeratum, Kochia scoparia, Salsola* spp.

Invasive Annual Grassland

Areas that are dominated by introduced annual grass species such as: *Avena* spp., *Bromus* spp., *Schismus* spp.

Invasive Perennial Forbland

Areas that are dominated by introduced perennial forb species such as: *Circium arvense, C. vulgare, Centaurea* spp., *Euphorbia esula, Isatis tinctora, Lepidium* sp., *Melilotus albus, M. officinalis,* and *Onopordum acanthium.*

Invasive Perennial Grassland

Areas that are dominated by introduced perennial grass species such as: *Agropyron cristatum, Bromus inermis, Eragrostis lehmannianna, Pennisetum* spp., *Poa bulbosa, P. pratensis, Thinopyrum intermedium.*

Invasive Southwest Riparian Woodland and Shrubland

Areas that are dominated by introduced riparian woody species such as: *Tamarix* spp. and *Elaeagnus angustifolius.*

Madrean Encina

Madrean Encinal occurs on foothills, canyons, bajadas, and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, extending north into Trans-Pecos Texas, southern New Mexico, and sub-Mogollon Arizona. These woodlands are dominated by Madrean

evergreen oaks along a low-slope transition below Madrean Pine-Oak Forest and Woodland and Madrean Pinyon-Juniper Woodland. Lower elevation stands are typically open woodlands or savannas where they transition into desert grasslands, chaparral or in some cases desertscrub. Common evergreen oak species include *Quercus arizonica, Quercus emoryi, Quercus intricata, Quercus grisea, Quercus oblongifolia, Quercus toumeyi*, and in Mexico, *Quercus chihuahuensis* and *Quercus albocincta*. Madrean pine, Arizona cypress, pinyon, and juniper trees may be present, but do not codominate. Chaparral species such as *Arctostaphylos pungens, Cercocarpus montanus, Purshia* spp., *Garrya wrightii, Quercus turbinella, Frangula betulifolia* (= *Rhamnus betulifolia*), or *Rhus* spp. may be present but do not dominate. The graminoid layer is usually prominent between trees in grassland or steppe that is dominated by warm-season grasses such as *Aristida* spp., *Bouteloua gracilis, Bouteloua curtipendula, Bouteloua rothrockii, Digitaria californica, Eragrostis intermedia, Hilaria belangeri, Leptochloa dubia, Muhlenbergia* spp., *Pleuraphis jamesii,* or *Schizachyrium cirratum*, species typical of Chihuahuan Piedmont Semi-Desert Grassland. This system includes seral stands dominated by shrubby Madrean oaks typically with a strong graminoid layer. In transition areas with drier chaparral systems, stands of chaparral are not dominated by Madrean oaks; however, Madrean Encinal may extend down along drainages.

Madrean Juniper Savanna

This Madrean ecological system occurs in lower foothills and plains of southeastern Arizona, southern New Mexico extending into west Texas, and Mexico. These savannas have widely spaced mature juniper trees and moderate to high cover of graminoids (>25% cover). The presence of Madrean *Juniperus* spp. such as *Juniperus coahuilensis, Juniperus pinchotii,* and/or *Juniperus deppeana* is diagnostic. *Juniperus monosperma* may be present in some stands, and *Juniperus deppeana* has a broader range than this Madrean system and extends north into southern stands of Southern Rocky Mountain Juniper Savanna and Woodland. Stands of *Juniperus pinchotii* may be short and resemble a shrubland. Graminoid species are a mix of those found in Western Great Plains Shortgrass Prairie and Chihuahuan Piedmont Semi-Desert Grassland, with *Bouteloua gracilis* and *Pleuraphis jamesii* being most common. In addition, these areas include succulents such as species of *Yucca, Opuntia,* and *Agave*. Juniper savanna expansion into grasslands has been documented in the last century.

Madrean Pinyon-Juniper Woodland

This system occurs on foothills, mountains, and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, Trans-Pecos Texas, southern New Mexico, and Arizona, generally south of the Mogollon Rim. Substrates are variable, but soils are generally dry and rocky. The presence of *Pinus cembroides, Pinus discolor*, or other Madrean trees and shrubs is diagnostic of this woodland system. *Juniperus coahuilensis, Juniperus deppeana, Juniperus pinchotii, Juniperus monosperma,* and/or *Pinus edulis* may be present to dominant. Madrean oaks such as *Quercus arizonica, Quercus emoryi, Quercus grisea,* or *Quercus mohriana* may be codominant. *Pinus ponderosa* is absent or sparse. If present, understory layers are variable and may be dominated by shrubs or graminoids.

Mogollon Chaparral

This ecological system occurs across central Arizona (Mogollon Rim), western New Mexico, and southern Utah and Nevada. It often dominants along the mid-elevation transition from the Mojave, Sonoran, and northern Chihuahuan deserts into mountains (1000–2200 m). It occurs on foothills, mountain slopes and canyons in drier habitats below the encinal and *Pinus ponderosa* woodlands. Stands are often associated with more xeric and coarse-textured substrates such as limestone, basalt, or alluvium, especially in transition areas with more mesic woodlands. The moderate to dense shrub canopy includes species such as *Quercus turbinella, Quercus toumeyi, Cercocarpus montanus, Canotia holacantha, Ceanothus greggii, Forestiera pubescens* (= *Forestiera neomexicana*), *Garrya wrightii, Juniperus deppeana, Purshia stansburiana, Rhus ovata, Rhus trilobata, and Arctostaphylos pungens* and *Arctostaphylos pringlei* at higher elevations. Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires.

Mojave Mid-Elevation Mixed Desert Scrub

This ecological system represents the extensive desert scrub in the transition zone above *Larrea tridentata – Ambrosia dumosa* desert scrub and below the lower montane woodlands (700–1800 m elevations) that occurs in the eastern and central Mojave Desert. It is also common on lower piedmont slopes in the transition zone into the southern Great Basin. The vegetation in this ecological systems is quite variable. Codominants and diagnostic species include *Coleogyne ramosissima, Eriogonum fasciculatum, Ephedra nevadensis, Grayia spinosa, Menodora spinescens, Nolina* spp.*, Opuntia acanthocarpa, Salazaria mexicana, Viguiera parishii, Yucca brevifolia,* or *Yucca schidigera*. Desert grasses, including *Achnatherum hymenoides, Achnatherum speciosum, Muhlenbergia porteri, Pleuraphis jamesii, Pleuraphis rigida,* or *Poa secunda,* may form an herbaceous layer. Scattered Juniperus osteosperma or desert scrub species may also be present.

North American Arid West Emergent Marsh

This widespread ecological system occurs throughout much of the arid and semi-arid regions of western North America, typically surrounded by savanna, shrub steppe, steppe, or desert vegetation. Natural marshes may occur in depressions in the landscape (ponds, kettle ponds), as fringes around lakes, and along slow-flowing streams and rivers (such riparian marshes are also referred to as sloughs). Marshes are frequently or continually inundated, with water depths up to 2 m. Water levels may be stable, or may fluctuate 1 m or more over the course of the growing season. Water chemistry may include some alkaline or semi-alkaline situations, but the alkalinity is highly variable even within the same complex of wetlands. Marshes have distinctive soils that are typically mineral, but can also accumulate organic material. Soils have characteristics that result from long periods of anaerobic conditions in the soils (e.g., gleyed soils, high organic content, redoximorphic features). The vegetation is characterized by herbaceous plants that are adapted to saturated soil conditions. Common emergent and floating

vegetation includes species of *Scirpus* and/or *Schoenoplectus*, *Typha*, *Juncus*, *Potamogeton*, *Polygonum*, *Nuphar*, and *Phalaris*. This system may also include areas of relatively deep water with floating-leaved plants (*Lemna*, *Potamogeton*, and *Brasenia*) and submergent and floating plants (*Myriophyllum*, *Ceratophyllum*, and *Elodea*).

North American Warm Desert Active and Stabilized Dune

This ecological system occurs across the warm deserts of North America and is composed of unvegetated to sparsely vegetated (generally <10% plant cover) active dunes and sandsheets derived from quartz or gypsum sands. Common vegetation includes *Ambrosia dumosa*, *Abronia villosa*, *Eriogonum deserticola*, *Larrea tridentata*, *Pleuraphis rigida*, *Poliomintha* spp., *Prosopis* spp., *Psorothamnus* spp., *Artemisia filifolia*, and *Rhus microphylla*. Dune "blowouts" and subsequent stabilization through succession are characteristic processes.

North American Warm Desert Bedrock Cliff and Outcrop

This ecological system is found from subalpine to foothill elevations and includes barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included are unstable scree and talus slopes that typically occur bellow cliff faces. Species present are diverse and may include *Bursera microphylla*, *Fouquieria splendens*, *Nolina bigelovii*, *Opuntia bigelovii*, and other desert species, especially succulents. Lichens are predominant lifeforms in some areas. May include a variety of desert shrublands less than 2 ha (5 acres) in size from adjacent areas.

North American Warm Desert Lower Montane Riparian Woodland and Shrubland

This ecological system occurs in mountain canyons and valleys of southern Arizona, New Mexico, and adjacent Mexico and consists of mid- to low-elevation (1100–1800 m) riparian corridors along perennial and seasonally intermittent streams. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include *Populus angustifolia*, *Populus deltoides ssp. wislizeni*, *Populus fremontii*, *Platanus wrightii*, *Juglans major*, *Fraxinus velutina*, and *Sapindus saponaria*. Shrub dominants include *Salix exigua*, *Prunus* spp., *Alnus oblongifolia*, and *Baccharis salicifolia*. Vegetation is dependent upon annual or periodic flooding and associated sediment scour and/or annual rise in the water table for growth and reproduction.

North American Warm Desert Pavement

This ecological system occurs throughout much of the warm deserts of North America and is composed of unvegetated to very sparsely vegetated (<2% plant cover) landscapes, typically flat basins where extreme temperature and wind develop ground surfaces of fine to medium gravel coated with "desert varnish." Very low cover of desert scrub species such as

Larrea tridentata or *Eriogonum fasciculatum* is usually present. However, ephemeral herbaceous species may have high cover in response to seasonal precipitation, including *Chorizanthe rigida, Eriogonum inflatum,* and *Geraea canescens*.

North American Warm Desert Playa

This system is composed of barren and sparsely vegetated playas (generally <10% plant cover) found across the warm deserts of North America, extending into the extreme southern end of the San Joaquin Valley in California. Playas form with intermittent flooding, followed by evaporation, leaving behind a saline residue. Salt crusts are common throughout, with small saltgrass beds in depressions and sparse shrubs around the margins. Subsoils often include an impermeable layer of clay or caliche. Large desert playas tend to be defined by vegetation rings formed in response to salinity. Given their common location in wind-swept desert basins, dune fields often form downwind of large playas. In turn, playas associated with dunes often have a deeper water supply. Species may include *Allenrolfea occidentalis, Suaeda* spp.*, Distichlis spicata, Eleocharis palustris, Oryzopsis* spp.*, Sporobolus* spp.*, Tiquilia* spp.*, or Atriplex* spp. Ephemeral herbaceous species may have high cover periodically. Adjacent vegetation is typically Sonora-Mojave Desert Mixed Salt Desert Scrub, Chihuahuan Mixed Salt Desert Scrub, Gulf of California Coastal Mixed Salt Desert Scrub, Baja California del Norte Gulf Coast Ocotillo-Limberbush-Creosotebush Desert Scrub, or Chihuahuan Creosotebush Basin Desert Scrub.

North American Warm Desert Riparian Mesquite Bosque

This ecological system consists of low-elevation (<1100 m) riparian corridors along intermittent streams in valleys of southern Arizona and New Mexico, and adjacent Mexico. Dominant trees include *Prosopis glandulosa* and *Prosopis velutina*. Shrub dominants include *Baccharis salicifolia, Pluchea sericea,* and *Salix exigua*. Vegetation, especially the mesquites, tap groundwater below the streambed when surface flows stop. Vegetation is dependent upon annual rise in the water table for growth and reproduction.

North American Warm Desert Riparian Woodland and Shrubland

This ecological system consists of low-elevation (<1200 m) riparian corridors along medium to large perennial streams throughout canyons and the desert valleys of the southwestern United States and adjacent Mexico. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include *Acer negundo, Fraxinus velutina, Populus fremontii, Salix gooddingii, Salix lasiolepis, Celtis laevigata* var. *reticulata,* and *Juglans major*. Shrub dominants include *Salix geyeriana, Shepherdia argentea,* and *Salix exigua*. Vegetation is dependent upon annual or periodic flooding and associated sediment scour and/or annual rise in the water table for growth and reproduction.

North American Warm Desert Volcanic Rockland

This ecological system occurs across the warm deserts of North America and is restricted to barren and sparsely vegetated (<10% plant cover) volcanic substrates such as basalt lava (malpais) and tuff. Vegetation is variable and includes a variety of species depending on local environmental conditions, e.g., elevation, age and type of substrate. Typically scattered *Larrea tridentata, Atriplex hymenelytra,* or other desert shrubs are present.

North American Warm Desert Wash

This ecological system is restricted to intermittently flooded washes or arroyos that dissect bajadas, mesas, plains, and basin floors throughout the warm deserts of North America. Although often dry, the intermittent fluvial processes define this system, which are often associated with rapid sheet and gully flow. This system occurs as linear or braided strips within desert scrub- or desert grassland-dominated landscapes. The vegetation of desert washes is quite variable ranging from sparse and patchy to moderately dense and typically occurs along the banks, but may occur within the channel. The woody layer is typically intermittent to open and may be dominated by shrubs and small trees such as *Acacia greggii, Brickellia laciniata, Baccharis sarothroides, Chilopsis linearis, Fallugia paradoxa, Hymenoclea salsola, Hymenoclea monogyra, Juglans microcarpa, Prosopis* spp., *Psorothamnus spinosus, Prunus fasciculata, Rhus microphylla, Salazaria mexicana,* or *Sarcobatus vermiculatus*.

Open Water

Areas of open water, generally with less than 25% cover of vegetation or soil.

Recently Chained Pinyon-Juniper Areas

Areas that have recently been chained to remove Pinyon-Juniper and are clearly evident in the imagery (images acquired between 1999–2001).

Recently Logged Areas

Areas that have recently been clear-cut or thinned by 50% or more and are clearly evident in the imagery (images acquired between 1999–2001).

Recently Mined or Quarried

Areas where open pit mining or quarries are visible in the imagery (images acquired between 1999–2001), and are 2 ha or greater in size.

Rocky Mountain Alpine Bedrock and Scree

This ecological system is restricted to the highest elevations of the Rocky Mountains, from Alberta and British Columbia south into New Mexico, west into the highest mountain ranges of the Great Basin. It is composed of barren and sparsely vegetated alpine substrates, typically including both bedrock outcrop and scree slopes, with nonvascular- (lichen) dominated communities. Exposure to desiccating winds, rocky and sometimes unstable substrates, and a short growing season limit plant growth. There can be sparse cover of forbs, grasses, lichens, and low shrubs.

Rocky Mountain Alpine Fell-Field

This ecological system is found discontinuously at alpine elevations throughout the Rocky Mountains, west into the mountainous areas of the Great Basin, and north into the Canadian Rockies. Small areas are represented in the westside of the Okanagan Ecoregion in the eastern Cascades. These are wind-scoured fell-fields that are free of snow in the winter, such as ridgetops and exposed saddles, exposing the plants to severe environmental stress. Soils on these windy unproductive sites are shallow, stony, low in organic matter, and poorly developed; wind deflation often results in a gravelly pavement. Most fell-field plants are cushioned, or matted, frequently succulent, flat to the ground in rosettes and often densely haired and thickly cutinized. Plant cover is 15–50%, while exposed rocks make up the rest. Fell-fields are usually within or adjacent to alpine tundra dry meadows. Common species include *Arenaria capillaris, Carex albonigra, Carex paysonis, Geum rossii, Kobresia myosuroides, Minuartia obtusiloba, Myosotis asiatica, Paronychia pulvinata, Phlox pulvinata, Sibbaldia procumbens,* and *Silene acaulis.*

Rocky Mountain Alpine-Montane Wet Meadow

These are high-elevation communities found throughout the Rocky Mountains and Intermountain regions, dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. They range in elevation from montane to alpine (1000-3600 m). These types occur as large meadows in montane or subalpine valleys, as narrow strips bordering ponds, lakes, and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on sub-irrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches or on snowbeds. Soils of this system may be mineral or organic. In either case, soils show typical hydric soil characteristics, including high organic content and/or low chroma and redoximorphic features. This system often occurs as a mosaic of several plant associations, often dominated by graminoids, including *Calamagrostis stricta, Caltha leptosepala, Cardamine cordifolia, Carex illota, Carex microptera, Carex nigricans, Carex scopulorum, Carex utriculata, Carex vernacula, Deschampsia caespitosa, Eleocharis quinqueflora, Juncus drummondii, Phippsia algida, Rorippa alpina, Senecio triangularis, Trifolium parryi,* and *Trollius laxus*. Often alpine dwarf-shrublands, especially those dominated by *Salix,* are immediately adjacent to the wet meadows. Wet meadows are tightly associated with snowmelt and typically not subjected to high disturbance events such as flooding.

Rocky Mountain Aspen Forest and Woodland

This widespread ecological system is more common in the southern and central Rocky Mountains, but occurs throughout much of the western United States and north into Canada, in the montane and subalpine zones. Elevations generally range from 1525 to 3050 m (5000-10,000 feet), but occurrences can be found at lower elevations in some regions. Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand, and secondarily is limited by the length of the growing season or low temperatures. These are upland forests and woodlands dominated by *Populus tremuloides* without a significant conifer component (<25% relative tree cover). The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. Associated shrub species include *Symphoricarpos* spp., *Rubus parviflorus, Amelanchier alnifolia,* and *Arctostaphylos uva-ursi*. Occurrences of this system originate and are maintained by stand-replacing disturbances such as avalanches, crown fire, insect outbreak, disease and windthrow, or clearcutting by man or beaver, within the matrix of conifer forests.

Rocky Mountain Bigtooth Maple Ravine Woodland

This ecological system occurs in cool ravines, and on toeslopes and slump benches associated with riparian areas in the northern and central Wasatch Range and Tavaputs Plateau extending into southern Idaho, as well as in scattered localities in southwestern Utah, central Arizona and New Mexico, and the Trans-Pecos of Texas. Substrates are typically rocky colluvial or alluvial soils with favorable soil moisture. These woodlands are dominated by *Acer grandidentatum* but may include mixed stands codominated by *Quercus gambelii* or with scattered conifers. Some stands may include *Acer negundo* or *Populus tremuloides* as minor components. It also occurs on steeper, north-facing slopes at higher elevations, often adjacent to Rocky Mountain Gambel Oak-Mixed Montane Shrubland or Rocky Mountain Aspen Forest and Woodland.

Rocky Mountain Cliff and Canyon and Massive Bedrock

This ecological system of barren and sparsely vegetated landscapes (generally <10% plant cover) is found from foothill to subalpine elevations on steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. It is located throughout the Rocky Mountains and northeastern Cascade Ranges in North America. Also included are unstable scree and talus slopes that typically occur below cliff faces. There may be small patches of dense vegetation, but it typically includes scattered trees and/or shrubs. Characteristic trees includes species from the surrounding landscape, such as *Pseudotsuga menziesii, Pinus ponderosa, Pinus flexilis, Populus tremuloides, Abies concolor, Abies lasiocarpa,* or *Pinus edulis* and *Juniperus* spp. at lower elevations. There may be scattered shrubs present, such as species of *Holodiscus, Ribes, Physocarpus, Rosa, Juniperus,* and *Jamesia americana, Mahonia repens, Rhus trilobata,* or *Amelanchier alnifolia*. Soil development is limited, as is herbaceous cover.

Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland

This is a highly variable ecological system of the montane zone of the Rocky Mountains. It occurs throughout the southern Rockies, north and west into Utah, Nevada, western Wyoming, and Idaho. These are mixed-conifer forests occurring on all aspects at elevations ranging from 1200 to 3300 m. Rainfall averages less than 75 cm per year (40–60 cm) with summer "monsoons" during the growing season contributing substantial moisture. The composition and structure of overstory is dependent upon the temperature and moisture relationships of the site, and the successional status of the occurrence. *Pseudotsuga menziesii* and *Abies concolor* are most frequent, but *Pinus ponderosa* may be present to codominant. *Pinus flexilis* is common in Nevada. *Pseudotsuga menziesii* forests occupy drier sites, and *Pinus ponderosa* is a common codominant. *Abies concolor*-dominated forests occupy cooler sites, such as upper slopes at higher elevations, canyon sideslopes, ridgetops, and north- and east-facing slopes which burn somewhat infrequently. *Picea pungens* is most often found in cool, moist locations, often occurring as smaller patches within a matrix of other associations. As many as seven conifers can be found growing in the same occurrence, and there are a number of cold-deciduous shrub and graminoid species common, including *Arctostaphylos uva-ursi, Mahonia repens, Paxistima myrsinites, Symphoricarpos oreophilus, Jamesia americana, Quercus gambelii,* and *Festuca arizonica*. This system was undoubtedly characterized by a mixed severity fire regime in its "natural condition," characterized by a high degree of variability in lethality and return interval.

Rocky Mountain Dry Tundra

This widespread ecological system occurs above upper treeline throughout the Rocky Mountain cordillera, including alpine areas of ranges in Utah and Nevada, and isolated alpine sites in the northeastern Cascades. It is found on gentle to moderate slopes, flat ridges, valleys, and basins, where the soil has become relatively stabilized and the water supply is more or less constant. Vegetation in these areas is controlled by snow retention, wind desiccation, permafrost, and a short growing season. This system is characterized by a dense cover of low-growing, perennial graminoids and forbs. Rhizomatous, sod-forming sedges are the dominant graminoids, and prostrate and mat-forming plants with thick rootstocks or taproots characterize the forbs. Dominant species include *Artemisia arctica, Carex elynoides, Carex siccata, Carex scirpoidea, Carex nardina, Carex rupestris, Deschampsia caespitosa, Festuca brachyphylla, Festuca idahoensis, Geum rossii, Kobresia myosuroides, Phlox pulvinata,* and *Trifolium dasyphyllum*. Although alpine tundra dry meadow is the matrix of the alpine zone, it typically intermingles with alpine bedrock and scree, ice field, fell-field, alpine dwarfshrubland, and alpine/subalpine wet meadow systems.

Rocky Mountain Gambel Oak-Mixed Montane Shrubland

This ecological system occurs in the mountains, plateaus, and foothills in the southern Rocky Mountains and Colorado Plateau including the Uinta and Wasatch ranges and the Mogollon Rim. These shrublands are most commonly found along dry foothills, lower mountain slopes, and at the edge of the western Great Plains from approximately 2000 to 2900 m in

elevation, and are often situated above pinyon-juniper woodlands. Substrates are variable and include soil types ranging from calcareous, heavy, fine-grained loams to sandy loams, gravelly loams, clay loams, deep alluvial sand, or coarse gravel. The vegetation is typically dominated by *Quercus gambelii* alone or codominant with *Amelanchier alnifolia, Amelanchier utahensis, Artemisia tridentata, Cercocarpus montanus, Prunus virginiana, Purshia stansburiana, Purshia tridentata, Robinia neomexicana, Symphoricarpos oreophilus,* or *Symphoricarpos rotundifolius*. There may be inclusions of other mesic montane shrublands with Quercus gambelii absent or as a relatively minor component. This ecological system intergrades with the lower montane-foothills shrubland system and shares many of the same site characteristics. Density and cover of *Quercus gambelii* and *Amelanchier* spp. often increase after fire.

Rocky Mountain Lodgepole Pine Forest

This system is widespread in upper montane to subalpine elevations of the Rocky Mountains, Intermountain region, and north into the Canadian Rockies. These are subalpine forests where the dominance of *Pinus contorta* is related to fire history and topo-edaphic conditions. Following stand-replacing fires, *Pinus contorta* will rapidly colonize and develop into dense, even-aged stands. Most forests in this ecological system are early- to mid-successional forests which developed following fires. Some *Pinus contorta* forests will persist on sites that are too extreme for other conifers to establish. These include excessively well-drained pumice deposits, glacial till and alluvium on valley floors where there is cold air accumulation, warm and droughty shallow soils over fractured quartzite bedrock, and shallow moisture-deficient soils with a significant component of volcanic ash. Soils supporting these forests are typically well-drained, gravelly, coarse-textured, acidic, and rarely formed from calcareous parent materials. These forests are dominated by *Pinus contorta* with shrub, grass, or barren understories. Sometimes there are intermingled mixed conifer/*Populus tremuloides* stands with the latter occurring with inclusions of deeper, typically fine-textured soils. The shrub stratum may be conspicuous to absent; common species include *Arctostaphylos uva-ursi, Ceanothus velutinus, Linnaea borealis, Mahonia repens, Purshia tridentata, Spiraea betulifolia, Spiraea douglasii, Shepherdia canadensis, Vaccinium caespitosum, Vaccinium scoparium, Vaccinium membranaceum, Symphoricarpos albus,* and *Ribes* spp. In southern interior British Columbia, this system is usually an open lodgepole pine forest found extensively between 500 and 1600 m elevation in the Columbia range. In the Interior Cedar Hemlock and Interior Douglas-fir zones, *Tsuga heterophylla* or *Pseudotsuga menziesii* may present.

Rocky Mountain Lower Montane-Foothill Shrubland

This ecological system is found in the foothills, canyon slopes, and lower mountains of the Rocky Mountains and on outcrops and canyon slopes in the western Great Plains. It ranges from southern New Mexico extending north into Wyoming, and west into the Intermountain region. These shrublands occur between 1500–2900 m elevations and are usually associated with exposed sites, rocky substrates, and dry conditions, which limit tree growth. It is common where *Quercus gambelii* is absent such as the northern Colorado Front Range and in drier foothills and prairie hills. This system is generally drier than Rocky Mountain Gambel Oak-Mixed Montane

Shrubland, but may include mesic montane shrublands where *Quercus gambelii* does not occur. Scattered trees or inclusions of grassland patches or steppe may be present, but the vegetation is typically dominated by a variety of shrubs including *Amelanchier utahensis, Cercocarpus montanus, Purshia tridentata, Rhus trilobata, Ribes cereum, Symphoricarpos oreophilus,* or *Yucca glauca*. In northeastern Wyoming and north into adjacent Montana, *Cercocarpus ledifolius,* usually with *Artemisia tridentata,* is the common dominant shrub. Grasses are represented as species of *Muhlenbergia, Bouteloua, Hesperostipa*, and *Pseudoroegneria spicata*. Fires play an important role in this system as the dominant shrubs usually have a severe dieback, although some plants will stump sprout. *Cercocarpus montanus* requires a disturbance such as fire to reproduce, either by seed sprout or root crown sprouting. Fire suppression may have allowed an invasion of trees into some of these shrublands, but in many cases sites are too xeric for tree growth.

Rocky Mountain Lower Montane Riparian Woodland and Shrubland

This system is found throughout the Rocky Mountain and Colorado Plateau regions within a broad elevation range from approximately 900 to 2800 m. This system often occurs as a mosaic of multiple communities that are tree-dominated with a diverse shrub component. This system is dependent on a natural hydrologic regime, especially annual to episodic flooding. Occurrences are found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks. They can form large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. It is also typically found in backwater channels and other perennially wet but less scoured sites, such as floodplains swales and irrigation ditches. Dominant trees may include *Acer negundo, Populus angustifolia, Populus balsamifera, Populus deltoides, Populus fremontii, Pseudotsuga menziesii, Picea pungens, Salix amygdaloides,* or *Juniperus scopulorum*. Dominant shrubs include *Acer glabrum, Alnus incana, Betula occidentalis, Cornus sericea, Crataegus rivularis, Forestiera pubescens, Prunus virginiana, Rhus trilobata, Salix monticola, Salix drummondiana, Salix exigua, Salix irrorata, Salix lucida, Shepherdia argentea,* or *Symphoricarpos* spp. Exotic trees of *Elaeagnus angustifolia* and *Tamarix* spp. are common in some stands. Generally, the upland vegetation surrounding this riparian system is different and ranges from grasslands to forests.

Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland

These are mixed-conifer forests of the Rocky Mountains west into the ranges of the Great Basin, occurring predominantly in cool ravines and on north-facing slopes. Elevations range from 1200 to 3300 m. Occurrences of this system are found on cooler and more mesic sites than Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland. Such sites include lower and middle slopes of ravines, along stream terraces, moist, concave topographic positions and north- and east-facing slopes which burn somewhat infrequently. *Pseudotsuga menziesii* and *Abies concolor* are most common canopy dominants, but *Picea engelmannii, Picea pungens,* or *Pinus ponderosa* may be present. This system includes mixed conifer/*Populus tremuloides* stands. A number of cold-deciduous shrub species can occur, including *Acer glabrum, Acer grandidentatum, Alnus incana, Betula occidentalis, Cornus sericea, Jamesia americana,*

Physocarpus malvaceus, Robinia neomexicana, Vaccinium membranaceum, and *Vaccinium myrtillus*. Herbaceous species include *Bromus ciliatus, Carex geyeri, Carex rossii, Carex siccata, Muhlenbergia virescens, Pseudoroegneria spicata, Erigeron eximius, Fragaria virginiana, Luzula parviflora, Osmorhiza berteroi, Packera cardamine, Thalictrum occidentale,* and *Thalictrum fendleri*. Naturally occurring fires are of variable return intervals, and mostly light, erratic, and infrequent due to the cool, moist conditions.

Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland

Engelmann spruce and subalpine fir forests comprise a substantial part of the subalpine forests of the Cascades and Rocky Mountains from southern British Columbia east into Alberta, south into New Mexico and the Intermountain region. They are the matrix forests of the subalpine zone, with elevations ranging from 1275 m in its northern distribution to 3355 m in the south (4100–11,000 feet). They often represent the highest elevation forests in an area. Sites within this system are cold year-round, and precipitation is predominantly in the form of snow, which may persist until late summer. Snowpacks are deep and late-lying, and summers are cool. Frost is possible almost all summer and may be common in restricted topographic basins and benches. Despite their wide distribution, the tree canopy characteristics are remarkably similar, with *Picea engelmannii* and *Abies lasiocarpa* dominating either mixed or alone. *Pseudotsuga menziesii* may persist in occurrences of this system for long periods without regeneration. *Pinus contorta* is common in many occurrences, and patches of pure *Pinus contorta* are not uncommon, as well as mixed conifer/*Populus tremuloides* stands. In some areas, such as Wyoming, *Picea engelmannii*-dominated forests are on limestone or dolomite, while nearby codominated spruce-fir forests are on granitic or volcanic rocks. Xeric species may include *Juniperus communis, Linnaea borealis, Mahonia repens,* or *Vaccinium scoparium*. More northern occurrences often have taller, more mesic shrub and herbaceous species, such as *Empetrum nigrum, Rhododendron albiflorum,* and *Vaccinium membranaceum*. Disturbance includes occasional blow-down, insect outbreaks and stand-replacing fire.

Rocky Mountain Subalpine Mesic Meadow

This Rocky Mountain ecological system is restricted to sites in the subalpine zone where finely textured soils, snow deposition, or wind-swept dry conditions limit tree establishment. It is found typically above 3000 m in elevation in the southern part of its range and above 1500 m in the northern part. These upland communities occur on gentle to moderate-gradient slopes. The soils are typically seasonally moist to saturated in the spring, but if so will dry out later in the growing season. These sites are not as wet as those found in Rocky Mountain Alpine-Montane Wet Meadow. Vegetation is typically forb-rich, with forbs contributing more to overall herbaceous cover than graminoids. Important taxa include *Erigeron* spp., *Asteraceae* spp., *Mertensia* spp., *Penstemon* spp., *Campanula* spp., *Lupinus* spp., *Solidago* spp., *Ligusticum* spp., *Thalictrum occidentale, Valeriana sitchensis, Balsamorhiza sagittata, Wyethia* spp., *Deschampsia caespitosa, Koeleria macrantha,* and *Dasiphora fruticosa*. Burrowing mammals can increase the forb diversity.

Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland

This is a high-elevation system of the Rocky Mountains, dominated by *Picea engelmannii* and *Abies lasiocarpa*. It extends eastward into the northeastern Olympic Mountains and the northeastern side of Mount Rainier in Washington. Occurrences are typically found in locations with cold-air drainage or ponding, or where snowpacks linger late into the summer, such as north-facing slopes and high-elevation ravines. They can extend down in elevation below the subalpine zone in places where cold-air ponding occurs; northerly and easterly aspects predominate. These forests are found on gentle to very steep mountain slopes, high-elevation ridgetops and upper slopes, plateau-like surfaces, basins, alluvial terraces, well-drained benches, and inactive stream terraces. In the Olympics and northern Cascades, the climate is more maritime than typical for this system, but due to the lower snowfall in these rainshadow areas, summer drought may be more significant than snowpack in limiting tree regeneration in burned areas. *Picea engelmannii* is rare in these areas. Mesic understory shrubs include *Menziesia ferruginea, Vaccinium membranaceum, Rhododendron albiflorum, Amelanchier alnifolia, Rubus parviflorus, Ledum glandulosum, Phyllodoce empetriformis,* and *Salix* spp. Herbaceous species include *Actaea rubra, Maianthemum stellatum, Cornus canadensis, Erigeron eximius, Gymnocarpium dryopteris, Rubus pedatus, Saxifraga bronchialis, Tiarella* spp., *Lupinus arcticus* ssp. *subalpinus, Valeriana sitchensis,* and *graminoids Luzula glabrata* var. *hitchcockii* or *Calamagrostis canadensis*. Disturbances include occasional blow-down, insect outbreaks and stand-replacing fire.

Rocky Mountain Subalpine–Montane Limber-Bristlecone Pine Woodland

This ecological system occurs throughout the Rocky Mountains on dry, rocky ridges and slopes near upper treeline above the matrix spruce-fir forest. It extends down to the lower montane in the central and northern Rocky Mountains and northeastern Great Basin mountains where dominated by *Pinus flexilis*, particularly along the Front Range north into Canada. Sites are harsh, exposed to desiccating winds, with rocky substrates and a short growing season that limit plant growth. Higher-elevation occurrences are found well into the subalpine-alpine transition on wind-blasted, mostly westfacing slopes and exposed ridges. Calcareous substrates are important for Pinus flexilis-dominated communities in the northern Rocky Mountains and possibly elsewhere. The open tree canopy is often patchy and is strongly dominated by *Pinus flexilis* or *Pinus aristata* with the latter restricted to southern Colorado, northern New Mexico and the San Francisco Mountains in Arizona. In the northern Rockies and northern Great Basin, *Pinus albicaulis* is found in some occurrences. Other trees such as *Juniperus* spp., *Pinus contorta, Pinus ponderosa,* or *Pseudotsuga menziesii* are occasionally present. *Arctostaphylos uva-ursi, Cercocarpus ledifolius, Juniperus communis, Mahonia repens, Purshia tridentata, Ribes montigenum,* or *Vaccinium* spp. may form an open shrub layer in some stands. The herbaceous layer, if present, is generally sparse and composed of xeric graminoids, such as *Calamagrostis purpurascens, Festuca arizonica, Festuca idahoensis, Festuca thurberi,* or *Pseudoroegneria spicata,* or more alpine plants.

Rocky Mountain Subalpine-Montane Riparian Shrubland

This system is found throughout the Rocky Mountain cordillera from New Mexico north into Montana, and also occurs in mountainous areas of the Intermountain region and Colorado Plateau. These are montane to subalpine riparian shrublands occurring as narrow bands of shrubs lining streambanks and alluvial terraces in narrow to wide, low-gradient valley bottoms and floodplains with sinuous stream channels. Generally it is found at higher elevations, but can be found anywhere from 1700–3475 m. Occurrences can also be found around seeps, fens, and isolated springs on hillslopes away from valley bottoms. Many of the plant associations found within this system are associated with beaver activity. This system often occurs as a mosaic of multiple communities that are shrub- and herb-dominated and includes above-treeline, willow-dominated, snowmelt-fed basins that feed into streams. The dominant shrubs reflect the large elevational gradient and include *Alnus incana, Betula nana*, *Betula occidentalis, Cornus sericea, Salix bebbiana, Salix boothii, Salix brachycarpa, Salix drummondiana, Salix eriocephala, Salix geyeriana, Salix monticola, Salix planifolia,* and *Salix wolfii*. Generally the upland vegetation surrounding these riparian systems are of either conifer or aspen forests.

Rocky Mountain Subalpine-Montane Riparian Woodland

This riparian woodland system is comprised of seasonally flooded forests and woodlands found at montane to subalpine elevations of the Rocky Mountain cordillera, from southern New Mexico north into Montana, and west into the Intermountain region and the Colorado Plateau. It occurs throughout the interior of British Columbia and the eastern slopes of the Cascade Mountains. This system contains the conifer and aspen woodlands that line montane streams. These are communities tolerant of periodic flooding and high water tables. Snowmelt moisture in this system may create shallow water tables or seeps for a portion of the growing season. Stands typically occur at elevations between 1500 and 3300 m (4920–10,830 feet), farther north elevation ranges between 900 and 2000 m. This is confined to specific riparian environments occurring on floodplains or terraces of rivers and streams, in V-shaped, narrow valleys and canyons (where there is cold-air drainage). Less frequently, occurrences are found in moderate-wide valley bottoms on large floodplains along broad, meandering rivers, and on pond or lake margins. Dominant tree species vary across the latitudinal range, although it usually includes *Abies lasiocarpa* and/or *Picea engelmannii*; other important species include *Pseudotsuga menziesii, Picea pungens, Picea engelmannii X glauca, Populus tremuloides,* and *Juniperus scopulorum*. Other trees possibly present but not usually dominant include *Alnus incana, Abies concolor, Abies grandis, Pinus contorta, Populus angustifolia, Populus balsamifera* ssp. *trichocarpa,* and *Juniperus osteosperma*.

Sonora-Mojave Creosotebush-White Bursage Desert Scrub

This ecological system forms the vegetation matrix in broad valleys, lower bajadas, plains and low hills in the Mojave and lower Sonoran deserts. This desert scrub is characterized by a sparse to moderately dense layer (2–50% cover) of xeromorphic microphyllous and broad-leaved shrubs. *Larrea tridentata* and *Ambrosia dumosa* are typically dominants, but many

different shrubs, dwarf-shrubs, and cacti may codominate or form typically sparse understories. Associated species may include *Atriplex canescens, Atriplex hymenelytra, Encelia farinosa, Ephedra nevadensis, Fouquieria splendens, Lycium andersonii,* and *Opuntia basilaris*. The herbaceous layer is typically sparse, but may be seasonally abundant with ephemerals. Herbaceous species such as *Chamaesyce* spp., *Eriogonum inflatum, Dasyochloa pulchella, Aristida* spp., *Cryptantha* spp., *Nama* spp., and *Phacelia* spp. are common.

Sonora-Mojave Mixed Salt Desert Scrub

This system includes extensive open-canopied shrublands of typically saline basins in the Mojave and Sonoran deserts. Stands often occur around playas. Substrates are generally fine-textured, saline soils. Vegetation is typically composed of one or more *Atriplex* species such as *Atriplex canescens* or *Atriplex polycarpa* along with other species of *Atriplex*. Species of *Allenrolfea, Salicornia, Suaeda,* or other halophytic plants are often present to codominant. Graminoid species may include *Sporobolus airoides* or *Distichlis spicata* at varying densities.

Sonoran Mid-Elevation Desert Scrub

This transitional desert scrub system occurs along the northern edge of the Sonoran Desert in an elevational band along the lower slopes of the Mogollon Rim/Central Highlands region between 750 and 1300 m. Stands occur in the Bradshaw, Hualapai, and Superstition mountains, among other desert ranges, and are found above Sonoran Paloverde-Mixed Cacti Desert Scrub and below Mogollon Chaparral. Sites range from a narrow strip on steep slopes to very broad areas such as the Verde Valley. Climate is too dry for chaparral species to be abundant, and freezing temperatures during winter are too frequent and prolonged for many of the frost-sensitive species that are characteristic of Sonoran Paloverde-Mixed Cacti Desert Scrub, such as *Carnegia gigantea, Parkinsonia microphylla, Prosopis* spp., *Olneya tesota, Ferocactus* sp., and *Opuntia bigelovii*. Substrates are generally rocky soils derived from parent materials such as limestone, granitic rocks or rhyolite. The vegetation is typically composed of an open shrub layer of *Larrea tridentata, Ericameria linearifolia,* or *Eriogonum fasciculatum* with taller shrub such as *Canotia holacantha* (limestone or granite) or *Simmondsia chinensis* (rhyolite). The herbaceous layer is generally sparse.

Sonoran Paloverde-Mixed Cacti Desert Scrub

This ecological system occurs on hillsides, mesas, and upper bajadas in southern Arizona and extreme southeastern California. The vegetation is characterized by a diagnostic sparse, emergent tree layer of *Carnegia gigantea* (3–16 m tall) and/or a sparse to moderately dense canopy codominated by xeromorphic deciduous and evergreen tall shrubs *Parkinsonia microphylla* and *Larrea tridentata* with *Prosopis* sp., *Olneya tesota,* and *Fouquieria splendens* less prominent. Other common shrubs and dwarf-shrubs include *Acacia greggii, Ambrosia deltoidea, Ambrosia dumosa* (in drier sites), *Calliandra eriophylla, Jatropha cardiophylla, Krameria erecta, Lycium* spp., *Menodora scabra, Simmondsia chinensis,* and many cacti

including *Ferocactus* spp., *Echinocereus* spp., and *Opuntia* spp. (both cholla and prickly pear). The sparse herbaceous layer is composed of perennial grasses and forbs with annuals seasonally present and occasionally abundant. On slopes, plants are often distributed in patches around rock outcrops where suitable habitat is present.

Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland

See Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland

Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland

See Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland.

Southern Rocky Mountain Montane-Subalpine Grassland

This Rocky Mountain ecological system typically occurs between 2200 and 3000 m on flat to rolling plains and parks or on lower sideslopes that are dry, but it may extend up to 3350 m on warm aspects. Soils resemble prairie soils in that the A horizon is dark brown, relatively high in organic matter, slightly acid, and usually well-drained. An occurrence usually consists of a mosaic of two or three plant associations with one of the following dominant bunch grasses: *Danthonia intermedia*, *Danthonia parryi*, *Festuca idahoensis*, *Festuca arizonica*, *Festuca thurberi*, *Muhlenbergia filiculmis,* or *Pseudoroegneria spicata*. The subdominants include *Muhlenbergia montana, Bouteloua gracilis,* and *Poa secunda*. These large-patch grasslands are intermixed with matrix stands of spruce-fir, lodgepole, ponderosa pine, and aspen forests. In limited circumstances (e.g., South Park in Colorado), they form the “matrix” of high-elevation plateaus.

Southern Rocky Mountain Pinyon-Juniper Woodland

This southern Rocky Mountain ecological system occurs on dry mountains and foothills in southern Colorado east of the Continental Divide, in mountains and plateaus of north-central New Mexico, and extends out onto limestone breaks in the southeastern Great Plains. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. *Pinus edulis* and/or *Juniperus monosperma* dominate the tree canopy. *Juniperus scopulorum* may codominate or replace *Juniperus monosperma* at higher elevations. Stands with *Juniperus osteosperma* are representative the Colorado Plateau and are not included in this system. In southern transitional areas between Madrean Pinyon-Juniper Woodland and Southern Rocky Mountain Pinyon-Juniper Woodland in central New Mexico,

Juniperus deppeana becomes common. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species are more typical of southern Rocky Mountains than the Colorado Plateau and include *Artemisia bigelovii, Cercocarpus montanus, Quercus gambelii, Achnatherum scribneri, Bouteloua gracilis, Festuca arizonica,* or *Pleuraphis jamesii*.

Southern Rocky Mountain Ponderosa Pine Woodland

This very widespread ecological system is most common throughout the cordillera of the Rocky Mountains, from the Greater Yellowstone region south. It is also found in the Colorado Plateau region, west into scattered locations in the Great Basin, and in the Black Hills of South Dakota and Wyoming. These woodlands occur at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from less than 1900 m in northern Wyoming to 2800 m in the New Mexico mountains. Occurrences are found on all slopes and aspects; however, moderately steep to very steep slopes or ridgetops are most common. This ecological system generally occurs on igneous, metamorphic, and sedimentary material derived soils, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acid pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. Northern Rocky Mountain Ponderosa Pine Woodland in the eastern Cascades, Okanagan and northern Rockies regions receives winter and spring rains, and thus has a greater spring "green-up" than the drier woodlands in the central Rockies. *Pinus ponderosa* (primarily var. *scopulorum* and var. *brachyptera*) is the predominant conifer; *Pseudotsuga menziesii, Pinus edulis,* and *Juniperus* spp. may be present in the tree canopy. The understory is usually shrubby, with *Artemisia nova, Artemisia tridentata, Arctostaphylos patula, Arctostaphylos uva-ursi, Cercocarpus montanus, Purshia stansburiana, Purshia tridentata, Quercus gambelii, Symphoricarpos oreophilus, Prunus virginiana, Amelanchier alnifolia,* and *Rosa* spp. common species. *Pseudoroegneria spicata* and species of *Hesperostipa, Achnatherum, Festuca, Muhlenbergia,* and *Bouteloua* are some of the common grasses. Mixed fire regimes and ground fires of variable return intervals maintain these woodlands, depending on climate, degree of soil development, and understory density.

Undifferentiated Barren Land

(Rock/Sand/Clay)–Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits, and other accumulation of earthen material. Generally, vegetation accounts for less than 15% of total cover.

I.3 REFERENCES

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this PEIS. It is likely that at the time of publication of this PEIS, some of these Web pages may no longer be available or their URL

addresses may have changed. The original information has been retained and is available through the Public Information Docket for this PEIS.

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APPENDIX J:

SPECIAL STATUS SPECIES ASSOCIATED WITH BLM'S ALTERNATIVES IN THE SIX-STATE STUDY AREA

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APPENDIX J:

SPECIAL STATUS SPECIES ASSOCIATED WITH BLM'S ALTERNATIVES IN THE SIX-STATE STUDY AREA

J.1 INTRODUCTION

This section describes the definitions of special status species considered in analyses, data sources, and the analytical approach used to determine impacts of solar energy development within the U.S. Department of the Interior (DOI) Bureau of Land Management (BLM) alternative areas on special status species. These analyses were conducted for this *Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States* (Solar PEIS).

As discussed in Appendix M, special status species considered in the analyses included the following groups of species[1]:

- Species listed as threatened or endangered under the Endangered Species Act (ESA);
- Species that are proposed for listing, under review, or candidates for listing under the ESA;
- Species that are designated by the BLM as sensitive;
- Species that are listed as threatened or endangered by the state or states in the affected area[2]; and
- Species that are considered rare in the affected area. These include species that have been ranked by state natural heritage programs as S1 or S2, species listed by the state(s) as species of concern, or species listed by the U.S. Fish and Wildlife Service (USFWS) as species of concern. The inclusion of species with high state ranks also accounted for species with high global ranks (i.e., G1 or G2), because these species invariably have high state ranks as well.

The sources of species status and distribution data are presented in Table M.12-1 in Appendix M. This information includes data provided by state natural resource agencies, BLM field offices, and region-wide gap analysis programs, as well as information provided by

[1] Note that some of the categories of species included here do not fit BLM's definition of special status species as defined in BLM Manual 6840 (BLM 2008). These species are included here to ensure broad consideration of species that may be most vulnerable to impacts. Their inclusion is not intended to imply status by the BLM.

[2] State-listed species are considered to be those species that are protected by individual state regulatory statutes (e.g., California: California Endangered Species Act; Nevada: *Nevada Revised Statutes* [NRS] 501 or NRS 527).

NatureServe and the USFWS. Additional information on the number and types of special status species that were analyzed for each solar energy zone (SEZ) is discussed here in Sections J.2 through J.6.

The approach used to analyze the impacts of solar energy development on special status species within the areas available for development under PEIS alternatives was based on the distribution or presence of special status species. For the no action alternative, the analysis area consisted of approximately 99 million acres (400,000 km^2); for the solar energy program alternatives, it was approximately 22 million acres (87,336 km^2) For the SEZ alternative, both the area of direct effects and the area of indirect effects were considered. The area of direct effects was defined as the area that would be physically modified during project development (i.e., where ground-disturbing activities would occur). For some SEZs, the area of direct effects was limited to the SEZ itself, because no new transmission corridors or access roads were expected to be needed. For other SEZs, the area of direct effects included an assumed area of development for a transmission corridor needed to connect projects on the SEZ to the grid and/or access roads to connect projects to the road network. The area of indirect effects was defined as the area where ground-disturbing activities would not occur but that could be indirectly affected by project activities in the area of direct effects related to groundwater withdrawals, surface runoff, dust, noise, lighting, and accidental spills. The potential magnitude of indirect effects would decrease with increasing distance away from the SEZ. An example is the analysis of the proposed Amargosa Valley SEZ in Nevada, where groundwater withdrawals have the potential to deplete regional groundwater supplies that are needed to maintain seeps, springs, wetlands, and surface water bodies in the Amargosa River, Oasis Valley, and Ash Meadows, which are up to 25 mi (40 km) away from the SEZ boundary. Collectively, the areas of direct and indirect effects constituted the affected area. Special status species that had the potential to occur within the affected area of the proposed SEZs were included in this assessment. See Appendix M for a description on the analysis approach used.

Only those species that are known to occur in the SEZ regions (i.e., within 50 mi [80 km] of the SEZ centers) are discussed here in Appendix J because an expanded species analysis by alternative was identified too late during the preparation of the Draft PEIS to be accommodated in this version of the document. It is anticipated that a discussion of all species with the potential for being impacted under each alternative will be developed between the time of the Draft and Final PEISs. Of the species identified, 763 may occur in the no action alternative area, 562 may occur in the program alternative area, and 400 may occur in the affected area of the proposed SEZs analyzed in this PEIS. A summary of the total number of special status species that may occur in the affected area of each SEZ is presented in Table J.1-1.

J.2 SPECIES LISTED, PROPOSED FOR LISTING, CANDIDATES FOR LISTING, OR UNDER REVIEW FOR LISTING UNDER THE ENDANGERED SPECIES ACT

In total, there are 122 species listed as threatened or endangered under the ESA or that are candidates, proposed, or under review for listing under the ESA that may occur within the

TABLE J.1-1 Total Number of Special Status Species That May Occur in the Affected Area of Each SEZ

State	SEZ	Total Number of Special Status Species That May Occur in the Affected Area
Arizona	Brenda	20
Arizona	Bullard Wash	39
Arizona	Gillespie	29
California	Imperial East	35
California	Iron Mountain	43
California	Pisgah	54
California	Riverside East	70
Colorado	Antonito Southeast	38
Colorado	DeTilla Gulch	33
Colorado	Fourmile East	59
Colorado	Los Mogotes East	51
Nevada	Amargosa Valley	52
Nevada	Dry Lake	62
Nevada	Delamar Valley	49
Nevada	Dry Lake Valley North	22
Nevada	East Mormon Mountain	32
Nevada	Gold Point	21
Nevada	Millers	19
New Mexico	Afton	35
New Mexico	Mason Draw	29
New Mexico	Red Sands	43
Utah	Escalante Valley	18
Utah	Milford Flats South	20
Utah	Wah Wah Valley	22

affected area of one or more of the proposed SEZs. A summary of these species that may occur in the affected area of each SEZ is shown in Table J.2-1. (The sum of the species in Table J.2-1 is greater than the total number of species with a known or pending status under the ESA because some species could occur in the affected area of more than one SEZ.) Note that some species with a known or pending status under the ESA may also be BLM-designated sensitive, state-listed, or rare.

Consultation with the USFWS under Section 7 of the ESA is required for those species currently listed under the ESA; coordination with the USFWS should be conducted for those species that are candidates, proposed, or under review for listing under the ESA. Section 7 of the ESA requires all federal agencies to consult with the USFWS to ensure that agency actions are not likely to jeopardize the continued existence of listed species or result in destructive or adverse modification of critical habitat. The consultation process (also referred to as the Section 7 process) includes the development of a biological assessment (BA), which is a

TABLE J.2-1 Number of Species Listed under the ESA or Species That Are Candidates, Proposed, or under Review for ESA Listing That May Occur in the Affected Area of the Proposed SEZ

State	SEZ	Listed Threatened	Listed Endangered	Proposed for Listing	Candidate	Under Review	Total
Arizona	Brenda	1	0	0	0	1	2
Arizona	Bullard Wash	2	3	0	0	1	6
Arizona	Gillespie	1	2	0	2	1	6
California	Imperial East	0	1	1	0	0	2
California	Iron Mountain	1	0	0	0	0	1
California	Pisgah	1	1	0	0	0	2
California	Riverside East	1	1	0	0	0	2
Colorado	Antonito Southeast	0	1	0	1	1	3
Colorado	DeTilla Gulch	0	1	0	1	1	3
Colorado	Fourmile East	0	1	0	1	0	2
Colorado	Los Mogotes East	0	1	0	1	1	3
Nevada	Amargosa Valley	7	5	0	0	16	28
Nevada	Dry Lake	1	3	0	1	6	11
Nevada	Delamar Valley	1	4	0	1	5	11
Nevada	Dry Lake Valley North	1	0	0	0	0	1
Nevada	East Mormon Mountain	1	0	0	1	0	2
Nevada	Gold Point	0	0	0	1	0	1
Nevada	Millers	0	0	0	1	2	3
New Mexico	Afton	0	2	0	1	0	3
New Mexico	Mason Draw	0	2	0	0	0	2
New Mexico	Red Sands	0	4	0	0	0	4
Utah	Escalante Valley	1	0	0	1	0	2
Utah	Milford Flats South	1	0	0	1	0	2
Utah	Wah Wah Valley	1	0	0	1	3	5

document prepared to determine whether the proposed federal action is likely to adversely affect listed species, proposed species, or designated critical habitat. As a result of the BA and the consultation process, the USFWS will form a biological opinion formally stating whether or not the federal action is likely to jeopardize the continued existence of listed or proposed species or result in the destruction of adverse modification of critical habitat. Often, at the request of the USFWS, species that are not listed but are candidates or under review for ESA listing may be included in the BA for review if it is possible that the species may become listed under the ESA in the near future.

J.3 BLM-DESIGNATED SENSITIVE SPECIES

The BLM has established a policy, as specified in BLM Manual 6840, *Special Status Species Management* (BLM 2008b), whose purpose is "to provide policy and guidance for the conservation of BLM special status species and the ecosystems upon which they depend on BLM-administered lands." Objectives of the BLM special status species policy are to (1) conserve and/or recover ESA-listed species and the ecosystems on which they depend so that ESA protections are no longer needed for these species and (2) initiate proactive conservation measures that reduce or eliminate threats to Bureau sensitive species to minimize the likelihood of and need for listing of these species under the ESA. BLM special status species are "(1) species listed or proposed for listing under the ESA, and (2) species requiring special management consideration to promote their conservation and reduce the likelihood and need for future listing under the ESA, which are designated as Bureau sensitive by the State Director(s). All Federal candidate species, proposed species, and delisted species in the 5 years following delisting will be conserved as Bureau sensitive species." Each BLM state director maintains a list of sensitive species, and impacts on these species would have to be considered in project-specific assessments developed before approval of any activity that would affect listed or proposed species or critical habitat. A summary of the BLM-designated sensitive species that may occur in the affected area of each SEZ is presented in Table J.3-1.

J.4 STATE-LISTED SPECIES

For analyses presented in this PEIS, state-listed species were defined as those species considered to be protected by individual state regulatory statutes, as follows:

- Arizona: Plant species that are protected under the Arizona Native Plant Law (AZDA 2008) or wildlife that are species of special concern (WSC).

- California: Plant and animal species that are listed as threatened or endangered under the California Endangered Species Act (CESA).

- Colorado: Plant and animal species that are protected under *Colorado Revised Statute* (CRS) 33-2-101.

- Nevada: Species that are protected under NRS 501 (animals) or 527 (plants).

TABLE J.3-1 Total Number of BLM-Designated Sensitive Species That May Occur in the Affected Area of Each SEZ

State	SEZ	Total Number of BLM-Designated Species That May Occur in the Affected Area
Arizona	Brenda	11
Arizona	Bullard Wash	18
Arizona	Gillespie	15
California	Imperial East	15
California	Iron Mountain	15
California	Pisgah	28
California	Riverside East	27
Colorado	Antonito Southeast	17
Colorado	DeTilla Gulch	9
Colorado	Fourmile East	13
Colorado	Los Mogotes East	18
Nevada	Amargosa Valley	25
Nevada	Dry Lake	35
Nevada	Delamar Valley	34
Nevada	Dry Lake Valley North	21
Nevada	East Mormon Mountain	21
Nevada	Gold Point	16
Nevada	Millers	16
New Mexico	Afton	17
New Mexico	Mason Draw	16
New Mexico	Red Sands	23
Utah	Escalante Valley	17
Utah	Milford Flats South	18
Utah	Wah Wah Valley	21

- New Mexico: Plants that are listed under the Endangered Plant Species Act (*New Mexico Statutes Annotated* [NMSA] 1978 § 75-6-1) or wildlife that are listed under the Wildlife Conservation Act (NMSA 1978 § 17-2-37)

- Utah: The State of Utah does not maintain a separate list of state-regulated species; however, the Utah Department of Wildlife Resources (UDWR) publishes a list of "wildlife species of concern" that conveys no regulatory status.

A summary of the state-listed species that may occur in the affected area of each SEZ is presented in Table J.4-1. Some state-listed species may also be federally listed under the ESA or as a BLM-designated sensitive species or considered to be a rare species.

TABLE J.4-1 Total Number of State-Listed Species That May Occur in the Affected Area of Each SEZ

State	SEZ	Total Number of State-Listed Species That May Occur in the Affected Area
Arizona	Brenda	10
Arizona	Bullard Wash	21
Arizona	Gillespie	18
California	Imperial East	7
California	Iron Mountain	4
California	Pisgah	3
California	Riverside East	6
California	Antonito Southeast	4
California	DeTilla Gulch	3
California	Fourmile East	2
Colorado	Los Mogotes East	4
Nevada	Amargosa Valley	19
Nevada	Dry Lake	18
Nevada	Delamar Valley	15
Nevada	Dry Lake Valley North	8
Nevada	East Mormon Mountain	8
Nevada	Gold Point	8
Nevada	Millers	5
New Mexico	Afton	10
New Mexico	Mason Draw	9
New Mexico	Red Sands	16
Utah	Escalante Valley[a]	0
Utah	Milford Flats South[a]	0
Utah	Wah Wah Valley[a]	0

[a] The state of Utah does not maintain a separate list of state-regulated species.

J.5 RARE SPECIES

For analyses presented in this PEIS, rare species were defined as those species that may be locally or regionally rare but do not possess any state or federal regulatory status. This includes species identified by state resource agencies as species of concern, USFWS species of concern, and species with a state rank of S1 or S2, where S2 refers to a species that is imperiled in the state (e.g., fewer than 20 populations) and S1 refers to a species that is critically imperiled in the state (e.g., fewer than 5 populations). The inclusion of species with high state ranks also accounted for species with high global ranks (i.e., G1 or G2), because these species invariably have high state ranks as well.

A summary of the rare species that may occur in the affected area of each SEZ is presented in Table J.5-1 (The sum of the species in Table J.5-1 is greater than the total number of rare species because some species could occur in the affected area of more than one SEZ.) Some rare species may also be federally listed under the ESA or as a BLM-designated sensitive species or state protected.

J.6 SPECIAL STATUS SPECIES INFORMATION

This section presents information on all special status species that may occur in the region of the proposed SEZs. Table J.6-1 lists each of these species, their current status, a brief habitat description, and their potential to occur within the areas available for development under PEIS alternatives. (In the table, species are listed in this order: plants, fish, amphibians, invertebrates, birds, and mammals). Species accounts are presented for those species that may

TABLE J.5-1 Total Number of Rare Species That May Occur in the Affected Area of Each SEZ

State	SEZ	Total Number of Rare Species That May Occur in the Affected Area
Arizona	Brenda	18
Arizona	Bullard Wash	34
Arizona	Gillespie	22
California	Imperial East	35
California	Iron Mountain	42
California	Pisgah	51
California	Riverside East	69
Colorado	Antonito Southeast	33
Colorado	DeTilla Gulch	30
Colorado	Fourmile East	58
Colorado	Los Mogotes East	48
Nevada	Amargosa Valley	49
Nevada	Dry Lake	60
Nevada	Delamar Valley	47
Nevada	Dry Lake Valley North	20
Nevada	East Mormon Mountain	28
Nevada	Gold Point	19
Nevada	Millers	17
New Mexico	Afton	30
New Mexico	Mason Draw	23
New Mexico	Red Sands	36
Utah	Escalante Valley	16
Utah	Milford Flats South	18
Utah	Wah Wah Valley	20

TABLE J.6-1 Special Status Species Reviewed in the PEIS and Their Potential Occurrence in the Alternative Analysis Areas[a]

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants						
Abrams' spurge	*Chamaesyce abramsiana*	CA-S1	Restricted to deserts of southern California. Inhabits sandy substrates within creosote bush scrub communities in the Mojave and Sonoran Deserts at elevations below 3,000 ft.	x	x	x
Ackerman milkvetch	*Astragalus ackermanii*	NV-S2	Endemic to the Sheep and Pintwater ranges of southern Nevada. Occurs in crevices and ledges of carbonate cliffs in the mixed shrub, sagebrush, and juniper woodland habitat communities at elevations between 4,000 and 6,200 ft.	x	x	x
Acuna cactus	*Echinomastus erectocentrus* var. *acunensis*	ESA-C; AZ-HS; AZ-S1	Endemic to Arizona and nearby Sonora, Mexico. Occurs on well-drained knolls, gravel ridges, and desert flats between major washes at elevations between 1,200 and 2,790 ft. Known to occur in the palo verde saguaro association of southwestern Arizona.	x	x	
Alamo beardtongue	*Penstemon alamosensis*	FWS-SC; NM-SC	Known from the Sacramento and San Andres Mountains in Dona Ana and Otero Counties, New Mexico, as well as the Hueco Mountains in El Paso County, Texas. Occurs on sheltered rocky areas, canyon sides, and canyon bottoms on limestone substrate. Elevations range between 4,300 and 5,300 ft.	x	x	x
Algodones Dunes sunflower	*Helianthus niveus* spp. *tephrodes*	BLM-S; CA-E; AZ-S2; CA-S1; FWS-SC	Primarily restricted to the Algodones Dunes in Imperial County, California. Inhabits desert sand dune habitats at elevations below 328 ft.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Alkali mariposa-lily	*Calochortus striatus*	BLM-S; FWS-SC; CA-S2; NV-S1	Restricted to wetlands in the western Mojave Desert. Inhabits alkaline seeps, springs, and meadows at elevations between 2,600 and 4,600 ft.	x	x	x
Alpine braya	*Braya humilis*	CO-S2	Slightly disturbed microsites that are within exposed slopes, solifluction lobes, and scree slopes that have calcerous soils of Leadville limestone or Manitou dolomite derivation. Elevational ranges between 11,400 and 12,800 ft.	x		
Altai chickweed	*Stellaria irrigua*	CO-S2	Mountain rills and scree above 8,200 ft. This species has a remarkably disjunct distribution where it is known only to occur in Colorado and Siberia.	x	x	x
Amargosa beardtongue	*Penstemon fruticiformis* var. *amargosae*	BLM-S; CA-S2; FWS-SC	Primarily known from the Death Valley region of California and also adjacent western Nevada. Inhabits Mojave Desert scrub communities at elevations between 2,600 and 4,600 ft.	x	x	
Amargosa niterwort	*Nitrophila mohavensis*	ESA-E; CA-E; NV-P; NV-S1	Endemic to the Amargosa Valley in Inyo County, California, and Nye County, Nevada. It inhabits playas and alkaline wetlands near the Ash Meadows region.	x	x	x
American yellow lady's-slipper	*Cypripedium calceolus* spp. *parviflorum*	CO-S2	Aspen groves, ponderosa, and Douglas fir forests with rich humus and decaying leaf litter. Soil substrates are sandy to loam. Prefers rocky north or east facing hillsides at elevations between 7,400 and 8,500 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Angel trumpets	*Acleisanthes longiflora*	CA-S1	Restricted to California from a single occurrence in the Maria Mountains. Rocky, gravelly, loamy, or sandy calcerous, gypsiferous, or igneous-derived soils in deserts, grasslands, shrublands, or woodlands at elevations between 295 and 310 ft.	x	x	
Annual rock-nettle	*Eucnide rupestris*	CA-S2	Inhabits San Diego and Imperial Counties of southern California. Occurs on rock or talus slopes within Sonoran Desert scrub and Creosote bush scrub communities at elevations between 1,650 and 1,970 ft.	x		
Antelope Canyon goldenbush	*Ericameria cervina*	NV-S1	Known from Arizona, Nevada, and Utah. Occurs in rock crevices and talus in shadscale and Douglas-fir-bristlecone pine communities often on calcareous substrates; less commonly on ash flow tuff. Elevation ranges between 3,100 and 8,800 ft.	x	x	x
Aquarius milkvetch	*Astragalus newberryi* var. *aquarii*	BLM-S; AZ-S1	Endemic to Burro Creek in Mohave County, Arizona. Inhabits limey-clay soils in Sonoran Desert scrub communities, primarily on BLM lands in the Clay Hills area of critical environmental concern (ACEC). Elevation ranges between 2,000 and 2,600 ft.	x	x	
Aravaipa wood fern	*Thelypteris puberula* var. *sonorensis*	BLM-S; AZ-S2	Moist soils in shady canyon regions, riparian habitats such as riverbanks, seepage areas, and mesic meadow habitats. Elevation ranges between 2,220 and 4,500 ft.	x	x	x
Arid tansy-aster	*Machaeranthera arida*	AZ-S1	Low sand dunes, alkaline flats, riverbanks, and sandy roadsides.	x	x	x
Arizona cliff rose	*Purshia subintegra*	ESA-E; AZ-HS; AZ-S1	Endemic to central Arizona near Horseshoe Lake (Maricopa County), Cottonwood (Yavapai County), Burro Creek (Mohave County), and Bylas (Graham County) in rolling, rocky, limestone hills and slopes within the creosote bush-crucifixion thorn habitat. Elevation ranges between 2,100 and 4,000 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Arizona coralroot	*Hexalectris spicata*	BLM-S; NM-E; FWS-SC; NM-S2	Known from southern Arizona, New Mexico, Texas, and adjacent Mexico. Occurs in oak and pinyon-juniper woodland communities in areas of heavy leaf litter.	x	x	x
Arizona giant sedge	*Carex ultra*	BLM-S; AZ-S2	Shaded southeast-facing exposures of moist gravelly substrates near perennially wet springs and streams. Elevation ranges between 2,000 and 6,000 ft.	x	x	x
Arizona phlox	*Phlox amabilis*	AZ-S2	Endemic to Arizona on open limestone-rocky slopes within pinyon-juniper woodlands and ponderosa pine-gambel oak communities. Elevation ranges between 3,500 and 7,800 ft.	x		
Arizona pholistoma	*Pholistoma auritum* var. *arizonicum*	CA-S1	Restricted to the Whipple Mountains in southeastern California. Inhabits creosote bush scrub and desert scrub communities at elevations between 900 and 2,700 ft.	x	x	
Arizona Sonoran rosewood	*Vauquelinia californica* spp. *sonorensis*	BLM-S; AZ-S1	Known from the Ajo, Diablo, Mesquite, Sand Tank, and Santa Rosa Mountains in southwestern Arizona. Occurs on rocky slopes of hillsides and canyons on a variety of substrates. Associated with Sonoran Desert chaparral plant communities at elevations between 2,300 and 3,700 ft.	x	x	
Arizona willow	*Salix arizonica*	CO-S1	Subalpine wet meadows, low-gradient streambanks, wet drainage ways, and cienegas typically within coniferous forest matrix. Sites often occur as narrow, linear strips associated with perennial water and are unshaded to partly shaded. Slopes are generally flat to moderate (< 9%) at elevations between 7,500 and 11,700 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Arkansas Canyon stickleaf	*Nuttallia densa*	CO-S2	Washes, naturally disturbed sites, and steep rocky slopes having pinyon-juniper, sagebrush, or mountain mahogany. Substrates are composed of granodiorite, gneiss, gravel, and scree at elevations between 5,800 and 7,200 ft.	x		
Ash Meadows blazingstar	*Mentzelia leucophylla*	ESA-T; NV-P; NV-S1	Endemic to the Ash Meadows region in Nye County, Nevada, where it is narrowly confined to spring-fed desert wetlands.	x	x	x
Ash Meadows buckwheat	*Eriogonum contiguum*	CA-S2; NV-S1	Known from the Mojave Desert of Inyo County, California, and Clark and Nye Counties, Nevada. Occurs on sandy to gravelly flats and slopes in association with creosote scrub and mesquite communities at elevations below 3,280 ft.	x	x	x
Ash Meadows gumplant	*Grindelia fraxinopratensis*	ESA-T; NV-P; NV-S2	Endemic to the Ash Meadows region in Nye County, Nevada, where it is confined to saltgrass meadows along spring-fed desert wetlands.	x	x	x
Ash Meadows ivesia	*Ivesia kingii eremica*	ESA-T; NV-P; NV-S2	Endemic to the Ash Meadows region in Nye County, Nevada, where it is confined to a single spring-fed wetland area with saline soils.	x	x	x
Ash Meadows sunray	*Enceliopsis nudicaulis corrugata*	ESA-T; NV-P; NV-S2	Endemic to the Ash Meadows region in Nye County, Nevada, where it is confined to a single spring-fed wetland area with saline soils.	x	x	x
Ash-gray paintbrush	*Castilleja cinerea*	ESA-T; BLM-S; CA-S2	Endemic to the eastern end of the San Bernardino Mountains in southern California. Primarily found on pebble plains (dense clay soils, usually covered with a cobble pavement of quartzite). Also known from pine forests and dry sagebrush scrublands.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Autumn buttercup	*Ranunculus aestivalis*	ESA-E; UT-S1	Endemic to Garfield County, Utah. Only two populations are known to occur in sedgegrass meadows associated with seeps and springs in the Sevier River Valley. Occurs at elevations near 6,500 ft.	x	x	
Autumn willow	*Salix serissima*	CO-S1	Marshes or fens associated with other *Salix* and *Carex* species. Elevation ranges between 7,800 and 9,300 ft.	x	x	x
Aztec milkvetch	*Astragalus proximus*	CO-S2	Rocky Mountain ponderosa pine woodland, Colorado Plateau pinyon-juniper woodland, intermountain-basins, semi-desert shrub-steppe, and Rocky Mountain gambel oak-mixed montane shrublands at elevations between 5,400 and 7,300 ft.	x	x	x
Baja California ipomopsis	*Ipomopsis effusa*	CA-S1	Endemic to southern California in the southeastern Peninsular Ranges. Inhabits alluvial fan and sandy substrates within chaparral, creosote bush scrub, and Sonoran Desert scrub communities at elevations below 330 ft.	x		
Baja navarretia	*Navarretia peninsularis*	BLM-S; CA-S2	Inhabits meadows and seeps in lower montane coniferous forests and pinyon-juniper woodlands at elevations between 4,900 and 7,550 ft.	x		
Baldwin Lake linanthus	*Linanthus killipii*	BLM-S; CA-S2; FWS-SC	Restricted to the region of Baldwin Lakes, San Bernardino County, California. Inhabits dry open areas with pinyon-juniper and red fir forest communities, including dry slopes, alkaline meadows, and pebble plains. Elevation ranges between 5,000 and 7,900 ft.	x		
Bare-stem larkspur	*Delphinium scaposum*	CA-S1	Restricted to the Whipple Mountains of southern California. Inhabits rocky substrates of juniper woodlands and grasslands at elevations between 890 and 3,450 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Barstow woolly sunflower	*Eriophyllum mohavense*	BLM-S; CA-S2; FWS-SC	Known only from area surrounding Barstow, California. Inhabits sandy or rocky substrates associated with creosote bush scrub, chenopod scrub, and playas. Elevation ranges between 2,000 and 3,000 ft.	x	x	x
Barton Flats horkelia	*Horkelia wilderae*	BLM-S; CA-S1; FWS-SC	Known from fewer than 10 occurrences in the Barton Flats area in San Bernardino County, California. Inhabits lower and upper montane coniferous forests at elevations between 5,900 and 9,800 ft.	x		
Bear Lake buckwheat	*Eriogonum microthecum* var. *lacus-ursi*	BLM-S; CA-S1	Known from only one occurrence near Bear Lake in the San Bernardino Mountains. Inhabits Great Basin scrub communities and lower montane coniferous forests on rocky-clay outcrops. Elevation ranges between 6,550 and 6,900 ft.	x		
Bear Valley pyrrocoma	*Pyrrocoma uniflora* var. *gossypina*	BLM-S; CA-S2; FWS-SC	Known from fewer than 20 occurrences near Bear Valley, San Bernardino County, California. Inhabits moist meadows and seeps on pebble plain substrates at elevations between 5,250 and 7,500 ft.	x		
Bearded screwmoss	*Pseudocrossidium crinitum*	NV-S1	Known from only 12 occurrences in Nevada. Occurs on or near gypsiferous deposits and outcrops or limestone boulders, especially on east- to north- facing slopes of loose, uncompacted soil, often associated with other mosses and lichens at elevations between 1,300 and 2,300 ft.	x	x	x
Beautiful sedge	*Carex concinna*	BLM-S; CO-S1	Broadly distributed in boreal regions from Alaska to Colorado. In Colorado, the species is associated with cool, moist forests with mosses and well-drained soils at elevations between 8,000 and 10,500 ft.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Beaver Dam breadroot	*Pediomelum castoreum*	FWS-SC	Known from Arizona, California, and Nevada. Occurs in dry, sandy desert communities.	x	x	x
Big Bear Valley milkvetch	*Astragalus lentiginosus* var. *sierrae*	BLM-S; CA-S1; FWS-SC	Endemic to San Bernardino County, California, from the Big Bear Valley and Baldwin Lake region. Inhabits scrub habitats, meadows, pinyon-juniper woodlands, and montane coniferous forests on gravelly or rocky substrates. Elevation ranges between 5,900 and 8,500 ft.	x		
Big Bear Valley phlox	*Phlox dolichantha*	BLM-S; CA-S2; FWS-SC	Known from the Big Bear Valley in San Bernardino County, California. Inhabits openings in montane coniferous forests on pebble plain substrates. Elevation ranges between 5,900 and 9,800 ft.	x		
Big Bear Valley sandwort	*Arenaria ursina*	ESA-T; BLM-S; CA-S2	Located in pebble plains, which are dense clay soils, usually covered with a cobble pavement of quartzite. Occurs in sparsely vegetated openings in forests at elevations between 5,900 and 7,500 ft.	x		
Big Bear Valley woollypod	*Astragalus leucolobus*	BLM-S; CA-S2; FWS-SC	Endemic to San Bernardino County, California, from the Big Bear Valley. Occurs in open habitats, including pebble plains in yellow pine forest and sagebrush scrub at elevations between 6,600 and 7,800 ft.	x		
Bigelow onion	*Allium bigelovii*	AZ-SR; AZ-S2	Gentle slopes on open, dry rocky soil in grassland, chaparral, and Sonoran–Mohave Desert scrub communities. Elevation ranges between 2,000 and 5,000 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Bigelow's tansy-aster	*Machaeranthera bigelovii* var. *bigelovii*	AZ-S2	Regionally endemic where it occurs at high elevations of the northeastern Sonoran Desert. Rangewide habitats include mountain brush, aspen, spruce-fir forest, montane grassland, and alpine meadow communities with dry granite gravel substrates. Known to occur at elevations between 7,000 and 8,528 ft.	x	x	
Birdbill day-flower	*Commelina dianthifolia*	CO-S1	Rocky soils at middle elevations in shade of pines and junipers. Elevation ranges between 4,000 and 7,000 ft.	x		
Bitter hymenoxys	*Hymenoxys odorata*	CA-S2	Sandy substrates within riparian and Sonoran Desert scrub communities. Also occurs within open flats, mesquite flats, ditches, and drainage areas and along roads and streams. Elevation ranges between 150 and 500 ft.	x	x	x
Black bog-rush	*Schoenus nigricans*	CA-S2	Endemic to California on alkaline or calcerous substrates within grasslands, marshes, springs, and swamps. Elevation ranges between 500 and 6,500 ft.	x	x	x
Black milkvetch	*Astragalus funereus*	BLM-S; FWS-SC; NV-S2	Known only from the Death Valley region of California and southern Nevada. There are only five occurrences of this species currently known. It inhabits gravelly-clay ridges and ledges on limestone or volcanic substrates at elevations between 4,200 and 6,900 ft.	x	x	x
Blaine fishhook cactus	*Sclerocactus blaneii*	BLM-S; NV-P; FWS-SC; NV-S1	Endemic to southeastern Nevada and southwestern Utah, where it occurs on alkaline substrates and volcanic gravels in valley bottoms. Elevation ranges between 5,100 and 5,300 ft. There are only three occurrences of this species currently known.	x	x	x
Blue giant hyssop	*Agastache foeniculum*	CO-S1	Mixed grass and tallgrass prairies, as well as moist woodlands, mesic meadows, lakeshores, and wet ditches.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Blue sand lily	*Triteleiopsis palmeri*	BLM-S; AZ-SR; AZ-S1	Known from few occurrences in Yuma County, Arizona. Inhabits Sonoran Desert scrub communities and sand dunes at elevations between 250 and 1,660 ft. The species is not known to occur in the state of California.	x	x	
Blue-eyed grass	*Sisyrinchium demissum*	CO-S2	Moist areas, springs, stream banks, meadows, and forest seeps at elevations between 1,600 and 9,500 ft.	x	x	x
Bodin milkvetch	*Astragalus bodinii*	CO-S2	Generally considered to occur in open forest clearings in association with aspen, pinyon-juniper, and ponderosa pine woodlands.	x	x	x
Booth's evening-primrose	*Camissonia boothii* spp. *boothii*	CA-S2	Shrubby, open, or dry areas of Joshua and pinyon-juniper woodlands. Elevation ranges between 3,000 and 7,900 ft.	x	x	x
Brandegee's milkvetch	*Astragalus brandegeei*	BLM-S; CO-S1	Sandy or gravelly banks, flats, and stony meadows within pinyon-juniper woodlands. Substrates are usually sandstone with granite or occasional basalt. Elevation ranges between 5,400 and 8,800 ft.	x	x	x
Brandegee's wild buckwheat	*Eriogonum brandegeei*	BLM-S; CO-S1	Narrowly endemic to Chaffee and Fremont Counties in Colorado on the Dry Union and Morrison Formations. Occurs on outcrops with volcanic-derived (bentonite) soils. Often found on slopes as steep as 90%.	x	x	
Broadbeard beardtongue	*Penstemon angustifolius dulcis*	BLM-S; FWS-SC; UT-S2	Endemic to the Great Basin in Juab and Millard Counties, Utah. Occurs in saltbush, sagebrush, and juniper communities in sand dune habitats at elevations between 4,500 and 5,500 ft.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Broadfruit burreed	*Sparganium eurycarpum*	CO-S2	Occurs in mud, sand, or gravel of lowland marshes, shores, and ditches with neutral to alkaline waters. Tolerant of some desiccation.	x	x	
Broadleaf lupine	*Lupinus latifolius* spp. *leucanthus*	AZ-S1	Occurs along streams and moist soils of stream beds, oak-cottonwood communities, mixed shrub, and ponderosa pine forest communities. Elevation ranges between 4,800 and 7,000 ft.	x	x	
Broad-leaved twayblade	*Listera convallarioides*	CO-S2	Rich humus in open woods to boggy meadows with cool, circumneutral soils at elevations below 8,500 ft.	x	x	x
Brown turbans	*Malperia tenuis*	CA-S1	Known from the Colorado Desert in southeastern California. Inhabits rocky hillsides, alluvium washes, sandy flats, and lava flats within Sonoran Desert scrub and creosote bush scrub communities. Elevation ranges between 50 and 1,100 ft.	x	x	x
Bullfrog Hills sweetpea	*Lathyrus hitchcockianus*	NV-S2	Open, dry to slightly moist gravels of rocky drainage bottoms in canyons and on upper alluvial slopes, often at bases of boulders or canyon walls and climbing up through shrubs, in areas of volcanic tuff or carbonate rocks in the mixed-shrub, sagebrush, and pinyon-juniper zones.	x	x	x
Burgess' scale broom	*Lepidospartum burgessii*	BLM-S; NM-E; FWS-SC; NM-S1	Known from southern Otero County, New Mexico, and adjacent Texas. Occurs on stabilized gypsum dunes in Chihuahuan Desert scrub and grassland communities. Elevations range between 3,500 and 3,700 ft.	x	x	x
California barrel cactus	*Ferocactus cylindraceus* var. *cylindraceus*	AZ-SR	Gravelly or rocky hillsides, canyon walls, alluvial fans, and desert washes at elevations between 200 and 2,900 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
California dandelion (California taraxacum)	*Taraxacum californicum*	ESA-E; BLM-S; CA-S2	Endemic to the San Bernardino Mountains of southern California. Found along edges of moist meadows at elevations between 5,250 and 9,200 ft.	x	x	
California ditaxis	*Ditaxis serrata* var. *californica*	CA-S2	Sonoran Desert scrub and creosote bush scrub communities at elevations between 100 and 3,300 ft.	x	x	x
California fan palm	*Washingtonia filifera*	AZ-SR; AZ-S1	Considered common in the state of California (not ranked); rare in Arizona where it is state-protected. Occurs in desert oases in isolated areas of the Sonoran and Mojave Deserts at elevations between 500 and 1,000 ft.	x	x	x
California satintail	*Imperata brevifolia*	CA-S2	Occurs in chaparral, coastal sage scrub, creosote bush, desert scrub, mesic riparian scrub, and alkaline meadow and seep communities. Elevation ranges between 0 and 1,650 ft.	x	x	x
California saw-grass	*Cladium californicum*	CA-S2	Alkaline, freshwater, and riparian habitats including meadows, marshes, swamps, and seeps. Elevation ranges between 200 and 2,000 ft.	x	x	x
California snakewood	*Colubrina californica*	AZ-S2	Sandy desert washes, steep gullies, and rocky or gravelly slopes at elevations below 3,000 ft.	x	x	x
Castetter's milkvetch	*Astragalus castetteri*	FWS-SC; NM-SC	Endemic to New Mexico from the Caballo and San Andres Mountains in Dona Ana and Sierra Counties. Occurs on dry, rocky slopes in montane scrub and open juniper woodland communities. Elevations range between 5,000 and 7,050 ft.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Cedar Breaks goldenbush	*Haplopappus zionis*	BLM-S; FWS-SC; UT-S2	Endemic to southwestern Utah in Garfield, Iron, and Kane Counties. Occurs in spruce-fir and ponderosa pine communities on limestone substrates at elevations between 8,000 and 10,000 ft. Known to occur only in Dixie National Forest, Cedar Breaks National Monument, and Bryce Canyon National Park.	x		
Chaparral sand-verbena	*Abronia villosa* var. *aurita*	BLM-S; CA-S2	Endemic to southern California. Inhabits chaparral desert sand dunes at elevations between 350 and 5,250 ft.	x	x	x
Charleston goldenbush	*Ericameria compacta*	NV-S2	Endemic to the Spring and Sheep ranges in southern Nevada, where the species is known from 10 occurrences. Occurs on forested carbonate slopes and adjacent ridges and low outcrops within the subalpine and montane conifer communities at elevations between 2,850 and 11,300 ft.	x	x	x
Charleston grounddaisy	*Townsendia jonesii* var. *tumulosa*	BLM-S; FWS-SC	Endemic to Nevada, where the species is known from 27 occurrences encompassing an area of less than 10 acres. Occurs in open, sparsely vegetated calcareous areas; on shallow, gravelly carbonate soils of slopes; and on exposed knolls in forest clearings. Most commonly associated with montane conifer habitat but will also inhabit pinyon-juniper and lower subalpine conifer communities, recurring on knolls of white, alkaline, calcareous, silty lacustrine deposits of the upper shadscale/mixed-shrub and lower sagebrush zones. Elevation ranges between 5,200 and 11,000 ft.	x	x	x
Charleston pinewood lousewort	*Pedicularis semibarbata* var. *charlestonensis*	FWS-SC	Endemic to Nevada. A high-elevation species that is locally abundant except on steep slopes. Associated with *Cercocarpus ledifolius*, *Pinus monophylla*, *P. ponderosa* var. *scopulorum*, and *Populus tremuloides* var. *aurea*. Elevation ranges between 7,200 and 9,000 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Cienega Seca oxytheca	*Acanthoscyphus parishii* var. *cienegensis*	BLM-S; CA-S1; FWS-SC	Endemic to San Bernardino County, California; known from approximately five locations. Inhabits pinyon-juniper woodlands and montane coniferous forests at elevations between 6,900 and 8,050 ft.	x		
Clarke phacelia	*Phacelia filiae*	BLM-S; NV-S2	Endemic to Nevada. Occurs on light-colored soils of calcareous sandstone, siltstone, tuffaceous claystone, and limestone substrates. Inhabits relatively flat areas or low knolls of valley floors, primarily above the playas and in the foothills of desert mountains within shadscale, blackbrush, and creosote bush scrub communities at elevations between 6,500 and 12,000 ft.	x		
Clokey eggvetch	*Astragalus oophorus* var. *clokeyanus*	FWS-SC; NV-S2	Endemic to the Spring Mountains of southern Nevada. Occurs in dry to slightly moist open slopes, flats; or drainages on gravelly soil derived from limestone or rhyolitic volcanics; in openings or under shrubs in ponderosa pine forests, pinyon-juniper woodlands, and burned areas. Elevations range between 5,400 and 9,000 ft.	x		
Clokey milkvetch	*Astragalus aequalis*	BLM-S; NV-S2	Endemic to the Spring Mountains of southern Nevada. Occurs on calcareous gravelly flats, hillsides, and open ridges, often sheltering under sagebrush (*Artemisia* sp.), pine trees, or oak trees. Other common associates include Utah juniper (*Juniperus osteosperma*) and curl-leaf mountain mahogany (*Cercocarpus ledifolius* var. *intermontanus*). Elevation ranges between 6,000 and 8,400 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Clokey mountain sage	*Salvia dorrii* var. *clokeyi*	BLM-S; FWS-SC	Endemic to the Spring and Sheep ranges in southern Nevada, where the species is known from 19 occurrences. Occurs on shallow, rocky to gravelly carbonate soils of ridges, slopes, and drainages in pinyon-juniper, montane conifer, mountain mahogany, and subalpine conifer communities. Elevation ranges between 7,000 and 9,800 ft.	x		
Clokey paintbrush	*Castilleja martinii* var. *clokeyi*	FWS-SC	Restricted to California and Nevada. Inhabits pinyon-juniper woodland communities at elevations between 6,500 and 9,500 ft.	x	x	x
Clokey's cryptantha	*Cryptantha clokeyi*	BLM-S; CA-S1	Restricted to few locations near Barstow, California. Occurs on Mojave Desert scrub on sandy or gravelly soils at elevations between 2,625 and 2,950 ft.	x	x	x
Clustered barrel cactus	*Echinocactus polycephalus* var. *polycephalus*	AZ-SR; AZ-S2	Occurs in the driest parts of the Sonoran and Mohave Deserts in western Arizona on rocky and gravelly slopes. Often found with creosote bush scrub or the periphery of pinyon-juniper woodlands. Elevation ranges between 230 and 1,120 ft.	x	x	
Coachella Valley milkvetch	*Astragalus lentiginosus* var. *coachellae*	ESA-E; BLM-S; CA-S2	Endemic to Riverside County, California, where it is primarily known from the Coachella Valley. A disjunct population is also known from the Chuckwalla Valley near the SEZ. Occupies sandy areas in washes and sometimes on dunes in creosote bush scrub or in blow sand areas around valley margins. Elevation ranges between 160 and 2,130 ft.	x	x	x
Colorado larkspur	*Delphinium ramosum* var. *alpestre*	CO-S2; NM-S2	Meadows, aspen woodlands, and *Artemisia* scrub communities at elevations between 6,900 and 10,500 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Colorado tansy-aster	*Machaeranthera coloradoensis*	CO-S2	Restricted to the Rocky Mountains of south central Wyoming and western Colorado. Occurs on gravelly substrates situated in mountain parks, slopes, and rock outcrops, reaching dry tundra. Elevation ranges between 8,500 and 12,500 ft.	x	x	
Colorado wild buckwheat	*Eriogonum coloradense*	BLM-S; CO-S2	Narrowly endemic to the mountains of central Colorado. Occurs on alpine talus slopes on gravelly or sandy soils at elevations between 8,500 and 12,500 ft.	x		
Compact cat's-eye	*Cryptantha compacta*	BLM-S; FWS-SC; NV-S1; UT-S2	Known from southwestern Millard County and northwestern Beaver County, Utah, and eastern Nevada. Occurs in salt desert shrub and mixed shrub communities at elevations between 5,000 and 8,400 ft.	x	x	x
Coulter's goldfields	*Lasthenia glabrata* spp. *coulteri*	BLM-S; CA-S2	Endemic to California from salt marshes, swamps, playas, alkaline sinks, and vernal pools at elevations below 4,000 ft.	x	x	x
Coves' cassia	*Senna covesii*	CA-S2	Sonoran Desert dry washes and slopes with sandy substrates within desert scrub and creosote bush scrub communities. Elevation ranges between 1,000 and 3,500 ft.	x	x	x
Crandall's rockcress	*Arabis crandallii*	BLM-S; CO-S2	Endemic to west central Colorado in the Upper Gunnison Basin. Inhabits rocky or gravelly areas, including cliffs, talus slopes, and ridges on granite or limestone substrate at elevations between 6,500 and 10,500 ft.	x		
Creamy blazing star	*Mentzelia tridentata*	BLM-S; CA-S2	Inhabits Mojave Desert creosote bush scrub communities on rocky and sandy substrates at elevations below 3,900 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Creeping milkvetch	Astragalus troglodytus	AZ-S2	Endemic to Coconino and Yavapai Counties in Arizona. Occurs in ponderosa pine forests, pinyon-juniper woodlands, chaparral communities, and grasslands. Elevation ranges between 4,260 and 8,100 ft.	x		
Currant milkvetch	*Astragalus uncialis*	BLM-S; FWS-SC; NV-S1; UT-S2	Regionally endemic to the Great Basin in Millard County, Utah, and Nye County, Nevada. Occurs in shadscale and budsage communities on alkaline limestone substrates at elevations between 4,500 and 6,000 ft.	x		
Cushenbury buckwheat	*Eriogonum ovalifolium* var. *vineum*	ESA-E; BLM-S; CA-S1	Restricted to a carbonate belt in the northeastern San Bernardino Mountains, San Bernardino County, California. Inhabits desert slopes, primarily in open areas on substrates derived from limestone or dolomite. Soils are typically powdery-fine, with little accumulation of organic matter and with numerous interspersed rocks. Elevation ranges between 4,600 and 7,875 ft.	x		
Cushenbury milkvetch	*Astragalus albens*	ESA-E; BLM-S; CA-S1	A limestone endemic, primarily found on soils derived directly from decomposing limestone bedrock. Occurs on open, very rocky slopes at elevations between 3,300 and 6,500 ft.	x		
Cushenbury oxytheca	*Acanthoscyphus parishii* var. *goodmaniana*	ESA-E; BLM-S; CA-S1	Restricted to a carbonate belt in the northeastern San Bernardino Mountains, San Bernardino County, California, and known from fewer than 20 occurrences. Inhabits pinyon-juniper woodlands on talus slopes at elevations between 3,900 and 7,875 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Dainty moonwort	*Botrychium crenulatum*	BLM-S; NV-S1	Widely distributed throughout western North America in high-elevation montane habitats (between 8,000 and 11,200 ft). Aquatic/wetland- dependent occurring in wet, marshy, and riparian areas, including wet meadows, edges of marshes, saturated soils of seeps, bottoms and stabilized margins of small streams, and wet roadside swales and ditches. Sites tend to be partly to heavily shaded and usually have a dense, diverse cover of forbs and graminoids. Dominant plant species may include spruce, alders, and dogwood.	x		
Darwin rock-cress	*Arabis pulchra* var. *munciensis*	CA-S1	Occurs on carbonate substrates along canyons, slopes, and washes. Elevation ranges between 3,600 and 6,800 ft.	x	x	x
Davidson sage	*Salvia davidsonii*	AZ-S2	Rocky substrates in canyons, and in moist soils on wooded slopes, often on bedrock. Elevation ranges between 1,600 and 9,500 ft.	x	x	x
Death Valley beardtongue	*Penstemon fruticiformis* spp. *amargosae*	BLM-S; FWS-SC; NV-S2	Known only from the Death Valley region of California and southern Nevada. It inhabits Mojave desert scrub communities at elevations between 2,800 ft and 4,600 ft.	x	x	x
Death Valley mormon tea	*Ephedra funerea*	AZ-S1	Occurs on sandy, dry soils within upper, shrub-covered desert slopes and valley floor, fans, washes, rocky scrub areas, and sometimes on stabilized dunes in association with creosote bush scrub communities at an elevations between 1,150 and 5,580 ft.	x	x	
Degener's beardtongue	*Penstemon degeneri*	BLM-S; CO-S2	Endemic to south central Colorado along the Arkansas River corridor. Found in open pinyon-juniper woodlands and montane grasslands with rocky soils at elevations between 6,000 and 7,000 ft. Grows in cracks of large rock slabs around the canyon rims.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Desert ageratina	*Ageratina herbacea*	CA-S2	Known from the eastern Mojave Desert Mountains on rocky substrates along streams, slopes, ridges, and washes within pine, pine-oak, and juniper, pinyon-juniper woodlands. Elevation ranges between 5,000 and 7,200 ft.	x	x	
Desert bedstraw	*Galium proliferum*	CA-S2	Endemic to southern California on carbonate (limestone) substrates of rocky banks and ledges. Occurs within Joshua tree woodlands, creosote bush scrub, Mojave Desert scrub, and pinyon-juniper woodland habitats at elevations between 3,900 and 5,150 ft.	x	x	x
Desert cymopterus	*Cymopterus deserticola*	BLM-S	Restricted to western Mojave Desert habitats with deep, loose, well drained, fine to coarse sandy soils of alluvial fan basins. Often occurs in low sand dunes and on sandy slopes. Elevation ranges between 2,060 and 3,060 ft.	x	x	x
Desert germander	*Teucrium glandulosum*	CA-S1	Restricted to the Whipple Mountains of the Sonoran Desert in southern California. Occurs on rocky slopes and canyons within creosote bush scrub and Sonoran Desert scrub communities. Elevation ranges between 1,300 and 2,600 ft.	x		
Desert night-blooming cereus	*Peniocereus greggii* var. *greggii*	BLM-S; NM-E; FWS-SC; NM-S1	Known from southern New Mexico and western Texas. Occurs in sandy to silty gravelly soils in desert grassland communities. Also found in gravelly flats and washes.	x	x	x
Desert pincushion	*Coryphantha chlorantha*	CA-S1	Occurs on gravelly bajadas, limestone or dolomite rocky slopes associated with desert scrub communities within pinyon-juniper woodlands and Joshua tree woodlands. Elevation ranges between 148 and 7,875 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Desert spike-moss	*Selaginella eremophila*	CA-S2	Gravelly or rocky slopes within creosote bush scrub and Sonoran Desert scrub communities. Elevation ranges between 650 and 2,950 ft.	x	x	x
Desert wild-buckwheat	*Eriogonum deserticola*	AZ-S1	Locally common in southeastern California and western Arizona on deep moving sand dunes and sandy flats within desert scrub communities at elevations below 650 ft.	x		
Dune sunflower	*Helianthus deserticola*	NV-S2	Known from Arizona, Nevada, and Utah. Dependent on sand dune communities where it occurs on dry, open, deep, loose sandy soils of aeolian deposits, vegetated dunes, and dune skirt areas, on flats and gentle slopes of all aspects, generally in alkaline areas. Elevation ranges between 1,325 and 4,900 ft.	x	x	x
Dwarf bear-poppy	*Arctomecon humilis*	ESA-E; UT-S1	Endemic to Washington County, Utah. Inhabits warm, open desert shrub communities on gypsiferous clay soils in the Moenkopi Formation. Occurs at elevations between 2,600 and 4,500 ft.	x	x	
Dwarf germander	*Teucrium cubense* ssp. *depressum*	CA-S2	Desert dunes, playas, riparian, creosote bush scrub, and desert scrub communities. Elevation ranges between 150 and 1,300 ft.	x	x	x
Dwarf hawksbeard	*Askellia nana*	CO-S2	Steep alpine scree and talus slopes at elevations between 10,000 and 14,000 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Eastwood milkweed	*Asclepias eastwoodiana*	BLM-S; FWS-SC; NV-S2	Endemic to Nevada from public and private lands in Esmeralda, Lander, Lincoln, and Nye Counties. Occurs in open areas on a wide variety of basic (pH usually >8) soils, including calcareous clay knolls; sand, carbonate, or basaltic gravels; or shale outcrops, generally barren and lacking competition. Frequently occurs in small washes or other moisture-accumulating microsites at elevations between 4,700 and 7,100 ft.	x	x	x
Emory's barrel-cactus	*Ferocactus emoryi*	AZ-SR; AZ-S1	Endemic to Arizona from the Sierra Estrella (Maricopa County) to the Organ Pipe Cactus National Monument and Papago Indian Reservation (Pima County). Occurs on rocky hills and sandy or rocky flats including washes, alluvial fans, and mesas. Elevation ranges between 1,500 and 3,000 ft.	x	x	
Emory's crucifixion-thorn	*Castela emoryi*	CA-S2	Restricted to deserts of southern California and southwestern Arizona where it occurs at low densities. Inhabits slightly wet areas within Mojave Desert scrub, non-saline playas, creosote bush scrub, and Sonoran Desert scrub communities. Preferred sites are described as being moist, having fine-textured alluvial bottomland soils, and associated with basalt flows. Elevation ranges between 295 and 2,200 ft.	x	x	x
Ewan's cinquefoil	*Potentilla glandulosa* spp. *ewanii*	BLM-S; CA-S1	Known from only one occurrence in the San Bernardino Mountains in southern California. Inhabits montane coniferous forests near seeps and springs at elevations between 6,230 and 7,875 ft.	x		
Fendler's Townsend-daisy	*Townsendia fendleri*	CO-S2	Sandy or rocky soils within desert scrub and pinyon-juniper woodlands. Elevation ranges between 3,900 and 7,900 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Five-flower rockdaisy	*Perityle quinqueflora*	FWS-SC; NM-SC	Known from southern New Mexico and western Texas. Inhabits crevices of limestone bluffs in high canyons and caprock at elevations between 5,000 and 6,000 ft.	x	x	
Flagstaff beardtongue	*Penstemon nudiflorus*	AZ-S2	Endemic to Arizona. Occurs in dry ponderosa pine forests in mountainous regions south of the Grand Canyon. Elevation ranges between 5,000 and 7,375 ft.	x	x	
Flannel bush	*Fremontodendron californicum*	BLM-S; AZ-SR; AZ-S2	Known from Arizona and California. Occurs on well-drained rocky hillsides and ridges, in chaparral and pinyon-juniper and ponderosa pine woodlands. Occurs primarily on the dry, north slopes in canyons. Elevation ranges between 3,500 and 6,500 ft.	x	x	
Flat-seeded spurge	*Chamaesyce platysperma*	BLM-S; CA-S1	Recently observed from two separate occurrences in southern California and southwestern Arizona. Inhabits sandy substrates of desert dunes within Sonoran Desert scrub communities at elevations below 650 ft.	x	x	x
Fragile rockbrake	*Cryptogramma stelleri*	BLM-S; CO-S2	Moist soils on shaded limestone cliffs at elevations greater than 7,000 ft and often in association with mosses.	x	x	x
Fremont's gentian	*Gentiana fremontii*	CA-S2	Restricted to disjunct locations in California and Colorado. Within California, the species inhabits wet meadows and seeps within red fir, lodgepole, and upper montane coniferous forests. Elevation ranges between 7,900 and 8,850 ft.	x		
Frisco buckwheat	*Eriogonum soredium*	ESA-UR; BLM-S; UT-S1	Endemic to the San Francisco Mountains in Beaver County, Utah. Occurs in sagebrush and pinyon-juniper communities on white limestone outcrops. Elevation ranges between 6,600 and 7,300 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Frisco clover	*Trifolium friscanum*	ESA-UR; BLM-S; UT-S1	Known from the San Francisco and Beaver Lake Mountains in Beaver County, Utah. Occurs on volcanic gravels and limestone substrates in association with pinyon-juniper woodlands at elevations between 6,900 and 7,300 ft.	x	x	x
Giant Spanish-needle	*Palafoxia arida* var. *gigantea*	BLM-S; CA-S1	Occurs on desert sand dune habitats at elevations below 330 ft.	x	x	x
Gilman milkvetch	*Astragalus gilmanii*	BLM-S; NV-S1	Known from California and Nevada. Occurs on light-colored volcanic slopes in pinyon-juniper woodland communities at elevations between 5,400 and 6,000 ft.	x	x	
Glandular ditaxis	*Ditaxis claryana*	CA-S1	Sandy substrates within desert scrub communities at elevations below 1,525 ft.	x	x	x
Glass Mountain coral-root	*Hexalectris nitida*	BLM-S; NM-E; FWS-SC; NM-S1	Known from southern New Mexico and western Texas. Inhabits deep canyons in litter and under oak trees at elevations near 4,300 ft.	x	x	x
Gold Butte moss	*Didymodon nevadensis*	BLM-S; NV-S1	Known from only Nevada and Texas. Occurs on or near gypsiferous deposits and outcrops or limestone boulders, especially on east- to north-facing slopes of loose, uncompacted soil. Typically associated with other mosses and lichens. Elevation ranges between 1,300 and 2,300 ft.	x	x	x
Golden barrel cactus	*Ferocactus cylindraceus* var. *eastwoodiae*	AZ-SR; AZ-S1	Endemic to central Arizona on gravelly or rocky hillsides, canyon walls, and wash margins. Elevation ranges between 1,200 and 4,000 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Golden bladderpod	*Lesquerella aurea*	FWS-SC; NM-SC; NM-S2	Restricted to the Jicarilla and Sacramento Mountains in south central New Mexico. Occurs in open sites and bare areas of rocky limestone soil. Primarily known from montane coniferous forests at elevations between 6,500 and 9,000 ft.	x		
Golden blazing star	*Nuttallia chrysantha*	CO-S2	Barren slopes of limestone, shale, or clay at elevations between 5,120 and 5,700 ft.	x		
Golden columbine	*Aquilegia chrysantha* var. *rydbergii*	CO-S1	Occurs along montane streams or in rocky ravines at elevations between 5,500 and 6,000 ft.	x		
Golden columbine	*Aquilegia chrysantha* var. *chaplinei*	FWS-SC; NM-SC; NM-S2	Known from southern New Mexico and western Texas. Inhabits limestone seeps and springs in montane scrub or riparian canyon bottoms at elevations between 4,700 and 5,500 ft.	x	x	x
Grama grass cactus	*Sclerocactus papyracanthus*	BLM-S	Known from southern Arizona, New Mexico, and western Texas. Occurs in pinyon-juniper woodlands and desert grasslands on sandy soils at elevations between 4,900 and 7,200 ft.	x	x	x
Grassy slope sedge	*Carex oreocharis*	CO-S1	Regionally endemic to the southern Rocky Mountains. Occurs on granitic soils on dry slopes at elevations between 7,200 and 10,800 ft.	x	x	x
Gray's Peak whitlow-grass	*Draba grayana*	CO-S2	Regionally endemic within the state of Colorado. Inhabits gravelly alpine slopes and fellfields at elevations between 11,500 and 14,000 ft.	x	x	x
Green spleenwort	*Asplenium trichomanes-ramosum*	CO-S1	Limestone and other basic rocks at elevations between 9,850 and 13,100 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Greene's milkweed	*Asclepias uncialis* spp. *uncialis*	BLM-S; CO-S2	Occurs in small colonies scattered along the eastern edge of the southern Rocky Mountains in eastern Colorado. Plants are often found at the base of escarpments at elevations between 4,000 and 7,600 ft.	x	x	
Gunnison's milkvetch	*Astragalus anisus*	BLM-S; CO-S2	Endemic to west-central Colorado in the Gunnison River Basin. Associated with sagebrush shrubland systems on flat to rolling hills with well-drained clay soils at elevations between 7,000 and 10,000 ft.	x	x	
Hairy stickleaf	*Mentzelia hirsutissima*	CA-S2	Patchy distribution in southern California. Occurs on washes, fans, or slopes having rocky or sandy substrates within Sonoran Desert scrub and creosote bush scrub communities at elevations below 2,300 ft.	x	x	x
Hairy Townsend-daisy	*Townsendia strigosa*	BLM-S; CO-S1	In Colorado, currently known to occur only on alluvial gravel substrates of the Lookout Mountain area of critical ecological concern (ACEC) in Moffat County, outside the analysis area (>50 mi).	x	x	
Halfmoon milkvetch	*Astragalus allochrous* var. *playanus*	CO-S1	Gravelly washes and sandbars of summer-dry streams at elevations between 3,000 and 4,000 ft.	x	x	x
Halfring milkvetch	*Astragalus mohavensis* var. *hemigyrus*	BLM-S; FWS-SC; NV-S2	Endemic to Nevada. Occurs on carbonate gravels and derivative soils on terraced hills and ledges, open slopes, and along washes within the creosote-bursage, blackbrush, and mixed-shrub habitat communities. Elevation ranges between 3,000 and 5,600 ft.	x	x	x
Hall fescue	*Festuca hallii*	CO-S1	Alpine tundra and dry subalpine grasslands at elevations between 11,000 and 12,000 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Harwood's eriastrum	*Eriastrum harwoodii*	BLM-S; CA-S2	Known from fewer than 20 occurrences in southern California. Occurs on desert dunes and other sandy habitats at elevations between 650 and 3,000 ft.	x	x	x
Harwood's milkvetch	*Astragalus insularis* var. *harwoodii*	CA-S2	Occurs in the Sonoran Desert of Arizona and California on sandy or gravelly substrates of desert dunes within desert scrub communities. Elevation ranges between 0 and 2,325 ft.	x	x	x
Helleborine	*Epipactis gigantea*	CO-S2	Wet gravelly and sandy stream shores and bars, seeps on sandstone cliffs, and, to a lesser extent, chaparral, marshes, hot springs, or riparian willow, box elder, and river birch woodlands. Elevation ranges between 4,800 and 8,000 ft.	x	x	x
Hitchcock bladderpod	*Physaria hitchcockii* var. *hitchcockii*	NV-S2	Restricted to the Sheep Range and Spring Mountains of southern Nevada and Table Cliff Plateau of Utah. Occurs on gravelly or rocky limestone substrates at elevations between 7,500 and 11,500 ft.	x		
Hohokam agave	*Agave murpheyi*	BLM-S; AZ-HS; FWS-SC; AZ-S2	Endemic to Arizona and Sonora, Mexico, on benches or alluvial terraces on gentle bajada slopes above major drainages in desert scrub communities. Elevation ranges between 1,300 and 3,200 ft.	x	x	x
Holmgren lupine	*Lupinus holmgrenianus*	BLM-S; NV-S2	Known only from the Death Valley region of California and southern Nevada. It inhabits dry desert slopes, washes, and valleys on volcanic substrates, sometimes in association with pinyon-juniper woodlands. Elevation ranges between 4,600 and 8,200 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Holmgren milkvetch	*Astragalus holmgreniorum*	ESA-E; UT-S1	Endemic to Washington County, Utah, and Mohave County, Arizona. Inhabits warm desert shrub communities along Virgin River limestone cobble at elevations between 2,700 and 2,800 ft.	x	x	
House Range primrose	*Primula cusickiana* var. *domensis*	BLM-S	Endemic to the Great Basin in Millard County, Utah. Occurs in limestone crevices in the House Range at elevations between 8,500 and 9,000 ft.	x		
Jackass-clover	*Wislizenia refracta* spp. *refracta*	CA-S1	Known from the Mojave and northern Sonoran Deserts. Inhabits dunes, sandy washes, roadsides, and playas within creosote bush scrub, alkali sink, or desert scrub communities. Elevation ranges between 2,000 and 2,600 ft.	x	x	x
Jaeger beardtongue	*Penstemon thompsoniae* spp. *jaegeri*	NV-S2	Endemic to southern Nevada, where it is known from 24 occurrences. Occurs on limestone soils of knolls and slopes, in drainages, and under conifers within pinyon-juniper through the subalpine conifer zones. Elevation ranges between 5,600 and 11,000 ft.	x	x	x
James' cat's-eye	*Oreocarya cinerea* var. *pustulosa*	CO-S1	In gypsum and sandy substrates within sagebrush, pinyon-juniper, oak mountain brush, and ponderosa pine communities at elevations between 5,400 and 8,500 ft.	x	x	x
Johnston's buckwheat	*Eriogonum microthecum* var. *johnstonii*	BLM-S; CA-S1; FWS-SC	Known from fewer than 10 occurrences in San Bernardino County, California. Inhabits subalpine coniferous forests on rocky substrates at elevations between 6,050 and 9,850 ft.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Jone's globemallow	*Sphaeralcea caespitosa*	BLM-S; FWS-SC; NV-S2; UT-S2	Known from at least four occurrences in western Utah and six occurrences in eastern Nevada on federal and state lands. Occurs on sevy dolomite calcareous soils in association with mixed shrub, pinyon-juniper, and grassland communities at elevations between 5,000 and 6,500 ft.	x	x	x
Keystone Canyon thistle	*Cirsium arizonicum* var. *tenuisectum*	NV-S1	Restricted to California and Nevada. Occurs on rocky slopes, drainages, roadsides, and disturbed areas within Joshua tree woodland, Mojave Desert scrub, pine-oak-juniper woodland, montane coniferous forests, and pinyon-juniper woodland communities. Elevation ranges between 4,900 and 9,200 ft.	x		
King's campion	*Gastrolychnis kingii*	CO-S1	Regionally endemic to Colorado. Occurs in spruce-fir, sedge, and alpine tundra communities at elevations between 10,800 and 11,300 ft.	x	x	x
Kofa barberry	*Berberis harrisoniana*	BLM-S; AZ-S1; CA-S1	Known from disjunct locations in southwestern Arizona and southern California. Known from only one occurrence in California in the Whipple Mountains. Occurs in deeply shaded places, such as alcoves in narrow steep-walled canyons on andesite and rhyolite soils. Elevation ranges between 2,450 and 3,925 ft.	x	x	
Kuenzler's hedgehog cactus	*Echinocereus fendleri* var. *kuenzleri*	ESA-E; NM-E; NM-S1	Endemic to southern New Mexico from the Capitan, Guadalupe, and Sacramento Mountains. Occurs primarily on gentle, gravelly to rocky slopes and benches on limestone. Also occurs in Great Plaines grasslands, oak woodlands, and pinyon-juniper woodlands. Elevation ranges between 5,200 and 6,600 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Lane Mountain milkvetch	*Astragalus jaegerianus*	ESA-E; BLM-S; CA-S1	Endemic to the Mojave Desert in San Bernardino County, California, where it is known from fewer than 10 locations. Occurs on Coolgardie Mesa desert scrub habitats on granitic-sandy soils. Elevation ranges between 3,000 and 3,800 ft	x		
Las Vegas bearpoppy	*Arctomecon californica*	NV-P; FWS-SC	Restricted to Arizona and Nevada. Occurs in open, dry, spongy or powdery, often dissected ("badland") or hummocked soils with high gypsum content, typically with well-developed soil crust, in areas of generally low relief on all aspects and slopes, with a sparse cover of other gypsum-tolerant species. Elevation ranges between 1,050 and 3,650 ft.	x	x	x
Las Vegas buckwheat	*Eriogonum corymbosum* var. *nilesii*	ESA-C; BLM-S; NV-S1	Restricted to southern Nevada, where the species is known from 15 occurrences encompassing an area of less than 1,500 acres. Occurs on or near gypsum soils, in washes, drainages, or in areas of generally low relief. Elevation ranges between 1,900 and 3,850 ft.	x	x	x
Latimer's woodland-gilia	*Saltugilia latimeri*	BLM-S; CA-S2	Mojave Desert scrub communities, pinyon-juniper woodlands, and washes on rocky or sandy substrates at elevations between 1,300 and 6,500 ft.	x	x	x
Leadville milkvetch	*Astragalus molybdenus*	CO-S2	Rocky slopes and turf hillsides at elevations between 11,400 and 13,200 ft. Substrates are typically limestone.	x	x	
Least moonwort	*Botrychium simplex*	CO-S1	Open habitats, including pastures, meadows, orchards, prairies, wetlands, fens, sand dunes, and in lake and stream edge vegetation.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Leathery grape fern	*Botrychium multifidum*	CO-S1	Wet meadows, forest edges, lake shores, stony lake margins, and trail sides at elevations between 6,300 and 11,500 ft. Sites are usually flat and open and have acidic soils that are seasonally wet.	x	x	x
Lemon lily	*Lilium parryi*	BLM-S; CA-S2; FWS-SC	Wet soils of mountainous terrain, generally in forested areas between 5,000 and 9,000 ft in elevation. Usually found growing along shaded edges of streams, seeps, and boggy meadows.	x		
Lesser bladderwort	*Utricularia minor*	CO-S2	Shallow wetlands, including poor to extremely rich fens, freshwater marshes, beaver ponds, and enriched seeps at higher elevations corresponding to the Rocky Mountain Subalpine-Montane Fen and North American Arid West Emergent Marsh ecological systems. Preferred sites are inundated mudflats or areas with emergent vegetation.	x		
Lime-loving willow	*Salix lanata* spp. *calcicola*	CO-S1	Calcareous lakeshores at elevations near 12,000 ft.	x	x	
Limestone beardtongue	*Penstemon calcareus*	BLM-S; CA-S2	Inhabits Mojave Desert scrub communities, pinyon-juniper forests, and Joshua tree woodlands on rocky carbonate substrates. Elevation ranges between 3,280 and 6,550 ft.	x	x	x
Little purple monkeyflower	*Mimulus purpureus*	BLM-S; CA-S2; FWS-SC	Inhabits wet meadows and seeps in upper montane coniferous forests on pebble plain substrates. Elevation ranges between 6,225 and 7,550 ft.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Little San Bernardino Mountains linanthus	*Linanthus maculatus*	BLM-S; CA-S1	Known from fewer than 20 occurrences in southern California near Joshua Tree National Park. Inhabits desert dunes and sandy flats with creosote bush scrub and Joshua tree woodland communities at elevations less than 6,900 ft.	x	x	x
Littlefield milkvetch	*Astragalus preussii* var. *laxiflorus*	NV-S1	Endemic to the Lake Mead region of Arizona and Nevada and disjunctly in California. Occurs on alkaline clay flats and gravelly washes within shadscale and chenopod scrub communities at elevations between 2,300 and 2,450 ft.	x	x	x
Livemore fiddleleaf	*Nama dichotomum*	CO-S1	Specific habitat requirements for this species are largely unknown. Generally known to occur in plains and prairies. Occurs within the analysis area at elevations between 7,000 and 10,200 ft.	x	x	x
Lobed ground-cherry	*Physalis lobata*	CA-S1	Known from the northeastern Sonoran and southeastern Mojave Deserts. Inhabits decomposed granitic substrates within creosote bush scrub, alkali sink, desert scrub, and playas communities. Elevation ranges between 1,650 and 2,600 ft.	x	x	x
Lone Mountain goldenhead	*Tonestus graniticus*	BLM-S; NV-S1	Endemic to Esmeralda County, Nevada. Occurs in crevices of granitic cliffs and outcrops on protected exposures (north to east aspects in deep canyons) in pinyon-juniper communities at elevations near 7,800 ft.	x		
Long-calyx milkvetch	*Astragalus oophorus* var. *lonchocalyx*	BLM-S; FWS-SC; NV-S2; UT-S1	Regionally endemic to the Great Basin in western Utah and eastern Nevada. Occurs in pinyon-juniper woodlands, sagebrush, and mixed shrub communities at elevations between 5,800 and 7,500 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Longleaf sandpaper plant	*Petalonyx linearis*	AZ-S2	Known in southeastern California from the Mojave and Sonoran Deserts. Occurs on sandy or rocky canyons within creosote bush scrub communities at elevations below 3,300 ft.	x	x	
Long-stem evening-primrose	*Oenothera longissima*	CA-S1	Restricted to Inyo and San Bernardino Counties in California. Inhabits seasonally mesic desert scrub, creosote bush scrub, and pinyon-juniper woodland habitat. Elevation ranges between 3,300 and 5,500 ft.	x	x	x
Male fern	*Dryopteris filix-mas*	CA-S1	Known from the San Bernardino, White, and Inyo Mountains of California. Occurs on rocky cliffs and talus of granitic or igneous derivation within pinyon-juniper woodland and upper montane coniferous forest habitat. Elevation ranges between 7,900 and 10,000 ft.	x	x	
Many-flowered gilia	*Ipomopsis multiflora*	CO-S1	Open sites, desert shrublands, and woodlands.	x	x	x
Many-stemmed spider-flower	*Cleome multicaulis*	BLM-S; CO-S2; FWS-SC	Populations exist in the San Luis Valley on saturated soils created by waterfowl management regimes on public lands.	x	x	x
Marble Canyon rockcress	*Sibara grisea*	BLM-S; FWS-SC; NM-SC	Known from southern New Mexico and western Texas. Occurs in rock crevices and at the bases of limestone cliffs in chaparral and pinyon-juniper woodland communities at elevations between 4,500 and 6,000 ft.	x	x	x
Marsh cinquefoil	*Comarum palustre*	CO-S1	Lake shores, bogs, swamps, and stream banks in mucky, peaty soil.	x	x	x
Marsh-meadow indian-paintbrush	*Castilleja lineata*	CO-S1	Montane woodlands and meadows at elevations between 8,500 and 12,000 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
McKelvey's agave	*Agave mckelveyana*	AZ-SR	Endemic to Arizona in dry scrubland between 3,000 and 6,000 ft.	x	x	x
Meadow Valley sandwort	*Eremogone stenomeres*	NV-S2	Endemic to Nevada, where it is restricted to Clark and Lincoln Counties. Occurs on limestone cliffs at elevations between 2,950 and 3,950 ft.	x	x	x
Mecca-aster	*Xylorhiza cognata*	BLM-S; CA-S2	Restricted to the Indio Hills and Mecca Hills in Riverside County, California. Inhabits desert scrub on steep canyon slopes, at the bases of canyons, and in canyon washes at elevations below 1,300 ft.	x		
Mescalero milkwort	*Polygala rimulicola* var. *mescalerorum*	BLM-S; NM-E; FWS-SC; NM-S1	Known only from the San Andres Mountains in Dona Ana County, New Mexico. Occurs in rock crevices in sandy limestone cliffs at elevations between 5,700 and 6,300 ft.	x		
Mingan's moonwort	*Botrychium minganense*	CO-S1	Dense forest to open meadow and from summer-dry meadows to permanently saturated fens and seeps, but most common in moist meadows and woodlands in association with riparian corridors. Recorded sites are often associated with old (>10 year) disturbances.	x	x	x
Mohave thistle	*Cirsium mohavense*	AZ-S1	Restricted to wetland habitats in the Mojave Desert region; common at perennial springs. Found in moist canyons, stream banks, and poorly drained alkaline flats, seeps, and springs.	x	x	x
Mojave monkeyflower	*Mimulus mohavensis*	BLM-S; CA-S2; FWS-SC	Endemic to the western Mojave Desert in San Bernardino County, California. Inhabits gravelly banks of desert washes at elevations below 3,900 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Mokiak milkvetch	*Astragalus mokiacensis*	BLM-S; NM-S1	Known only from the valleys and canyons of the Colorado and Virgin Rivers in northern Mohave County, Arizona, and eastern Clark County, Nevada. Occurs on sandy soils of bluffs, cliff terraces, gullied badlands, and disturbed areas along streams. Elevation ranges between 2,000 and 4,200 ft.	x		
Money wild buckwheat	*Eriogonum nummulare*	BLM-S; UT-S1	Occurs in western Utah and eastern Nevada on gravelly washes, flats, and slopes in saltbrush and sagebrush communities. Also known to occur in pinyon-juniper woodlands.	x	x	x
Mosquito plant	*Agastache cana*	FWS-SC; NM-SC	Known from southern New Mexico and western Texas. Occurs in rock crevices of granite cliffs or in canyon habitats at the lower edge of the pinyon-juniper zone. Elevations range between 4,600 and 5,900 ft.	x	x	x
Mottled milkvetch	*Astragalus lentiginosus* var. *stramineus*	NV-S1	Restricted to the lower Virgin River Valley in Mohave County, Arizona, and Clark County, Nevada. Inhabits sandy and gravelly flats and dunes at elevations between 2,000 and 3,000 ft.	x	x	x
Mount Charleston sandwort	*Eremogone congesta* var. *charlestonensis*	NV-S2	Restricted to southeastern California and southern Nevada. Occurs on sandy ridges at elevations between 7,200 and 10,000 ft.	x	x	
Mountain bladder fern	*Cystopteris montana*	CO-S1	Moist, rich soil in closed-canopied spruce-fir forests at elevations between 9,000 and 11,000 ft.	x	x	x
Mountain whitlow-grass	*Draba rectifructa*	CO-S2	Openings in sagebrush ponderosa pine, aspen, spruce-fir, lodgepole pine, and moderately moist alpine meadow communities at elevations between 6,400 and 9,600 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Mt. Dellenbaugh sandwort	*Arenaria aberrans*	AZ-S2	Endemic to Arizona. Occurs in pinyon-juniper, oak, and pine forests at elevations between 5,500 and 9,000 ft.	x	x	
Mud nama	*Nama stenocarpum*	CA-S1	Known from margins of freshwater wetlands in southern California, including lakes, streams, rivers, marshes, and swamps. Elevation ranges between 0 and 1,640 ft.	x	x	x
Mud sedge	*Carex limosa*	CO-S2	Sphagnum bogs, wet meadows, and shores at elevations below 6,500 ft.	x		
Munz's cholla	*Opuntia munzii*	BLM-S; CA-S1; FWS-SC	Gravelly or sandy to rocky soils, often on lower bajadas, washes, and flats. Also occurs in hills and canyon sides. Occurs in Sonoran Desert creosote bush shrub communities at elevations below 3,280 ft.	x	x	x
Narrow-leaved cottonwood	*Populus angustifolia*	CA-S2	Occurs in upland riparian forest habitats at elevations between 3,900 and 5,900 ft.	x	x	x
Narrow-leaved psorothamnus	*Psorothamnus fremontii* var. *attenuates*	CA-S2	Occurs on volcanic substrates of slopes, flats, and canyons within Sonoran Desert scrub communities at elevations between 1,100 and 3,000 ft.	x	x	x
Narrow-leaved yerba santa	*Eriodictyon angustifolium*	CA-S2	Restricted to the New York and Granite Mountains in California. Occurs in washes and slopes within pinyon-juniper woodland habitats at elevations between 4,900 and 6,200 ft.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Navajo mountain phlox	*Phlox cluteana*	AZ-S2	Known from the mountains along the Arizona-Utah border and adjacent northwestern New Mexico. Occurs in open ponderosa pine forests on flat to gentle mountain slopes with light to heavy shade. Elevations range between 6,000 and 10,400 ft.	x		
Needle Mountains milkvetch	*Astragalus eurylobus*	BLM-S; FWS-SC; NV-S2	Occurs on gravel washes and sandy soils in alkaline desert and arid grasslands at elevations between 4,250 and 6,250 ft.	x	x	x
Nevada dune beardtongue	*Penstemon arenarius*	BLM-S; FWS-SC; NV-S2	Endemic to western Nevada. Dependent on sand dunes or deep sand occurring on deep, loose, sandy soils of valley bottoms, aeolian deposits, and dune skirts, often in alkaline areas, sometimes on road banks and other recovering disturbances crossing such soils, in shadscale communities.	x	x	x
Nevada willowherb	*Epilobium nevadense*	BLM-S; FWS-SC; NV-S2; UT-S1	Known from eastern Nevada and western Utah. Occurs in pinyon-juniper woodlands and oak/mountain mahogany communities, on talus slopes and rocky limestone outcrops. Elevation ranges between 5,000 and 8,800 ft.	x	x	x
New Mexico beardtongue	*Penstemon neomexicanus*	FWS-SC; NM-SC	Endemic to south central New Mexico from the Capitan and Sacramento Mountains. Occurs on wooded slopes or open glades in ponderosa pine or other coniferous forests. Elevation ranges between 6,000 and 9,000 ft.	x	x	
New Mexico cliff fern	*Woodsia neomexicana*	CO-S2	Cliffs and rocky slopes usually on sandstone or igneous substrates. Elevations range between 7,875 and 11,500 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
New Mexico milkvetch	*Astragalus neomexicanus*	FWS-SC; NM-SC	Endemic to south central New Mexico primarily from the Sacramento Mountains. Occurs on dry hillsides, pinyon-juniper woodlands, or ponderosa pine forests at elevations between 6,850 and 8,450 ft.	x	x	
New Mexico rock daisy	*Perityle staurophylla* var. *staurophylla*	BLM-S; FWS-SC; NM-SC	Endemic to south central New Mexico. Occurs in crevices of limestone cliffs and boulders at elevations between 4,900 and 7,000 ft.	x	x	x
New York Mountains cats'-eye	*Cryptantha tumulosa*	NV-S2	Known from California and Nevada. Occurs on gravelly or clay, granitic or carbonate substrates within Mojave Desert scrub, creosote bush scrub, and pinyon-juniper woodland communities. Elevation ranges between 4,500 and 9,900 ft.	x	x	x
Nodding rockdaisy	*Perityle cernua*	BLM-S; FWS-SC; NM-SC; NM-S2	Endemic to the Organ Mountains in Dona Ana County, New Mexico. Occurs on volcanic or igneous cliffs at elevations between 5,000 and 8,800 ft.	x	x	
Northern moonwort	*Botrychium pinnatum*	CO-S1	Grassy slopes, stream banks, and woodlands at elevations below 8,200 ft.	x	x	x
Northern twayblade	*Listera borealis*	CO-S2	In moist, rich humus of mossy spruce-dominant or mixed hardwood forests and swamps. Prefers banks of cold streams fed by melting snow with high acidic soils at elevations between 8,700 and 10,800 ft.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
One-leaflet Torrey milkvetch	*Astragalus calycosus* var. *monophyllidius*	NV-S2	Known from Nevada and Utah. Utilizes areas having dry, ashy-sand, tuffaceous sediments in drainage bottoms and lower to upper slope and crest positions. Typically occurs on southern and western exposures within open juniper, big sagebrush communities. Elevation ranges between 5,350 and 7,500 ft.	x	x	
Orcutt's linanthus	*Linanthus orcuttii*	BLM-S; CA-S2; FWS-SC	Chaparral and lower montane coniferous forests in gravelly clearings and disturbed open areas. Elevation ranges between 3,280 and 6,550 ft.	x		
Orcutt's woody-aster	*Xylorhiza orcuttii*	BLM-S; CA-S2	Inhabits Sonoran Desert scrub, often in washes of desert canyons on rocky substrates. Also occurs on slopes and bottoms of ravines. Elevation ranges between 875 and 1,200 ft (265 and 365 m). Known only to occur in Imperial and San Diego Counties, California.	x		
Organ Mountains evening-primrose	*Oenothera organensis*	BLM-S; FWS-SC; NM-SC; NM-S2	Endemic to the Organ Mountains in Dona Ana County, New Mexico. Inhabits seeps, springs, and colluvium substrates in the bottom of drainages in montane scrub and pinyon-juniper woodland communities. Elevation ranges between 5,700 and 7,600 ft.	x		
Organ Mountains giant-hyssop	*Agastache pringlei* var. *verticillata*	FWS-SC; NM-SC; NM-S2	Endemic to the Organ Mountains in southern New Mexico. Occurs on humus-covered volcanic talus and boulders at the bases of steep cliffs in coniferous woodlands. Elevation ranges between 5,900 and 7,500 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Organ Mountains paintbrush	*Castilleja organorum*	BLM-S; FWS-SC; NM-SC	Endemic to the Organ Mountains in Dona Ana County, New Mexico. Inhabits open to partly shaded montane slopes and rocky canyons in pinyon-juniper woodlands or montane coniferous forests at elevations between 7,000 and 8,000 ft.	x		
Organ Mountains pincushion cactus	*Escobaria organensis*	BLM-S; NM-E; FWS-SC; NM-S2	Endemic to the Franklin and Organ Mountains in Dona Ana County, New Mexico. Inhabits granite and limestone substrates in desert scrub and pinyon-juniper woodlands at elevations between 4,400 and 8,530 ft.	x		
Organ pipe cactus	*Stenocereus thurberi*	AZ-SR	Endemic to Arizona and northern Mexico. Widespread in the Sonoran Desert, occurring on hills and bajadas below 3,700 ft. Found on south- to southeast-facing slopes on the Organ Pipe Cactus National Monument and elsewhere throughout the Sonoran Desert. Associated with upland Sonoran Desert scrub plant communities.	x	x	
Orocopia sage	*Salvia greatae*	BLM-S; CA-S2	Inhabits creosote bush scrub communities and dry washes at elevations less than 2,600 ft.	x	x	x
Ostler's ivesia	*Ivesia shockleyi ostleri*	BLM-S; FWS-SC; UT-S1	Endemic to the Wah Wah Mountains and Needle Range of western Beaver County, Utah. Occurs in pinyon-juniper and adjacent ponderosa pine woodland communities in crevices of quartzite outcrops at elevations between 6,500 and 8,000 ft.	x		
Ostler's pepper-grass	*Lepidium ostleri*	ESA-UR; BLM-S; UT-S1	Endemic to the San Francisco Mountains in Beaver County, Utah. Occurs in pinyon-juniper communities in crevices in limestone outcrops at elevations between 5,800 and 6,800 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Pagosa bladderpod	*Lesquerella pruinosa*	CO-S2	Primarily found in exposed gray clay barrens and Mancos slate or shale meadows with slopes of approximately 15% and a high level of disturbance at elevations between 6,890 and 8,800 ft.	x		
Pahute green gentian	*Frasera pahutensis*	FWS-SC	Endemic to Nye County, Nevada, in montane habitats (elevations between 7,000 and 8,400 ft). Occurs on flat to very gentle slopes in relatively deep, stable, sandy or sandy-rocky soils on or near protected (wooded or north-sloping) exposures or on more open, south-sloping exposures at higher elevations, mostly derived from rhyolitic, granitoid, or andesitic parent materials within pinyon-juniper and lower montane scrub communities.	x		
Pahute Mesa beardtongue	*Penstemon pahutensis*	BLM-S; FWS-SC	Restricted to southeastern California and Nye County, Nevada, where it is locally abundant. Occurs in loose soil and rock crevices among boulders in pinyon-juniper woodlands and sagebrush shrubland at elevations between 5,400 and 7,500 ft.	x		
Pale blue-eye-grass	*Sisyrinchium pallidum*	BLM-S; CO-S2	Endemic to central Colorado in the Pike and San Isabel National Forests. Occurs in wet, poorly drained meadows, stream banks, and roadside ditches where water is available through the early growing season.	x		
Pale moonwort	*Botrychium pallidum*	CO-S2	Open exposed hillsides, burned or cleared areas, or old mining situations at elevations between 9,800 and 10,600 ft.	x	x	x
Palmer's mariposa-lily	*Calochortus palmeri* var. *palmeri*	BLM-S; CA-S2; FWS-SC	In moist to wet meadows or on moist grassy knolls. Also found along creeks or swales and within chaparral, pinyon woodlands, and pine forest communities. Elevation ranges between 3,280 and 7,850 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Panamint Mountains bedstraw	*Galium hilendiae* spp. *carneum*	NV-S1	Restricted to southeastern California and western Nevada. Occurs on rocky or gravelly substrates of rocky slopes or open flats within Mojave desert scrub and pinyon-juniper woodlands at elevations between 4,000 and 11,200 ft.	x	x	x
Parish's alkali grass	*Puccinellia parishii*	BLM-S; CA-S1	Inhabits meadows, seeps, and moist areas near springs on alkaline soils at elevations between 2,300 and 7,350 ft.	x	x	x
Parish's alumroot	*Heuchera parishii*	BLM-S; CA-S2	Inhabits alpine and lower montane coniferous forests on rocky carbonate substrates. Elevation ranges between 5,900 and 12,450 ft.	x		
Parish's brittlescale	*Atriplex parishii*	BLM-S; CA-S1; FWS-SC	Restricted to chenopod scrub, playas, and vernal pools in southern California. Occurs at elevations between 100 and 6,200 ft.	x	x	x
Parish's checkerbloom	*Sidalcea hickmanii* spp. *parishii*	BLM-S; CA-S1	Inhabits chaparral communities and montane coniferous forests at elevations between 3,280 and 8,200 ft.	x		
Parish's club-cholla	*Grusonia parishii*	CA-S2	Silty, sandy, or gravelly flats, dunelets, and hills within Joshua tree woodlands, creosote bush scrub, and desert scrub communities. Elevation ranges between 100 and 5,000 ft.	x	x	x
Parish's daisy	*Erigeron parishii*	ESA-T; BLM-S; CA-S2	Restricted to carbonate substrates in the San Bernardino Mountains in southern California. Occurs on dry rocky slopes and outwash plains. Sometimes found on sites underlain by granite, usually with an overlying wash of limestone materials. Elevation ranges between 3,280 and 6,560 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Parish's desert-thorn	*Lycium parishii*	CA-S2	Regionally endemic in southeastern California, occurring on coastal sage scrub, creosote bush scrub, and Sonoran Desert scrub communities. Elevation ranges between 1,000 and 3,300 ft.	x		
Parish's onion	*Allium parishii*	BLM-S; AZ-SR; AZ-S1	Known from western Arizona and southeastern California. Inhabits open rocky and sandy slopes in the Mohave Desert. Primarily known from the Kofa Mountains in Yuma County, Arizona. Elevation ranges between 2,720 and 2,900 ft.	x		
Parish's phacelia	*Phacelia parishii*	BLM-S; CA-S1; NV-S2; FWS-SC	Known from Arizona, California, and Nevada. An aquatic/wetland dependent species, occurring in moist to superficially dry, open, flat, mostly barren, salt-crusted silty-clay soils. Generally known to occur on valley bottoms, lake deposits, and playa edges. Often in close proximity to seepage areas surrounded by saltbush scrub vegetation. Elevation ranges between 2,200 and 5,950 ft.	x	x	x
Parish's popcorn-flower	*Plagiobothrys parishii*	BLM-S; CA-S1	Known from Rabbit Springs in San Bernardino County, California. Inhabits Joshua tree woodlands on alkaline mesic soils at elevations between 2,600 and 4,900 ft.	x		
Parish's rock-cress	*Arabis parishii*	BLM-S; CA-S2; FWS-SC	Endemic to the San Bernardino Mountains in southern California. Inhabits pinyon-juniper forests and montane coniferous forests on mostly pebble-clay substrates. Elevation ranges between 5,800 and 9,800 ft.	x		
Parish's yampah	*Perideridia parishii* ssp. *parishii*	CA-S2	Inhabits meadows, seeps, lodgepole forest, red fir forest, yellow pine forest, as well as upper and lower montane coniferous forests. Elevation ranges between 4,800 and 9,800 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Parry's crazy-weed	*Oxytropis parryi*	CO-S1	Gravelly, calcareous soil on exposed ridgetops in the alpine zone. Occurs within the analysis area at elevations between 8,200 and 10,200 ft.	x	x	x
Parry's spurge	*Chamaesyce parryi*	CA-S1	Restricted to the vicinity of Kelso, California. Inhabits desert dunes, creosote bush scrub, and Mojave Desert scrub at elevations between 1,300 and 2,400 ft.	x		
Peck sedge	*Carex peckii*	CO-S1	Calcareous soils on dry to mesic slopes in partial shade within rich, deciduous or mixed deciduous-coniferous woodlands; open woods; bases of slopes; or full sun on exposed outcrops. Occurs at elevations below 6,600 ft.	x	x	x
Pedate checker-mallow (bird-foot checkerbloom)	*Sidalcea pedata*	ESA-E; BLM-S; CA-E; CA-S1	Known from fewer than 20 occurrences in the San Bernardino mountains in southern California. Inhabits moist meadows and seeps on mesic soils and pebble plains at elevations between 5,900 and 8,200 ft.	x		
Peirson's milkvetch	*Astragalus magdalenae* var. *peirsonii*	ESA-T; BLM-S; CA-E; CA-S2	Currently known to occur along the north and west flanks of the Algodones Dunes in California. Found on the slopes of mobile sand dunes in the Sonoran Desert scrub plant community. It most often grows in conically shaped hollows on the leeward side of the dunes. Elevation ranges between 164 and 820 ft.	x	x	
Peirson's pincushion	*Chaenactis carphoclinia* var. *peirsonii*	BLM-S; CA-S1	Known only from the eastern Santa Rosa Mountains. Inhabits Sonoran Desert scrub communities at elevations below 2,000 ft.	x	x	
Philadelphia fleabane	*Erigeron philadelphicus*	CO-S1	Disturbed sites, low prairies, and stream banks with open and moist conditions.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Pima indian mallow	*Abutilon parishii*	BLM-S; AZ-SR; FWS-SC; AZ-S2	Mesic and riparian areas on hillsides, cliff bases, canyon bottoms, rocks and boulders, and washes. Elevation ranges between 1,720 and 4,900 ft.	x	x	x
Pine Valley goldenbush	*Haplopappus crispus*	BLM-S; FWS-SC; UT-S2	Known only from the Pine Valley Mountains in Washington County, Utah. Occurs in ponderosa pine, spruce-fir, and aspen communities at elevations between 8,000 and 10,000 ft.	x		
Pink fairy-duster	*Calliandra eriophylla*	CA-S2	Sandy or rocky substrates in creosote and desert scrub communities. Elevation ranges between 390 and 4,900 ft.	x	x	x
Pinyon rock-cress	*Arabis dispar*	CA-S2	Restricted to the southern High Sierra Nevada and northern San Bernardino Mountains east of the Sierra Nevada. Occurs on granitic and gravelly substrates on loose slopes or compact talus. Elevation ranges between 3,900 and 8,300 ft.	x		
Pioche blazingstar	*Mentzelia argillicola*	BLM-S; NV-S1	Endemic to Nevada. Occurs on dry, soft, silty clay soils on knolls and slopes with sparse vegetation consisting mainly of *Artemisia pygmaea, Eriogonum nummulare, Gutierrezia sarothrae,* and *Salvia dorrii* var. *dorrii*.	x	x	x
Plain thistle	*Cirsium inornatum*	FWS-SC; NM-SC	Known only from the Sacramento Mountains in southern New Mexico. Inhabits mountain meadows and roadsides at elevations above 7,500 ft.	x		
Plank's catchfly	*Silene plankii*	BLM-S; FWS-SC; NM-SC; NM-S2	Known from New Mexico and western Texas. Inhabits volcanic cliffs and rocky outcrops at elevations between 5,000 and 9,200 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Playa milkvetch	*Astragalus allochrous* var. *playanus*	CA-S1	Known from the eastern Mojave Desert on sandy soils within desert scrub communities at elevations near 2,600 ft.	x	x	x
Plummer's mariposa-lily	*Calochortus plummerae*	BLM-S; FWS-SC	Endemic to southern California. Inhabits chaparral, cismontane woodlands, coastal scrub, and montane coniferous forests on rocky substrates. Elevation ranges between 330 and 5,550 ft.	x		
Porsild's whitlow-grass	*Draba porsildii*	CO-S1	Moist to sometimes drier sites with rocky or gravelly substrates in limestone or shale talus, scree, and grassy meadows; along ridges and slopes; and in summits within the alpine zone at elevations between 9,600 and 13,000 ft.	x	x	x
Prairie violet	*Viola pedatifida*	CO-S2	Rocky sites within prairies, open woodlands, and forest openings at elevations between 5,800 and 8,800 ft.	x	x	x
Prairie wedge grass	*Sphenopholis obtusata*	CA-S2	Cismontane woodland, foothill woodland, streambanks, ponds, and mesic meadows and seeps. Elevation ranges between 990 and 6,500 ft.	x	x	x
Providence Mountains lotus	*Lotus argyraeus* var. *notitius*	BLM-S; CA-S1	Restricted to the Providence Mountains in San Bernardino County, California. Occurs in pinyon-juniper woodlands at elevations between 3,900 and 6,550 ft.	x		
Pueblo goldenweed	*Oonopsis puebloensis*	CO-S2	Barren shale outcrops in sparse shrublands or pinyon-juniper woodlands at elevations between 4,800 and 5,500 ft. Substrates are derived from the Smoky Hill Member of the Niobrara Formation.	x		
Purple-nerve cymopterus	*Cymopterus multinervatus*	CA-S2	Occurs on sandy or gravelly slopes within desert scrub, Joshua tree woodland, and pinyon-juniper woodland communities. Elevation ranges between 2,600 and 5,900 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Pygmy pussypaws	*Calyptridium pygmaeum*	BLM-S; CA-S2	Endemic to the High Sierra Nevada and the San Bernardino Mountains. Inhabits dry sandy or gravelly soils in upper montane and subalpine coniferous forests. Elevation ranges between 6,230 and 11,475 ft.	x		
Remote rabbitbrush	*Chrysothamnus eremobius*	BLM-S; NV-S1	Endemic to Clark and Lincoln Counties, Nevada. Known from the Sheep and Pintwater ranges on crevices or rubble of north-facing carbonate cliffs at elevations between 4,850 and 6,400 ft.	x		
Retrorse sedge	*Carex retrorsa*	CO-S1	Perennially wet areas, with a strong preference for banks along small channels, small to mid-size depressional wetlands, open mudflats at pond margins, and surface drying mud. Occurs at elevations between 5,000 and 10,000 ft.	x	x	x
Ripley biscuitroot	*Cymopterus ripleyi var. ripleyi*	FWS-SC; NV-S2	Restricted to southeastern California and western Nevada. A sand-dune-dependent species occurring on deep loose, sandy soils of stabilized dunes, dune skirt areas, aeolian deposits, and alluvial drainage areas at elevations between 4,400 and 6,000 ft.	x	x	x
Ripley's milkvetch	*Astragalus ripleyi*	BLM-S; CO-S2	Mixed conifer and shrubland habitats on rocky substrates at elevations above 8,000 ft.	x	x	x
Robison's monardella	*Monardella robisonii*	BLM-S; CA-S2	Known from fewer than 20 occurrences in Riverside and San Bernardino Counties, California. Inhabits pinyon-juniper woodlands at elevations below 4,900 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Rock phacelia	*Phacelia petrosa*	BLM-S; NV-S2	Known from Arizona, Nevada, and Utah. Occurs on dry limestone and volcanic talus slopes of foothills, washes, and gravelly canyon bottoms on substrates derived from calcerous material. Inhabits mixed desert scrub, creosote bush, and blackbrush communities at elevations between 2,500 and 5,800 ft.	x	x	x
Rock purpusia	*Ivesia arizonica* var. *saxosa*	BLM-S; NV-S1	Endemic to southern Nevada. It inhabits crevices of cliffs and boulders on volcanic substrates in pinyon-juniper communities at elevations between 4,900 and 6,900 ft.	x	x	x
Rock purslane	*Calandrinia ambigua*	AZ-S2	Limited distribution in California. Coastal bluff scrub, coastal prairie, coastal scrub, marshes and swamps, valley and foothill grasslands, and margins of vernal pools. Elevation ranges from 0 to 1,425 ft. Populations in California have no federal or state status or rank.	x		
Rock sandwort	*Minuartia stricta*	CO-S1	Moist, granitic gravels sedge meadows, heath, alpine, or arctic tundra. Elevation ranges from 300 to 12,500 ft.	x	x	x
Rockcress draba	*Draba globosa*	CO-S1	Alpine meadows, granitic talus slopes, and rock crevices at elevations between 11,500 and 12,500 ft.	x		
Rock-loving aletes	*Neoparrya lithophila*	BLM-S; CO-S2	Endemic to south-central Colorado on igneous rock outcrops on north-facing cliffs and ledges. Found on north-facing cliffs and ledges within pinyon-juniper woodlands at elevations greater than 7,000 ft.	x	x	x
Rocky Mountain bladderpod	*Lesquerella calcicola*	CO-S2	Shale bluffs, limy hillsides, gypseous knolls and ravines, and various calcareous substrates at elevations between 5,000 and 7,500 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Rocky Mountain blazing-star	*Liatris ligulistylis*	CO-S1	Dry, rocky slopes, rocky woodlands, gravelly ground in valleys, stream sides, prairies, and open moist sites.	x	x	x
Rollins' twinpod	*Physaria rollinsii*	CO-S2	Regionally endemic to approximately 1,439 mi^2 in southwestern Colorado. Occurs on granitic talus, open knolls, limestone chiprock, steep slopes, clay banks, and sagebrush, and in close proximity to granite boulders.	x		
Rosy two-tone beardtongue	*Penstemon bicolor* spp. *roseus*	BLM-S; FWS-SC	Known from Arizona, California, and Nevada. Occurs on calcareous, granitic, or volcanic soils in washes, roadsides, scree at outcrop bases, rock crevices, or similar places receiving enhanced runoff, within creosote-bursage, blackbrush, and mixed-shrub communities. Elevation ranges between 1,800 and 4,850 ft.	x	x	x
Rough angelica	*Angelica scabrida*	BLM-S; NV-S2	Endemic to the Spring Mountains in southern Nevada. An aquatic/wetland-dependent species occurring in moist, rocky calcareous drainages, canyon bottoms, or seepy or north-facing slopes over carbonate or sandstone rock in interior chaparral, mountain brush, and montane coniferous forest communities. Elevation ranges between 4,000 and 9,350 ft.	x	x	
Rough dwarf greasebush	*Glossopetalon pungens* var. *pungens*	BLM-S; NV-S2	Endemic to the Spring and Sheep Ranges in southern Nevada where the species is known from seven occurrences. Inhabits crevices of carbonate cliffs and outcrops, generally avoiding southerly exposures, within pinyon-juniper, mountain mahogany, and montane conifer communities. Elevation ranges between 4,400 and 7,800 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Rough fringemoss	*Crossidium seriatum*	NV-S2	Known from only eight occurrences in Nevada. Occurs in sandstone and gypsiferous bluffs, outcrops, rock piles, and soils, often protected on the north or east sides of rocks or shrubs, or at bases of bluffs, in the creosote-bursage zone at elevations between 1,300 and 2,450 ft.	x	x	x
Round-leaf four-o'clock	*Oxybaphus rotundifolius*	CO-S2	Restricted to barren shale outcrops in sparse shrublands or pinyon-juniper woodlands at elevations between 4,800 and 5,600 ft. Substrate derived from the Smoky Hill Member of the Niobrara Formation.	x	x	
Round-leaved filaree	*California macrophylla*	BLM-S	Found on clay substrates of valleys and foothill grasslands within montane woodland communities at elevations ranging between 50 and 3,950 ft.	x		
Royal Gorge stickleaf	*Mentzelia densa*	BLM-S	Narrowly endemic to central Colorado in Chaffee and Fremont Counties. Occurs in dry open sites, such as washes, roadside ditches, and steep rocky slopes. Found on gravelly substrates at elevations between 6,000 and 7,200 ft.	x		
Sacramento groundsel	*Senecio sacramentanus*	FWS-SC; NM-SC	Known only from the Sacramento-White Mountains in southern New Mexico. Inhabits mountain meadows and aspen glades in lower and upper montane coniferous forests. Elevation ranges between 8,000 and 11,000 ft.	x	x	
Sacramento Mountain fleabane	*Erigeron rybius*	FWS-SC; NM-SC	Known only from the Sacramento-White Mountains in southern New Mexico. Inhabits mountain meadows and forest openings in lower and upper montane coniferous forests. Elevation ranges between 7,000 and 9,200 ft.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Sacramento Mountains prickly-poppy	*Argemone pleiacantha* ssp. *pinnatisecta*	ESA-E; NM-E; NM-S2	Endemic to the Sacramento Mountains in Otero County, New Mexico. Inhabits loose, gravelly soils of open disturbed sites in canyon bottoms, on slopes, and along roadsides. Elevation ranges between 4,200 and 7,100 ft.	x	x	x
Sacramento Mountains thistle	*Cirsium vinaceum*	ESA-T; NM-E; NM-S2	Endemic to the Sacramento Mountains in Otero County, New Mexico. Inhabits wet soils at springs, seeps, and along streams in meadows or forest margins at elevations between 7,500 and 9,500 ft.	x	x	
Saguaro cactus	*Carnegiea gigantea*	CA-S1	Regionally endemic, found only in the Sonoran Desert. Occurs in low numbers along the Colorado River from the Whipple Mountains to Laguna Dam. Inhabits rocky substrates within Sonoran Desert scrub and creosote scrub communities at elevations between 160 and 4,900 ft.	x	x	x
Salt Spring checkerbloom	*Sidalcea neomexicana*	CA-S2	Alkaline or mesic substrates within riparian wetlands, marshes, springs, chaparral, coastal scrub, coniferous forest, desert scrub, and playas habitats. Elevation ranges between 50 and 5,000 ft.	x	x	x
San Bernardino aster	*Symphyotrichum defoliatum*	BLM-S	Known primarily from the San Bernardino Mountains in southern California. Inhabits montane coniferous forests, moist meadows and seeps, marshes and swamps, and valley foothill habitats at elevations below 6,500 ft.	x		
San Bernardino blue grass	*Poa atropurpurea*	ESA-E; BLM-S; CA-S2	Edges of moist meadows and seeps in the San Bernardino, Palomar, and Laguna Mountains of southern California. Elevation ranges between 4,600 and 8,200 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
San Bernardino gilia	*Gilia leptantha* ssp. *leptantha*	BLM-S; CA-S2	Known only from the San Bernardino Mountains in southern California. Inhabits lower montane coniferous forests on sandy or gravelly substrates at elevations between 4,900 and 8,500 ft.	x		
San Bernardino Mountains bladderpod	*Lesquerella kingii* spp. *Bernardina*	ESA-E; BLM-S; CA-S1	Dolomite substrates, typically on open, gentle to moderate slopes within pine-juniper woodlands and fir forests at elevations between 6,900 and 8,850 ft. Soils typically have little accumulation of organic material.	x		
San Bernardino Mountains dudleya	*Dudleya abramsii* spp. *Affinis*	BLM-S; CA-S2; FWS-SC	Restricted to the San Bernardino Mountains in southern California. Inhabits upper montane coniferous forests and pinyon-juniper woodlands on granitic, quartzite, or carbonate soils. Elevation ranges between 4,100 and 8,500 ft.	x		
San Bernardino Mountains monkeyflower	*Mimulus exiguous*	BLM-S; CA-S2; FWS-SC	Known only from the San Bernardino Mountains in southern California. Inhabits upper montane coniferous forests, seeps, and wet meadows on mesic clay substrates. Elevation ranges between 5,900 and 7,700 ft.	x		
San Bernardino Mountains owl's-clover	*Castilleja lasiorhyncha*	BLM-S; CA-S2; FWS-SC	Known primarily from the San Bernardino Mountains of southern California. Inhabits meadows, pebble plains, and upper montane coniferous forests at elevations between 4,275 and 7,875 ft.	x		
San Bernardino ragwort	*Packera bernardina*	BLM-S; CA-S2	Known from fewer than 20 occurrences in the San Bernardino Mountains of southern California. Inhabits open areas with coniferous forests, including wet meadows, dry rocky slopes, and pebble plains habitats. Elevation ranges between 5,900 and 7,550 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
San Bernardino rock-cress	*Arabis breweri* var. *pecuniaria*	BLM-S; CA-S1; FWS-SC	Known from only two extant locations in San Bernardino County, California. Inhabits rocky substrates in subalpine coniferous forests at elevations between 8,900 and 10,500 ft.	x		
Sand evening-primrose	*Camissonia arenaria*	CA-S2	Sandy washes and rocky slopes within Sonoran Desert scrub communities at elevations below 3,000 ft.	x	x	x
Sand flat milkvetch	*Astragalus insularis*	AZ-S2	Known from Arizona and California. Inhabits desert dunes and sandy washes at elevations below 1,000 ft.	x		
Sand food	*Pholisma sonorae*	BLM-S; AZ-HS; AZ-S1; CA-S2; FWS-SC	Inhabits Sonoran sand dune habitats at elevations below 650 ft.	x	x	x
Sand prickly-pear cactus	*Opuntia arenaria*	NM-E; FWS-SC; NM-S2	Known from southern New Mexico, western Texas, and northern Mexico. Inhabits sandy areas, particularly semi-stabilized sand dunes among open Chihuahuan desert scrub. Often associated with sparse cover of grasses. Elevation ranges between 3,800 and 4,300 ft.	x	x	x
Sandberg pincushion cactus	*Escobaria sandbergii*	FWS-SC; NM-SC; NM-S2	Known from the San Andres and Fra Cristobal Mountains in Dona Ana and Sierra Counties, New Mexico. Occurs on rocky limestone soils in Chihuahuan desert scrub and open oak and pinyon-juniper woodlands at elevations between 4,200 and 7,400 ft.	x	x	x
Sandhill goosefoot	*Chenopodium cycloides*	BLM-S; NM-S2	Known from south central New Mexico as well as southern Colorado and western Texas. Inhabits open sandy areas, frequently along the edges of sand dunes.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Sanicle biscuitroot	*Cymopterus ripleyi* var. *saniculoides*	BLM-S; FWS-SC	Endemic to Nevada. Occurs on loose, sandy to gravelly, often somewhat alkaline soils on volcanic tuff deposits and mixed valley alluvium within blackbrush, mixed-shrub, sagebrush, and lower pinyon-juniper communities. Elevation ranges between 3,150 and 6,700 ft.	x	x	x
Santa Rosa Mountains leptosiphon	*Leptosiphon floribundus* spp. *hallii*	BLM-S; CA-S1	Endemic to the Santa Rosa Mountains of southern California. Inhabits Sonoran Desert scrub and pinyon and juniper woodland communities at elevations between 3,280 and 6,560 ft.	x		
Scalloped moonwort	*Botrychium crenulatum*	CA-S2	Scattered distribution in southern California from bogs, fens, marshes, swamps, meadows, and seeps within yellow pine forests and montane coniferous forests. Elevation ranges between 4,150 and 10,750 ft.	x	x	
Scaly sandplant	*Pholisma arenarium*	BLM-S; AZ-HS; AZ-S2	Occupies a variety of habitats, including coastal and inland sand dunes, chaparral, and Sonoran and Mohave desert habitats at elevations below 900 ft.	x	x	
Scheer's pincushion cactus	*Coryphantha scheeri* var. *valida*	NM-E; FWS-SC; NM-S2	Known from southern New Mexico in desert grassland and Chihuahuan desert scrub communities, occasionally on rocky benches, washes, or bajadas. Elevation ranges between 3,300 and 3,600 ft.	x	x	x
Schlesser pincushion cactus	*Sclerocactus schlesseri*	BLM-S; NV-P; FWS-SC; NV-S1	Endemic to Lincoln County, Nevada, where it is known to occur within a 134-ac area within the Meadow Valley. Occurs in open, stable, gravelly, or silty soils derived from gypsiferous sediments on mesic microsites on north to east aspects. Elevation ranges between 4,760 and 5,150 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Schott wire lettuce	*Stephanomeria schottii*	BLM-S; AZ-S2	Endemic to sand dunes of the Gran Desierto region. Occurs on semi-stabilized sand dunes with creosote, white bursage, and big galleta grass. Elevation ranges between 350 and 800 ft.	x	x	
Selkirk violet	*Viola selkirkii*	CO-S1	Generally known to occur in moist woods and alder thickets. Within the SEZ analysis area, the species is known to occur at elevations between 7,875 and 8,850 ft.	x		
Sheep fleabane	*Erigeron ovinus*	BLM-S; FWS-SC; NV-S2	Endemic to Mount Irish and the Sheep and Groom Ranges in southern Nevada, where the species is known from fewer than 15 occurrences. Inhabits crevices of carbonate cliffs and ridgeline outcrops within pinyon-juniper and montane conifer communities. Elevation ranges between 3,600 and 8,400 ft.	x	x	x
Sheep Mountain milkvetch	*Astragalus amphioxys* var. *musimonum*	BLM-S; FWS-SC; NV-S2	Restricted to the foothills of the Sheep Mountains in southern Nevada (historically occurred in Arizona). Occurs in on carbonate alluvial gravels, particularly along drainages, roadsides, and in other microsites with enhanced runoff, at elevations between 4,400 and 6,000 ft.	x	x	x
Shivwit's milkvetch	*Astragalus ampullarioides*	ESA-E; UT-S1	Endemic to Washington County, Utah. Inhabits warm desert shrub, creosote bush, and juniper communities on gypsiferous soils on the Chinle Formation. Occurs at elevations between 3,400 and 4,000 ft.	x		
Shockley's rock-cress	*Arabis shockleyi*	CA-S2	Restricted to the San Bernardino Mountains and Mojave Desert in southern California. Occurs on rocky or gravelly ridges of carbonate or quartzite derivations within Pinyon-juniper woodlands. Elevation ranges between 2,900 and 7,500 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Sierra Blanca kittentails	*Besseya oblongifolia*	FWS-SC; NM-SC; NM-S2	Endemic to the Sacramento Mountains in Lincoln and Otero Counties, New Mexico. Occurs in alpine meadows at elevations between 11,000 and 12,000 ft.	x		
Silver-cup mock-orange	*Philadelphus argyrocalyx*	FWS-SC; NM-SC	Known from the Capitan, Sacramento, and White Mountains in southern New Mexico. Inhabits rocky slopes in montane regions in association with pinyon-juniper and coniferous woodlands. Elevation ranges between 6,900 and 8,500 ft.	x		
Silver-haired ivesia	*Ivesia argyrocoma*	BLM-S; CA-S2; FWS-SC	Known from an extremely narrow range in the San Bernardino Mountains. Inhabits dry alkaline meadows, decomposed granite soils, and pebble plains habitats. Associated with yellow pine forests, red fir forests, and montane coniferous forest communities at elevations between 5,900 and 9,500 ft.	x		
Silverleaf sunray	*Enceliopsis argophylla*	BLM-S; NV-S1	Nearly entirely confined to Clark County, Nevada, the species is also known to occur in Arizona and Utah. Inhabits dry, open, relatively barren areas on gypsum badlands, volcanic gravels, or loose sands, within creosote-bursage communities. Elevation ranges between 1,200 and 2,400 ft.	x	x	x
Slender cottongrass	*Eriophorum gracile*	CO-S2	Found in fens and subalpine wetlands at elevations between 7,100 and 12,000 ft that are supported by groundwater discharge or snowmelt. Soils tend to be peaty and highly saturated.	x	x	x
Slender cottonheads	*Nemacaulis denudata* var. *gracilis*	CA-S2	Occurs in southern California within the Mojave and Sonoran Deserts. Inhabits sandy soils within coastal dunes, desert dunes, creosote bush scrub, and desert scrub communities at elevations below 1,300 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Slender sedge	*Carex lasiocarpa*	CO-S1	Very wet sites, including sedge meadows, fens, bogs, lakeshores, and stream banks. A dominant species of boreal wetlands, where it often forms large, floating mats.	x	x	x
Slender-petaled mustard	*Thelypodium stenopetalum*	ESA-E; BLM-S; CA-E; CA-S1	Restricted to the Big Bear Basin in San Bernardino County, California. It is protected in part at Baldwin Lake Ecological Reserve. Occurs in meadows and seeps at elevations between 5,250 and 8,200 ft.	x		
Slender-spined all-thorn	*Koeberlinia spinosa* spp. *tenuispina*	CA-S2	Known from the Chocolate Mountains of the Sonoran Desert in southeastern California. Occurs in riparian woodland, creosote bush scrub, and Sonoran Desert scrub communities. Elevation ranges between 500 and 1,675 ft.	x	x	
Slender-stem bean	*Phaseolus filiformis*	CA-S1	Restricted to a single occurrence in the Coachella Valley of southern California. Occupies washes within Sonoran Desert scrub and creosote bush scrub communities at elevations near 400 ft.	x		
Small-flowered androstephium	*Androstephium breviflorum*	CA-S1	Dry sandy to rocky soil substrates. Occurs on desert dunes within creosote bush scrub and Mojave Desert scrub at elevations between 720 and 2,100 ft.	x	x	x
Small-flowered sand-verbena	*Tripterocalyx micranthus*	CA-S1	Restricted to the vicinity of Kelso, California. Occurs on sandy substrates within desert dunes, desert grasslands, creosote bush scrub, and desert scrub. Elevation ranges between 1,800 and 2,800 ft.	x		
Small-winged sedge	*Carex stenoptila*	CO-S2	Open, rocky sites within coniferous woodlands at elevations between 7,900 and 9,500 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Smith whitlow-grass	*Draba smithii*	CO-S2	Endemic to the mountains of southern Colorado. Occurs on talus slopes providing shaded and protected crevices at elevations between 8,000 and 11,000 ft.	x	x	x
Smooth dwarf greasebush	*Glossopetalon pungens* var. *glabrum*	BLM-S; FWS-SC; NV-S1	Endemic to the Spring and Sheep Ranges in southern Nevada, where the species is known from three occurrences. Inhabits crevices of carbonate cliffs and outcrops, generally avoiding southerly exposures, within pinyon-juniper, mountain mahogany, and montane conifer communities. Elevation ranges between 6,000 and 7,800 ft.	x		
Smooth figwort	*Scrophularia laevis*	BLM-S; FWS-SC; NM-SC; NM-S2	Known from the Organ Mountains in Dona Ana County, New Mexico. Inhabits moist canyons on quartz monzonite substrates in pinyon-juniper woodlands and coniferous forests at elevations between 6,900 and 8,500 ft.	x		
Sneed's pincushion cactus	*Escobaria sneedii* var. *sneedii*	ESA-E; NM-E; NM-S2	Known from southern New Mexico and western Texas. Found primarily in limestone cracks of broken terrain on steep slopes. Also found on limestone edges and rocky slopes in mountainous regions. Elevation ranges between 4,000 and 6,000 ft.	x	x	x
Snow gooseberry	*Ribes niveum*	CO-S1	Once considered to be extirpated in Colorado, occurs in thickets along streams or open hillsides at elevations between 1,300 and 7,900 ft.	x		
Southern jewel-flower	*Streptanthus campestris*	BLM-S; CA-S2	Inhabits chaparral, pinyon-juniper, and montane coniferous habitats on rocky substrates at elevations between 3,280 and 7,875 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Southern mountain buckwheat	*Eriogonum kennedyi* var. *austromontanum*	ESA-T; BLM-S; CA-S2	Restricted to pebble plains—dense clay soils, usually covered with a cobble pavement of quartzite. These areas usually occur as sparsely vegetated openings in forested habitats. Elevation ranges between 5,900 and 7,900 ft.	x		
Southern mountains skullcap	*Scutellaria bolanderi* spp. *austromontana*	BLM-S; CA-S2	Inhabits chaparral communities and montane coniferous forests on mesic soils at elevations between 1,650 and 6,500 ft.	x		
Southern Rocky Mountain cinquefoil	*Potentilla ambigens*	CO-S1	Scattered distribution in Colorado. Occurs on gravelly soils within dry, open shrublands and grasslands at middle elevations.	x	x	x
Spear-leaf matelea	*Matelea parvifolia*	CA-S2	Regionally endemic to southeastern California. Occurs on rocky substrates within creosote bush and desert scrub communities at elevations between 1,450 and 3,600 ft.	x	x	x
Spiny cliff-brake	*Pellaea truncata*	CA-S2	Rocky slopes and cliffs of volcanic or granitic derivation within pinyon-juniper woodlands. Elevation ranges between 4,000 and 7,000 ft.	x	x	x
Spiny-spored quillwort	*Isoetes setacea* ssp. *muricata*	CO-S2	In sandy sediment of shallow water and shores of lakes as well as sluggish, acidic streams.	x		
Spreading sandwort	*Arenaria lanuginosa* spp. *saxosa*	CA-S1	Restricted to the San Bernardino Mountains and Peninsular Ranges of southern California. Inhabits mesic and sandy substrates along streams within red fir, lodgepole, subalpine coniferous, and upper montane coniferous forests. Elevation ranges between 5,900 and 8,500 ft.	x		
Spring-loving centaury	*Centaurium namophilum*	ESA-T; NV-P; NV-S2	Endemic to the Ash Meadows region in Nye County, Nevada, where it is restricted to moist clay soils along the banks of seeps and streams.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Squalid milkvetch	*Astragalus serenoi* var. *sordescens*	NV-S2	Endemic to Nevada. Occurs on dry, open, gravelly or sandy soils along gentle slopes of alluvial fans or light-colored clay hills, within mixed-shrub, sagebrush, and lower pinyon-juniper communities at elevations between 5,000 and 6,800 ft.	x	x	x
St. George blue-eyed grass	*Sisyrinchium radicatum*	NV-S1	Restricted to southern Nevada and southwestern Utah, where it is primarily known from the Las Vegas-St. George region. Occurs in moist, sometimes alkaline, meadows, stream banks, and spring borders at elevations between 2,000 and 4,300 ft.	x	x	x
Standley's whitlow-grass	*Draba standleyi*	BLM-S; FWS-SC; NM-SC; NM-S2	Known from southern Arizona, New Mexico, and western Texas. Inhabits sandy areas, particularly semi-stabilized sand dunes among open Chihuahuan desert scrub. Often associated with sparse cover of grasses. Elevation ranges between 5,500 and 9,400 ft.	x	x	
Stephens' beardtongue	*Penstemon stephensii*	BLM-S; CA-S2; FWS-SC	Restricted to Inyo and San Bernardino Counties, California. Occurs on rocky (usually carbonate) substrates including rock crevices, cliffs, rocky slopes, and washes associated with pinyon-juniper and creosote bush scrub communities. Elevation ranges between 3,900 and 6,550 ft.	x	x	x
Sticky buckwheat	*Eriogonum viscidulum*	NV-P; FWS-SC; NV-S2	Known only from Clark County, Nevada, and Mohave County, Arizona. Dependent on sand dune communities, where it occurs on deep, loose, sandy soils in washes, flats, roadsides, steep aeolian slopes, and stabilized dune areas. Elevation ranges between 1,200 and 2,200 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Straw-top cholla	*Opuntia echinocarpa*	AZ-SR	Sandy or gravelly soil of benches, slopes, mesas, flats, and washes at elevations between 1,000 and 6,700 ft.	x	x	x
Strigose easter-daisy	*Townsendia strigosa*	CO-S1	Open sites, sands, shales, and clays with desert scrub, junipers, pinyons at elevations between 4,900 and 6,500 ft.	x		
Sweet moustache moss	*Trichostomum sweetii*	NV-S1	Known from only two occurrences in Nevada. Occurs on sandstone bluffs and sandstone-derived soil, often shaded by rocks at elevations between 2,000 and 2,230 ft.	x	x	x
Tecopa birdbeak	*Cordylanthus tecopensis*	BLM-S; NV-S2	In Nevada known only from the Ash Meadows area and in Fishlake Valley. Occurs on open, moist to saturated, alkali-crusted clay soils of seeps, springs, outflow drainages, and meadows at elevations between 2,100 and 4,900 ft.	x		
Thorny milkwort	*Polygala acanthoclada*	CA-S2	Occupies loose, sandy or gravelly slopes within shadscale scrub, chenopod scrub, Joshua tree woodland, and pinyon-juniper woodland communities at an elevations between 2,500 and 7,500 ft.	x	x	x
Three-awned grama	*Bouteloua trifida*	CA-S2	Occurs in eastern Mojave Desert mountains on dry, rocky, often calcareous slopes within desert scrub communities. Elevation ranges between 2,300 and 6,500 ft.	x	x	x
Threecorner milkvetch	*Astragalus geyeri* var. *triquetrus*	NV-P; FWS-SC; NV-S2	Known only from Clark County, Nevada, and Mohave County, Arizona. Dependent on open, deep, sandy soils, desert washes, or dunes, generally stabilized by vegetation and/or a gravel veneer. Elevations range between 1,500 and 2,500 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Thurber pilostyles	*Pilostyles thurberi*	AZ-S2	Known from the Sonoran Desert in southern Arizona and southern California. Occurs in Sonoran Desert scrub communities at elevations below 1,200 ft.	x		
Tidestrom's milkvetch	*Astragalus tidestromii*	CA-S2	Known from fewer than 15 occurrences in the east-central Mojave Desert mountains. Occurs on sandy or gravelly substrates of carbonate (limestone) derivation within creosote bush and desert scrub communities. Elevation ranges between 1,950 and 5,200 ft.	x	x	x
Tiehm blazingstar	*Mentzelia tiehmii*	BLM-S; NV-S1	Endemic to Nevada. Occurs on hilltops of white soil, sparsely vegetated white calcareous knolls, and bluffs with scattered perennials.	x	x	x
Tiehm buckwheat	*Eriogonum tiehmii*	BLM-S; NV-P; NV-S1	Endemic to the Silver Peak Range in Esmeralda County, Nevada. Occurs on dry, open, relatively barren, light-colored rocky clay soils derived from a formation of interbedded claystones, shales, tuffaceous sandstones, and limestones.	x		
Timberland blue-eyed grass	*Sisyrinchium longipes*	CA-S1	Restricted to San Bernardino County, California. Inhabits mesic meadows, stream banks, moist mixed conifer forest openings, and seeps at elevations near 6,750 ft.	x		
Todsen's pennyroyal	*Hedeoma todsenii*	ESA-E; NM-E; NM-S2	Endemic to the Sacramento and San Andres Mountains in southern New Mexico. Inhabits loose, gypseous limestone soils on steep north- or east-facing slopes in pinyon-juniper woodlands. Elevations range between 6,200 and 7,400 ft.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Tonopah milkvetch	*Astragalus pseudiodanthus*	NV-S2	Restricted to southeastern California and western Nevada. A sand-dune-dependent species that occurs in deep, loose, sandy soils of stabilized and active dune margins, old beaches, valley floors, or drainages at elevations between 4,500 and 6,000 ft.	x	x	x
Tonopah pincushion	*Sclerocactus nyensis*	BLM-S; NV-P; NV-S1	Endemic to Esmeralda and Nye Counties, Nevada. Occurs on dry rocky soils and low outcrops of rhyolite, tuff, and possibly other rock types, on gentle slopes in open areas or under shrubs in the upper salt desert and lower sagebrush zones. Elevation ranges between 5,700 and 5,800 ft	x	x	x
Toquima milkvetch	*Astragalus toquimanus*	BLM-S; NV-S2	Endemic to Nevada. Occurs on dry, stiff, sandy to gravelly, basic or calcareous soils along gentle slopes or flats at elevations between 6,500 and 7,500 ft.	x	x	x
Triple-ribbed milkvetch	*Astragalus tricarinatus*	ESA-E; BLM-S; CA-S1	Narrowly endemic to a small area extending from Morongo Wash to the hills northeast of Mecca in Riverside and San Bernardino Counties, California. Exists in sandy and gravelly soils of dry washes or on decomposed granite or gravelly soils at the base of canyons. Elevation ranges between 1,475 and 3,900 ft.	x		
Tumamoc globeberry	*Tumamoca macdougalii*	BLM-S; AZ-SR	Endemic to southern Arizona and northern Mexico in xeric situations, in shady areas of nurse plants along gullies and sandy washes at elevations below 3,000 ft.	x	x	x
Tundra saxifrage	*Muscaria monticola*	CO-S1	Rock outcrops, crevices, talus, scree slopes, rocky tundra, fellfields, nunataks, and stream banks at elevations below 14,700 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Tusayan flame flower	*Talinum validulum*	AZ-SR; FWS-SC	Endemic to Arizona from Coconino and Yavapai Counties. In open mountain meadows, ponderosa pine forests, and pinyon-juniper woodlands and along canyon rims. Elevation ranges between 5,590 and 7,700 ft.	x	x	
Twinevine	*Sarcostemma crispum*	CO-S1	In rocky soils on hills, open-wooded slopes, arid slopes, and canyons at elevations between 5,250 and 6,500 ft.	x		
Upright burrhead	*Echinodorus berteroi*	AZ-S1	Clay soils of wet ditches, streams, and shallow ponds at elevations below 2,600 ft. Populations in California are not listed or ranked.	x		
Upswept moonwort	*Botrychium ascendens*	NV-S1	Widely scattered and rare throughout western North America in high-elevation montane habitats (elevations between 8,000 and 11,200 ft). Occurs in mesic habitats in coniferous forests.	x	x	
Utah glasswort	*Sarcocornia utahensis*	CA-S1	Known from only two occurrences in California. Occurs on alkaline substrates within chenopod scrub and playa habitats at elevations near 1,050 ft.	x	x	x
Utah swallowwort	*Cynanchum utahense*	AZ-S2	Sandy or gravelly substrates within Sonoran and Mojave Desert scrub communities. Elevation ranges between 160 and 4,700 ft.	x	x	x
Varied fishhook cactus	*Mammillaria viridiflora*	AZ-SR	Known throughout Arizona and western New Mexico. In sandy granitic soils of high hills and mountain sides in oak woodlands and at edge of forest at elevations between 5,000 and 6,888 ft.	x	x	
Vasey's bitter-weed	*Hymenoxys vaseyi*	FWS-SC; NM-SC; NM-S2	Known from the Organ and San Andres Mountains in Dona Ana County, New Mexico. Occurs in dry sites with coarse soils in montane pinyon-juniper woodland communities. Elevation ranges between 6,900 and 8,200 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Veyo milkvetch	*Astragalus ensiformis* var. *gracilior*		Restricted to Lincoln County, Nevada, and Washington County, Utah. Occurs on stiff clay soil of open washes, valley floors, and hillsides under sagebrush within pinyon-juniper communities. Elevation ranges between 4,200 and 5,000 ft.	x	x	x
Villard pincushion cactus	*Escobaria villardii*	BLM-S; NM-E; FWS-SC; NM-S2	Known from the Franklin and Sacramento Mountains in Otero and Dona Ana Counties, New Mexico. Occurs on loamy soils of desert grassland on broad limestone benches at elevations between 4,500 and 6,500 ft.	x	x	x
Violet twining snapdragon	*Maurandya antirrhiniflora* ssp. *antirrhiniflora*	CA-S1	Within California, known from fewer than 10 locations in the Providence Mountains in eastern San Bernardino County. Occurs on carbonate substrates within creosote bush scrub, Joshua tree woodland, and desert scrub habitats. Elevation ranges between 2,500 and 5,000 ft.	x		
Virgin River thistle	*Cirsium virginense*	NV-S1	Known from only a few wet saline areas in Washington County, Utah; Mohave County, Arizona; and Clark County, Nevada. Occurs in open, moist, alkaline clay soils of seep and spring areas or gypsum knolls at elevations between 1,950 and 6,550 ft.	x	x	x
Wahatoya Creek larkspur	*Delphinium robustum*	CO-S2	Broad canyon bottoms, aspen groves, subalpine meadows, riparian woodlands, and lower and upper montane coniferous forest at elevations between 7,200 and 11,200 ft.	x	x	x
Wand-like fleabane daisy	*Erigeron oxyphyllus*	CA-S1	Restricted to the Whipple Mountains in southern California. Inhabits rocky slopes and washes around seeps or springs, canyons, and cliff bases within desert scrub communities at elevations between 2,100 and 2,600 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Waxflower	*Jamesia tetrapetala*	BLM-S; FWS-SC; NV-S2	Restricted to southern Nevada and southwestern Utah. Occurs in crevices on limestone cliffs, alpine boulder fields, and rock fields having granitic or carbonate substrates at elevations between 7,000 and 10,500 ft.	x		
Weasel phacelia	*Phacelia mustelina*	NV-S2	Mojave desert scrub and pinyon-juniper woodlands on volcanic or gravelly substrates at elevations between 5,000 and 5,500 ft.	x	x	x
Western moonwort	*Botrychium hesperium*	CO-S2	Early successional habitats with coarse gravelly soil that undergo periodic disturbance. These include grassy mountain slopes, snow fields, road ditches, and gneiss outcrops and cliffs, as well as old fields at elevations between 650 and 11,300 ft.	x	x	x
Western sedge	*Carex occidentalis*	CA-S2	Restricted to the San Bernardino, San Jacinto, Inyo, and White Mountains in southern California. Inhabits dry grasslands, meadows, and seeps within yellow pine and lower montane coniferous forests at elevations between 5,400 and 10,282 ft.	x		
White bearpoppy	*Arctomecon merriamii*	BLM-S	Endemic to the Death Valley region of California and Nevada. It inhabits barren, gravelly areas, rocky slopes, and limestone outcrops at elevations between 2,000 and 5,900 ft.	x	x	x
White bog adder's-mouth	*Malaxis monophyllos* spp. *brachypoda*	CA-S1	Restricted to disjunct locations in California and Colorado. Within California, the species inhabits bogs, fens, meadows, and seeps in mesic red fir, yellow pine, and upper montane coniferous forests. Elevation ranges between 7,200 and 9,000 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
White Mountain alum-root	*Heuchera wootonii*	FWS-SC; NM-SC	Known from the Datil, Sacramento, and White Mountains in Catron, Lincoln, and Otero Counties, New Mexico. Occurs on mountain slopes in oak thickets, pinyon-juniper woodlands, and montane coniferous forests at elevations between 7,000 and 12,000 ft.	x		
White Mountain false-penny-royal	*Hedeoma pulcherrima*	FWS-SC; NM-SC; NM-S2	Known from the Capitan, Sacramento, and White Mountains in southern New Mexico. Inhabits steep rocky hillsides and slopes in disturbed areas along roadsides, montane coniferous forests, and pinyon-juniper woodlands. Elevation ranges between 5,000 and 9,000 ft.	x		
White Mountain larkspur	*Delphinium novomexicanum*	FWS-SC; NM-SC; NM-S2	Canyon bottoms, forest meadows, and road banks in lower and upper montane coniferous forest at elevations between 7,200 and 11,200 ft.	x		
White Mountain lupine	*Lupinus sierrae-blancae*	FWS-SC; NM-SC	Meadows and roadsides in pine and fir forest at elevations between 5,900 and 10,000 ft.	x		
White River cat's-eye	*Cryptantha welshii*	BLM-S; FWS-SC	Endemic to southern Nevada on dry, open, sparsely vegetated outcrops. Known to occur on carbonate substrates at elevations between 4,500 and 6,600 ft.	x	x	x
White-bracted spineflower	*Chorizanthe xanti* var. *leucotheca*	BLM-S; CA-S2	Inhabits Mojave Desert scrub communities and pinyon-juniper woodlands on sandy or gravelly soils. Occurs at elevations below 3,925 ft.	x	x	x
White-margined beardtongue	*Penstemon albomarginatus*	BLM-S; FWS-SC; CA-S1; NV-S2	Inhabits desert sand dune habitats and Mojave Desert scrub communities at elevations below 3,600 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
White-margined everlasting	*Antennaria marginata*	CA-S1	Restricted to San Gorgonio Mountain and the South Fork Santa Ana River area in southwestern San Bernardino County, California. Inhabits moist slopes, ridge tops, and forest openings within lodgepole, red fir, and yellow pine as well as the lower and upper montane coniferous forests. Elevation ranges between 6,950 and 11,000 ft.	x		
Wiggins' cholla	*Opuntia wigginsii*	CA-S1	Sandy substrates of small washes and flats within creosote bush scrub and Sonoran Desert scrub communities. Elevation ranges between 100 and 2,900 ft.	x	x	x
Wiggins' croton	*Croton wigginsii*	CA-S1	Known only from Imperial County, California; Yuma County, Arizona; and northern Mexico. Restricted to desert dunes of the Sonoran Desert. Elevation ranges between 164 and 330 ft.	x	x	x
Winged milkvetch	*Astragalus altus*	FWS-SC; NM-SC; NM-S2	Endemic to the Sacramento Mountains of southern New Mexico. Occurs on limestone soils on steep slopes and road cuts in lower montane coniferous forest. Elevation ranges between 7,000 and 8,500 ft.	x		
Woods draba	*Draba oligosperma*	CO-S2	Considered relatively common throughout Colorado. Occurs on gravel terraces, sandy and shaley bluffs, and alpine fell fields on gravel or sand substrates at elevations between 6,500 and 14,200 ft.	x		
Woolly heads	*Nemacaulis denudata*	AZ-S2	Known from southwestern California on well developed coastal habitats and sand dunes at elevations below 330 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Plants (Cont.)						
Wooton's wild buckwheat	*Eriogonum jamesii* var. *wootonii*	FWS-SC; NM-SC; NM-S2	Endemic to the Sacramento, White, and Gallinas Mountains of south central New Mexico. Occurs on mountain slopes and small openings in lower and upper montane coniferous forests. Elevation ranges between 7,000 and 11,500 ft.	x		
Wright's cliff-brake	*Pellaea wrightiana*	CO-S2	Occurs on a variety of acidic to mildly basic substrates on exposed or partially shaded cliffs and rocky slopes. Elevation ranges between 5,200 and 9,500 ft.	x	x	x
Wright's marsh thistle	*Cirsium wrightii*	BLM-S; NM-E; FWS-SC; NM-S2	Known from south central New Mexico, western Texas, and Chihuahua, Mexico. Inhabits wet, alkaline soils in springs, seeps, and marshy areas of streams and ponds. Elevation ranges between 3,450 and 8,500 ft.	x	x	x
Yellow flame flower	*Talinum angustissimum*	AZ-S2	Mountainous habitats, including meadows, ponderosa pine forests, pinyon-juniper woodlands, and along canyon rims at elevations between 5,000 and 8,000 ft.	x		
Yellow stargrass	*Hypoxis hirsuta*	CO-S1	Wet to dry woodlands and prairies at elevations below 5,500 ft.	x		
Yellow two-tone beardtongue	*Penstemon bicolor* spp. *bicolor*	BLM-S; FWS-SC; NV-S2	Endemic to Clark County, Nevada, on mostly BLM lands in the vicinity of Las Vegas. Occurs on calcerous or carbonate soils in washes, roadsides, rock crevices, or outcrops at elevations between 2,500 and 5,500 ft.	x	x	x
Invertebrates						
Aegialian scarab beetle	*Aegialia knighti*	BLM-S; NV-S1	Endemic to Clark County, Nevada, where it is known from one location encompassing an area less than 3,000 acres. Confined to the low, red sand hills and sand blow-outs in the Meadow Valley Wash– Weiser Wash–Muddy River drainage system.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Invertebrates (Cont.)						
Algodones sand jewel beetle	*Lepismadora algodones*	CA-S1	Endemic to a narrow north-south corridor along the western edge of the Algodones Dunes in southern California. Habitat is active or partially stabilized desert sand dunes with widely scattered perennial vegetation cover.	x		
Amargosa naucorid	*Pelocoris shoshone amargosa*	ESA-UR; NV-S1	Endemic to the Amargosa Valley in Inyo County, California, and Nye County, Nevada. Inhabits spring-fed aquatic habitats, where it prefers quiet waters among vegetation.	x	x	x
Amargosa tryonia	*Tryonia variegata*	ESA-UR; BLM-S; NV-S2	Endemic to the Amargosa Valley in Nye County, Nevada. Inhabits spring-fed aquatic habitats where there is an abundance of detritus or aquatic macrophytes.	x	x	x
Andrew's dune scarab beetle	*Pseudocotalpa andrewsi*	CA-S2	Known from a single metapopulation in southern California. Restricted to a region of inland desert sand dunes. Preferred habitat described as troughs of loose, drifting, desert sand dunes.	x		
Andrew's marble butterfly	*Euchloe hyantis andrewsi*	CA-S1; FWS-SC	Narrowly endemic to the Baldwin Lake area in southwestern San Bernardino County, California. Utilizes hills and washes having the host plants *Streptanthus bernardinus, Arabis holboellii*, and *Thelypodium stenopetalum*.	x		
Anthony blister beetle	*Lytta mirifica*	BLM-S; FWS-SC; NM-SC	Occurs terrestrially on flowering plants. Often found in agricultural areas where the species may be a pest to certain crops.	x	x	x
Ash Meadows naucorid	*Ambrysus amargosus*	ESA-T; NV-S1	Endemic to the Ash Meadows National Wildlife Refuge, where it is restricted to Point of Rocks and Kings Springs.	x	x	x
Ash Meadows pebblesnail	*Pyrgulopsis erythropoma*	ESA-UR; NV-S1	Endemic to the Ash Meadows National Wildlife Refuge, where it is known from six spring systems.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Invertebrates (Cont.)						
Ash Springs riffle beetle	*Stenelmis lariversi*	NV-S1	Endemic to Ash Springs in Lincoln County, Nevada. An arthropod that inhabits warm springs.	x	x	x
Baker's desertsnail	*Eremarionta rowelli bakerensis*	CA-S1	A terrestrial gastropod narrowly endemic to a region less than 39 mi^2 in size near Soda Lake in San Bernardino County, California. Primarily occurs among rocks on talus slopes.	x	x	
Big Dune miloderes weevil	*Miloderes* sp. 1	BLM-S; NV-S1	Endemic to the Big Dune area of Nye County, Nevada, where the species is known to be dependent on deep sand habitats.	x	x	x
Bishop Cap tubesnail	*Coelostemma pyrgonasta*	NM-S1	Endemic to the Bishops Cap Mountain in Dona Ana County, New Mexico. Occurs terrestrially under limestone blocks below cliffs.	x		
Blunt ambersnail	*Oxyloma retusum*	NM-S1	Widely distributed across North America. Known to occur in marshy riparian habitats in association with wetland plants.	x	x	x
Boisduval's blue butterfly	*Icaricia icarioides*	FWS-SC	Known from western North America, from British Columbia, Canada, south to Arizona and New Mexico. Occurs in a variety of habitats, including desert sand dunes, mountain meadows, riparian areas, open woodlands, and sagebrush-dominated landscapes.	x	x	x
Borrego parnopes cuckoo wasp	*Parnopes borregoensis*	CA-S1	Endemic to California, where it is known from the Sonoran and Mojave Deserts. General habitat preferences are poorly understood. May occur in desert scrub, creosote bush scrub, yucca and cholla cactus, saltbush, and desert dune communities.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Invertebrates (Cont.)						
Bradley's cuckoo wasp	*Ceratochrysis bradleyi*	CA-S1	Endemic to California, where it is known only from eastern Riverside County. May occur in Sonoran Desert scrub, creosote bush scrub, yucca and cholla cactus, saltbush, and desert dune communities.	x	x	x
Brian Head mountainsnail	*Oreohelix parawanensis*	FWS-SC; UT-SC; UT-S1	Known only from the southwestern slope of Brian Head Peak in southeastern Iron County, Utah. Inhabits alpine rocky scree habitats. Occurs among dense clumps of currants on limestone and basaltic substrates at elevations between 10,600 and 11,000 ft.	x		
Brown tassel trigonoscuta weevil	*Trigonoscuta brunnotesselata*	CA-S1	Endemic to Mojave Desert of California, this species is known only from the Kelso Dunes in San Bernardino County.	x		
California floater	*Anodonta californiensis*	BLM-S; UT-SC; NV-S1; UT-S1	Locally abundant in streams and creeks of the western United States. Occurs in pools of lower- elevation creeks along sandy or muddy substrates.	x	x	
California McCoy snail	*Eremarionta rowelli mccoiana*	CA-S1	Known only from Riverside County, California, within an area less than 40 mi^2 near the southern Palen/McCoy Wilderness. Lives terrestrially among rocks on talus slopes.	x	x	x
Carlson's dune beetle	*Anomala carlsoni*	CA-S2	Endemic to the Algodones Dunes in southern California. Occurs in desert dune habitats associated with creosote scrub communities.	x	x	
Cheeseweed owlfly (cheeseweed moth lacewing)	*Oliarces clara*	CA-S1	Occurs within the Colorado River drainage of southwestern Arizona and southern California. Known to occur within creosote bush scrub communities on or near bajadas at elevations below 330 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Invertebrates (Cont.)						
Circus beetle	*Eleodes hirtipennis*	CO-S1	Endemic to Colorado, restricted to great Sand Dunes and Indian Springs Natural Area. Inhabits sparsely vegetated, windblown sand dunes and flats.	x		
Colorado blue	*Euphilotes rita coloradensis*	CO-S2	Regionally endemic, naturally rare, and susceptible to disturbance. Small isolated populations persist on transition zone prairies. Sites are undisturbed with the occurrence of host plant *Erigonum effusum* at elevations between 5,000 and 7,000 ft.	x		
Crescent Dunes aegialian scarab	*Aegialia crescenta*	ESA-UR; BLM-S; NV-S1	Endemic to Nevada, where it is restricted to the Crescent Dunes and possibly also the San Antonio and Game Range Dunes. This species is a sand dune obligate species.	x	x	x
Crescent Dunes serican scarab	*Serica ammomenisco*	ESA-UR; BLM-S; NV-S1	Endemic to Nevada, where it is restricted to the Crescent Dunes. This species is a sand dune obligate species.	x	x	x
Crystal springsnail	*Pyrgulopsis crystalis*	ESA-UR; NV-S1	Endemic to the Ash Meadows National Wildlife Refuge, where it is known only from Crystal Spring.	x	x	x
Cuckoo bee	*Paranomada californica*	CA-S1	Restricted to two locations in southern San Bernardino County in California. The ecology of this species is poorly understood. It is generally known to occur in desert scrub habitats and in association with the host *Exomalopsis verbesinae*.	x		
Desert monkey grasshopper	*Psychomastax deserticola*	CA-S1	Historically known from shrubland and chaparral habitats in California and Nevada. The species is presumably extirpated from Nevada and is currently known from only two locations in southwestern San Bernardino County.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Invertebrates (Cont.)						
Distal gland springsnail	*Pyrgulopsis nanus*	ESA-UR; NV-S1	Endemic to the Ash Meadows National Wildlife Refuge, where it is known from only four spring systems.	x	x	x
Distorted metastoma	*Metastoma roemeri*	NM-SC; NM-S2	Known to occur in southern New Mexico from the Guadalupe, San Andres, Franklin, and Sacramento Mountains. This species is an obligate calciphile, not found in areas of volcanic rock. Occurs terrestrially along canyon walls under stones and dead plant material and in accumulations of limestone talus. Known to occur on the White Sands Missile Range.	x		
Dona Ana talussnail	*Sonorella todseni*	BLM-S; NM-T; FWS-SC; NM-S1	Endemic to the Dona Ana Mountains in Dona Ana County, New Mexico. Occurs terrestrially in a small, arid range of volcanic rock. Found in volcanic rock talus under sparse growth of oak and xeric-adapted shrubs.	x		
Dusted skipper	*Atrytonopsis hianna*	CO-S2	Widespread but discontinuous geographic range. Dry open fields, open woodlands, barren, mid grass, and tall grass prairies, foothills, and prairie gulches, outcrops, and glades. The key habitat feature is the dominance of the food plants *Andotpogo gerardii* and *Schizachyrium scoparius* with intermixed patches of bare sand or rock. Prefers relatively undisturbed canyons and open pine woods at elevations between 5,300 and 7,200 ft.	x		
Elongate gland springsnail	*Pyrgulopsis isolata*	ESA-UR; NV-S1	Endemic to the Ash Meadows National Wildlife Refuge, where it is known only from the spring at Clay Pits.	x	x	x
Endemic ant	*Neivamyrmex nyensis*	NV-S1	Known from only one colony in very rocky terrain in Clark County, Nevada, south of Beatty.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Invertebrates (Cont.)						
Fairbanks springsnail	*Pyrgulopsis fairbanksensis*	ESA-UR; NV-S1	Endemic to the Ash Meadows National Wildlife Refuge, where it is known only from Fairbanks Spring.	x	x	x
Flag springsnail	*Pyrgulopsis breviloba*	ESA-UR; NV-S1	Endemic to Nevada, where it is known from only two spring systems in Lincoln and Nye Counties. Occurs in rheocrene or limnocrene springs. Associated vegetation includes rush (*Juncus* spp.), bulrush (*Schoenoplectus* and *Scirpus* spp.), spikerush (*Eleocharis* spp.), and water cress (*Rorripa* spp.).	x		
Franklin Mountain talussnail	*Sonorella metcalfi*	NM-SC; NM-S1	Known from the Organ Mountains in Dona Ana County, New Mexico. Occurs terrestrially, where it is restricted to mounds of rhyolitic talus in the upper Sonoran Life Zone (6,000 ft). Often occurs in association with pinyon-juniper woodlands.	x	x	
Franklin Mountain woodlandsnail	*Ashmunella pasonis pasonis*	NM-S1	Known from the San Andres Mountains in southern New Mexico. Occurs terrestrially in accumulations of limestone talus at elevations between 3,300 and 10,600 ft. Known to occur on the White Sands Missile Range.	x	x	
Giant Sand treader cricket	*Daihinibaenetes giganteus*	CO-S1	Endemic to Colorado on sand dunes and sandy washes.	x	x	
Giuliani's dune scarab beetle	*Pseudocotalpa giulianii*	ESA-UR; BLM-S; NV-S1	Endemic to the Big Dune and Lava Dune regions of Nye County, Nevada, where the species is known to be dependent on deep sand habitats.	x	x	x
Grated tryonia	*Tryonia clathrata*	ESA-UR; BLM-S; NV-S2	Endemic to the Muddy River spring system in southeastern Nevada. Occurs in on or in algae and detritus substrates of slow-moving freshwater spring systems.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Invertebrates (Cont.)						
Great Basin silverspot butterfly	*Speyeria nokomis nokomis*	BLM-S; CO-S1; NM-S1	Occurs in isolated populations in streamside meadows and open seepage areas associated with violets.	x	x	x
Great Sand Dunes anthicid beetle	*Amblyderus werneri*	CO-S1	Endemic to Colorado, restricted to active dunes, sandy blowouts, or shifting sands with vegetative cover of less than 15%. Known global range is within an area of 112 mi^2 of the Great Sand Dunes.	x	x	
Hamlin Valley pyrg	*Pyrgulopsis hamlinensis*	ESA-UR; BLM-S; UT-SC; UT-S1	Known from only one complex of springs in the Hamlin–Snake Valleys watershed in Beaver County, Utah. Occurs in high-elevation springs (7,160 ft) with rocky substrates.	x	x	
Hardy's dune beetle	*Anomala hardyorum*	CA-S2	Endemic to the Algodones Dunes in southern California. Known to occur on active north- or east-facing dunes.	x	x	
Hebard's blue-winged desert grasshopper	*Anconia hebardi*	NM-SC	Occurs in open sand dune habitats.	x	x	x
Hoary skimmer	*Libellula nodisticta*	CO-S1	Wetlands with emergent vegetation, including marshes, shallow pools, and slow springs.	x	x	x
Hot Springs physa	*Physa acuta*	CO-S2	Drainage ditches, ponds, swamps, and streams at elevations below 10,500 ft.	x	x	
Hubbs pyrg	*Pyrgulopsis hubbsi*	ESA-UR; NV-S1	Endemic to Nevada, where it is restricted to Hiko and Crystal Springs. Occurs in rheocrene and limnocrene springs in association with vegetation that includes saltgrass (*Distichlis spicata*).	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Invertebrates (Cont.)						
Kelso Dunes scarab glaresis beetle	*Glaresis arenata*	CA-S1; FWS-SC	Endemic to California from the Kelso Dunes in San Bernardino County.	x	x	
Kelso giant sand treader cricket	*Macrobaenetes kelsoensis*	CA-S1; FWS-SC	Endemic to California from the Kelso Dunes in San Bernardino County.	x	x	
Kelso Jerusalem cricket	*Ammopelmatus kelsoensis*	CA-S1; FWS-SC	Endemic to California from the Kelso Dunes in San Bernardino County.	x	x	
Large aegialian scarab beetle	*Aegialia magnifica*	ESA-UR; BLM-S; NV-S1	Endemic to the Big Dune and Lava Dune regions of Nye County, Nevada, where the species is known to be dependent on deep sand habitats.	x	x	x
Longitudinal gland pyrg	*Pyrgulopsis anguina*	ESA-UR; UT-SC; NV-S1; UT-S1	Known from only two springs in Snake Valley on the Utah–Nevada border. The one spring in Utah in which it occurs is Clay Spring in northwestern Millard County.	x	x	
MacNeill sooty wing skipper	*Hesperopsis gracielae*	BLM-S; FWS-SC; NV-S1	Endemic to a section of the Colorado River from the Arizona–Nevada–Utah border south into California and adjacent Baja California, Mexico. Occurs along desert alkali flats adjacent to river sources within desert washes and in arid canyons.	x	x	
Maricopa tiger beetle	*Cicindela oregona maricopa*	FWS-SC	Known primarily from Maricopa County, Arizona, in sandy riparian areas, such as stream banks and sand bars.	x	x	x
Median gland springsnail	*Pyrgulopsis pisteri*	ESA-UR; NV-S1	Endemic to the Ash Meadows National Wildlife Refuge, where it is known from only three spring-fed habitats.	x	x	x
Minute tryonia	*Tryonia ericae*	ESA-UR; NV-S1	Endemic to the Ash Meadows National Wildlife Refuge, where it is known from fewer than four spring-fed habitats.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Invertebrates (Cont.)						
Moapa pebblesnail	*Pyrgulopsis avernalis*	ESA-UR; NV-S1	Endemic to Moapa Springs in Clark County, Nevada. A benthic species of freshwater springs and brooks.	x	x	x
Moapa Valley pebblesnail	*Pyrgulopsis carinifera*	ESA-UR; NV-S1	Endemic to the Moapa Valley in Clark County, Nevada, where it occurs in freshwater spring-fed habitats.	x	x	x
Moapa Warm Spring riffle beetle	*Stenelmis moapa*	ESA-UR; BLM-S; NV-S1	Endemic to the Warm Springs Area of Clark County, Nevada. A warm springs obligate species occurring in swift, shallow waters of freshwater outlet springs on gravel substrates. Often found near vegetation and bare tree roots.	x	x	x
Mojave gypsum bee	*Andrena balsamorhizae*	BLM-S; NV-S2	Endemic to Nevada, where the species is restricted to gypsum soils associated with habitats of its single larval host plant *Enceliopsis argophylla*. Such habitats include warm desert shrub communities on dry slopes and sandy washes.	x	x	x
Mojave poppy bee	*Perdita meconis*	BLM-S; NV-S2	Known only from Clark County, Nevada, where the species is dependent on poppy plants (genus *Arctomecon*). Such habitats include roadsides, washes, and barren desert areas on gypsum soils.	x	x	x
Neararctic riffle beetle	*Stenelmis occidentalis*	NV-S1	Widespread distribution in western North America. Occurs in high-gradient creeks as well as low- to mid-gradient rivers, springs, and brooks. Preferred sites are characterized as having woody debris, rocks, and exposed, submerged, or overhanging vegetation.	x	x	x
Nelson's miloderes weevil	*Miloderes nelsoni*	CA-S1; FWS-SC	Endemic to sand dune habitats in the Eureka–Salin Valley and Mojave regions of California. Currently restricted to two locations from Inyo and San Bernardino Counties.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Invertebrates (Cont.)						
Nevada admiral	*Limenitis weidemeyerii nevadae*	NV-S2	Endemic to southern Nevada, where it is restricted to the Spring Mountains and Sheep Range. Occurs in riparian areas associated with its host plants *Populus*, *Salix*, and *Amelanchier* at elevations above 6,500 ft.	x	x	
Oasis Valley springsnail	*Pyrgulopsis micrococcus*	ESA-UR; BLM-S; NV-S2	Endemic to the Amargosa River drainage and the Death, Panamint, and Saline Valleys in Inyo County, California, and Nye County, Nevada. Inhabits small springs and stream outflows on stone, travertine, and detritus.	x	x	x
Obese thorn snail	*Carychium exiguum*	NM-S2	Occurs in damp habitats, such as marshy riparian areas, floodplains, and ponds.	x	x	x
Organ Mountain talussnail	*Sonorella orientis*	NM-SC	Known from the Organ and San Andres Mountains in southern New Mexico. Occurs terrestrially in limestone talus in montane pinyon-juniper woodlands. Elevations range between 4,900 and 7,900 ft. Known to occur on the White Sands Missile Range.	x		
Organ Mountain woodlandsnail	*Ashmunella organensis*	NM-S2	Endemic to the Organ Mountains in Dona Ana County, New Mexico. Occurs terrestrially in volcanic rock talus in montane ponderosa pine and gambel oak woodlands. Elevation ranges between 5,000 and 8,000 ft.	x		
Pahranagat naucorid	*Pelocoris shoshone shoshone*	BLM-S; NV-S1	Known only to occur in the Muddy and White River Basins in southern Nevada. Inhabits quiet waters of warm, spring-fed habitats.	x	x	x
Pahranagat pebblesnail	*Pyrgulopsis merriami*	ESA-UR; NV-S1	Endemic to spring-fed systems in southern Nevada. Occurs on rocks and submergent vegetation near the outflow of freshwater springs.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Invertebrates (Cont.)						
Point of Rocks tryonia	*Tryonia elata*	ESA-UR; NV-S1	Endemic to the Ash Meadows National Wildlife Refuge, where it is known only from Point of Rocks Springs.	x	x	x
Red-tailed blazing star bee	*Megandrena mentzeliae*	NV-S2	Endemic to southern Nevada, where it is known only from Clark County. The species is primarily associated with the host plant *Mentzelia tricuspis*. Such habitats include open, dry, barren areas with gypsum to gravelly soils.	x	x	x
Riverside cuckoo wasp	*Hedychridium argenteum*	CA-S1	Endemic to California, where it is known only from eastern Riverside County. May occur in Sonoran Desert scrub, creosote bush scrub, yucca and cholla cactus, saltbush, and desert dune communities.	x	x	x
Roberts' rhopalolemma bee	*Rhopalolemma robertsi*	CA-S1	Endemic to southern California from desert wash habitats in southern San Bernardino County.	x	x	x
Sacramento Mountains checkerspot butterfly	*Euphydryas anicia cloudcrofti*	FWS-SC	Restricted to meadows in mixed-conifer forests of the Sacramento Mountains in southern New Mexico. Elevation ranges between 8,000 and 9,000 ft.	x		
Samalayuca Dune grasshopper	*Cibolacris samalayucae*	NM-SC	Occurs terrestrially in open sand dune habitats.	x	x	x
San Emigdio blue butterfly	*Plebulina emigdionis*	CA-S2; FWS-SC	Endemic to California, where populations are extremely localized within the southern San Joaquin Valley, Mojave Desert, and Victorville area. The entire range is limited to 97 to 193 mi^2. Utilizes dry river courses and intermittent streamsides as well as adjacent flats. The host plant is *Atriplex canescens*.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Invertebrates (Cont.)						
San Luis Dunes tiger beetle	*Cicindela theatina*	CO-S1	Endemic to Colorado, where it is restricted to active dunes, sandy blowouts, or shifting sands with vegetative cover of less than 15%. Known global range is within a 112-mi^2 area of the Great Sand Dunes. Adults prefer sandy slopes with sparse bunches of vegetation but are not found on open sand. Larvae are restricted to burrowing to leeward slopes of dunes, with particular preference for northeast aspects. Burrows are typically established on northern aspects of the crests of dune blowouts with more apparent vegetation.	x	x	
Shotwell's range grasshopper	*Shotwellia isleta*	NM-SC	Known from southern New Mexico and adjacent Mexico. Occurs in nonsaline playas that are composed of clay soils.	x	x	x
Simple hydroporus diving beetle	*Hydroporus simplex*	CA-S1; FWS-SC	Endemic to California, where it is currently known only from the vicinity of Big Bear Lake in southwestern San Bernardino County. Inhabits shallow edge areas of creeks, lakes, or ponds.	x		
Sphinx moth	*Sphinx dollii*	CO-S2	Madrean oak woodland, arid brushlands, and desert foothills with woody broad-leafed shrubs.	x	x	x
Sporting goods tryronia	*Tryonia angulata*	ESA-UR; NV-S1	Endemic to the Ash Meadows National Wildlife Refuge, where it is known from only three spring systems.	x	x	x
Spring Mountains springsnail	*Pyrgulopsis deaconi*	BLM-S; NMV-S1	Endemic to freshwater springs of the Spring Mountains in southern Nevada.	x	x	x
Squaw Park talussnail	*Sonorella allynsmithi*	FWS-SC; AZ-S1	Endemic to Squaw Peak Park and Mummy Mountain, Maricopa County, Arizona. Suitable habitat is restricted to steep, north-facing, talus slopes where limestone talus breaks off and forms piles or slides.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Invertebrates (Cont.)						
Uncompahgre fritillary butterfly	*Boloria improba crocnema*	ESA-E; CO-S1	Endemic to the San Juan Mountains of southwestern Colorado. Habitat is moist alpine slopes above 12,000 ft with extensive snow willow patches. Primarily known from Mt. Uncompahgre and Redcloud Peak, more than 75 mi west of the SEZ.	x		
Utah physa	*Physella utahensis*	BLM-S; FWS-SC; UT-SC; UT-S1	Current populations are known only from Utah. Primarily known from tributaries of Utah Lake, this species also occurs in shallow, spring-fed pools with muddy or sandy substrates.	x	x	
Victorville shoulderband	*Helminthoglypta mohaveana*	CA-S1	Endemic to California in the vicinity of Victorville in southwestern San Bernardino County. Primarily known from shrub-scrub habitats along the Mojave River.	x		
Warm Springs naucorid	*Limnocoris moapensis*	NV-S1	Endemic to southern Nevada, where it is restricted to the Warm Springs Area. Occurs among the pebble beds of quiet waters or stream outlets.	x	x	x
White desertsnail	*Eremarionta immaculata*	CA-S1; FWS-SC	Endemic to the Riverside Mountains of eastern Riverside County, California, where its current known range is less than 100 mi^2. Lives terrestrially among rocks on talus slopes.	x		
Fish						
Arkansas darter	*Etheostoma cragini*	CO-S2	Occurs in the Upper Arkansas, Fountain Creek, Horse Creek, Upper Arkansas at John Martin, Big Sandy Creek, Rush Creek, Black Squirrel Creek, and Chico Creek drainages. Preferred habitat includes spring-fed creeks with cool, clear water and herbaceous aquatic vegetation and pools with sand, fine gravel, or organic detritus substrate.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Fish (Cont.)						
Arroyo chub	*Gila orcuttii*	CA-S2	Endemic to the southern coastal drainages of California where populations are restricted to a small range. A benthic species that uses small to moderate-sized streams, with the majority of habitat being runs and pools. Occurs in headwaters, creeks, and small to medium rivers; often, intermittent streams are also used.	x	x	x
Ash Meadows Amargosa pupfish	*Cyprinodon nevadensis mionectes*	ESA-E; NV-P; NV-S2	Endemic to the Ash Meadows National Wildlife Refuge, where it is known to be in the outflows of spring-fed systems.	x	x	x
Ash Meadows speckled dace	*Rhinichthys osculus nevadensis*	ESA-E; NV-P; NV-S1	Endemic to the Ash Meadows National Wildlife Refuge, where it is known to be in the outflows of spring-fed systems.	x	x	x
Big Spring spinedace	*Lepidomeda mollispinis pratensis*	ESA-T; NV-P; NV-S1	Endemic to Lincoln County, Nevada, where it is restricted to stream habitats of Meadow Valley Wash. Restricted to a 5-mi section of stream in Condor Canyon, which flows through private and publicly owned lands. Inhabits clean, flowing, spring-fed stream habitats with deep pool areas and shallow marshy areas near the shore.	x		
Bluehead sucker	*Catostomus discobolus*	BLM-S	Known from the Virgin River basin in the project area. Occurs in the mainstem and large tributaries of the Virgin River. Adults prefer fast-flowing water over rubble substrates; young prefer quiet, shallow margins.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Fish (Cont.)						
Bonytail	*Gila elegans*	ESA-E; AZ-WSC; AZ-S1	Historically widespread in larger Colorado River basin streams; currently known from a few scattered occurrences. Inhabits mainstem portions of larger rivers, usually over mud or rocks. Occupies a variety of habitats in reservoirs but appears to prefer open water areas.	x		
Bonytail chub	*Gila elegans*	ESA-E; NV-P; NV-S1	Historically widespread in larger Colorado River basin streams; currently known from a few scattered occurrences. Inhabits mainstem portions of larger rivers, usually over mud or rocks. Occupies a variety of habitats in reservoirs but prefers open water areas.	x	x	
Colorado pikeminnow	*Ptychocheilus lucius*	ESA-E; CA-E; CA-SX	Formerly widespread in the Colorado River basin; currently considered extirpated in California. Young prefer small, quiet backwaters. Adults use various habitats, including deep, turbid, strongly flowing water, eddies, runs, flooded bottoms, or backwaters.	x	x	
Desert pupfish	*Cyprinodon macularius*	ESA-E; AZ-WSC; CA-E; AZ-S1; CA-S1	Known from the Colorado and Gila River drainages in desert springs and outflow marshes, river-edge marshes, backwaters, saline pools, and streams. Prefers areas with sand/silt substrates and aquatic plant life, limited surface flow, and water less than 3-ft deep.	x	x	x
Desert sucker	*Catostomus clarkii*	BLM-S; FWS-SC; UT-SC; NV-S2; UT-S2	Known from the lower Colorado, Gila, and Virgin River Basins. Found in rapids and flowing pools of streams and rivers. Adults primarily live in pools; young inhabit riffles.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Fish (Cont.)						
Devils Hole pupfish	*Cyprinodon diabolis*	ESA-E; NV-P; NV-S1	Endemic to the Ash Meadows National Wildlife Refuge, where it is known only from Devils Hole.	x	x	x
Flannelmouth sucker	*Catostomus latipinnis*	BLM-S; FWS-SC; AZ-S2; CA-S1; NV-S1; UT-S2	Found throughout the Colorado River Basin, from Wyoming to southern Arizona and California. Considered rare in the lower Colorado River Basin, populations have been introduced in areas of the Colorado River below Lake Mead.	x	x	
Gila longfin dace	*Agosia chrysogaster chrysogaster*	BLM-S; FWS-SC	Native to the Gila and Bill Williams drainages in Arizona. Habitat ranges from intermittent, hot, low-desert streams to cool brooks at higher elevations. Occupies relatively small or medium-sized streams with sandy or gravelly bottoms, eddies, and pools near overhanging banks or other cover.	x	x	
Gila topminnow	*Poeciliopsis occidentalis occidentalis*	ESA-E; AZ-WSC; AZ-S1	Gila River system, currently only at a few localities in the Gila River drainage and one locality in the Bill Williams drainage. Inhabits headwater springs and vegetated margins and backwater areas of intermittent and perennial streams and rivers.	x	x	x
Greenback cutthroat trout	*Oncorhynchus clarkii stomias*	ESA-T; CO-S2	Found only in cold, clear, oxygenated headwater streams in the Arkansas and South Platte River drainages in eastern Colorado. Occurs in streams along the eastern escarpment of the Sangre de Cristo Mountains.	x	x	
Hiko White River springfish	*Crenichthys baileyi grandis*	ESA-E; NV-P; NV-S1	Endemic to Lincoln and Mineral Counties, Nevada, where it is restricted to the remaining waters of the White River and the stream and outflow habitats of Hiko and Crystal Springs. The species has also been introduced into Blue Link Spring.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Fish (Cont.)						
Least chub	*Iotichthys phlegethontis*	ESA-UR; BLM-S; UT-S1	Endemic to the Bonneville Basin in western Utah. Historically occurred in alkaline marshes, slow rivers and creeks, and spring-fed habitats. Currently known to occur only in alkaline spring habitats.	x	x	
Meadow Valley speckled dace	*Rhinichthys osculus* sp. 11	ESA-UR; BLM-S; NV-S2	Endemic to Meadow Valley Wash and Clover Creek in Lincoln County, Nevada. Inhabits cool to warm freshwater streams having gravel or rock substrates.	x		
Meadow Valley Wash desert sucker	*Catostomus clarkii* sp. 2	BLM-S; NV-P; NV-S2	Endemic to the Meadow Valley Wash system in Lincoln County, Nevada. Preferred habitat includes rapids and flowing pools of small to medium streams and rivers primarily over bottoms of gravel-rubble with sandy silt in the interstices. Adults live in pools, moving at night to swift riffles and runs, while juveniles inhabit riffles.	x		
Mexican tetra	*Astyanax mexicanus*	NM-T; NM-S1	Historically occurred in the Rio Grande and Pecos River drainages in New Mexico and Texas. Currently considered extirpated from the SEZ region. Inhabits springs and streams in pools and below swift areas in eddies.	x	x	
Moapa dace	*Moapa coriacea*	ESA-E; NV-P; NV-S1	Endemic to Clark County, Nevada, where the species is restricted to 6 mi of aquatic habitat in the warm spring area at the headwaters of the Muddy River. Preferred habitat includes spring pools, outflows, and the main stem of the Muddy River where the water is clear and warm. Habitat use varies with age; juveniles tend to occur in spring pools and outflows where water velocities are slower and temperatures are warmer, while adults tend to occur in outflows and in the Muddy River where water velocities are faster and temperatures are slightly cooler.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Fish (Cont.)						
Moapa speckled dace	*Rhinichthys osculus moapae*	ESA-UR; BLM-S; NV-P; NV-S1	Endemic to Clark County, Nevada, where it is restricted to the Muddy River. Uses stream bottoms in shallow cobble riffles. Occurs in low-velocity areas behind rocks. Spawning habitat consists of small patches of bare rocks and pebbles.	x	x	x
Moapa White River springfish	*Crenichthys baileyi moapae*	ESA-UR; NV-P; NV-S2	Endemic to southern Nevada, where it is restricted to five warmwater springs in the upper Muddy River. Preferred habitat includes spring pools and backwaters in spring outflows. More abundant in and near the springs than in the river.	x	x	x
Mohave tui chub	*Gila bicolor mohavensis*	ESA-E; CA-E; CA-S2	Currently restricted to a few known locations in San Bernardino County, California. Inhabits deep pools or shallow portions of mineralized, alkaline waters. Formerly in mainstream Mohave River; now in lakes and mineral spring pools.	x	x	x
Oasis Valley speckled dace	*Rhinichthys osculus* sp. 6	BLM-S; NV-P; FWS-SC; NV-S1	Endemic to the Oasis Valley in Nye County, Nevada, where it is restricted to spring-fed habitats.	x	x	x
Pahranagat roundtail chub	*Gila robusta jordani*	ESA-E; NV-P; NV-S1	Endemic to Nevada, where it is restricted to the White River system. A benthic species that uses small freshwater streams.	x	x	x
Pahranagat speckled dace	*Rhinichthys osculus velifer*	ESA-UR; BLM-S; NV-P; NV-S1	Endemic to Nevada, where it is restricted to the White River Valley system. Inhabits rivers, streams, tributaries, springs, brooks, marshes, lakes, and reservoirs.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Fish (Cont.)						
Pahrump poolfish	*Empetrichthys latos latos*	ESA-E; NV-P; NV-S1	Historically endemic to the Pahrump Valley in southern Nye County, Nevada. It is currently extirpated from its native range. Introduced populations are currently known to occur in three spring-fed habitats in Clark and White Pine Counties, Nevada: Corn Creek Springs (Desert National Wildlife Range), Shoshone Springs, and an irrigation reservoir fed by Sandstone Spring (Spring Mountain State Park).	x	x	x
Railroad Valley springfish	*Crenichthys nevadae*	ESA-T; NV-P; NV-S2	Endemic to the Railroad Valley in eastern Nye County, Nevada. It is extirpated from much of its historic natural habitat and has been introduced elsewhere. Inhabits warm spring pools, outflows, streams, and adjacent marsh habitats.	x	x	
Razorback sucker	*Xyrauchen texanus*	ESA-E; AZ-WSC; CA-E; NV-P; AZ-S1; CA-S1; NV-S1	Historically widespread in larger Colorado River basin streams; currently known from a few scattered occurrences. Inhabits slow areas, backwaters, and eddies of medium to large rivers and their impoundments. The largest extant populations occur in Lake Mohave, Lake Mead, and Lake Havasu.	x	x	
Rio Grande chub	*Gila pandora*	BLM-S; CO-S1; CO-SC; NM-S2	Restricted to streams of the Rio Grande Basin. Inhabits clear, cool, fast-flowing water over rubble or gravel substrates.	x	x	x
Rio Grande chub	*Gila pandora*	NM-SC; NM-S2	Known from larger tributaries in the Colorado Basin, from Wyoming south to Arizona and New Mexico. Occupies cool to warm water streams and rivers consisting of pools adjacent to riffles and runs. Suitable habitats include boulders, tree roots, submerged trees and branches, and undercut cliff walls.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Fish (Cont.)						
Rio Grande cutthroat trout	*Oncorhynchus clarkii virginalis*	ESA-C; BLM-S; CO-S1	Historically inhabited tributary streams of the Rio Grande, Pecos, and Canadian River Basins. The current distribution in is confined to streams of the Rio Grande Basin.	x	x	
Rio Grande shiner	*Notropis jemezanus*	BLM-S; FWS-SC; NM-SC; NM-S2	Historically occurred in the Rio Grande and Pecos River drainages in New Mexico and Texas. Inhabits large, open rivers and large streams with sand, gravel, or rubble substrates.	x	x	
Rio Grande silvery minnow	*Hybognathus amarus*	ESA-E; NM-E; NM-S1	Historically known from the Rio Grande drainage in Mexico, New Mexico, and Texas. Currently confined to perennial reaches of the Rio Grande. Inhabits low-gradient, large streams with shifting sand or silty bottoms.	x	x	
Rio Grande sucker	*Catostomus plebeius*	CO-E; CO-S1; NM-S2	Restricted to streams of the Rio Grande Basin. It is found in channels and backwaters near rapidly flowing waters.	x	x	x
Roundtail chub	*Gila robusta*	BLM-S; AZ-WSC; FWS-SC; AZ-S2; NV-S1; UT-S2	Larger tributaries in the Colorado Basin, from Wyoming south to Arizona and New Mexico; cool to warm water streams and rivers consisting of pools adjacent to riffles and runs and with boulders, tree roots, submerged trees and branches, and undercut cliff walls.	x	x	x
Saratoga Springs pupfish	*Cyprinodon nevadensis nevadensis*	CA-S1	Endemic to California, where populations are primarily known from Saratoga Springs (Death Valley National Park); also known to co-occur with the Mojave tui chub in Lake Tuendae near the Soda Lake playa in the Mojave National Preserve. Utilizes shallow areas of herbaceous lakes, marshes, springs, and brooks.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Fish (Cont.)						
Smallmouth buffalo	*Ictiobus bubalus*	NM-S2	Native to the Rio Grande and Pecos River. Inhabits larger pools of higher-order rivers with low-velocity currents and abundant aquatic vegetation. Prefers clean to moderately turbid, deep, warm waters.	x	x	x
Sonora sucker	*Catostomus insignis*	BLM-S; FWS-SC	Known from the Gila and Bill Williams drainages in Arizona and New Mexico. Found in a variety of habitats from warm water rivers to cooler higher- elevation streams. Adults tend to remain near cover in daylight and move to runs and riffles at night; young live in runs and quiet eddies.	x	x	
Southern leatherside chub	*Lepidomeda aliciae*	UT-SC; UT-S1	Utah Lake and Sevier River drainages, Utah; apparently extirpated from the Provo River at Utah Lake and from the Beaver River.	x	x	
Speckled dace	*Rhinichthys osculus*	BLM-S; FWS-SC	Known to occur in most major watersheds in the western United States. Found in rocky riffles, runs, and pools of headwaters, streams, rivers, and occasionally in lakes. Often congregates below riffles and eddies.	x	x	
Unarmored threespine stickleback	*Gasterosteus aculeatus williamsoni*	ESA-E; CA-E; CA-S1	Inhabits clear, slow-flowing streams with sand or mud substrate, water temperature of less than 75°F, and abundant aquatic vegetation.	x	x	
Virgin River chub	*Gila seminuda*	ESA-E; NV-P; NV-S1; UT-S1	Endemic to the Virgin River system, occurring in slower-flowing mainstem pools in areas with vegetation and boulders.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Fish (Cont.)						
Virgin River spinedace	*Lepidomeda mollispinis mollispinis*	BLM-S; NV-P; NV-S1; UT-S1	Endemic to the Virgin River system, occurring in mainstem and tributary reaches, particularly areas with swift runs interspersed with shaded pools.	x		
Warm Springs Amargosa pupfish	*Cyprinodon nevadensis pectoralis*	ESA-E; NV-P; NV-S1	Endemic to the Ash Meadows National Wildlife Refuge, where it is known to be in the outflows of spring-fed systems.	x	x	x
White River desert sucker	*Catostomus clarkii intermedius*	BLM-S; NV-P; NV-S1	Endemic to Nevada, where it is restricted to remnant streams of the White River system. Inhabits small to medium-sized rivers.	x	x	x
White River spinedace	*Lepidomeda albivallis*	ESA-E; NV-P; NV-S1	Endemic to east central Nevada in cool, clear, spring-fed habitats. Historical habitat included spring-fed habitats in the White River system in Nye County, Nevada, north to the mouth of Ellison Creek and south to 10 mi south of Flag Springs. Currently restricted to Flag Springs.	x	x	
White River springfish	*Crenichthys baileyi baileyi*	ESA-E; NV-P; NV-S1	Currently restricted to the Ash Spring system in southeastern Nevada. Occurs in warm springs and their outflows and marshes. Tolerates extreme temperature and dissolved oxygen conditions.	x	x	x
White Sands upfish	*Cyprinodon tularosa*	NM-T; FWS-SC; NM-S1	Endemic to the Tularosa Basin in southern New Mexico. Restricted to Malpais Spring and Lost River in Otero County, Salt Creek in Sierra County, and Mound Springs in Lincoln County. Occupies shallow pools and calm spring runs over mud-silt and sand-gravel substrates.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Fish (Cont.)						
Woundfin	*Plagopterus argentissimus*	ESA-E; NV-P; NV-S1; UT-S1	Restricted to the Virgin River system, occurring in seasonally warm and turbid runs and riffles. Juveniles typically prefer slower and deeper habitats than adults.	x	x	
Amphibians						
Amargosa toad	*Bufo nelsoni*	ESA-UR; BLM-S; NV-P; NV-S2	Endemic to the Amargosa Valley in Nye County, Nevada, where it is confined to isolated riparian and spring-fed habitats along the Amargosa River. Usually observed near water at the outflow of warm springs.	x	x	x
Arroyo toad	*Anaxyrus californicus*	ESA-E; CA-S2	Washes, streams, arroyos, and adjacent uplands and along rivers that have shallow, gravelly pools adjacent to sandy terraces.	x	x	
Boreal (western) toad	*Bufo boreas*	CO-E; CO-S1	In close proximity to ponds, marshes, lakes, reservoirs, rivers, and streams within grassland and mountain meadow habitats at elevations between 7,000 and 11,860 ft, with highest densities occurring between 9,500 and 11,000 ft. Associated plant communities include lodgepole pine forests, spruce-fir forests, and alpine meadows characterized by *Salix* spp., *Betula glandulosa*, and *Potentilla fruticosa*.	x	x	
California red-legged frog	*Rana draytonii*	ESA-T; CA-S2	In or near the quiet, permanent water of streams, marshes, or ponds; also damp woods and meadows some distance from water. Breeding occurs in permanent or seasonal ponds, marshes, or quiet stream pools; eggs are often attached to emergent vegetation and float near the surface.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Amphibians (Cont.)						
Couch's spadefoot	*Scaphiopus couchii*	CA-S2	Known to occur in scattered populations east of the Algodones Mountains and north along the Colorado River. Wetland habitats include temporary pools ponds and puddles. Often occurs in arid and semiarid shrublands, shortgrass plains, mesquite savanna, creosote bush desert, thorn forest, and cultivated areas. Elevation ranges between 690 and 1,120 ft.	x	x	x
Great Plains narrow-mouthed toad	*Gastrophryne olivacea*	BLM-S; AZ-WSC	Mesquite semi-desert grasslands and oak woodlands near streams, springs, and pools. Found in deep, moist burrows, often with rodents, and under large flat rocks, dead wood, or other debris near water.	x	x	
Lowland leopard frog	*Lithobates yavapaiensis*	BLM-S; AZ-WSC; CA-SC; FWS-SC	Known from central and southern Arizona, northern Mexico, and extreme southeastern California. Inhabits aquatic systems in desert grasslands and pinyon-juniper woodlands. A habitat generalist that will breed in a variety of natural and man-made habitats, including rivers, streams, ponds, cattle tanks, canals, and ditches.	x	x	x
Mountain yellow-legged frog	*Rana muscosa*	ESA-E; CA-S1	Sunny riverbanks, meadow streams, isolated pools, and lake borders in the southern Sierra Nevada and the mountains of southern California. Prefers sloping banks with rocks or vegetation to the water's edge.	x		
Northern leopard frog	*Rana pipiens*	ESA-UR; BLM-S; CA-S2; CO-SC; NM-S2; NV-S2	Wetland community types, including low-gradient creeks, moderate-gradient rivers, pools, springs, canals, floodplains, reservoirs, and shallow lakes. Permanent water with rooted aquatic vegetation is the preferred wetland habitat. Terrestrial habitats include wet meadows and fields.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Amphibians (Cont.)						
Relict leopard frog	*Rana onca*	ESA-C; NV-P; NV-S1	Current range is restricted to a few small areas in Arizona and Nevada within the Lake Mead National Recreation Area. Occupies a variety of habitats, including springs, streams, outlet creeks, and wetlands characterized by clean, clear water, in both deep and shallow water. The five recently extant populations inhabit spring systems with largely unaltered hydrology and no introduced American bullfrogs or game fishes. Breeding habitat includes pools or slow-moving side areas of streams.	x	x	
Sacramento Mountain salamander	*Aneides hardii*	BLM-S; NM-T; FWS-SC	Endemic to southern New Mexico from the Sacramento and Capitan Mountains. Known to occur in moist coniferous forests at elevations above 7,875 ft. Found under litter, logs, bark, rocks, and woody debris.	x		
Southwestern toad	*Bufo microscaphus*	BLM-S; FWS-SC; NV-S2; UT-SC; UT-S2	Inhabits woodlands and low-elevation riparian habitats in association with permanent or semi-permanent water bodies. Occurs in and along streams, ditches, flooded fields, irrigated croplands, and permanent reservoirs.	x	x	x
Western toad	*Bufo boreas*	FWS-SC; CO-E; CO-S1; UT-SC; UT-S2	Inhabits a variety of habitats, including arid shrublands, mountain meadows, springs, lakes, ponds, and rivers at elevations below 12,000 ft.	x	x	
Reptiles						
Arizona mud turtle	*Kinosternon arizonense*	AZ-S2	Known only from Arizona and Mexico. In Arizona, distribution is limited to southern Maricopa and Pima Counties. Inhabits various quiet or slow-flowing bodies of water, usually with soft mud or sand bottom.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Reptiles (Cont.)						
Arizona night lizard	*Xantusia arizonae*	AZ-S1	Endemic to Arizona from Mohave, Pinal, and Yavapai Counties in arid and semiarid granite outcroppings and rocky areas, among fallen leaves, trunks of agave, or other vegetative debris. Associated with pinyon-juniper and chaparral-oak plant communities.	x	x	x
Arizona skink	*Eumeces gilberti arizonensis*	AZ-WSC; FWS-SC; AZ-S1	Known only from west central Arizona. Among rocks, logs, and leaf litter areas near permanent or semi-permanent streams; riparian drainages up through oak-pine woodlands.	x	x	x
Barefoot banded gecko	*Coleonyx switaki*	CA-T; CA-S1	Known from southern California from Borrego Springs south to Baja California. Found in arid, rocky areas on flatlands and canyons where there are large boulders and rock outcrops with sparse vegetation. Elevation ranges from sea level to 2,000 ft.	x		
California mountain kingsnake (San Bernardino population)	*Lampropeltis zonata (parvirubra)*	CA-S1; FWS-SC	Valley-foothill hardwood, hardwood-conifer, and coniferous forests as well as mixed and montane chaparral, valley-foothill, and wet meadow habitats. Uses sites having dense shrub, rock, or boulder cover in close proximity to stream or lake shores.	x	x	
Chuckwalla	*Sauromalus ater* (*Sauromalus obesus*)	BLM-S; FWS-SC; UT-SC; UT-S2	Widely distributed throughout the Mojave and Sonoran Deserts in California and Arizona. Considered a BLM-designated sensitive species in the state of Arizona. Inhabits rocky flats and hillsides, lava flows, and large outcrops associated with desert creosote bush communities at elevations below 6,000 ft.	x	x	
Coachella Valley fringe-toed lizard	*Uma inornata*	ESA-T; CA-T; CA-S1	Endemic to the Coachella Valley of Riverside County, California. Inhabits sparsely vegetated, windblown sand dunes and sandy flats with fine, loose sand for burrowing at elevations below 1,600 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Reptiles (Cont.)						
Colorado Desert fringe-toed lizard	*Uma notata*	BLM-S; CA-S2	Known from the Sonoran Desert in California from the Salton Sea east to the Colorado River and south to Baja California. Inhabits sparsely vegetated, arid areas with windblown sand, including dunes, flats, and washes, at elevations below 1,600 ft.	x	x	x
Desert night lizard	*Xantusia vigilis*	UT-SC; UT-S2	Arid and semiarid habitats among fallen leaves and trunks of yuccas, agaves, cacti, and other large plants; also in crevices of rock outcroppings and under logs and bark of foothill pines; ranges locally into pinyon-juniper, sagebrush-blackbrush, and chaparral-oak.	x	x	
Desert rosy boa	*Charina trivirgata gracia*	BLM-S; FWS-SC	Known from southeastern California and western Arizona. Arid scrublands, rocky deserts, and canyons with permanent or intermittent streams.	x	x	x
Desert tortoise	*Gopherus agassizii*	ESA-T; ESA-UR; BLM-S; CA-T; AZ-WSC; NV-P; NV-S2; UT-S1	Mojave and Sonoran Deserts in desert creosote bush communities on firm soils for digging burrows, along riverbanks, washes, canyon bottoms, creosote flats, and desert oases. Mojave populations north and west of the Colorado River are listed as threatened under the ESA; Sonoran populations south and east of the Colorado River are under review for ESA listing.	x	x	x
Flat-tailed horned lizard	*Phrynosoma mcallii*	ESA-P; BLM-S; AZ-WSC; AZ-S2; CA-S2	Known primarily from the Imperial Valley in California. Inhabits sandy desert hardpan or gravel flats with sparse vegetation and low species diversity at elevations below 850 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Reptiles (Cont.)						
Gila monster	*Heloderma suspectum*	BLM-S; NV-P; FWS-SC; CA-S1; NV-S2; UT-S1	Scattered distribution in the Mojave and Sonoran Deserts. Occurs in rocky, deeply incised topography and riparian habitat, desert scrub, thorn scrub, xero-riparian, oak woodland, and semi-desert grassland. On lower mountain slopes, rocky bajadas, canyon bottoms, and arroyos at elevations below 3,950 ft.	x	x	x
Mexican rosy boa	*Charina trivirgata trivirgata*	BLM-S; FWS-SC; AZ-S1	Sonoran Desert near rocky hillsides and rock outcroppings.	x	x	x
Milk snake	*Lampropeltis triangulum*	BLM-S	Occurs throughout much of southern Colorado and northern New Mexico at elevations below 8,000 ft. Inhabits shortgrass prairie, sandhills, shrubby hillsides, pinyon-juniper woodlands, and arid river valleys.	x	x	x
Mojave fringe-toed lizard	*Uma scoparia*	BLM-S; AZ-WSC; AZ-S1	Known from sandy habitats in the Mojave Desert from Death Valley south to the Colorado River near Blythe, California, and extreme western Arizona. Inhabits sparsely vegetated desert areas with fine windblown sand, including dunes, flats, and washes at elevations below 3,000 ft.	x	x	x
Mojave rattlesnake	*Crotalus scutulatus*	BLM-S; FWS-SC; UT-SC; UT-S1	Occurs only in the extreme southwestern corner of Utah, where it can be found in barren desert and desert scrub habitats.	x	x	
Mojave shovel-nosed snake	*Chionactis occipitalis occipitalis*	AZ-S1	Known only from Arizona in sparsely vegetated desert area on rocky slopes, dunes, washes, and sandy flats.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Reptiles (Cont.)						
Mottled rock rattlesnake	*Crotalus lepidus lepidus*	NM-T; NM-S2	Known to occur in the Guadalupe Mountains in southern New Mexico. Inhabits mountain areas of boulders and rocks, including talus slopes and pinyon-juniper woodlands.	x	x	
Northern red-diamond rattlesnake	*Crotalus ruber ruber*	CA-S2	Endemic to California from rocky areas of bare rock-talus-scree, chaparral shrubland, desert scrub, thorn scrub, open chaparral, mesquite/cactus, and pine-oak woodland communities. Occurs at elevations below 2,950 ft.	x		
Redback whiptail	*Aspidoscelis xanthonota*	FWS-SC; AZ-S2	Known from Arizona and adjacent Mexico. In canyons and hills in juniper-oak woodlands, in Sonoran Desert upland habitats, among dense shrubby vegetation, and along streams and arroyos.	x	x	
Sidewinder	*Crotalus cerastes*	BLM-S; UT-SC; UT-S2	Known to occur in the project area from Lincoln County, Nevada, and Washington County, Utah. Occurs nearly exclusively in open sandy habitat in creosote and sand sage communities. During periods of inactivity, populations occupy underground burrows of rodents or tortoises.	x	x	
Southern rubber boa	*Charina umbratica*	CA-T; CA-S2; FWS-SC	Found only in a few disjunct areas in montane southern California. Inhabits mixed-coniferous montane forests at elevations between 5,000 and 9,000 ft, often under rocks or logs.	x	x	
Southwestern pond turtle	*Actinemys marmorata pallida*	CA-S2	Uses ponds, lakes, rivers, streams, creeks, marshes, and irrigation ditches within woodland, forest, and grassland habitats. Prefers slow-moving, shallow waters with abundant vegetation, and either rocky or muddy bottoms. Logs, rocks, cattail mats, and exposed banks are critical habitat components for thermoregulatory behavior.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Reptiles (Cont.)						
Texas horned lizard	*Phrynosoma cornutum*	BLM-S	Flat, open, generally dry country with little plant cover, except for desert scrub, bunchgrass, and cactus. Occurs in areas of loose soil that is sandy, loamy, or rocky.	x	x	x
Triploid Colorado checkered whiptail	*Aspidoscelis neotesselata*	CO-S2	Endemic to Colorado in the Arkansas River Valley. Occurs on valleys, arroyos, canyons, and on hillsides within herbaceous grassland, shrublands, chaparral, and coniferous woodlands. Utilizes sites characterized by plains, grasslands, or juniper woodlands at elevations below 7,000 ft.	x	x	
Tucson shovel-nosed snake	*Chionactis occipitalis klauberi*	ESA-C; BLM-S; AZ-S1	Endemic to Arizona from Pima, Pinal, and Maricopa Counties in creosote-mesquite floodplain habitats with soft, sandy, loam soils and sparse gravel.	x	x	x
Western banded gecko	*Coleonyx variegatus*	BLM-S; UT-SC; UT-S2	Desert scrub habitat along rocky hillsides and sandy flats and washes of canyon lands.	x	x	
Western blind snake	*Leptotyphlops humilis*	BLM-S; UT-SC; UT-S1	Fossorial, generally occurring in sandy areas, alluvial deposits, and other areas with loose soils. May sometimes be found under rocks or wood debris, among plant roots, or in crevices.	x	x	
Yuma Desert fringe-toed lizard	*Uma rufopunctata*	BLM-S; AZ-WSC; FWS-SC; AZ-S2	Restricted to extreme southwestern Arizona and adjacent Mexico. Known from the Mowhawk and Yuma dune systems in Yuma County, Arizona, as well as the Pinta Sands in Pima County, Arizona. Restricted to sparsely vegetated, fine, windblown sand dunes, flats, riverbanks, and washes of very arid desert.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Reptiles (Cont.)						
Zebra-tailed lizard	*Callisaurus draconoides*	BLM-S; UT-SC; UT-S2	Open desert habitat, often in wash bottoms or other areas sparsely vegetated with creosote.	x	x	
Birds						
American peregrine falcon	*Falco peregrinus anatum*	BLM-S; AZ-WSC; NM-T; CO-SC; CO-S2; NM-S2; FWS-SC	Delisted from the ESA in 1999, populations have reoccupied much of the historic habitat in California and Arizona. Nests along cliffs and bluffs, as well as in urban areas on buildings. Prefers open areas to hunt for other bird species and small mammals.	x	x	x
American redstart	*Setophaga ruticilla*	AZ-WSC; AZ-S1	Breeding habitat is composed of mature and second-growth wooded habitats. Deciduous and mixed deciduous-coniferous forest; old-growth forests with regenerating trees, thickets, small groves, and swamps.	x		
American white pelican	*Pelecanus erythrorhynchos*	BLM-S; FWS-SC; CO-S1; UT-SC; NV-S2; UT-S1	May occur as a summer resident in large reservoirs within the project area. Suitable habitat does not occur on any of the proposed SEZs in Utah; however, flocks may be observed migrating through each SEZ.	x	x	x
Arizona bell's vireo	*Vireo bellii arizonae*	CA-E; CA-S1	A summer resident of willow and mesquite riparian habitat of the lower Colorado River Valley. Historically occurred throughout the lower Colorado River, currently known in the solar analysis area from Yuma, Arizona.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Baird's sparrow	*Ammodramus bairdii*	BLM-S; NM-T; FWS-SC; NM-S1	A winter nonbreeding resident in the southwestern United States and northern Mexico. Nonbreeding habitat includes open grasslands and overgrown fields.	x	x	x
Bald eagle	*Haliaeetus leucocephalus*	ESA-T; BLM-S; CO-T; NV-P; AZ-WSC; NM-T; FWS-SC; CO-S1; NM-S1; NV-S1; UT-SC; UT-S1	Near large bodies of water or free-flowing rivers with abundant fish and waterfowl prey. Nesting occurs in tall trees near bodies of water; winters near open water. Occasionally forages in arid shrubland habitats. Sonoran populations in Arizona are listed as threatened under the ESA; populations elsewhere are not listed under the ESA.	x	x	x
Barrow's goldeneye	*Bucephala islandica*	BLM-S; CO-S2; NM-S2	A winter resident in southern Colorado. Occurs on larger lakes and rivers.	x	x	x
Bell's vireo	*Vireo bellii*	NM-T; FWS-SC; NM-S2	Dense shrublands or woodlands along lower-elevation riparian areas among willows, scrub oak, and mesquite. May nest in any successional stage with dense understory vegetation.	x	x	x
Belted kingfisher	*Megaceryle alcyon*	AZ-WSC; AZ-S2	Rivers, brooks, ponds, lakes, coasts, streams, creeks, mangroves, swamps, and estuaries.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Bendire's thrasher	*Toxostoma bendirei*	BLM-S	A summer resident in localized areas throughout the SEZ region. Uses a variety of desert habitats with fairly large shrubs or cacti and open ground or with open woodland with scattered shrubs and trees, between 0 and 1,800 ft in elevation.	x	x	x
Black skimmer	*Rynchops niger*	CA-S1	Known in California from coastal, estuarine, marsh, and wetland habitats, including the Salton Sea in Imperial and Riverside Counties. Breeding habitats are usually small islands or impounded levees along aquatic habitats; nests are constructed on bare ground. Winter habitat includes mud flats in estuaries as well as urban beaches associated with estuaries or protected harbors and near river mouths.	x		
Black swift	*Cypseloides niger*	FWS-SC; UT-SC; UT-S1	Aerial; forages over forests and in open areas. Nests behind or next to waterfalls and wet cliffs.	x	x	
Black tern	*Chlidonias niger*	BLM-S; FWS-SC	A migratory transient in the southwestern United States. Inhabits wet grasslands, marshes, and flooded agricultural fields. Also occurs along playa margins and open water habitats in desert lowland areas.	x	x	x
Black-and-white warbler	*Mniotilta varia*	AZ-S1	Considered a migratory transient in the western United States. Nonbreeding habitat varies from early successional disturbed areas to mature forests.	x		
Black-bellied whistling-duck	*Dendrocygna autumnalis*	AZ-WSC	Estuaries, rivers, ponds, stock tanks, marshes, and swamps. Often found in riparian areas or thickets. Uses natural cavities in live or dead trees for nesting.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Black-necked stilt	*Himantopus mexicanus*	AZ-S2	Patchily distributed in central and southern California; rarely occurs in Arizona. Populations in California have no federal or state status or rank. Populations in Arizona, however, are imperiled in the state (S2). Populations occur in the Central Valley of California, from San Francisco south along the Pacific coast and east to the Colorado River. Inhabits barren, estuarine, and fresh emergent wetlands; irrigated grain crops; irrigated hayfields; lacustrine, riverine, and saline emergent wetlands; and wet meadows.	x	x	
Boreal owl	*Aegolius funereus*	CO-S2; NM-S2	Prefers mature, structurally complex spruce-fir forest close to open grassy locations. Also associated with habitats composed of dense coniferous forest, mixed forest, or alder, aspen, or stunted spruce thickets.	x		
Broad-billed hummingbird	*Cynanthus latirostris*	NM-T; NM-S2	Riparian woodlands at low to moderate elevations (2,800 to 5,500 ft), characterized by cottonwood or sycamore trees. Nests in a variety of trees, shrubs, and forbs. Also occurs in Chihuahuan desert scrub in open stands of creosote bush and large succulents.	x		
Brown-crested flycatcher	*Myiarchus tyrannulus*	CA-S2	Occurs in riparian woodlands or forests dominated by cottonwoods and willows in southern California. The presence of woodpeckers or other cavity- excavating species is important.	x	x	
California black rail	*Laterallus jamaicensis coturniculus*	BLM-S; AZ-WSC; CA-T; AZ-S1; CA-S1; FWS-SC	Within the analysis area, this species is known year-round from the Imperial Valley and lower Colorado River in Arizona and California. May be locally common in marshes along the Colorado River or canal systems.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
California brown pelican	*Pelecanus occidentalis californicus*	CA-S1	Generally restricted to California coastal areas, including those near shores, bays, sounds, lagoons, river mouths, scrub-shrub wetlands, bare rock/talus/scree, cliffs, and sand dunes, with nesting occurring on islands.	x	x	
California gull	*Larus californicus*	CA-S2	Seacoasts, bays, estuaries, mudflats, marshes, irrigated fields, lakes, ponds, agricultural lands, and urban areas. Islands, lake shores, and pond shores having open sandy or gravelly areas serve as nesting habitat.	x	x	
Cattle egret	*Bubulcus ibis*	AZ-S1	Known from southern California and southwestern Arizona. Primary habitat communities include herbaceous, scrub-shrub, forested, and riparian wetlands as well as croplands and herbaceous grasslands. Within those communities, wet pasture land, marshes, fresh and brackish locations, dry fields, agricultural areas, and garbage dumps are utilized.	x	x	x
Clark's grebe	*Aechmophorus clarkii*	BLM-S; AZ-WSC	A year-round resident in the lower Colorado River Valley. Considered common in California (not ranked); less common in Arizona (S3), where it is state-protected and listed as a BLM-designated sensitive species. Primarily associated with permanent open water areas, including marshes, lakes, bays, and rivers.	x	x	
Common black-hawk	*Buteogallus anthracinus*	BLM-S; AZ-WSC; NM-S2; FWS-SC	Obligate riparian nester, dependent on mature riparian habitats supported by permanent flowing streams. Nests in groves of trees in riparian areas. Also known to occur in mixed savannah, dunes, and grasslands where a water source is nearby.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Common ground-dove	*Columbina passerina*	NM-E; NM-S1	Previously most common in open country with trees and bushes and in open, sandy areas in forest and savannah, but now, over much of its range, it is found primarily on cultivated land, in villages, and in towns at elevations below 5,400 ft. Nests in shrubs or low trees.	x		
Costa's hummingbird	*Calypte costae*	NM-T; NM-S2	Desert and semi-desert, arid brushy foothills, chaparral; during migration and in winter, also found in adjacent mountains and open meadows and gardens. Nests in trees, shrubs, vines, or cacti.	x		
Crissal thrasher	*Toxostoma crissale*	CA-SC; FWS-SC	A year-round resident in the deserts of southeastern California and southwestern Arizona. Occupies dense thickets of scrub or low trees in desert riparian and desert wash habitats. Also occurs in washes within pinyon-juniper habitats.	x	x	x
Dickcissel	*Spiza americana*	NM-S1	Grassland, meadows, savanna, cultivated lands, brushy fields. Nests on the ground in grass, tall weeds, or low shrubs or trees. Prefers habitat with dense, moderate to tall vegetation and moderately deep litter. Suitable habitats are found in old fields, hayfields, fence rows, hedge rows, road rights-of-way, planted cover, and moderately grazed prairie.	x	x	x
Eastern bluebird	*Sialia sialis*	NM-S1	Forest edges, open woodlands, and partly open locations with scattered trees, from coniferous or deciduous forest to riparian woodland. Also occurs in pine woodlands or savannas. Nests are in natural cavities, old woodpecker holes, bird boxes, or similar sites.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Elegant trogon	*Trogon elegans*	NM-E; NM-S1	Open woodland, pine-oak association, scrubby woodland and second-growth, primarily in arid or semiarid situations, less frequently in humid woodland.	x		
Elf owl	*Micrathene whitneyi*	CA-E; CA-S1	A rare spring and summer resident of the lower Colorado River Valley. Nests in desert riparian habitat dominated by saltcedar. Also utilizes tall trees and snags, such as cottonwood, sycamore, willow, mesquite, and saguaro cactus.	x	x	
Ferruginous hawk	*Buteo regalis*	BLM-S; AZ-WSC; FWS-SC; AZ-S2; CO-SC; NM-S2; NV-S2; UT-S2	Grasslands, sagebrush and saltbrush habitats, and the periphery of pinyon-juniper woodlands. Nests in tall trees or on rock outcrops along cliff faces. May forage in various desert shrubland habitats.	x	x	x
Forster's tern	*Sterna forsteri*	CO-S2	Large freshwater marshes and lakes with deep water and extensive reed beds or muskrat burrows.	x	x	
Gila woodpecker	*Melanerpes uropygialis*	CA-E; CA-S1	A fairly uncommon year-round resident in southern California and southwestern Arizona along the Colorado River. Occurs primarily in desert riparian and desert wash habitats, but also found in orchard-vineyard and urban habitats.	x	x	x
Gilded flicker	*Colaptes chrysoides*	CA-E; CA-S1	Stands of saguaro cactus, Joshua tree, and cottonwood or ironwood forests in southern Arizona and southern California along the Colorado River.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Gray vireo	*Vireo vicinior*	BLM-S; NM-T; CA-S2; CO-S2; NM-S2; FWS-SC	An uncommon summer resident in arid pinyon-juniper and chaparral habitats of southern California. Elevation ranges between 2,000 and 6,500 ft.	x	x	x
Gray-headed junco	*Junco hyemalis caniceps*	CA-S1	Occupies coniferous, mixed, and deciduous forests, forest edges and clearings, bogs, open woodlands, brushy areas adjacent to forest, and burned-over lands.	x		
Great egret	*Ardea alba*	BLM-S; AZ-WSC; AZ-S1	Year-round resident in the lower Colorado River Valley. Primarily associated with areas of open water, such as marshes, estuaries, lagoons, lakes, ponds, rivers, and flooded fields.	x	x	x
Greater sage-grouse	*Centrocercus urophasianus*	ESA-C; BLM-S; UT-SC; UT-S2	Plains, foothills, and mountain valleys dominated by sagebrush (*Artemisia* spp.). Lek sites are located in relatively open areas surrounded by sagebrush or in areas where sagebrush density is low. Nesting usually occurs on the ground where sagebrush density is higher. Some populations may travel up to 60 mi between summer and winter habitats.	x	x	x
Greater sandhill crane	*Grus canadensis tabida*	CO-S2	Open, shallow, freshwater wetlands adjacent to grassland or short-vegetation uplands dominated by *Artemisia* spp., *Potentilla* spp., and *Populus* spp. Breeding habitat includes marshes, swamps, and bulrush and sedge meadows generally larger than 2.5 ac in size. Nesting wetlands are secluded and free from disturbance.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Green kingfisher	*Chloroceryle americana*	AZ-S2	A summer breeder in southwestern North America from Arizona, New Mexico, and Texas. Populations are not known to occur in California. Inhabits arroyos and riparian, flooded forest, coastal lagoon, mangrove, marsh, and forested wetland habitats. Nests in horizontal burrows dug in the banks of streams. Elevations range between 450 ft and 4,600 ft.	x	x	
Gull-billed tern	*Gelochelidon nilotica*	CA-S1	Breeds along the Salton Sea and in the San Diego Bay in southern California. Occupies primarily coastlines, salt marshes, estuaries, lagoons, plowed fields, and, less frequently, rivers, lakes, and freshwater marshes. Requires isolated nesting habitat composed of small, bare islets of fine clay.	x		
Gunnison sage-grouse	*Centrocercus minimus*	ESA-UR; BLM-S; CO-SC; CO-S1	Year-round resident in the Gunnison Basin in south central Colorado. Inhabits large expanses of sagebrush with mixed grasses and forbs.	x	x	x
Hepatic tanager	*Piranga flava*	CA-S1	A summer resident in the SEZ region in southern California and southwestern Arizona. Inhabits open coniferous forests, montane pine-oak forests, riparian woodlands, and pine savanna. Nests high in coniferous or deciduous trees.	x	x	x
Interior least tern	*Sterna antillarum athalassos*	ESA-E; CO-E; NM-E; CO-S1; NM-S1	A migratory transient in the southwestern United States. Inhabits beaches and sandbars of large rivers and lakes. May occasionally be observed at open water habitats and playas in the southwestern United States.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Least Bell's vireo	*Vireo bellii pusillus*	ESA-E; CA-E; CA-S2	Small summer range in southern California and Baja California. Inhabits dense brush, willow-cottonwood forest, streamside thickets, and scrub oak in arid regions near water in southern California. Nests in low trees in riparian habitats.	x		
Least bittern (western)	*Ixobrychus exilis* (*hesperis*)	BLM-S; AZ-WSC; NV-P; FWS-SC; CA-S1; CA-SC; NV-S2	A year-round resident in the lower Colorado River Valley. Breeding habitat includes freshwater and brackish marshes with dense, tall growths of aquatic or semiaquatic vegetation. Winter habitat is primarily composed of brackish and saline swamps and marshes.	x	x	x
LeConte's thrasher	*Toxostoma lecontei*	BLM-S; NV-P; FWS-SC; NV-S2	Known from Arizona, southern California, and southern Nevada, where it is uncommon throughout its range. Inhabits saltbush-cholla scrub communities in desert flats, dunes, or alluvial fans.	x	x	x
Lewis's woodpecker	*Melanerpes lewis*	UT-SC; UT-S2	A year-round resident in the southwestern United States. Inhabits open ponderosa pine, Douglas-fir, pinyon-juniper, mixed conifer, and oak forests. Prefers areas with understory grasses and shrubs to support insect prey populations. Nests in cavities of dead or dying trees and stumps.	x	x	x
Loggerhead shrike	*Lanius ludovicianus*	BLM-S; CA-SC; FWS-SC	Known to breed in southern California in the solar analysis area. Breeding habitat includes open woodlands with moderate grass cover interspersed with areas of bare ground.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Long-billed curlew	*Numenius americanus*	BLM-S; CO-S2; UT-SC; NV-S2; UT-S2	May occur as a summer resident throughout the project area. Inhabits short-grass grasslands near standing water. Suitable habitat for this species does not occur on any of the proposed SEZs in Utah; however, flocks may be observed migrating through each SEZ.	x	x	x
Long-eared owl	*Asio otus*	FWS-SC; AZ-S2	Deciduous and evergreen forests, orchards, wooded parks, farm woodlots, riparian areas, and desert oases. Nests in trees in old nests of other birds or squirrels; sometimes nests in tree cavities.	x	x	x
Lucy's warbler	*Vermivora luciae*	CA-S2; CA-SC	Restricted to very limited areas in the Mojave and Colorado Deserts. Occurs in riparian, chaparral, and hardwood woodlands having standing snags or hollow trees. Utilizes almost exclusively mesquite thickets within riparian woodlands. Nonbreeding habitat includes dry washes and riparian forests.	x		
Mexican spotted owl	*Strix occidentalis lucida*	ESA-T; AZ-WSC; CO-T; CO-S1; NM-SC; NM-S2; UT-S2	Inhabits deep, sheer-walled canyons in old-age, mixed coniferous forests.	x	x	
Mountain plover	*Charadrius montanus*	BLM-S; CA-S2; CA-SC; UT-SC; UT-S1	Prairie grasslands and arid plains and fields. Nests in shortgrass prairies associated with prairie dogs, bison, and cattle. More than 50% of the global population nests in the states of Colorado and New Mexico. May be a winter resident in southern California.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Mountain quail	*Oreortyx pictus*	BLM-S; NV-P	Scattered occurrences in western North America, from southwestern British Columbia south and east to Idaho, Washington, Oregon, Nevada, California, and Baja California. Uses high-altitude areas on steep slopes with tall, dense shrubs, close to water within brushy mountain sides, coniferous forest, and mixed forests. Elevations typically range from 4,000 to 10,000 ft.	x		
Neotropic cormorant	*Phalacrocorax brasilianus*	NM-T; NM-S2	Rivers, lakes, marshes, and seacoasts.	x		
Northern aplomado falcon	*Falco femoralis septentrionalis*	ESA-E; NM-E; NM-S1	Open rangeland and savanna, semiarid grasslands with scattered trees, mesquite, and yucca. Nests in old stick nests of other raptor species. Nests are located in trees or shrubs in areas of desert grassland.	x	x	x
Northern cardinal	*Cardinalis cardinalis superba*	CA-S1	Widely distributed throughout eastern and central North America. Rarely occurs in California at the western periphery of its range. The species is a rare inhabitant of riparian areas along the lower Colorado River in California.	x	x	
Northern goshawk	*Accipiter gentilis*	BLM-S; AZ-WSC; NV-P; FWS-SC; NM-SC; NM-S2; NV-S2	Mature mountain forest and riparian zone habitats. Nests in trees in mature deciduous, coniferous, and mixed forests. Forages in both heavily forested and relatively open shrubland habitats.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Osprey	*Pandion haliaetus*	NM-SC; NM-S2	Primarily along rivers, lakes, reservoirs, and seacoasts. Typically builds large stick nests on living or dead trees and also uses numerous man-made structures, such as utility poles, wharf pilings, windmills, microwave towers, chimneys, and channel markers. Nests are usually near or above water.	x	x	x
Ovenbird	*Seiurus aurocapillus*	CO-S2	Uses mid-late successional, closed-canopied deciduous or deciduous-coniferous forests having deep leaf litter and limited understory for breeding season. Forest types included oak-hickory, oak-pine, maple-basswood, maple-birch, maple-birch-beech, hemlock-oak, trembling aspen, and spruce.	x	x	
Peregrine falcon	*Falco peregrinus*	BLM-S; NV-P; FWS-SC; NV-S2	Occurs in open habitats, including deserts, shrublands, and woodlands that are associated with high, nearly vertical cliffs and bluffs above 200 ft. When not breeding, its activity is concentrated in areas with ample prey, such as farmlands, marshes, lakes, rivers, and urban areas.	x	x	x
Phainopepla	*Phainopepla nitens*	BLM-S; NV-P; FWS-SC; NV-S2	Known from the southwestern United States and Mexico, where it breeds from central California east to southern Nevada and south to western Texas, including the southern half of Arizona and southern New Mexico. Inhabits desert scrub, mesquite, and pinyon-juniper woodland communities. Also occurs in desert riparian areas and orchards. Nests in trees or shrubs that are 3 to 45 ft above the ground.	x	x	x
Prairie falcon	*Falco mexicanus*	BLM-S	Year-round resident in the Nevada SEZ region, primarily in open habitats in mountainous areas, steppe, grasslands, or cultivated areas. Typically nests in well-sheltered ledges of rocky cliffs and outcrops.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Short-eared owl	*Asio flammeus*	BLM-S; CO-S2; NM-S2; UT-SC; UT-S2	Known to occur throughout the project area. Inhabits grasslands, shrublands, and other open habitats. It is nomadic, often selecting unique breeding sites each year, depending on local rodent densities. Nests on the ground near shrubs.	x	x	x
Snowy egret	*Egretta thula*	BLM-S; AZ-WSC; AZ-S1; CO-S2	Primarily associated with open water areas, such as marshes, estuaries, lagoons, lakes, ponds, rivers and flooded fields. A year-round resident in the lower Colorado River Valley.	x	x	x
Sonoran yellow warbler	*Dendroica petechia sonorana*	CA-S1	Restricted to the lower Colorado River Valley. Occupies riparian vegetation close to water along streams and wet meadows. Associated with *Salix* spp. and *Populus* spp. Also uses xeric montane shrub fields, chaparral shrub fields, and mixed-conifer forests having shrubby understories.	x	x	
Southwestern willow flycatcher	*Empidonax traillii extimus*	ESA-E; AZ-WSC; CA-E; CO-E; NV-P; NM-E; AZ-S1; CA-S1; NM-S2; NV-S1; UT-S1	Riparian shrublands and woodlands. Nests in thickets, scrubby and brushy areas, open second-growth, swamps, and open woodlands.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Summer tanager	*Piranga rubra*	CA-S2; FWS-SC	An uncommon summer resident and breeder in desert riparian habitat along the lower Colorado River. Occurs very locally elsewhere in southwestern Arizona and southern California. Inhabits dense stands of cottonwood and willow in riparian areas for feeding and breeding.	x	x	
Swainson's hawk	*Buteo swainsoni*	BLM-S; NV-P; FWS-SC; CA-S2; NV-S2	Savanna, open pine-oak woodlands, grasslands, and cultivated lands. Nests in solitary trees, bushes, or small groves.	x	x	x
Swainson's thrush	*Catharus ustulatus*	AZ-S1	Widely distributed throughout North America. Inhabits dense coniferous forests, aspen forests, and willow or alder thickets. Prefers damp forests or forests adjacent to water at elevations between 7,300 and 9,200 ft. Populations in California are apparently secure (S4) and have no federal or state status or rank.	x	x	
Varied bunting	*Passerina versicolor*	NM-T; NM-S2	Summer breeding resident in southern Arizona, southern New Mexico, and southern Texas. In New Mexico, this species is known to summer in Carlsbad Caverns National Park and Guadalupe Canyon. Inhabits shrublands, second-growth, and similar habitats consisting of mesquite (*Prosopis* sp.). Also found along canyon bottoms.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Vermilion flycatcher	*Pyrocephalus rubinus*	CA-S2	Breeding and summer habitat occurs in southeastern California and southwestern Arizona along the Colorado River, as well as in southern California near the Salton Sea. Breeding habitat consists of arid scrub, farmlands, savanna, agricultural areas, and riparian woodlands. Used sites are associated with surface water as well as *Populus* spp. and *Salix* spp.	x	x	
Western burrowing owl	*Athene cunicularia hypugaea*	BLM-S; FWS-SC; CO-T; AZ-S2; AZ-SC; CA-S2; CA-SC; NM-SC; UT-SC	A year-round resident within the solar analysis area. Occurs locally in open areas with short, sparse vegetation, including grasslands, agricultural fields, and disturbed areas. Nests in burrows created by mammals or tortoises. Local abundance is determined by small mammal prey abundance.	x	x	x
Western snowy plover	*Charadrius alexandrinus nivosus*	BLM-S; AZ-WSC; NV-P; AZ-S1; CO-S1; CO-SC	Breeds on alkali flats around reservoirs and sandy shorelines. A known summer breeder and winter resident in portions of the six-state solar energy region.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	ESA-C; AZ-WSC; CA-E; NV-P; CA-S1; NM-SC; NV-S1; UT-S1	Breeds in scattered areas along the lower Colorado River and larger bodies of water in the southwestern United States. Primarily associated with riparian cottonwood and willow forests with dense understory foliage.	x	x	x
White-faced ibis	*Plegadis chihi*	BLM-S; AZ-S2; CA-S1; CO-S2; NM-SC; NM-S2; FWS-SC	Forages in fresh emergent wetlands, shallow lacustrine waters, muddy ground of wet meadows, and irrigated or flooded pastures and croplands. Dense, fresh emergent wetlands serve as nesting habitat. Roosts amidst dense, freshwater emergent vegetation, such as bulrushes, cattails, reeds, or low shrubs over water.	x	x	x
White-tailed kite	*Elanus leucurus*	AZ-S2	Savanna, open woodlands, marshes, cleared areas, and cultivated fields.	x	x	
Willet	*Catoptrophorus semipalmatus*	CO-S1	Large expanses of short, sparse grasslands for nesting and wetland complexes for foraging. Habitat types include marshes, lake margins, and river mouths.	x	x	
Wood duck	*Aix sponsa*	AZ-S2	Wooded freshwater habitats with an abundance of cover. Inhabits riparian areas, wooded swamps, and freshwater marshes. Areas of shallow, flooded timber and emergent vegetation are preferred.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Birds (Cont.)						
Yellow warbler	*Dendroica petechia brewsteri*	CA-S2; CA-SC	San Joaquin and Colorado River Valleys. Occupies riparian vegetation close to water along streams and wet meadows. Associated with *Salix* spp. and *Populus* spp. Also uses xeric montane shrub fields, chaparral shrub fields, and mixed-conifer forests having shrubby understories.	x	x	
Yuma clapper rail	*Rallus longirostris yumanensis*	ESA-E; AZ-WSC; CA-T; NV-P; CA-S1; NV-S1	Freshwater marshes containing dense stands of cattails. Nests on dry hummocks or in small shrubs among dense cattails or bulrushes along the edges of shallow ponds in freshwater marshes with stable water levels.	x	x	x
American three-toed woodpecker	*Picoides dorsalis*	UT-SC; NV-S2; UT-S2	Year-round resident of montane coniferous forests in Utah. Nests in loose colonies in spruce, tamarack, pine, cedar, and aspen trees. Forages for insects on scaly-barked trees, such as spruce, hemlock, lodgepole pine, and tamarack.	x	x	
Mammals						
Allen's big-eared bat	*Idionycteris phyllotis*	BLM-S; NV-P; FWS-SC; NV-S1; UT-S2	Known to occur in isolated locations throughout the southwestern United States. Habitat is primarily mountainous, wooded areas composed of ponderosa pine, pinyon-juniper, Mexican woodland, and oak brush as well as cottonwood riparian woodland. Occurs within the range of Mohave Desert scrub of low-desert ranges to white fir forest zones with summer ranges occurring at higher elevations. Roosts in caverns, rock fissures, and mines.	x	x	x
American mink	*Mustela vison*	NM-S1	Once considered to be extirpated from New Mexico; now considered extremely rare. Associated with montane riparian areas.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Mammals (Cont.)						
Arizona myotis	*Myotis occultus*	BLM-S; CA-S2; NM-SC; FWS-SC	Known from extreme southeastern California and southern Arizona, occurring only along the Colorado River lowlands and in adjacent desert mountain ranges. Inhabits ponderosa pine and oak-pine woodlands close to water; also occurs in riparian forests within desert areas along the Colorado River.	x	x	x
Big free-tailed bat	*Nyctinomops macrotis*	BLM-S; FWS-SC; CA-S2; CA-SC; NM-S2; NV-S1; UT-S2	Associated with bare rock/talus/scree, cliff, shrub desert, hardwood woodland, and riparian communities. Roosts in rock crevices on cliff faces or in buildings. Forages primarily in coniferous forests and arid shrublands to feed on moths.	x	x	x
Black-footed ferret	*Mustela nigripes*	ESA-E, ESA-XN; CO-E; CO-S1	Believed to be extirpated from the state of Colorado since the 1950s. Experimental populations were reintroduced to the northwestern portion of the State beginning in 2001. Historically it inhabited prairies and semiarid shrublands, where it preyed on prairie dogs.	x	x	
Black-tailed prairie dog	*Cynomys ludovicianus*	FWS-SC; NM-SC; NM-S2	A species of the Great Plains, occurring from southern Saskatchewan, Canada, south to the desert grasslands of western Texas and southern New Mexico. Inhabits dry, flat or gently sloping, open grasslands with relatively sparse vegetation. May inhabit some areas grazed by cattle or vacant lots in residential areas.	x	x	x
Botta's pocket gopher	*Thomomys bottae rubidus*	CO-SC; CO-S1	Agricultural fields, grasslands, roadsides, parks, pinyon-juniper woodlands, open montane forest, montane shrublands, and semi-desert shrublands at an elevation ranging from 4,000 to 8,500 ft.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Mammals (Cont.)						
Brazilian free-tailed bat	*Tadarida brasiliensis*	BLM-S; NV-P	Found primarily throughout the southern half of North America, the species may occur in isolated locations throughout the southwestern United States. Forages in desert grassland, old field, savanna, shrubland, and woodland habitats as well as urban areas. Roosts in old buildings, caves, mines, and hollow trees.	x	x	x
California leaf-nosed bat	*Macrotus californicus*	BLM-S; AZ-WSC; CA-S2; CA-SC; FWS-SC	A year-round resident in southern California and southwestern Arizona. May be locally common in some areas. Occurs in desert riparian, desert wash, desert scrub, and palm oasis habitats at elevations below 2,000 ft. Roosts in mines, caves, and buildings.	x	x	x
Canada lynx	*Lynx canadensis*	ESA-T; CO-E; CO-S1	Montane conifer and conifer-hardwood habitats; a dense understory that supports snowshoe hare populations. Within the solar analysis region, this species is currently restricted to extremely isolated areas of the mountains in the central portion of Colorado.	x	x	
Cave myotis	*Myotis velifer*	BLM-S; FWS-SC; CA-S1	Lower Colorado River Basin in desert scrub, shrublands, washes, and riparian habitats. Roosts in colonies in caves.	x	x	x
Colorado River cotton rat	*Sigmodon arizonae plenus*	AZ-S2	Restricted to the lower Colorado River floodplain in Arizona and California. Confined to isolated mesic habitats, such as desert riparian, grassland, and freshwater wetlands and flooded agricultural areas.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Mammals (Cont.)						
Colorado Valley woodrat	*Neotoma albigula venusta*	CA-S1	Known from extreme southeastern California. Inhabits low-lying desert, creosote-mesquite, and pinyon-juniper habitats. Distribution is strongly influenced by the availability of den-building materials—including litter of opunita, cholla, prickly pear, mesquite, and catclaw—as well as its low tolerance for cold temperatures.	x	x	x
Common hog-nosed skunk	*Conepatus leuconotus*	CO-S1	Woodlands, grasslands, deserts, brushy areas, and rocky canyons in mountainous regions. Utilized sites are characterized as scrub oak, pinyon scrub, and pinyon-juniper woodlands with sandy soils, grassy understories, and rocks at elevations below 9,000 ft.	x	x	x
Dark kangaroo mouse	*Microdiposops megacephalus*	BLM-S; UT-SC; UT-S2	Occurs in the Great Basin region within the project area in sagebrush-dominated areas with sandy soils. Nocturnally active during warm weather, the species remains in underground burrows during the day and cold winter months.	x	x	x
Desert bighorn sheep	*Ovis canadensis mexicana*	NM-E; NM-SC; NM-S1	Visually open, steep rocky terrain in mountainous habitats in desert regions. Rarely uses desert lowlands, but may use them as corridors for travel between mountain ranges.	x	x	x
Desert pocket gopher	*Geomys arenarius*	FWS-SC	Scattered distribution in southern New Mexico, western Texas, and northern Mexico. Inhabits loose soils of disturbed areas or sandy areas near open water. Often occurs along rivers, ponds, or canals.	x	x	x
Desert Valley kangaroo mouse	*Microdipodops megacephalus albiventer*	BLM-S; NV-P; FWS-SC; NV-S2	Endemic to central Nevada. Inhabits desert areas at playa margins and dune habitats.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Mammals (Cont.)						
Dwarf shrew	*Sorex nanus*	CO-S2	Utilizes rocky sites within alpine, bare rock/talus/scree, coniferous forests, herbaceous grasslands, shrubland/chaparral, and woodland-conifer forests. Other habitats include sedge marsh, subalpine meadow, dry brushy slopes, arid shortgrass prairie, dry stubble fields, and pinyon-juniper woodlands.	x	x	x
Fringed myotis	*Myotis thysanodes*	BLM-S; NV-P; FWS-SC; NV-S2; UT-SC	A wide range of habitats, including lowland riparian, desert shrub, pinyon-juniper, and sagebrush habitats. Roost sites have been reported in buildings and caves. May be a summer or year-round resident throughout the six-state solar energy region.	x	x	x
Gray-footed chipmunk	*Neotamias canipes*	BLM-S	Known from New Mexico and western Texas. Occurs in montane woodlands where dense stands of mixed timber are present. Also occurs on brushy hillsides with rock crevices.	x		
Gunnison's prairie dog	*Cynomys gunnisoni*	ESA-C; NM-S2	Known from the Gunnison Basin in central and south central Colorado. Inhabits mountain valleys, plateaus, and open brush habitats in the project area at elevations between 6,000 and 12,000 ft.	x	x	x
Hualapai Mexican vole	*Microtus mexicanus hualpaiensis*	ESA-E; AZ-WSC; AZ-S1	Endemic to western and central Arizona. Primarily associated with dry grass/forb habitats on steep slopes in ponderosa pine woodlands. Currently only known from moist, grass/sedge habitats along permanent and semipermanent water sources at elevations between 3,000 and 8,400 ft.	x	x	
Kit fox	*Vulpes macrotis*	BLM-S; UT-SC	Open prairie, plains, and desert habitats, where it inhabits burrows and preys on rodents, rabbits, hares, and small birds.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Mammals (Cont.)						
Lodgepole chipmunk	*Neotamias speciosus speciosus*	CA-S2	Occurs in isolated populations in mountains of California. Occurs within open-canopy forests of mixed conifer, Jeffrey pine, lodgepole, and limber pine, as well as chaparral. Elevation ranges between 6,400 and 10,800 ft.	x	x	
Long-eared myotis	*Myotis evotis*	BLM-S; FWS-SC	Year-round resident in California, primarily occurring in coastal habitats. Rarely occurs in arid desert habitats, but may forage along riparian areas and coniferous forests. Roosts in buildings, crevices, and snags.	x	x	
Long-legged myotis	*Myotis volans*	BLM-S	Primarily in montane coniferous forests, also in riparian and desert habitats. May change habitats seasonally. Uses caves and mines as hibernacula, but winter habits are poorly known. Roosts in abandoned buildings, rock crevices, and under bark of trees.	x	x	x
Mohave ground squirrel	*Spermophilus mohavensis*	CA-T; CA-S2	Known from the Mojave Desert in San Bernardino County, California. Inhabits open desert scrub, grasslands, and Joshua tree woodlands at elevations between 1,800 and 5,000 ft. Utilizes burrows at the base of shrubs.	x	x	x
Mohave river vole	*Microtus californicus mohavensis*	CA-S1; FWS-SC	Endemic to California, where it is restricted to two localities along the Mojave River. Occupies moist habitats, including meadows, freshwater and tidal marshes, irrigated pastures, and oak woodlands.	x		
Nelson's bighorn sheep	*Ovis canadensis nelsoni*	BLM-S; FWS-SC	Visually open, steep, rocky terrain in mountainous habitats of the eastern Mojave and Sonoran Deserts in California. Rarely uses desert lowlands, but may use them as corridors for travel between mountain ranges.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Mammals (Cont.)						
New Mexican jumping mouse	*Zapus hudsonius luteus*	ESA-C; BLM-S; NM-E; NM-S2	Herbaceous riparian areas along permanent streams, including wet meadows within river floodplains. Also known along irrigation ditches. In many areas, moist riparian zones with tall, dense sedges provide suitable habitat.	x		
Organ Mountains chipmunk	*Neotamias quadrivittatus australis*	BLM-S; NM-T; FWS-SC; NM-S1	Endemic to New Mexico in the Organ Mountains. Most common around Aguirre Springs at elevations between 6,050 and 7,300 ft. Inhabits north-facing slopes in association with ponderosa pine, oak, and pinyon-juniper woodlands.	x		
Pahranagat Valley montane vole	*Microtus montanus fucosus*	BLM-S; NV-P; FWS-SC; NV-S2	Endemic to Lincoln County, Nevada, where it is restricted to springs in the Pahranagat Valley. Within that area, isolated populations use mesic montane and desert riparian patches.	x	x	x
Pale kangaroo mouse	*Microdipodops pallidus*	NV-P; NV-S2	Known from southwestern Nevada and southeastern California. Inhabits fine sands in alkali sink and desert scrub dominated by shadscale (*Atriplex confertifolia*) or big sagebrush (*Artemisia tridentata*). Often burrows in areas of soft, windblown sand piled at the bases of shrubs.	x	x	x
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM-S; CO-SC; CO-S2; FWS-SC	A subspecies of Townsend's big-eared bat known primarily within the solar analysis region from the state of Colorado. Inhabits semiarid shrublands, pinyon-juniper woodlands, and montane forests below elevations of 9,500 ft. Roosts in caves, mines, or rock crevices, under bridges, or within buildings.	x	x	x
Pallid bat	*Antrozous pallidus*	BLM-S; NV-P; CA-SC; FWS-SC	Inhabits low-elevation desert communities, including grasslands, shrublands, and woodlands. During the day, roosts in caves, crevices, and mines. May be a summer or year-round resident throughout the six-state solar energy region.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Mammals (Cont.)						
Palm Springs pocket mouse	*Perognathus longimembris bangsi*	BLM-S; CA-S2	Known from the Coachella Valley in Riverside County California, south to the Salton Sea. Active above ground in warmer months, foraging on seeds in creosote scrub, desert scrub, and grasslands on loose or sandy soils.	x	x	x
Palmer's chipmunk	*Neotamias palmeri*	NV-P; NV-S2	Endemic to Nevada, where it is restricted to Mount Cheston in the Spring Mountains. Inhabits coniferous forests, from the yellow pine belt to the timber line, where it rarely ventures far from shelter among large rocks, logs, or cliff crevices.	x	x	
Penasco least chipmunk	*Neotamias minimus atristriatus*	NM-E; FWS-SC; NM-S1	Known only from the Sacramento Mountains in Otero County, New Mexico. Inhabits mesic meadows, riparian areas, agricultural fields, and pinyon-juniper woodlands.	x	x	
Peninsular bighorn sheep	*Ovis canadensis nelsoni* DPS	ESA-E; CA-E; CA-S1	A distinct population segment (DPS) of Nelson's bighorn sheep, restricted to the Peninsular Ranges of the San Jacinto Mountains in southern California. Inhabits visually open, steep, rocky terrain in mountainous habitats of the western Sonoran Desert. Rarely uses desert lowlands, but may use them as corridors for travel between ranges.	x		
Plains pocket mouse	*Perognathus flavescens relictus*	CO-S2	Confined to areas of sandy or sandy-loam soils at elevations between 3,000 and 7,500 ft. Inhabits xeric grassland communities, including tallgrass prairie, midgrass prairie, shortgrass prairie, and foothill/mountain grassland, as well as shrublands, pinyon-juniper forests, and sand dune habitats.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Mammals (Cont.)						
Pocketed free-tailed bat	*Nyctinomops femorosaccus*	CA-S2; FWS-SC	Confined to a few localities within southern California and southwestern Arizona. Uses almost exclusively arid lowland areas, including creosote bush and chaparral habitats, in association with very large boulders, high cliffs, rugged rock outcroppings, and rocky canyons.	x	x	x
Pygmy rabbit	*Brachylagus idahoensis*	BLM-S; NV-P; UT-S2; UT-SC	Sagebrush-shrubland habitats throughout the SEZ region. Prefers loose soils to dig burrows.	x	x	x
San Bernardino flying squirrel	Glaucomys sabrinus californicus	CA-S2; FWS-SC	Endemic to California, with three isolated populations occurring within the forests of the San Gabriel, San Bernardino, and San Jacinto Mountains. Occupies coniferous and deciduous forests, including riparian forest and mixed coniferous forest composed of Jeffrey pine, white fir, and black oak.	x		
Silver-haired bat	*Lasionycteris noctivagans*	BLM-S; FWS-SC	Primarily confined to high-elevation forested areas (1,600–8,500 ft) composed of aspen, cottonwood, white fir, pinyon-juniper, subalpine fir, willow, and spruce communities. Roost and nursery sites occur in tree foliage, cavities, or under loose bark. Rarely hibernates in caves.	x	x	x
Sonoran pronghorn	*Antilocapra americana sonoriensis*	ESA-E; AZ-WSC; AZ-S1	Endemic to southern and western Arizona and northern Mexico. Inhabits areas of the Lower Sonoran Desert Life Zone in broad alluvial valleys separated by mountains, where substrates consist of clay, silt, and alluvium deposited from wind and ephemeral streams. Mean elevation of the valleys ranges between 400 and 1,600 ft.	x	x	

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Mammals (Cont.)						
Spotted bat	*Euderma maculatum*	BLM-S; NV-P; NM-T; FWS-SC; CA-S2; CO-S2; NM-S2; NV-S2; UT-S2; UT-SC	Near forests and shrubland habitats throughout the SEZ region. Uses caves and rock crevices for day roosting and winter hibernation. May be a summer or year-round resident throughout the six-state solar energy region.	x	x	x
Townsend's big-eared bat	*Corynorhinus townsendii*	BLM-S; NV-P; FWS-SC; CA-S2; NM-SC; NV-S2; UT-SC	Near forests and shrubland habitats below 9,000 ft in elevation throughout the SEZ region. The species may use caves, mines, and buildings for day roosting and winter hibernation. May be a summer or year-round resident throughout the six-state solar energy region.	x	x	x
Utah prairie dog	*Cynomys parvidens*	ESA-T; UT-S1	Endemic to southwestern Utah. Inhabits grasslands in level mountain valleys and areas with deep, well-drained soils. Populations exist as colonies residing in underground burrow systems, which are dynamic in size and location.	x	x	x
Western mastiff bat	*Eumops perotis californicus*	BLM-S; NV-P; FWS-SC; NV-S1	An uncommon year-round resident in Arizona, California, and Nevada. Occurs in many open semiarid habitats, including conifer and deciduous woodlands, shrublands, grasslands, chaparral, and urban areas. Day roosts in crevices in cliff faces, buildings, and tall trees.	x	x	x

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Mammals (Cont.)						
Western red bat	*Lasiurus blossevillii*	BLM-S; AZ-WSC; NV-P; FWS-SC; NM-S2 NV-S1; UT-S1	Forages in riparian and other wooded areas. Roosts primarily in cottonwood trees along riparian areas and in fruit orchards.	x	x	x
Western small-footed myotis	*Myotis ciliolabrum*	BLM-S; FWS-SC; CA-S2	Occurs in a variety of woodlands and riparian habitats at elevations below 9,000 ft. Roosts in caves, buildings, mines, and crevices of cliff faces. May be a summer or year-round resident throughout the six-state solar energy region.	x	x	x
Western yellow bat	*Lasiurus xanthinus*	BLM-S; AZ-WSC; AZ-S2; CA-SC	An uncommon year-round resident in the foothills and desert regions of southern California and southwestern Arizona. Inhabits desert riparian, desert wash, and palm oasis habitats at elevations below 2,000 ft. Roosts in trees.	x	x	x
White sands woodrat	*Neotoma micropus leucophaea*	FWS-SC	Known only from the White Sands region in Otero County, New Mexico. Occurs in desert grasslands, shrublands, and riparian areas.	x	x	x
Wolverine	*Gulo gulo*	CO-S1	High-elevation habitats including aspen, spruce-fir, Douglas fir, lodgepole pine, limber pine, ponderosa pine/lodgepole, white fir, juniper, pinyon juniper, Rocky Mountain bristlecone pine, and mixed conifer forests as well as tundra, subalpine meadow, and xeric shrublands at elevations between 6,000 and 14,500 ft.	x		

TABLE J.6-1 (Cont.)

Common Name	Scientific Name	Listing Status[b]	Habitat[c]	Potential to Occur in Alternative Analysis Areas[d]		
				No Action Alternative	Program Alternative	SEZ Alternative
Mammals (Cont.)						
Yellow-faced pocket gopher	*Cratogeomys castanops*	NM-S2	Deep sandy or silty soils that are relatively free of rocks. Prefers deep, firm soils; rich soils of river valleys and streams; agricultural land (orchards, gardens, potato fields, and other croplands); and meadows. Also in mesquite-creosote bush habitat. Constructs shallow foraging burrows and deeper ones between nest and food cache.	x	x	x
Yuma hispid cotton rat	*Sigmodon hispidus eremicus*	AZ-S2; CA-S2; CA-SC; FWS-SC	Known from the southern Colorado River Valley in southwest Arizona and southwestern California. Occurs in dense stands of vegetation near wetlands, herbaceous grasslands, and hardwood woodland communities. Preferred sites are described as being dense, grassy areas, such as fields, marshes, and roadside edges; brushy areas along streams or ponds; irrigated fields; and desert scrub.	x	x	x
Yuma mountain lion	*Puma concolor browni*	CA-S1	Small range, mostly confined to the Colorado River Valley of southern California and southwestern Arizona. Establishes large home ranges composed of riparian bottomlands, cottonwood-willow forests, mesquite bosques, adjacent desert foothills, low and rocky mountains, and canyons within desert, chaparral shrubland, and mixed woodland communities.	x	x	x
Yuma myotis	*Myotis yumanensis*	BLM-S; FWS-SC	A widespread year-round resident throughout much of the southwestern United States. It is uncommon in the Mojave and Sonoran Desert regions, except for mountain ranges bordering the Colorado River and the San Bernardino Mountains. Prefers montane forest habitats at elevations between 2,000 and 8,000 ft. Roosts in buildings, mines, caves, and crevices.	x	x	x

Footnotes on next page.

TABLE J.6-1 (Cont.)

[a] Only species that may occur in the affected area of the SEZs are included in this table.

[b] AZ-HS = highly safeguarded plant species in Arizona; AZ-S1 = ranked as S1 in the state of Arizona; AZ-S2 = ranked as S2 in the state of Arizona; AZ-SR = salvage restricted plant species in Arizona; AZ-WSC = wildlife species of concern in the state of Arizona (formerly regarded as state-threatened); BLM-S = listed as a sensitive species by the BLM; CA-E = listed as endangered in the state of California; CA-S1 = ranked as S1 in the state of California; CA-S2 = ranked as S2 in the state of California; CA-SC = a state species of concern within the state of California; CA-SX = extirpated from the state of California; CA-T = listed as threatened by the state of California; ESA-C = candidate for listing under the ESA; ESA-E = listed as endangered under the ESA; ESA-P = proposed for listing under the ESA; ESA-T = listed as threatened under the ESA; ESA-UR = under review for ESA listing; ESA-XN = experimental, non-essential populations; FWS-SC = USFWS species of concern. CO-E = listed as endangered in Colorado; CO-S1 = ranked as S1 in Colorado; CO-S2 = ranked as S2 in Colorado; CO-SC = Colorado species of concern; CO-T = listed as threatened in Colorado; NM-E = listed as endangered in New Mexico; NM-S1 = ranked as S1 in New Mexico; NM-S2 = ranked as S2 in New Mexico; NM-SC = New Mexico species of concern; NM-T = listed as threatened in New Mexico; NV-P = protected in Nevada; NV-S1 = ranked as S1 in Nevada; NV-S2 = ranked as S2 in Nevada; UT-S1 = ranked as S1 in Utah; UT-S2 = ranked as S2 in Utah; UT-SC = species of concern in Utah.

[c] To convert from ft to m, multiply by 0.3048. To convert from acres to km^2, multiply by 0.004047. To convert from mi^2 to km^2, multiply by 2.590.

[d] The potential of any species to occur in any of the alternative analysis areas and their affected areas is based upon the presence of known occurrences or potentially suitable habitat. Potentially suitable habitat was determined from CAReGAP and SWReGAP habitat suitability and land cover models.

occur in the affected area of one or more of the proposed SEZs and that are (1) listed, proposed, candidate, or under review for listing under the ESA; (2) designated by the BLM as sensitive; or (3) listed as threatened, endangered, or a species of concern by the state in which the affected area is located. The species accounts include information on the species' life history, ecology, listing history, and threats to conservation.

J.6.1 Species Accounts

Species accounts are presented for those species that may occur in the affected area of one or more of the proposed SEZs and that are (1) listed, proposed, candidate, or under review for listing under the ESA; (2) designated by the BLM as sensitive; or (3) listed by the state in which the affected area is located. Species accounts are presented by taxonomic group (plants, invertebrates, fish, amphibians, reptiles, birds, and mammals) and alphabetically, by common name, within each taxonomic group.

J.6.1.1 Plants

Alkali Mariposa-Lily (*Calochortus striatus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S2

Alkali mariposa-lily is a herbaceous perennial monocot in the Liliaceae (lily) family that is native to California but also occurs in Nevada. The plant arises from an underground bulb with an erect stem that is usually 4–8 in. (10–20 cm) tall but may be much taller. The stem may branch toward the end and is subtended by a long, linear basal leaf that usually withers by the time the plant blooms. Alkali mariposa-lily blooms from April to June with white to lavender, bell-shaped flowers at the end of the stem. The flower petals are striped with purple veins, and each has a nectary at its base that is surrounded by hairs. The fruit is an erect, linear, angled capsule containing flat, yellowish or tan seeds (*Flora of North America* 2010; Jepson 2010; Nature Serve 2010).

Alkali mariposa-lily grows in wetlands, alkaline seeps, springs, meadows, and springy places in creosote bush scrub of the western Mojave Desert of southern California at elevations between 2,600 and 4,600 ft (800 and 1,400 m) (*Flora of North America* 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of alkali mariposa-lily in California, but conservation of this species is needed to ensure it remains a part of California's flora. Major

threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution.

The alkali mariposa-lily may occur in the affected area of the following SEZs: Pisgah and Riverside East.

Amargosa Niterwort (*Nitrophila mohavensis*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Endangered in California; Protected in Nevada
Rarity: Nevada State Rank S1

The Amargosa niterwort is confined to a few small depressions, or sinks, of the Carson Slough in Nevada and California (from Ash Meadows Wildlife Refuge in Nevada downstream to Franklin Playa, California) and from at least one locale on the eastern shore of the Amargosa River at Grimshaw Basin, California. This habitat is composed of highly saline and alkaline soils that are hydrated to varying degrees and are formed by seepage from freshwater springs that lie many miles to the north and east in Ash Meadows, Nevada (Nature Serve 2010).

The Amargosa niterwort grows on open, highly alkaline mudflats and low sand deposits in sinks, around alkali sink vegetation. All populations are known from wet alkaline flats that lack appreciable standing water and support very little vegetation, with extensive salt crust development. The species occurs in the open and is generally not found with, or under, any type of cover. It is found at elevations between approximately 1,970 and 2,460 ft (600 and 750 m). Associated plants include spiny saltbush, Parry's saltbush, iva, Tecopa bird's-beak, short-pedicelled cleomella, pickleweed, and saltgrass. Natural and unaltered hydrology within Lower Carson Slough appears critical for the survival of the Amargosa niterwort.

The Amargosa niterwort is a small, erect perennial from an extensive, heavy, underground rootstock. The largest population of the species is thought to consist of several thousand individuals, many of which are interconnected via underground rootstocks. Plants can overwinter as underground rootstocks, with new plants starting their growth in March. Flowering is from late April to October.

On June 19, 1985 (USFWS 1985), the Amargosa niterwort was federally listed as an endangered species, with designated critical habitat.

The restricted range of this species makes it susceptible to natural catastrophic events such as flooding and drought as well as to the genetic and demographic consequences of small populations. A majority of all suitable habitat in California for this species is on public lands. Potential threats to the species include local groundwater depletion; streambed alteration; highway maintenance; mining, including exploratory drilling and claim marker placement; off-road vehicle (ORV) travel; and trampling by wild horses. An additional threat is the potential introduction and spread of the exotic plant saltcedar. Saltcedar has not been observed near

Franklin Playa to date, although it does occur downstream on the Amargosa River in the vicinity of Grimshaw Basin (USFWS 1985; NatureServe 2010).

The Amargosa niterwort may occur in the affected area of the following SEZs: Pisgah Amargosa Valley.

Aravaipa Wood Fern (*Thelypteris puberula* var. *sonorensis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Arizona State Rank S2

Aravaipa wood fern is a large perennial fern that is native to Arizona but also occurs in California. Ferns reproduce via tiny spores shed into the air; therefore, the plants have no flowers, fruits, or seeds. The spores eventually settle to the soil and germinate to form inconspicuous gametophytes, from which aerial plants (sporophytes) develop. Aravaipa wood fern consists of evergreen, ascending and spreading fronds (leaves) arising from thick, scaly, creeping rhizomes. Individual fronds are light green, pinnately compound, papery to leathery, sparsely hairy, and from 20 to 51 in. (50 to 130 cm) in length. Densely hairy spore-bearing structures are in two rows on the underside of the frond pinnules. Spores are shed from January to September (*Flora of North America* 2010; Jepson 2010; Nature Serve 2010).

Aravaipa wood fern grows in a variety of habitats, including moist soils in shady canyon regions, riparian habitats such as riverbanks, seepage areas, and mesic meadow habitats at elevations between 2,220 and 4,500 ft (675 and 1368 m) (*Flora of North America*, 2010; Jepson 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Aravaipa wood fern in Arizona, but conservation of this species is needed to ensure it remains a part of Arizona's flora. Major threats are associated with habitat disturbance or destruction, recreation, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Aravaipa wood fern could occur in the affected area of the following SEZ: Bullard Wash.

Arizona Cliff-Rose (*Purshia subintegra*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Arizona Highly Safeguarded (HS)
Rarity: Arizona State Rank S1

The Arizona cliff-rose is a low, woody shrub that is endemic to limestone soils in central Arizona. The current range of the species includes Maricopa County (near Horseshoe Lake), Yavapai County (near Cottonwood), Mohave County (near Burro Creek), and Graham County (near Bylas). The landscape is dissected by ephemeral drainages and is sparsely vegetated. Plants typically grow on rolling, rocky, limestone hills and slopes, within Sonoran Desert scrub, at elevations of 2,120 to 4,000 ft (646 to 1,220 m). The species requires white tertiary limestone lakebed deposits high in lithium, nitrates, and magnesium. The Arizona cliff-rose tends to be the dominant or co-dominant shrub on sites where it occurs (AZGFD 2010; Nature Serve 2010). No information was found on reproduction in this species.

Four disjunct populations of Arizona cliff-rose exist along an area of central Arizona that is 200 mi (322 km) wide. The Cottonwood population includes the greatest number of individual plants, including seedlings. Existing populations are found on land under a number of different ownerships: private, BLM, Bureau of Indian Affairs, Forest Service, state of Arizona, and possibly the Bureau of Reclamation.

The Arizona cliff-rose was federally listed as endangered on May 29, 1984 (USFWS 1984a). Critical habitat has not been designated for this species.

This species is very vulnerable because of its limited number of populations, habitat specificity, and a number of threats. Livestock grazing, poor reproduction, mineral exploration and development, construction and maintenance of roads and utility corridors, recreation, ORV use, urbanization, pesticides, and urbanization are all threats to the species (Nature Serve 2010).

The Arizona cliff-rose may occur in the affected area of the following SEZ: Bullard Wash.

Arizona Coralroot (*Hexalectris spicata* var. *arizonica*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (New Mexico)
State Listing Status: Endangered in New Mexico
Rarity: New Mexico State Rank S2; USFWS Species of Concern

Arizona coralroot (*Hexalectris spicata* var. *arizonica*) is a subspecies of crested coralroot that occurs throughout southern Arizona, New Mexico, Texas, and adjacent Mexico. Within New Mexico, populations exist in Doña Ana, Hidalgo, Otero, and Sierra Counties. Arizona coralroot grows under heavy leaf litter in oak, mixed oak and conifer, and pinyon-juniper woodland communities, on the wooded sides of canyons, and on canyon bottoms from 3,480 to 6,950 ft (1,061 to 2,118 m) in Arizona and New Mexico. Substrate is limestone to calcareous sandy or organic soils. Associated orchids include spiny coralroot (*Corallorhiza wisteriana*), purple-spike coralroot (*H. warnockii*), Chisos coral-root (*H. revoluta*), and Huachuca Mountain adder's-mouth (*Malaxis corymbosa*) (NMRPTC 2010).

Emerging above ground only to flower from May to July in New Mexico, Arizona coralroot rarely flowers in consecutive years. It has a symbiotic relationship with mycorrhizal fungi until the plant is mature for flowering. Within New Mexico, this species grows as widely scattered individuals, with some small colonies developing up to six plants (AZGFD 2010; NMRPTC 2010).

Arizona coralroot is listed as endangered by the state of New Mexico and sensitive by the BLM (New Mexico), is ranked S2 by the state of New Mexico, and is a USFWS species of concern. Threats include mining, land-use conversion, habitat fragmentation, soil disturbance and compaction, and forest management practices.

The Arizona coralroot may occur in the affected area of the following SEZs: Afton and Mason Draw.

Arizona Giant Sedge (*Carex ultra*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Arizona)
State Listing Status: Not Listed
Rarity: Arizona State Rank S2

Arizona giant sedge is a large herbaceous perennial monocot in the Cyperaceae (sedge) family that is native to Arizona but also occurs in New Mexico. The tall plant arises from large rootstocks and consists of numerous stout, three-angled, erect stems that are 3.3- to 6.6-ft (1- to 2-m) tall, with very long strap-shaped leaves. Each stem bears 6 to 15 leathery, smooth leaves that may be red-tinged on the back side and clasp the stem at the base. Arizona giant sedge has separate male and female flowers (monoecious), mostly in separate long spikes that are near the ends of the stems. Some of the lower female spikes may have a short portion of male flowers at the tip. The male flower spikes are composed of fluffy reddish-brown flower scales. The female spikes are cylindrical; composed of achenes (the fruit) within a brownish, oval, papery sac (the perigynium) with a short narrow beak; and interspersed with reddish-brown scales. The female flower spikes mature and develop fruit during late March through September. The fruits are dark brown, three-sided, oval achenes. *Carex ultra* is a synonym for *Carex spissa* var. ultra (*Flora of North America* 2010, Jepson 2010; Nature Serve 2010).

Arizona giant sedge grows in shaded southeast-facing exposures of moist gravelly substrates near perennially wet springs and streams. Its elevation ranges between 2,000 and 6,000 ft (600 and 1,824 m) (*Flora of North America* 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Arizona giant sedge in Arizona, but conservation of this species is needed to ensure it remains a part of Arizona's flora. Major threats are associated with habitat disturbance or destruction, recreation, effects of small population size, exotic species invasion, succession, global climate change, and pollution.

Arizona giant sedge could occur in the affected area of the Bullard Wash SEZ.

Ash Meadows Blazingstar (*Mentzella leucophylla*)

ESA Listing Status: Threatened
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1

The Ash Meadows blazingstar is endemic to the Ash Meadows area of Nye County, Nevada. It occurs in open areas, on dry, hard, salt-crusted alkaline clay or sandy-clay soils. Plants grow on low bluffs, swales, flats, and drainages, in shadscale vegetation that surrounds spring and seep areas in warm desert scrub communities. Associated species include shadscale saltbush, alkali goldenbush, Ash Meadows sunray, and Ash Meadows milk-vetch. The Ash Meadows blazingstar is found at elevations between 2,240 and 2,300 ft (683 and 700 m). There are eight occurrences of this species over a range of approximately 6 mi (10 km), on land administered by the USFWS and the BLM as well as on privately owned land.

The Ash Meadows blazingstar is a biennial herb with bright yellow flowers that bloom from late May into September. Flowers open only for brief periods in the late afternoon. Observations made in early spring indicate that individuals of this species do not overwinter; there was no new growth from previous years. Sufficient rain is probably necessary to allow flowering. Since populations of mature plants vary greatly from year to year, it is likely that the total number of seeds produced varies also. The dispersal of this species' seeds is restricted to the sides of gullies and on raised knolls of the flats and lower foothills in the area of the existing populations. The Ash Meadows blazingstar is apparently sensitive to disturbance or habitat alteration, as it is not found on any disturbed sites either as seedlings or as established plants.

The Ash Meadows blazingstar was federally listed as threatened on May 20, 1985 (USFWS 1985). Critical habitat has been designated in the Ash Meadows area of Nye County, Nevada.

Ash Meadows blazingstar could occur in the affected area of the Amargosa Valley SEZ.

Ash Meadows Gumplant (Grindelia fraxinopratensis)

ESA Listing Status: Threatened
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2

The Ash Meadows gumplant is an erect, biennial or, more often, perennial herb of the sunflower (Asteraceae) family. It is known only from moist, meadow habitats along Carson Slough in Nevada and California, and from Ash Meadows Wildlife Refuge in Nevada

downstream to Franklin Playa, California; it has also been reported along the Amargosa River from near Tecopa, California.

The populations of the Ash Meadows gumplant follow drainage patterns from spring sources in the Ash Meadows region into Carson Slough, the major drainage system of Ash Meadows. The current population status of the Ash Meadows gumplant is unknown, and population trends are difficult to determine because long-term data are unavailable. The Ash Meadows gumplant primarily occurs in saltgrass meadows along streams and surrounding pools in the vicinity of ash-screwbean-mesquite woodlands and desert shadscale scrub vegetation. It occasionally occurs sparsely on open alkali clay soils in drier shadscale habitats or in the unique clay barrens where groundwater is at or near the surface and where other Ash Meadow endemics are supported. The species is quite robust in marshy areas along some dirt roads where runoff accumulates.

The dominant plant species occurring with the gumplant is saltgrass. Other common associates within the saltgrass meadow type community include spring-loving centaury, seep willow, Yerba mansa, western niterwort, loosestrife, and iva. In wooded areas and on drier sites, common associates include velvet ash, screwbean mesquite, shadscale, alkali sacaton, alkali goldenbush, rabbitbush, seepweed, and other saltbush species.

The Ash Meadows gumplant was federally listed as threatened with designated critical habitat on May 20, 1985 (USFWS 1985).

Threats to the Ash Meadows gumplant include the reduction of spring outflow caused by adjacent land development and/or water diversion; the destruction and/or modification of the limited habitat available to this species from camping, staging area, road maintenance, and/or mining activities; and the degradation of habitat resulting from wild horse grazing/trampling and ORV use impacts.

Ash Meadows gumplant could occur in the affected area of the Amargosa Valley SEZ.

Ash Meadows Ivesia (*Ivesia kingii* var. *eremica*)

ESA Listing Status: Threatened
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2

The Ash Meadows ivesia is a perennial herb that is endemic to the Ash Meadows area of Nevada. The species occurs in open areas, on moist to saturated, heavy to chalky alkaline soils. Plants grow in meadows on flats, drainages, and bluffs near springs and seeps. They are commonly associated with highly alkaline, clay lowlands or depressions where soil moisture remains high from perched groundwater maintained by springs and seeps. The taxon is typically found in saltgrass meadow, shadscale, and ash-mesquite, associated with the following species:

shadscale saltbush, saltgrass, baltic rush, mesquite, Mojave thistle, spring-loving centaury, velvet ash, Yerba mansa, and iva.

The Ash Meadows ivesia is a matted perennial herb/shrub that bears white flowers from August to October. The Ash Meadows ivesia is aquatic or wetland-dependent and occurs at elevations ranging from 2,200 to 2,300 ft (670 to 700 m). There are nine occurrences of the species that cover a combined total area of approximately 9 ac (3.6 ha), on land administered by the USFWS and the BLM, and on privately owned land.

The Ash Meadows ivesia was federally listed as threatened on May 20, 1985 (USFWS 1985). Critical habitat has been designated in the Ash Meadows area of Nye County, Nevada. Potential threats to the species include development, trampling and grazing, and the associated large-scale drawdown of water resources.

Ash Meadows ivesia could occur in the affected area of the Amargosa Valley SEZ.

Ash Meadows Sunray (Enceliopsis nudicaulis var. corrugate)

ESA Listing Status: Threatened
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2

The Ash Meadows sunray is endemic to the Ash Meadows area, occurring in both Nevada and adjacent California. The species occurs on dry to somewhat moist, hard, strongly alkaline silty to clay soils, in open areas, often on or near low calcareous outcrops. Plants are found in spring and seep areas, at elevations from 2,200 to 2,360 ft (670 to 720 m), in creosote-bursage and shadscale zones. Common associated plant species include shadscale saltbush, alkali goldenbush, saltgrass, broom snakeweed, ratany, basin yellow cryptantha, desert bearpoppy, Ash Meadows blazingstar, and Ash Meadows milk-vetch. This species is known from 11 sites that together total an area of 27 ac (0.1 km^2).

The Ash Meadows sunray is a perennial shrub that flowers in April and May. Flowers are borne singly on leafless flower stalks. Little is known about the reproductive biology and life history of this species.

The Ash Meadows sunray was federally listed as threatened on May 20, 1985 (USFWS 1985). Critical habitat has been designated in the Ash Meadows area of Nye County, Nevada. This subspecies is threatened by groundwater pumping and other agricultural development activities, road construction, and ORV traffic.

Ash Meadows sunray could occur in the affected area of the Amargosa Valley SEZ.

Barstow Woolly Sunflower (*Eriophyllum mohavense*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed in Any State
Rarity: California State Rank S2; USFWS Species of Concern

Barstow woolly sunflower is a small, annual herbaceous dicot in the Asteraceae (sunflower) family that is native to California and endemic to the Mojave Desert. The plant consists of a white-woolly tuft of numerous erect to spreading, branching stems that are only 0.4- to 1-in. (1- to 2.5-cm) tall. The stems are subtended by, and bear, a few spoon- or wedge-shaped, hairy leaves that may be smooth in outline or have three teeth at the wide end. Barstow woolly sunflower blooms from April to May with yellow composite flowers at the ends of the stems. The flowers are clustered among the leaves, giving the plant the appearance of a small mound. The fruit is a hairy, four-angled, club-shaped, black achene with a tuft of scales at one end (a pappus) (*Flora of North America* 2010; Jepson 2010; Nature Serve 2010).

Barstow woolly sunflower is known only from the Mojave Desert area surrounding Barstow, California. The plant grows on sandy or rocky substrates associated with creosote bush scrub, chenopod scrub, and playas. Its elevation ranges between 2,000 and 3,000 ft (600 and 900 m) (California Native Plant Society 2010; *Flora of North America* 2010; Jepson 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Barstow woolly sunflower in California, but because it is endemic to California and the Mojave Desert, conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (Nature Serve. 2010).

Barstow woolly sunflower could occur in the affected areas of the Pisgah SEZ.

Bigelow Onion (*Allium bigelovii*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Status: Arizona Salvage Restricted (SR)
Rarity: Arizona State Rank S2

Bigelow onion is a herbaceous perennial monocot in the Liliaceae (lily) family that is native to Arizona but also occurs in New Mexico. The plant arises from an underground bulb with a single, erect, smooth, flowering stem (scape) that is 2- to 5-in. (5- to 12-cm) tall. The stem bears two long, thick leaves that are rolled into a cylindrical shape and clasp the base of the stem. The basal leaf sheaths do not extend much above the soil surface. The leaves are often longer than the stem. Bigelow onion blooms from March to May with a hemispheric inflorescence of

10 to 25 bell-shaped flowers at the end of the leafless flower stem. The flowers are white, with each petal having a pink to reddish tip and midvein. The flowers are persistent and become papery and stiff as the fruits mature. The fruit is an erect, linear, angled capsule containing smooth, black, shiny seeds with a net-like pattern on their surfaces (*Flora of North America* 2010; Nature Serve 2010).

Bigelow onion grows on gentle slopes on open, dry rocky soil in grassland, chaparral, and Sonoran–Mohave Desert scrub communities at elevations between 2,000 and 5,000 ft (608 and 1,520 m) (*Flora of North America* 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Bigelow onion in Arizona, but conservation of this species is needed to ensure it remains a part of Arizona's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Bigelow onion could occur in the affected areas of the Bullard Wash SEZ.

Black Milkvetch (Astragalus funereus)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Status: Not Listed in Any State
Rarity: Nevada State Rank S2; USFWS Species of Concern

Black milkvetch is a small, tufted, herbaceous perennial dicot in the Fabaceae (bean) family that is native to Nevada but also occurs in California. This species is probably endemic to the Death Valley region in southern Nevada and California. The plant consists of a taproot with a woody crown that gives rise to several prostrate or trailing stems are woody below and 0.8- to 3-in. (2- to 8-cm) long. All of the herbage is covered with stiff hairs. The stems bear alternate, crowded, pinnately compound leaves. Black milkvetch blooms during April to May, with ascending clusters of pea-like flowers on stalks arising from the leaf bases. The flowers are pinkish purple with darker red veins, and each flower base (the calyx) is covered with black hairs. The fruits are large, oblong, pointed, hairy pods with a curved tip that are attached to the plant by ascending short stalks. The leathery pods contain numerous smooth, heart-shaped seeds that are olive, brown, or black. *Astragalus purshii* is a synonym for *Astragalus funereus* (Jepson 2010; Nature Serve 2010).

Black milkvetch grows on gravelly-clay ridges and ledges on limestone or volcanic substrates at elevations between 4,200 and 6,900 ft (1,277 and 2,098 m) (Jepson 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of black milkvetch in Nevada, but because this

species is probably endemic to the Death Valley region in southern Nevada and California, conservation of this species is needed to ensure it remains a part of Nevada's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Black milkvetch could occur in the affected areas of the Amargosa Valley SEZ.

Blaine Fishhook Cactus (*Sclerocactus blainei*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1; USFWS Species of Concern

Blaine fishhook cactus is a small perennial dicot cactus in the family Cactaceae that is native and endemic to southeastern Nevada and southwestern Utah. The plant is an erect, spiny cactus with an unbranched, unsegmented succulent stem that is pineapple-shaped and is 1.2- to 6-in. (3- to 15-cm) tall and 0.8- to 3-in. (2 to 8 cm) in diameter. The stem has 6 to 12 prominent ribs that are armed with clusters of stiff spines arising from wart-like tubercles (areoles). Each areole has 11 to 22 erect and spreading spines; some may be hooked, and others may be flat and ribbon-like. Young spines may be covered with very fine, soft hairs. Blaine fishhook cactus blooms from April to May with a cluster of funnel-shaped, pink-purplish flowers that are crowded among the dense spines at the top of the stem. The fruit is a barrel-shaped green to red berry that is persistent on the parent plant. When dry and mature, the fruit splits open to release large black seeds with small warts that are transported by winds and rain. The taxonomy of *Sclerocactus blainei* is not completely understood, and there are many questionable synonyms (*Flora of North America* 2010; Nature Serve 2010).

Blaine fishhook cactus grows in greasewood, galleta grass, shadscale, and sagebrush communities on alkaline substrates and volcanic gravels with a clay matrix in valley bottoms at elevations between 5,100 and 5,300 ft (1,550 and 1,611 m) (*Flora of North America* 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Blaine fishhook cactus in Nevada, but because this plant is an endemic, conservation of this species is needed to ensure it remains a part of Nevada's flora. There are only three occurrences of this species currently known. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution.

Blaine fishhook cactus could occur in the affected area of the Dry Lake Valley North SEZ.

Brandegee's Milkvetch (*Astragalus brandegeei*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Colorado)
State Listing Status: Not Listed
Rarity: Colorado State Rank S1

Brandegee's milkvetch is a herbaceous perennial dicot in the family Fabaceae (bean family) that is native to Colorado but is also found in other western states. The plant is less than 39-in. (100-cm) tall and has arching stems that may become prostrate or mat-forming. The stems may be smooth or hairy. The plant has alternate, pinnately compound leaves that are hairy on one or both surfaces. Clusters of pea-like flowers are produced from April to September on stalks arising from the leaf bases. The flowers are white or bicolored or with red, purple, or yellow streaks or spots. The fruits are oblong, pointed legumes (pods) that may be hairy or smooth and that contain numerous smooth seeds that are olive, brown, or black (*Colorado Rare Plant Field Guide* 2010; Nature Serve 2010).

Brandegee's milkvetch grows in a variety of habitats, including sandy or gravelly banks, flats, and stony meadows within pinyon-juniper woodlands. Substrates are usually sandstone with granite or occasional basalt. Its elevation ranges between 5,400 and 8,800 ft (1,600 and 2,700 m) (*Colorado Rare Plant Field Guide* 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Brandegee's milkvetch in Colorado, but conservation of this species is needed to ensure it remains a part of Colorado's flora. Major threats are associated with habitat disturbance or destruction, recreation, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Brandegee's milkvetch could occur in the affected area of the following SEZs: Antonito Southeast, Fourmile East, and Los Mogotes.

Burgess' Scale Broom (Lepidospartum burgessii)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (New Mexico)
State Listing Status: Endangered in New Mexico
Rarity: New Mexico State Rank S1; USFWS Species of Concern

Burgess' scale broom (*Lepidospartum burgessii*), also known as gypsum scalebroom, occurs in southern Otero County and Alkali Lakes, New Mexico, and adjacent Texas. Narrowly endemic to the Alkali Lakes area west of the Guadalupe Mountains, this species occurs in semi-stabilized gypsum dunes in Chihuahuan Desert scrub, alkali sacaton-furwing saltbush grasslands and shrublands, compacted gypsum soils at the edge of dry alkaline lakes, and arid grassland communities from 3,500 to 3,700 ft (1,050 to 1,110 m) elevation. In New Mexico, the plants

grow on stabilized, microbe-covered gypsum soils with 5% basal litter cover. Associated shrubs include *Atriplex canescens*, *Opuntia leptocaulis*, *Poliomintha incana*, and *Yucca elata* (NMRPTC 2010).

Flowering from June to October, this vascular flowering plant exhibits little evidence of recruitment. No seeds have been observed, despite flowering and clonal propagation that appear to be low [edit ok?]. The number of flowers per shrub varies from one to hundreds. The number of juvenile plants has declined (NMRPTC 2010).

Since Burgess' scale broom is substrate-specific and because probably fewer than 10,000 individuals remain, it is listed as sensitive by the BLM, listed as endangered in New Mexico, ranked S1 in New Mexico, and is a USFWS species of concern. Threats include the development of private land, use of ORVs, road building, and earth-moving activities.

The Burgess' scale broom may occur in the affected area of the Red Sands SEZ.

California Barrel Cactus (Ferocactus cylindraceus var. cylindraceus)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Arizona Salvage Restricted (SR)
Rarity: None

California barrel cactus is a large perennial dicot cactus in the family Cactaceae that is native to Arizona but also occurs in California. The plant is a large, erect, spiny cactus with an unbranched, unsegmented, succulent stem in the form of a cylinder that may be 6.5-ft (2-m) tall or higher and 1.3 ft (0.4 m) in diameter. The stem has 21 to 31 prominent ribs that are armed with clusters of stiff spines arising from wart-like tubercles (areoles). Each areole has 12 to 32 erect and spreading spines, the longest of which are 3- to 7-in. (7.5- to 17-cm) long, and may be whitish, yellow, pink, dull red, or brown. California barrel cactus blooms from April to May with a crown of flowers that are crowded among the dense spines at the top of the columnar stem. The individual flowers are maroon on the outside and yellow on the inside. The fruit is a yellow, ovoid, leathery or fleshy, smooth berry that is spineless and contains black seeds. The dried flower parts are persistent on the top of the mature fruit. *Ferocactus cylindraceus* var. *cylindraceus* is a synonym for *Echinocactus viridescens* var. *cylindraceus*, *Echinocactus cylindraceus*, *Echinocactus acanthodes*, and *Ferocactus acanthodes* (*Flora of North America* 2010; Jepson 2010; Nature Serve 2010).

California barrel cactus grows on gravelly or rocky hillsides, canyon walls, alluvial fans, and desert washes in Mojave Desert and Sonoran Desert scrub at elevations between 200 and 2,900 ft (61 and 882 m) (*Flora of North America* 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of California barrel cactus in Arizona, but conservation of this species is needed to ensure it remains a part of Arizona's flora. Major threats

are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution.

California barrel cactus could occur in the affected areas of the Gillespie SEZ.

California Fan Palm (Washingtonia filifera)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Arizona Salvage Restricted (SR)
Rarity: Arizona State Rank S1

California fan palm is a large perennial monocot palm tree in the Arecaceae family that is native to Arizona and California but also occurs in Nevada and Florida, probably as an exotic. The plant consists of an erect, columnar, unbranched trunk that is 20- to 75-ft (6- to 23-m) tall and 1 to 3 ft (0.3 to 1 m) in diameter, often clothed with a thick, skirt-like thatch of dead, persistent leaves that sometimes reaches all the way to the ground. The alternate leaves are fan-shaped and 3- to 6-ft (1- to 1.8-m) long with 40 to 60 folds, torn nearly to the base. The margins of the leaf divisions have numerous white, thread-like fibers. The very stout leaf stalks (petioles) are 2- to 5-ft (0.6- to 1.5-m) long and have large hooked teeth on the edges. These large leaves form a loose and open crown at the top of the trunk. California fan palm blooms from February to June with a large, branched, spike-like inflorescence that hangs down among the leaves and bears numerous white flowers. The fruit is a small, ovoid, black, fleshy, one-seeded drupe (Jepson 2010; Nature Serve 2010).

California fan palm grows in desert washes, seeps, and springs where underground water is continuously available and in desert oases in isolated areas of the Sonoran and Mojave Deserts at elevations between 500 and 1,000 ft (150 and 300 m) (*Flora of North America* 2010; Jepson 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of the California fan palm in Arizona, but conservation of this species is needed to ensure it remains a part of Arizona's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution.

California fan palm could occur in the affected areas of the Brenda SEZ.

Chaparral Sand-Verbena (*Abronia villosa* var. *aurita*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S2

Chaparral sand-verbena is a herbaceous annual dicot in the Nyctaginaceae family that is native to California and endemic to southern California. The plant consists of a loose mat of branched stems that are prostrate to ascending, widely spreading, and up to 30-in. (80-cm) long. The stems usually have a reddish tinge and are glandular-hairy. The stems bear opposite, oval, fleshy leaves that are grayish and glandular and may be hairy. Chaparral sand-verbena blooms from January to September with dense roundish clusters of magenta flowers on stalks that arise from leaf bases at the ends of the branches. The fruit is a winged achene (*Flora of North America* 2010; Jepson 2010; Nature Serve 2010).

Chaparral sand-verbena grows on sandy sites in chaparral desert sand dunes, coastal scrub habitats, and sage-scrub at elevations between 350 and 5,250 ft (100 and 1,600 m) (*Flora of North America* 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of chaparral sand-verbena in California, but because it is endemic to southern California, conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Chaparral sand-verbena could occur in the affected areas of the following SEZs: Imperial East, Iron Mountain, Pisgah, and Riverside East.

Charleston Grounddaisy (*Townsendia jonesii* var. *tumulosa*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: USFWS Species of Concern

Charleston grounddaisy is a small, herbaceous, short-lived, perennial dicot in the Asteraceae (sunflower) family that is endemic to Nevada. The species is known from only three sites in Clark County. The plant forms a cushion-shaped tuft with short, erect stems that are 0.4- to 1.6-in. (1- to 4-cm) tall. The stems bear alternate, closely spaced, spatula-shaped leaves that are mostly basal. All of the herbage is covered with very fine, stiff hair. Charleston grounddaisy blooms from April to June with composite flower heads that are borne at the ends of the stems and rise above the tuft of leaves. The flowers have white ray petals and yellow centers. The fruit is a hairy achene that has a tuft of scales (pappus) at one end (*Flora of North America* 2010; Nature Serve 2010).

Charleston grounddaisy grows in open, sparsely vegetated, calcareous areas, on shallow gravelly carbonate soils of slopes and exposed knolls in forest clearings. It is most commonly associated with montane conifer habitat but will also inhabit pinyon-juniper and lower subalpine conifer communities, recurring on knolls of white, alkaline, calcareous, silty, lacustrine deposits

of the upper shadscale/mixed-shrub and lower sagebrush zones. Its elevation ranges between 5,200 and 11,000 ft (1,580 and 3,344 m) (*Flora of North America* 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Charleston grounddaisy, but because this species is endemic to Nevada, conservation of this plant is needed to ensure it remains a part of Nevada's flora. Major threats are associated with habitat disturbance or destruction, recreation, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution (NatureServe, 2009).

Charleston grounddaisy could occur in the affected areas of the Delmar Valley SEZ.

Clokey's Cryptantha (*Cryptantha clokeyi*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S1

Clokey's cryptantha is an herbaceous annual dicot in the Boraginaceae family that is native and endemic in California. The plant is 3- to 6-in. (8- to 15-cm) tall and consists of numerous erect, branching stems that are covered with bristly hairs that lie flat against the stems. Each stem is subtended by a basal whorl of hairy leaves. The stems bear leaves that are linear-pointed to oblong, bristly-hairy, and opposite below and alternate above. Clokey's cryptantha blooms in April with curled, spike-like clusters of flowers at the ends of the stems. The flowers have small white petals, and the oval base of each flower (the calyx) is densely bristly. The fruit is a brown, triangular-ovate nutlet, covered with small warts, which has an open groove on one side. Four nutlets are produced by each flower (*Flora of North America* 2010; Jepson 2010; Nature Serve 2010).

Clokey's cryptantha is restricted to few locations near Barstow, California. It occurs on Mojave Desert scrub, ridge crests, and desert woodlands on sandy or gravelly soils at elevations between 2,625 and 2,950 ft (800 and 900 m) (Jepson 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Clokey's cryptantha in California, but because this plant is endemic to California, conservation of this species is needed to ensure it remains a part of the state's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Clokey's cryptantha could occur in the affected area of the Pisgah SEZ.

Compact Cat's-Eye (*Cryptantha compacta*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Nevada State Rank S1; Utah State Rank S2

Compact cat's-eye is an herbaceous perennial dicot in the Boraginaceae family that is native to Utah but also occurs in Nevada. The plant is 1- to 4-in. (3- to 10-cm) tall and consists of numerous erect bristly stems, each with a rosette of basal leaves, arising from a woody base. The crowded, alternate, oval leaves on the stems are also bristly. Compact cat's-eye blooms from May to June with clusters of blossoms, with white petals and yellow throats, at the ends of the branches. The oval base of each flower (the calyx) is covered with long, bristly hairs. The fruit is a small, smooth, brown nutlet, four of which are produced by each flower (Nature Serve 2010; *Utah Rare Plant Guide* 2010)

Compact cat's-eye grows in a variety of habitats, including salt desert shrub and mixed desert shrub communities, on gravelly loam and on open slopes and ridges at elevations of 6,200 to 7,400 ft (1,885 to 2,250 m) (*Utah Rare Plant Guide* 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of compact cat's-eye in Utah, but conservation of this species is needed to ensure it remains a part of Utah's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Compact cat's-eye could occur in the affected areas of the following SEZs: Escalante Valley, Milford Flats South, and Wah Wah Valley.

Coulter's Goldfields (*Lasthenia glabrata* ssp. *coulteri*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State rank S2

Coulter's goldfields is an annual herbaceous dicot in the Asteraceae (sunflower) family that is native to California and regionally endemic to California, Baja California, and Mexico. The plant consists of a simple or branching erect stem that is up to 24-in. (60-cm) tall and may be smooth or slightly hairy. The stems bear widely separated, smooth, opposite leaves that are linear or awl-shaped. The leaves at the ends of the stems may be alternate. Coulter's goldfields blooms from February to June with yellow composite flowers that arise from leaf bases at the ends of the stems. The fruit is a club-shaped, warty-hairy achene (*Flora of North America* 2010; Jepson 2010; Nature Serve, 2010).

Coulter's goldfields is endemic to California and grows in salt marshes, swamps, playas, alkaline sinks, and vernal pools at elevations below 4,000 ft (1,220 m) (Jepson 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Coulter's goldfields in California, but because it is endemic to California, conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Coulter's goldfields could occur in the affected areas of the Pisgah SEZ.

Creamy Blazing Star (*Mentzelia tridentata*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State rank S2

Creamy blazing star is an annual herbaceous dicot in the Loasaceae family that is native and endemic to California. The plant consists of a branching, erect, hairy stem that is 2- to 10-in. (5- to 25-cm) tall. The stem bears widely separated, opposite, lance-shaped leaves that are wavy-edged and have irregular teeth. Creamy blazing star blooms from March to May with white to pale yellow flowers that arise from leaf bases at the end of the stem. The fruit is a barrel-shaped to cylindrical capsule on a short stalk that may be erect or bent downward. The capsule contains a compressed, ashy-white seed (Jepson 2010; Nature Serve 2010).

Creamy blazing star is endemic to California and grows in Mojave Desert creosote bush scrub communities on rocky and sandy substrates at elevations below 3,900 ft (1,200 m) (Jepson 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of creamy blazing star in California, but because it is endemic to the central Mojave Desert of California, conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Creamy blazing star could occur in the affected areas of the Pisgah and Riverside East SEZs.

Death Valley Beardtongue (*Penstemon fruticiformis* ssp. *amargosae*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S2

Death Valley beardtongue is a shrubby perennial dicot in the Plantaginaceae family that is native and endemic to the Death Valley region of southern Nevada and California, where it is known only from Inyo and San Bernardino Counties in California and from Clark and Nye Counties in Nevada. The plant consists of a densely branched shrub that is 12- to 24-in. (30- to 60-cm) tall and is usually wider than tall. The erect to spreading stems are smooth and bear thick, opposite leaves that are long, narrow, and lance-shaped. The leaves are usually folded lengthwise or curved inward. Death Valley beardtongue blooms from April to June, with wide-mouthed tubular flowers in shades of white, blue, pink or purple, in clusters that arise from the bases of leaves or bracts at stem nodes. The bottom petal of each flower has a tuft of yellowish hair in its center and several purple veins. The outside of the flower petals are glandular-hairy. The fruit is an oval capsule that contains numerous irregularly angled seeds (Jepson 2010; Nature Serve 2010).

Death Valley beardtongue grows in Mojave Desert scrub communities at elevations between 2,800 and 4,600 ft (851 and 1,398 m) (Jepson 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Death Valley beardtongue in Nevada and California, but because it is endemic to the Death Valley region, conservation of this species is needed to ensure it remains a part of these state's flora. Other major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Death Valley beardtongue could occur in the affected areas of the Amargosa Valley SEZ.

Desert Cymopterus (*Cymopterus deserticola*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: None

Desert cymopterus is a long-lived, perennial, herbaceous dicot in the Apiaceae (carrot) family that is native to California and endemic to the Western Mojave Desert. The plant is stemless and is 2- to 8-in. (5- to 20-cm) tall. A cluster of basal leaves and a leafless flower stalk arise underground from the crown of a buried, deep taproot. The root crown also bears buds that will give rise to new plants in future years. The smooth, grayish-green, basal leaves are oval in outline and pinnately dissected into deep lobes. Desert cymopterus blooms from March to May

with a spherical inflorescence at the end of the erect flower stalk (scape) that rises above the basal leaves. The ball-like inflorescence is composed of hundreds of tiny purple flowers. The fruits are two flattened, appressed seeds that are hairy, have prominent ridges, and have wings on the edges (Jepson 2010; Nature Serve 2010).

Desert cymopterus is endemic to habitats in the Western Mojave Desert in California and grows in deep, loose, well-drained, fine to coarse sandy soils of alluvial fan basins. It often occurs in low sand dunes and on sandy slopes. Its elevation ranges between 2,060 and 3,060 ft (690 and 930 m) (Jepson 2010; Nature Serve 2010).

Desert cymopterus has experienced a short-term decline in recent years; the decline is suspected to be due mostly to human threats. Conservation of this endemic species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Desert cymopterus could occur in the affected area of the Pisgah SEZ.

Desert Night-Blooming Cereus (*Peniocereus greggii* var. *greggii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (New Mexico)
State Listing Status: Endangered in New Mexico
Rarity: New Mexico State Rank S1; USFWS Species of Concern

The desert night-blooming cereus is known from southern New Mexico and western Texas. It occurs in sandy to silty gravelly soils in desert grassland communities. It also found in gravelly flats and washes. Desert night-blooming cereus could occur in the affected area of the following SEZs: Afton and Mason Draw.

Eastwood Milkweed (*Asclepias eastwoodiana*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S2; USFWS Species of Concern

Eastwood milkweed is a perennial herbaceous dicot in the Asclepiadaceae (milkweed) family that is native and endemic to Arizona on public and private lands in Esmeralda, Lander, Lincoln, and Nye Counties. The plant consists of several erect to spreading thick stems arising from a buried root crown. The stems are 4- to 8-in. (10- to 20-cm) tall and bear thick, widely separated, opposite leaves that are oval in outline and pointed. The leaf margins are covered with short, woolly hair. Eastwood milkweed blooms in late spring with white hooded flowers in clusters that arise from leaf bases near the ends of the stems. After opening, each flower is

subtended by a ring of small, purplish, leaf-like bracts. The fruit is an erect, spindle-shaped, dry follicle (capsule) on a short stalk that splits open on one side when mature. Each of the numerous seeds has a tuft of silky hairs that help the seeds disburse on the wind. *Asclepias eastwoodiana* is a synonym for *Asclepias uncialis* ssp. *ruthiae* (Nature Serve 2010).

Eastwood milkweed grows in open areas on a wide variety of basic (pH usually >8) soils—including calcareous clay knolls, sand, carbonate or basaltic gravels, and shale outcrops—generally barren and lacking competition. It frequently occurs in small washes or other moisture-accumulating microsites in the shadscale, mixed-shrub, sagebrush, and lower pinyon-juniper zones at elevations between 4,700 and 7,100 ft (1,428 and 2,158 m) (Nevada Natural Heritage Program 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Eastwood milkweed in Nevada, but because this species is endemic to Nevada, conservation of this species is needed to ensure it remains a part of Nevada's flora. Major threats are associated with habitat disturbance or destruction, recreation, effects of small population size, exotic species invasion, succession, global climate change, and pollution.

Eastwood milkweed could occur in the affected areas of the following SEZs: Delmar Valley, Dry Lake Valley North, East Mormon Mountain, Gold Point, and Millers.

Flat-Seeded Spurge (*Chamaesyce platysperma*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S1

Flat-seeded spurge is an herbaceous annual dicot in the Euphorbiaceae family that is native to California but also occurs in Arizona. The plant forms sprawling mounds from 20 to 40 in. (50 to 100 cm) in diameter. The stems are arching-ascending when young but become more prostrate with age, and they contain milky sap. The widely spaced leaves are opposite and oval. Flat-seeded spurge blooms from February to September with solitary yellowish flowers on short stalks that arise from leaf bases along the stems. The fruit is a round capsule that is exserted from the flower base on a lax stalk and contains a white seed. *Chamaesyce platysperma* is a synonym for *Euphorbia platysperma* (Arizona Game and Fish Department 2010; Jepson 2010; Nature Serve 2010).

Flat-seeded spurge grows on sandy substrates of desert dunes within Sonoran Desert scrub communities at elevations below 650 ft (200 m) (California Native Plant Society 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of flat-seeded spurge in California, but conservation of this species is needed to ensure it remains a part of California's flora. Major

threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Flat-seeded spurge could occur in the affected areas of the following SEZs: Imperial East and Pisgah.

Fragile Rockbrake (*Cryptogramma stelleri)*

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Colorado)
State Listing Status: Not Listed
Rarity: Colorado State Rank S2

Fragile rockbrake is a perennial fern that is native to Colorado but also occurs in several western states and Canada. Ferns reproduce via tiny spores shed into the air; therefore, the plants have no flowers, fruits, or seeds. The spores eventually settle to the soil and germinate to form inconspicuous subterranean gametophytes, from which aerial plants (sporophytes) develop. Fragile rockbrake consists of scaly creeping stems (rhizomes) that are fleshy and brittle, which produce erect pinnately compound fronds (leaves) that are 2- to 8-in. (5- to 20-cm) tall and only persist until late summer, when they die and are shed. In this species, the fertile (spore-bearing) and sterile fronds are different in appearance. The fertile fronds are narrower but slightly longer than the sterile ones, and the edges of the pinnules curl under to cover the spore-bearing structures on their underside edges. Spores are shed during summer (*Flora of North America* 2010; Nature Serve 2010).

Fragile rockbrake grows in moist soils on shaded limestone cliffs and rock ledges, often in association with mosses, at elevations higher than 7,000 ft (2,100 m) (*Flora of North America* 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of fragile rockbrake in Colorado, but conservation of this species is needed to ensure it remains a part of Colorado's flora. Fragile rockbrake is afforded some protection by the remote, relatively inaccessible location of its habitat. Major threats are associated with habitat disturbance or destruction, recreation, effects of small population size, exotic species invasion, succession, global climate change, and pollution.

Fragile rockbrake could occur in the affected areas of the following SEZs: Antonito Southeast, Fourmile East, and Los Mogotes.

Frisco Buckwheat (*Eriogonum soredium*)

ESA Listing Status: Under review for listing
BLM Listing Status: Listed as Sensitive (Utah)

State Listing Status: Not Listed
Rarity: Utah State Rank S1

Frisco buckwheat is a densely matted, mound-forming, perennial dicot herb that is native to Utah and endemic to the San Francisco Mountains in Beaver County. The plant is 1- to 1.6-in. (2- to 4-cm) tall, and the herbage is white-hairy. The vegetative stems are densely crowded with elongated oval leaves that have a tendency to curl. The short, erect, leafless, flowering stalks (scapes) are hairy and rise above the cushion of vegetative stems, and they bear round clusters of white or pinkish flowers at their ends from June to September. The fruit is a light brown, three-sided achene (*Flora of North America* 2010; NatureServe 2010; *Utah Rare Plant Guide* 2010).

Frisco buckwheat grows on gravelly to rocky limestone slopes, in mixed saltbush and sagebrush communities and in pinyon-juniper communities on white limestone outcrops at elevations between 6,600 and 7,300 ft (2,006 and 2,220 m) (*Flora of North America* 2010; NatureServe 2010).

There are no data available from which meaningful inferences can be made regarding population trend or changes in the distribution of Frisco buckwheat in Utah, but conservation of this species is needed to ensure it remains a part of Utah's flora. Major threats are associated with habitat disturbance or destruction, mining, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Frisco buckwheat could occur in the affected area of the Wah Wah Valley SEZ.

Frisco Clover (*Trifolium friscanum*)

ESA Listing Status: Under review for listing
BLM Listing Status: Listed as Sensitive (Utah)
State Listing Status: Not Listed
Rarity: Utah State Rank S1

Frisco clover is a mat-forming herbaceous perennial dicot in the family Fabaceae (bean family) that is endemic to Beaver and Millard Counties in Utah. The plant consists of numerous short stems arising from a rhizomatous woody crown to form a cushion that is 0.3- to 1-in. (0.8- to 3-cm) tall. The stems are obscured by densely crowded, alternate, trifoliate compound leaves. The stems and leaves are silvery-hairy. Frisco clover blooms in June with clusters of reddish-purple, pea-like flowers that are produced on stalks arising from leaf bases at the ends of the stems. The fruits are oblong pods that are enclosed in the persistent, withered petals and calyx and contain several smooth brown or black seeds (*Flora of North America* 2010; NatureServe 2010; *Utah Rare Plant Guide* 2010).

Frisco clover grows on volcanic gravels and limestone substrates in association with pinyon-juniper woodlands at elevations between 6,900 and 7,300 ft (2,098 and 2,219 m) (*Utah Rare Plant Guide* 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Frisco clover in Utah, but conservation of this species is needed to ensure it remains a part of Utah's flora. Major threats are associated with habitat disturbance or destruction, mining, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Frisco clover could occur in the affected areas of the Wah Wah Valley SEZ.

Giant Spanish-Needle (*Palafoxia arida* var. gigantea)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State rank S1

Giant Spanish-needle is a large, shrubby, annual or perennial herbaceous dicot in the Asteraceae (sunflower) family that is native to California but also occurs in Arizona. The plant consists of numerous erect, slender, much-branched stems that are 36- to 72-in. (91- to 183-cm) tall. The stems bear widely spaced, long, linear, pointed, dark green leaves that are opposite near the base and alternate above. The stems may be glandular and hairy on their upper parts. Giant Spanish-needle blooms from February to May with white to pink-purple composite flowers at the ends of the branches. The fruit is a four-angled achene that has a tuft of scales at the end (a pappus), is dandelion-like, and is dispersed by the wind (California Native Plant Society 2010; NatureServe 2009).

Giant Spanish-needle grows on desert sand dunes, along riverine environments, and irrigation canals at elevations lower than 328 ft (100 m) (California Native Plant Society 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of giant Spanish-needle in California, but conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution.

Giant Spanish-needle could occur in the affected areas of the following SEZs: Imperial East and Riverside East.

Glass Mountain Coral-Root (*Hexalectris nitida*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Endangered in New Mexico
Rarity: New Mexico State Rank S1; USFWS Species of Concern

Glass mountain coralroot (*Hexalectris nitida*), also known as shining coralroot, occurs in southern New Mexico and central and western Texas. In New Mexico, the species occurs in Eddy and Otero Counties and in the Guadalupe and Cornudas Mountains (Nature Serve 2010; NMRPTC 2010).

Glass mountain coralroot inhabits deep, shaded canyon sides and bottoms in litter and oak-juniper-pinyon pine woodlands in humus at elevations ranging from 700 to 4,900 ft (200 to 1,500 m). Populations are small, and individuals grow widely scattered in very small colonies. Associated orchids include *Hexalectris spicata, Epipactis gigantean*, and *Hexalectris warnockii* (Nature Serve 2010; NMRPTC 2010).

Although glass mountain coralroot flowers from June to early August, the plants may not flower every year, and the number of flowering plants varies greatly between years. Individual plants may remain underground completely for more than one year. The plants are self-pollinating.

The Glass Mountain coral-root could occur in the affected areas of the Red Sands SEZ.

Gold Butte Moss (Didymodon nevadensis)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

Gold Butte moss is a small, perennial, evergreen moss that is native to Nevada but also occurs in Colorado, Texas, British Columbia (Canada), and southern Chihuahua in Mexico. The plant has a wide distribution but is rare locally. The plants form a dense, mat-like turf, blackish green above and reddish brown below. The moss turf consists of thin, leafy stems, branching occasionally, up to 0.4-in. (1-cm) long. The stems bear crowded, overlapping, long-oval, pointed leaves that are appressed to and twisted around the stem when dry and are weakly spreading when moist. The leaves have a large midvein and inrolled margins. The base of the turf produces several rhizoids that arise from leaf bases near the bases of the stems. Rhizoids are simple root-like structures that anchor the plant and absorb water. Mosses normally reproduce via tiny spores shed into the air; therefore, the plants have no flowers, fruits, or seeds. However, only female plants of Gold Butte moss have been found, and these reproduce asexually by producing round or oval tubers on branching rhizoids at the soil surface. Seasonal growth is initiated in autumn by the production of new stems from the tubers. Stem elongation occurs through the cooler months of autumn, winter, and early spring (*Flora of North America* 2010; Nature Serve 2010; Nevada Natural Heritage Program 2010).

Gold Butte moss grows on or near gypsiferous deposits and outcrops or limestone boulders, especially on east- to north-facing slopes of loose, uncompacted soil. It is typically associated with other mosses and lichens. Its elevation ranges between 1,300 and 2,300 ft (395

and 700 m) (*Flora of North America* 2010; Nature Serve 2010; Nevada Natural Heritage Program 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Gold Butte moss in Nevada, but conservation of this species is needed to ensure it remains a part of Nevada's flora. Major threats are associated with habitat disturbance or destruction, recreation, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

The Gold Butte moss may occur in the affected area of the following SEZs: Dry Lake and East Mormon Mountain.

Golden Barrel Cactus (*Ferocactus cylindraceus* var. eastwoodiae)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Arizona Salvage Restricted (SR)
Rarity: Arizona State Rank S1

Golden barrel cactus is a large perennial dicot cactus in the family Cactaceae that is native and endemic to Arizona. The plant is a large, erect, spiny cactus with an unbranched, unsegmented succulent stem in the form of a cylinder that may be 6.5-ft (2-m) tall or higher and 1.3 ft (0.4 m) in diameter. The stem has 21 to 31 prominent ribs that are armed with clusters of stiff spines arising from wart-like tubercles (areoles). Each areole has 12 to 32 erect and spreading spines, the longest of which are 3- to 7-in. (7.5- to 17-cm) long, and may be whitish, yellow, pink, dull red, or brown. In var. *eastwoodiae*, the central spine is conspicuously yellow or straw-yellow. Golden barrel cactus blooms from April to May with a crown of flowers that are crowded among the dense spines at the top of the columnar stem. The individual flowers are maroon on the outside and yellow on the inside. The fruit is a yellow, ovoid, leathery or fleshy, smooth berry that is spineless and contains black pitted seeds. The dried flower parts are persistent on the top of the mature fruit. *Ferocactus cylindraceus* var. *eastwoodiae* is a synonym for *Ferocactus acanthodes* var. *eastwoodiae* and *Ferocactus eastwoodiae* (Arizona Game and Fish Department 2010; *Flora of North America* 2010; NatureServe 2010).

Golden barrel cactus grows on gravelly or rocky hillsides, canyon walls, and wash margins in central Arizona. Its elevation ranges between 1,280 and 3740 ft (390 and 1,140 m) (Arizona Game and Fish Department 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Golden barrel cactus in Arizona, but because this plant is an endemic, conservation of this species is needed to ensure it remains a part of Arizona's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution.

Golden barrel cactus could occur in the affected areas of the Bullard Wash SEZ.

Grama Grass Cactus (Sclerocactus papyracanthus)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (New Mexico)
State Listing Status: Not Listed
Rarity: Not Listed

Grama grass cactus (*Sclerocactus papyracanthus*) occurs in southern Arizona, New Mexico, and Western Texas. Typical habitat is pinyon-juniper woodland, Chihuahuan desert scrub, and desert and Great Plains grassland on open flats or gentle slopes between 4,900 and 7,200 ft (1,500-2,200 m). Sandy soils with a calcerous or gypseous component are characteristic. Associated vegetation includes blue grama grass (*Bouteloua gracilis*), Fendler's three-awn (*Aristida fendleri*), and New Mexico feathergrass (*Stipa neomexicana*) (*Flora of North America* 2010; Nature Serve 2010; NMRPTC 2010).

Grama grass cactus' white flowers appear in April and May, with fruits appearing in early June that are dry and tan colored when mature (*Flora of North America* 2010; Nature Serve 2010).

Once abundant in parts of its range, grama grass cactus populations are sharply reduced due to rangeland degradation, collection, and development. Additional threats include the cactus and succulent trade, overgrazing and trampling by livestock, off-road vehicle traffic, and urbanization (Nature Serve 2010).

Grama grass cactus may occur in the affected area of the following SEZs: Afton, Mason Draw, and Red Sands.

Halfring Milkvetch (Astragalus mohavensis var. hemigyrus)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State rank S2; USFWS Species of Concern

Halfring milkvetch is a small, herbaceous, annual or short-lived perennial dicot in the Fabaceae (bean) family that is native and endemic to Nevada. The plant consists of a taproot with a woody crown that gives rise to several open, widely branched, weakly ascending stems that are 2- to 14-in. (5- to 35-cm) long. All of the herbage is covered with fine hair that gives the plant a silvery-gray appearance. The stems bear alternate, widely separated, pinnately compound leaves on long stalks. The oval-pointed, thick leaflets are opposite. Halfring milkvetch blooms during April to June with ascending clusters of pea-like flowers on stalks arising from leaf bases. The flowers are pinkish purple with darker purple veins, and each flower base (the calyx) is

covered with hairs. The fruits are large, oblong, curved, hairy pods that are attached to the plant by short stalks. The stiffly leathery pods contain numerous smooth seeds. *Astragalus hemigyrus* is a synonym for *Astragalus mohavensis* var. *hemigyrus* (Jepson 2010; NatureServe 2010; Nevada Natural Heritage Program 2010).

Halfring milkvetch grows on carbonate gravels and derivative soils on terraced hills and ledges, open slopes, and along washes within the creosote-bursage, blackbrush, and mixed-shrub habitat communities. Its elevation ranges between 3,000 and 5,600 ft (914 and 1,707 m) (Jepson 2010; Nature Serve 2010; Nevada Natural Heritage Program 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of halfring milkvetch in Nevada, but because this species is endemic to Nevada, conservation of this species is needed to ensure it remains a part of Nevada's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010; Nevada Natural Heritage Program 2010).

Halfring milkvetch could occur in the affected areas of the Dry Lake SEZ.

Harwood's Eriastrum (*Eriastrum harwoodii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State rank S2

Harwood's eriastrum is an annual herbaceous dicot in the Polemoniaceae (phlox) family that is native and endemic to California. The plant consists of a branching erect stem that is up to 8-in. (20-cm) tall. The stems bear widely separated alternate leaves that are thread-like and may be three-lobed near the base. The leaves are yellow-green and densely woolly. Harwood's eriastrum blooms from March to June with small, head-like inflorescences that are densely woolly and arise from leaf bases toward the ends of the stems. The individual flowers are straw-yellow, cream, or white. The fruit is a capsule that usually contains two seeds. *Eriastrum sparsiflorum* ssp. *harwoodii* is a synonym for *Eriastrum harwoodii* (Jepson 2010; Nature Serve 2010).

Harwood's eriastrum is endemic to southern California and grows on desert sand dunes in creosote bush scrub and other sandy habitats at elevations between 650 and 3,000 ft (200 and 915 m) (California Native Plant Society 2010; Jepson 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Harwood's eriastrum in California, but because it is endemic to southern California, conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or

destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (California Native Plant Society 2010).

Harwood's eriastrum could occur in the affected area of the following SEZs: Iron Mountain, Pisgah, and Riverside East.

Hohokam Agave (*Agave murpheyi*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Arizona)
State Listing Status: Arizona Highly Safeguarded (HS)
Rarity: Arizona State Rank S2; USFWS Species of Concern

Hohokam agave is a perennial monocot succulent in the Agavaceae family that is native and endemic to Nevada and Sonora, Mexico. The plant consists of a basal rosette of crowded, fleshy, long-lived leaves, and it is 24- to 47-in. (60- to 120-cm) tall. The ascending leaves are spatula-shaped, have undulating edges armed with spines, and have a stiff spine at the end of the leaf. The smooth leaves are light bluish-green to yellow-green, often cross-banded, and slightly incurved toward the center of the rosette. Hohokam agave matures to reproductive age after 10 to 30 years. The plant blooms from late winter to spring by producing a very tall, erect, flowering stalk that reaches 10 to 13 ft (3 to 4 m) in height. The terminal one-quarter of this stalk bears crowded flower clusters on slightly ascending side branches. The individual flowers are waxy cream-green with purplish or brownish tips. After flowering, the flower stalk's side branches produce numerous bulbils that can produce new plants. Hohokam agave blooms once and then dies. The fruit is an oval, beaked capsule on a short stalk. However, the plant rarely produces seed and propagates primarily via bulbils (*Flora of North America* 2010; Nature Serve 2010).

Hohokam agave grows on benches or alluvial terraces on gentle bajada slopes above major drainages in desert scrub communities at elevations between 1,300 and 3,200 ft (395 and 973 m). The bulbils are easily transported and transplanted, and some occurrences appear to be associated with old American Indian living sites (*Flora of North America* 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Hohokam agave in Arizona, but because this plant is endemic to the deserts of central Arizona, conservation of this species is needed to ensure it remains a part of Arizona's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution (AZGFD 2010).

Hohokam agave could occur in the affected areas of the following SEZs: Bullard Wash and Gillespie.

Holmgren Lupine (*Lupinus holmgrenianus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State rank S2

Holmgren lupine is an herbaceous perennial dicot in the Fabaceae (bean) family that is native to Nevada and probably endemic to the Death Valley region of southern Nevada and California. The plant consists of several stout, erect stems that are 16- to 26-in. (40- to 70-cm) tall. All of the herbage is covered with long hair. The stems are subtended by large, palmately compound basal leaves with four to seven spindle-shaped leaflets. The stems bear alternate leaves that are similar to the basal leaves, but smaller. Holmgren lupine blooms during April to June with attractive spikes of whorled pea-like flowers that rise above the leaves from the ends of the stems or that arise from leaf bases. The flowers are violet to purple with a yellow patch on the upper petal. The fruits are oblong, hairy, legume pods that are attached to the plant by short stalks. Each pod contains five to seven smooth seeds (Jepson 2010; Nature Serve 2010).

Holmgren lupine grows on dry desert slopes, washes, and valleys on volcanic substrates, sometimes in association with *Artemisia tridentata*-dominated communities, and in pinyon-juniper woodlands. Its elevation ranges between 4,600 and 8,200 ft (1,398 to 2,493 m) (Jepson 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Holmgren lupine in Nevada, but because this species is probably endemic to the Death Valley region of southern Nevada and California, conservation of this species is needed to ensure it remains a part of these state's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution (Jepson 2010; Nature Serve 2010; Nevada Natural Heritage Program 2010).

The Holmgren lupine may occur in the affected area of the following SEZs: Amargosa Valley and Gold Point.

Jone's Globemallow (*Sphaeralcea caespitosa*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Utah)
State Listing Status: Not Listed
Rarity: Nevada State Rank S2; Utah State Rank S2

Jone's globemallow is an herbaceous perennial dicot in the family Malvaceae that is native to Utah but also occurs in Nevada. The plant is 1- to 10-in. (2- to 25-cm) tall and consists of several erect, branching stems arising from a branched woody crown. All of the plant herbage

is densely hairy, giving the plant a gray appearance. Thick, fleshy, alternate leaves are crowded on the stems. Jone's globemallow blooms from May to June and again in September with red-orange flowers on flower stalks that arise from leaf bases at the ends of the stems. The fruit is a globe-shaped group of wedge-shaped carpels. Each carpel has dense hairs on the wide end and contains one or more kidney-shaped seeds (Nature Serve 2010; *Utah Rare Plant Guide* 2010).

Jone's globemallow typically grows on calcareous soils and gravels derived from Sevy dolomite, in association with mixed shrub, pinyon-juniper, and grassland communities at elevations between 5,000 and 6,500 ft (1,525 and 1,980 m) (Nature Serve 2010; *Utah Rare Plant Guide* 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Jone's globemallow in Utah, but conservation of this species is needed to ensure it remains a part of Utah's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Jone's globemallow could occur in the affected areas of the following SEZs: Escalante Valley, Milford Flats South, and Wah Wah Valley.

Kuenzler's Hedgehog Cactus (*Echinocereus fendleri* var. *kuenzleri*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Endangered in New Mexico
Rarity: New Mexico State Rank S1

The Kuenzler hedgehog cactus occurs in the central highlands of New Mexico. Populations are found in Chaves, Eddy, Lincoln, and Otero Counties; on the southern side of the Capitan Mountains; on the eastern and northwestern lower sides of the Sacramento Mountains; and on the northern end of the Guadalupe Mountains. The Kuenzler hedgehog cactus is normally found on gentle slopes or near the shoulders of hilltops or hillsides, at elevations from 5,800 to 6,400 ft. Within the range of the Kuenzler hedgehog cactus, the dominant species include yerba de pasmo, blue grama, plains lovegrass, Harvard's buckwheat, eggleaf silktassle, ribbed false pennyroyal, alligator juniper, oneseed juniper, trong bladderpod, little nipple cactus, pinyon pine, and mealycup sage (Nature Serve 2010; NMRPTC 2010).

The Kuenzler hedgehog cactus reproduces only by sexual reproduction and is unable to reproduce vegetatively by fragmentation like other species of cactus. There are no defined germination dates for this species. It appears that it can germinate during any part of the spring, summer, or fall if sufficient rainfall is present. Budding occurs in April, and flowering normally occurs in early May, although the species can flower earlier in warm, wet years. Fruits form in August, and the dispersal of seeds, which typically occurs in September and October, depends on the abundance of summer rainfall. Seeds are over 90% viable and survive about 5 years.

The Kuenzler hedgehog cactus was federally listed as endangered on October 26, 1979 (USFWS 1979a). Critical habitat has not been designated.

Few natural threats to the species are known. Although most of the area in which the species occurs is relatively open with little ground cover, it is believed that at one time, stands of grass covered the region, which may have acted as a crucial element in catching seeds and hiding seedlings from herbivores. The removal of grass and forb cover from the pinyon-juniper woodland appears to be the major factor contributing to the overall decline of this species. However, the construction of highways throughout the region has also resulted in loss of habitat. At present, the major cause of mortality is destruction by grazing, as cattle, sheep, and other grazers remove essential grass cover. The species is also sensitive to trampling by livestock. Other threats to the species include illegal collection and development (Nature Serve 2010; NMRPTC 2010).

The Kuenzler's hedgehog cactus may occur in the affected area of the Red Sands SEZ.

Las Vegas Bearpoppy (*Arctomecon californica*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: USFWS Species of Concern

Las Vegas bearpoppy is a herbaceous, short-lived perennial dicot that is native to Nevada. The plant consists of a stout taproot, from which arises a crowded basal clump of erect leaves that is about 5-in. (13-cm) tall. The leaves are wedge-shaped, with several shallow teeth on the top margin, and densely covered with long, white, shaggy hairs, which make them appear grayish-blue in color. The base of the plant is often surrounded by a layer of ash- or straw-colored dead leaves. Las Vegas bearpoppy blooms from April to May with several tall, smooth, flowering stems that rise above the basal leaf clump to a height of about 20 in. (50 cm). Each flowering stem bears at its end a cluster of stalked flower buds that are initially nodding but become upright when the buds open to produce attractive yellow flowers with a dark center. The fruit is an upright, egg-shaped, persistent capsule that opens at the top by dark-colored flaps when the fruit dries and becomes mature. The capsule contains numerous small, shiny, black seeds (AZGFD 2010; Nature Serve 2010; Nevada Natural Heritage Program 2010).

Las Vegas bearpoppy grows on open, dry, spongy or powdery, often dissected ("badland") or hummocked soils with high gypsum content, typically with a well-developed soil crust, in areas of generally low relief on all aspects and slopes, with a sparse cover of other gypsum-tolerant species. Its elevation ranges between 1,050 and 3,650 ft (319 and 1,110 m) (Nature Serve 2010; Nevada Natural Heritage Program 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Las Vegas bearpoppy in Nevada, but conservation of this species is needed to ensure it remains a part of Nevada's flora. Major threats

are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Las Vegas bearpoppy could occur in the affected areas of the Dry Lake SEZ.

Las Vegas Buckwheat (*Eriogonum corymbosum* var. *nilesii*)

ESA Listing Status: Candidate
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

Las Vegas buckwheat is a large perennial dicot shrub that is native and endemic to Nevada. The plant is known only from the Las Vegas and Muddy Mountains region of Clark County, Nevada. The plant consists of a mounded clump of spreading to upright, densely branched woody stems that are 12- to 48-in. (30- to 122-cm) tall. The branches are covered with woolly hair and somewhat swollen at the nodes. The branches bear alternate, oval leaves that are densely hairy on the underside and silvery with very fine hair above. Las Vegas buckwheat blooms from August to November with dense, branching clusters of small, yellow flowers that are borne at the ends of the branches. The flowering branches are covered with sparse, silvery tufts of cobwebby hair and may be thorny. The fruit is a light brown, oval, three-sided achene enclosed by three leaf-like bracts (*Flora of North America* 2010; Nature Serve 2010; Nevada Natural Heritage Program 2010).

Las Vegas buckwheat grows on or near gypsum soils, in washes, drainages, or in areas of generally low relief in the Mojave Desert. Its elevation ranges between 1,900 and 3,850 ft (578 and 1,170 m) (*Flora of North America* 2010; Nature Serve 2010; Nevada Natural Heritage Program 2010).

Las Vegas buckwheat populations are declining rapidly in Nevada, where the species is known from 15 occurrences encompassing an area of less than 1,500 acres (6 km^2). Because the species is endemic and declining, conservation of this species is essential to ensure it remains a part of Nevada's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution (Nevada Natural Heritage Program 2010)

Las Vegas buckwheat could occur in the affected areas of the following SEZs: Dry Lake and East Mormon Mountain.

Latimer's Woodland-Gilia (*Saltugilia latimeri*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S2

Latimer's woodland-gilia is an annual herbaceous dicot in the Polemoniaceae (phlox) family that is native and endemic to California. The plant consists of one to several erect branching stems that are 2- to 12-in. (5- to 30-cm) tall. The slender stems are subtended by a rosette of semi-erect basal leaves that are pinnately divided into deep lobes. The widely spaced stem leaves are similar but smaller or are merely toothed near the ends of the stems. Latimer's woodland-gilia blooms from March to June with small, ascending, head-like inflorescences that arise from leaf bases toward the ends of the stems. The individual funnel-shaped flowers are small and have pinkish-lavender petals and a purple throat. The fruit is a narrow, oval capsule that contains numerous seeds (Jepson 2010; Nature Serve 2010).

Latimer's woodland-gilia is endemic to California and grows in Mojave Desert scrub communities, pinyon-juniper woodlands, and dry washes on rocky or sandy substrates at elevations between 1,300 and 6,500 ft (400 and 2,000 m) (Jepson 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Latimer's woodland-gilia in California, but because it is endemic to southern California, conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Latimer's woodland-gilia could occur in the affected areas of the Pisgah and Riverside East SEZs.

Limestone Beardtongue (*Penstemon calcareus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S2

Limestone beardtongue is a perennial herbaceous dicot in the Scrophulariaceae family that is native to California and also occurs in Nevada. The plant consists of an erect hairy-glandular stem that is 3- to 10-in. (7- to 25-cm) tall and arises from a basal cluster of oblong leaves. The stem bears widely separated, opposite leaves that are lance- or spoon-shaped and may have shallow teeth. Limestone beardtongue blooms from April to May with bright pink to rose-purple, trumpet-shaped flowers in a spike-like inflorescence at the end of the stem. The

outer surfaces of the petals and other flower parts are minutely glandular-hairy. The fruit is an oval capsule that contains numerous seeds (Jepson 2010; Nature Serve 2010).

Limestone beardtongue grows in Mojave Desert scrub communities, pinyon-juniper forests, and Joshua tree woodlands in limestone crevices and on rocky carbonate substrates. Its elevation ranges between 3,280 and 6,550 ft (1,000 and 2,000 m) (Jepson 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of limestone beardtongue in California, but conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Limestone beardtongue could occur in the affected areas of the Pisgah SEZ.

Little San Bernardino Mountains Linanthus (*Linanthus maculatus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S1

Little San Bernardino Mountains linanthus is a very small annual herbaceous dicot in the Polemoniaceae (phlox) family that is native and endemic to California. The plant arises from a long taproot and is 0.4- to 1.2-in. (1- to 3-cm) high. The tiny, hairy stems branch to form small matted clusters on the sand surface. The stems bear oblong-linear, hairy, thick leaves that are only a few millimeters long. Little San Bernardino Mountains linanthus blooms from March to May with small, crowded, head-like flower clusters at the ends of the stems. The flowers are white with a red spot near the base of each recurved petal. The fruit is a capsule that contains several seeds. *Gilia maculata* is a synonym for *Linanthus maculatus* (Jepson 2010; Nature Serve 2010).

Little San Bernardino Mountains linanthus is known from fewer than 20 occurrences in southern California near Joshua Tree National Park in the Little San Bernardino Mountains. The plant grows on desert dunes and sandy flats in creosote bush scrub and Joshua tree woodland communities at elevations lower than 6,900 ft (2,100 m) (Jepson 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Little San Bernardino Mountains linanthus in California, but because it is endemic to southern California, conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Little San Bernardino Mountains linanthus could occur in the affected areas of the following SEZs: Pisgah and Riverside East.

Long-Calyx Milkvetch (*Astragalus oophorus* var. *lonchocalyx*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada and Utah)
State Listing Status: Not Listed
Rarity: Nevada State Rank S2; Utah State Rank S1

Long-calyx milkvetch is a herbaceous perennial dicot in the family Fabaceae (bean family) that is native to Colorado but also occurs in Nevada. The plant arises from a woody crown; is 6- to 12-in. (15- to 30-cm) tall; and has erect, branching, hairy stems. The stems bear alternate, pinnately compound hairy leaves. Clusters of pea-like flowers are produced in June on stalks arising from leaf bases at the ends of the stems. The large flowers are pinkish purple and hang down from the nodding flower stalks. The fruits are large, oblong, inflated, hairy pods that remain attached to the plant by short stalks and contain numerous smooth seeds (Nature Serve 2010; *Utah Rare Plant Guide* 2010).

Long-calyx milkvetch grows in a variety of habitats, including pinyon-juniper woodlands, sagebrush, and mixed desert shrub communities at elevations between 5,800 and 7,500 ft (1,750 and 2,300 m) (*Utah Rare Plant Guide* 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of long-calyx milkvetch in Utah, but conservation of this species is needed to ensure it remains a part of Utah's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Long-calyx milkvetch could occur in the affected area of the following SEZs: Delamar Valley, Dry Lake Valley North, Escalante Valley, and Wah Wah Valley.

Many-Stemmed Spider-Flower (*Cleome multicaulis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Colorado)
State Listing Status: Not Listed
Rarity: Colorado State Rank S2; USFWS Species of Concern

Many-stemmed spider-flower is a slender herbaceous annual dicot in the Capparaceae family that is native to Colorado. The usually unbranched or sparingly branched leafy stems are 8- to 28-in. (20- to 70-cm) tall, with alternate leaves that are palmately compound with three narrow leaflets that often fold along the midrib. Many-stemmed spider-flower blooms from

August to September with pink flowers that are borne on thin stalks arising from the base of reduced stem leaves. The fruits are large, oblong, multi-seeded capsules with a stalk-like base, and they droop at maturity. The round seeds are light brown and smooth (*Colorado Rare Plant Field Guide* 2010; Nature Serve 2010)

Many-stemmed spider-flower is restricted to habitats that include the margins of moist, slightly saline depressions, such as alkali sinks, alkaline meadows, and old lake beds at elevations of 3,600 to 4,200 ft (1,098 to 1,281 m) (Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of many-stemmed spider-flower in Colorado, but conservation of this species is needed to ensure it remains a part of Colorado's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Many-stemmed spider-flower could occur in the affected areas of the following SEZs: Antonito Southeast, Fourmile East, and Los Mogotes East.

Marble Canyon rockcress (*Sibara grisea*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (New Mexico)
State Listing Status: Not Listed
Rarity: New Mexico Species of Concern; USFWS Species of Concern

Marble canyon rockcress (*Sibara grisea*), also known as gray sibara, occurs in southern New Mexico and western Texas. Within New Mexico, its distribution includes Chaves, Eddy, and Otero Counties. Habitat includes rock crevices, the bases of limestone cliffs, limestone or travertine and cliff faces in chaparral, and mesic mountain canyons and pinyon-juniper woodland communities. Its elevation ranges from 4,500 to 6,000 ft (1,350 to 1,800 m). This annual forb/herb flowers in May and June (Nature Serve 2010; NMRPTC 2010).

Marble canyon rockcress is listed as sensitive by the BLM New Mexico State Office and is a New Mexico and USFWS species of concern. Livestock grazing and energy development do not threaten this species.

The Marble Canyon rockcress may occur in the affected area of the following SEZs: Afton, Mason Draw, and Red Sands.

McKelvey's Agave (*Agave mckelveyana*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed

State Listing Status: Arizona Salvage Restricted (SR)
Rarity: None

McKelvey's agave is a perennial monocot succulent in the Agavaceae family that is native and endemic to Nevada. The plant consists of a basal rosette of fleshy, long-lived leaves that is 8-18 in. (20-45 cm) tall. A few suckers (small plants that may eventually become independent) may form around the base of the rosette. The spreading leaves are spatula-shaped, concave towards the base, have undulating edges armed with spines, and have a stiff spine at the end of the leaf. The smooth leaves are light green, yellow-green, or dark green and are often cross-banded. McKelvey's agave matures to reproductive age after a variable number of years (ten or more) depending on environmental conditions. The plant blooms from mid-spring to mid-summer by producing a very tall, erect flowering stalk that reaches 6.5-16 ft. (2-5 m.) in height. The terminal one-third of this stalk bears yellow tubular flowers in crowded clusters on slightly ascending side branches. McKelvey's agave blooms once and then dies. The fruit is an oblong, striated, beaked capsule that contains black seeds and is borne on a short stalk (*Flora of North America* 2010; Nature Serve 2010).

McKelvey's agave grows on sandy to gravelly or rocky places with desert scrub, chaparral and pinyon-juniper woodlands at elevations between 3,000 and 6,000 ft (912-1824 m) (*Flora of North America* 2010; NatureServe 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of McKelvey's agave in Arizona, but because this plant is endemic to Arizona, conservation of this species is needed to ensure it remains a part of Arizona's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

McKelvey's agave could occur in the affected areas of the Bullard Wash SEZ.

Mojave Monkeyflower (*Mimulus mohavensis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S2; USFWS Species of Concern

Mojave monkeyflower is an annual herbaceous dicot in the Phrymaceae family (recently moved from the Scrophulariaceae family) that is native to California and endemic to San Bernardino County. The plant consists of an erect, hairy-glandular stem that is 0.75- to 4-in. (2- to 10-cm) tall and bears opposite, narrow oval leaves. All of the herbage is usually hairy and reddish green to red-purple in color. Mojave monkeyflower blooms from April to June with solitary flowers on short stalks, each arising from a leaf base near the end of the stem. The tubular neck of each flower is surrounded by a hairy, red, ribbed base (the calyx) with pointed lobes. The flower petals are maroon with a white or pinkish margin and a network of dark

maroon veins. The fruit is an oval capsule that contains numerous yellow to dark brown seeds (Jepson 2010; Nature Serve 2010).

Mojave monkeyflower is endemic to the western Mojave Desert in San Bernardino County, California. The plant grows on gravelly banks of desert washes and in Mojave Desert scrub and Joshua Tree woodland habitats at elevations below 3,900 ft (1,200 m) (Jepson 2010: Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Mojave monkeyflower in California, but because it is endemic to the Mojave Desert, conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Mojave monkeyflower could occur in the affected areas of the Pisgah SEZ.

Money Wild Buckwheat (*Eriogonum nummulare*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Utah)
State Listing Status: Not Listed
Rarity: Utah State Rank S1

Money wild buckwheat is a large perennial dicot shrub in the Polygonaceae family that is native to Utah but also occurs in other western states. The plant consists of a mounded clump of spreading to upright branching stems that are 12- to 31-in. (30- to 80-cm) tall and arise from a woody base. The stems may be hairy or smooth, and each has a cluster of oval basal leaves, with a few smaller alternate leaves along the branches. The leaves are densely white-hairy on the underside and greenish on the upper surface. Money wild buckwheat blooms from July to October with clusters of white flowers that are borne at the ends of erect, thin, branching stems. The fruit is a light brown, three-sided achene enclosed by three bracts (*Flora of North America* 2010; Nature Serve 2010).

Money wild buckwheat occurs in a variety of habitats that include sandy to occasionally gravelly washes, flats, and slopes; saltbush and sagebrush communities; and pinyon-juniper woodlands at elevations of 2,625 to 8,530 ft (800 to 2,600 m) (*Flora of North America* 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of money wild buckwheat in Utah, but conservation of this species is needed to ensure it remains a part of Utah's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Money wild buckwheat could occur in the affected areas of the following SEZs: Escalante Valley, Milford Flats South, and Wah Wah Valley.

Munz's Cholla (*Opuntia munzii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S2; USFWS Species of Concern

Munz's cholla is a large perennial dicot cactus in the Cactaceae family that is native to California but also occurs in Mexico (Baja California). The plant is a large, erect, spiny cactus in the form of a shrub or tree that may attain a height of 6.5 to 13 ft (2 to 4 m). One or more succulent, tree-like trunks produce ascending main branches that are gray-green and bear terminal tufts of usually drooping, jointed branchlets. These stem segments are easily detached and can function as vegetative propagules. The entire plant is armed with clusters of stiff spines arising from wart-like tubercles. Minute detachable bristles (glochids) form tufts at the base of the spines. Munz's cholla blooms from March to May with sparse reddish maroon-brown flowers on the branches. The fruit is a globose, dry berry that is tan when mature, contains pale yellow seeds, and is spineless but bears numerous long glochids (*Flora of North America* 2010; Jepson 2010; Nature Serve 2010).

Munz's cholla grows on gravelly or sandy to rocky soils, often on lower bajadas, washes, and flats. It also occurs on hills and canyon sides and occurs in Sonoran Desert creosote bush shrub communities at elevations below 3,280 ft (1,000 m) (California Native Plant Society 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Munz's cholla in California, but because it is rare in the state, conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Munz's cholla could occur in the affected areas of the following SEZs: Imperial East, Iron Mountain, and Riverside East.

Needle Mountains Milkvetch (*Astragalus eurylobus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S2; USFWS Species of Concern

Needle Mountains milkvetch is a small, herbaceous perennial dicot in the Fabaceae (bean) family that is native to Nevada and also occurs in Arizona and Utah. In Nevada, the plant is known from only six sites in Lincoln and Nye Counties. The plant consists of a taproot with a woody crown that gives rise to several prostrate or trailing stems are woody below and up to 24-in. (61-cm) long. All of the herbage is covered with hair, making the plant appear silvery. The stems bear alternate, pinnately compound leaves. The leaflets are oval-pointed and opposite. Needle Mountains milkvetch blooms during April to July with clusters of pink-purple, pea-like flowers on stalks arising from the leaf bases. The fruits are oblong legume pods that are strongly curved with pointed tips and are attached to the plant by short stalks. The wrinkled pods, which may be hairy, lie on the ground and eventually become woody. The pods contain numerous smooth, heart-shaped seeds that are olive, brown, or black. *Astragalus tephrodes* var. *eurylobus* is a synonym for *Astragalus eurylobus* (Nature Serve 2010; Nevada Natural Heritage Program 2010).

Needle Mountains milkvetch grows on gravel washes and sandy soils in alkaline desert and arid grasslands at elevations between 4,250 and 6,250 ft (1,292 and 1,900 m) (Nature Serve 2010; Nevada Natural Heritage Program 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Needle Mountains milkvetch in Nevada, but because this species is rare in the state, conservation of this species is needed to ensure it remains a part of Nevada's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

The Needle Mountains milkvetch may occur in the affected area of the following SEZs: Delamar Valley, Dry Lake Valley North, East Mormon Mountain, and Escalante Valley.

Nevada Dune Beardtongue (*Penstemon arenarius*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S2; USFWS Species of Concern

Nevada dune beardtongue is a herbaceous perennial dicot in the Scrophulariaceae family that is native and endemic to Nevada, where it is known only from Churchill, Mineral, and Nye Counties but is not abundant at any site. The plant consists of several stout, smooth, erect stems that are 4- to 12-in. (10- to 30-cm) tall, arising from a buried root crown. The stems bear widely spaced, leathery, opposite leaves that are oval-pointed and have coarse, sharp-pointed teeth. The leaves are usually folded lengthwise or curved inward along the midvein. Nevada dune beardtongue blooms from May to July with clusters of funnel-shaped flowers that arise from the bases of leaves or bracts at stem nodes. The flowers are in shades of white to purple and may be striped with magenta. The bottom petal of each flower has a small tuft of yellowish hair in its center. The fruit is an oval capsule that contains numerous irregularly angled seeds. *Penstemon*

maguirei is a synonym for *Penstemon arenarius* (Nature Serve 2010; Nevada Natural Heritage Program 2010).

Nevada dune beardtongue is dependent on sand dunes or deep sand occurring on deep, loose, sandy soils of valley bottoms, aeolian deposits, and dune skirts, often in alkaline areas, sometimes on road banks and other recovering disturbances crossing such soils, in shadscale communities at elevations of 3,920 to 5,960 ft (1,195 to 1,817 m) (Nature Serve 2010; Nevada Natural Heritage Program 2010).

Populations of Nevada dune beardtongue are declining at the sites where they grow in Nevada. Because the plant is endemic to the Nevada, conservation of this species is needed to ensure it remains a part Nevada's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (Nevada Natural Heritage Program 2010).

The Nevada dune beardtongue may occur in the affected area of Millers SEZ.

Nevada Willowherb (*Epilobium nevadense*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada and Utah)
State Listing Status: Not Listed
Rarity: Nevada State Rank S2; Utah State Rank S1; USFWS Species of Concern

Nevada willowherb is a somewhat shrubby, perennial herb that occurs in Colorado, Nevada, and Utah. The plant consists of several upright, persistent, woody branches that are 6- to 16-in. (15- to 40-cm) tall, arising from a stout taproot. Lance-shaped leaves that may be hairy or nearly smooth are crowded along the hairy branches. Nevada willowherb blooms from June to September with flower stalks that arise from leaf bases near the ends of the branches with clusters of rose-purple flowers. The fruit is an elongated hairy and/or glandular capsule on a short stalk that contains numerous dark brown seeds with a tuft of white hairs (pappus) at one end (Nature Serve 2010; Nevada Natural Heritage Program 2010; *Utah Rare Plant Guide* 2010).

Nevada willowherb grows in pinyon-juniper woodlands and oak/mountain mahogany communities, on talus slopes and rocky limestone outcrops at elevations between 5,000 and 8,800 ft (1,500 and 2,680 m) (*Utah Rare Plant Guide* 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Nevada willowherb in Utah, but conservation of this species is needed to ensure it remains a part of Utah's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Nevada willowherb could occur in the affected area of the following SEZs: Delamar Valley, Dry Lake Valley North, East Mormon Mountain, and Escalante Valley.

New Mexico Rock Daisy (*Perityle staurophylla* var. *staurophylla*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (New Mexico)
State Listing Status: Not Listed
Rarity: New Mexico Species of Concern; USFWS Species of Concern

New Mexico rock daisy (*Perityle staurophylla* var. *staurophylla*) is endemic to south central New Mexico in Doña Ana, Otero, and Sierra Counties and the Sacramento, San Andres, and Caballo Mountains. It occurs in crevices of dry limestone cliffs and boulders on protected north and east faces at elevations between 4,900 and 7,00 ft (1,500 and 2,100 m) (NMRPTC 2010).

The New Mexico rock daisy is classified as a perennial subshrub or forb/herb. It flowers from June to September (NMRPTC 2010). Although the species is locally common in its limited cliffside habitat that protects it from human impacts, it is listed as sensitive by the BLM New Mexico State Office and is a USFWS and New Mexico species of concern.

The New Mexico rock daisy may occur in the affected area of the following SEZs: Afton, Mason Draw, and Red Sands.

Orocopia Sage (*Salvia greatae*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S2

Orocopia sage is a large shrubby perennial dicot in the Lamiaceae (mint) family that is native and endemic to California. The plant is extensively branched from near ground level, resulting in a very dense, bushy habit. The evergreen, mound-like plants can be up to 4-ft (1.2-m) tall. The stems are covered with glandular hairs and bear widely separated, nondeciduous, opposite, hairy leaves. The thick, leathery leaves are oval in outline and have several long, pointed teeth with a spine at the end of each tooth. Orocopia sage blooms from March to April with clusters of lavender flowers arising from the bases of the paired leaves toward the ends of the branches. Each flower is subtended by a woolly, spiny base (the calyx). The fruit is a flat, keeled, gray to brown nutlet. The nutlets develop in groups of four at the base of each flower (Jepson 2010; Nature Serve 2010).

Orocopia sage is endemic to the Sonoran Desert of southern California. Its habitats include the Orocopia Mountains in Riverside County to the Chocolate Mountains in Imperial

County. It grows in creosote bush scrub communities and dry washes at elevations lower than 2,600 ft (800 m) (Jepson 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Orocopia sage in California, but because it is endemic to southern California, conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Orocopia sage could occur in the affected areas of the following SEZs: Iron Mountain and Riverside East.

Palmer's Mariposa-Lily (*Calochortus palmeri* var. *palmeri*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S2; USFWS Species of Concern

Palmer's mariposa-lily is an herbaceous perennial monocot in the Liliaceae (lily) family that is native and endemic to California. The plant arises from an underground bulb with an erect, smooth stem that is usually 12- to 24-in. (30- to 60-cm) tall. The stem may branch toward the end and is subtended by a long, linear basal leaf that usually withers by the time the plant blooms. Bulblets are usually present at the base of the stem. Palmer's mariposa-lily blooms from April to June with an inflorescence of up to five white, pink, or lavender bell-shaped flowers at the end of the leafless flower stem. Each flower petal has a brownish nectary at its base that is surrounded by yellow hairs. The fruit is an erect, linear, angled capsule containing numerous flat, yellowish or tan seeds (California Native Plant Society 2010; *Flora of North America* 2010; Nature Serve 2010).

Palmer's mariposa-lily is endemic to California, where it is distributed mostly throughout the coastal mountain ranges from the Los Angeles area to the San Francisco Bay area. It grows in moist to wet meadows or on moist grassy knolls. It is also found along creeks or swales and within chaparral, pinyon woodlands, and pine forest communities at elevations between 3,280 and 7,850 ft (1,000 and 2,390 m) (California Native Plant Society 2010; *Flora of North America* 2010; Nature Serve 2010).

Palmer's mariposa-lily is declining rapidly in the counties where it occurs. Therefore, conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Palmer's mariposa-lily could occur in the affected areas of the Pisgah SEZ.

Parish's Alkali Grass (*Puccinellia parishii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Arizona)
State Listing Status: Not Listed
Rarity: California State Rank S1

Parish's alkali grass is an annual herbaceous monocot grass in the Poaceae family that is native to Arizona but also occurs in California, Colorado, and New Mexico. The plant is geographically widespread but rare locally. Numerous erect stems arise from a base of fibrous roots and are 0.8- to 8-in. (2- to 20-cm) tall. Long, linear, spreading basal leaves clasp the stems at their basal ends. Stem leaves are very narrow and inrolled. The plant is bluish-green in color. Parish's alkali grass blooms from April to May with inflorescences that are slender spikes at the ends of the stems composed of the scale-like flower parts. It is an ephemeral grass, beginning to produce stems near the end of winter, flowering in early spring, and dying and withering away by July. The fruit is an oval caryopsis ("seed") with a longitudinal groove (AZGFD 2010; Nature Serve 2010).

Parish's alkali grass is restricted to alkaline or salty, moist soils, often forming a white crust on the surface, and it is typically found along seeps and streams and in canyon bottoms, playas, and marshes as well as in seasonally wet areas at the heads of drainages or on gentle slopes in pinyon-juniper associations to desert communities at elevations of 2,950 to 6,070 ft (900 to 1,850 m) (AZGFD 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Parish's alkali grass in Arizona, but conservation of this locally rare species is needed to ensure it remains a part of Arizona's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Parish's alkali grass could occur in the affected areas of the Bullard Wash SEZ.

Parish's Brittlescale (*Atriplex parishii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S1; USFWS Species of Concern

Parish's brittlescale is a small, annual herbaceous dicot in the Chenopodiaceae family that is native to California and essentially endemic to Riverside County, although the plant may occur in Mexico (Baja California). The plant consists of several fragile, white, branching stems that are erect or spreading to prostrate, 2- to 12-in. (5- to 30-cm) long, and covered with scurfy-mealy scales. The stems bear numerous oval-pointed leaves that are gray and densely scurfy or

hairy. The leaves are smaller and more widely separated toward the ends of the branches. Parish's brittlescale blooms from June to October with separate small female and male inflorescences (monoecious) at the bases of the leaves toward the ends of the stems. These inflorescences are the same gray-green color as the herbage. They are compact and inconspicuous, and each flower consists of several leaf-like bracts that enclose either the female (ovary) or male (stamens) flower parts. The fruit is capsule-like, a dark brown seed enclosed by the fused bracts, which form a winged achene (California Native Plant Society 2010; *Flora of North America* 2010; Nature Serve 2010).

Parish's brittlescale is essentially endemic to southern California. The plant is restricted to chenopod scrub, playas, and vernal pools in Riverside County, where it grows on saline and alkaline soils at elevations between 100 and 6,200 ft (33 and 1,900 m) (California Native Plant Society 2010; *Flora of North America* 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Parish's brittlescale in California, but because it is essentially endemic to southern California, conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Parish's brittlescale could occur in the affected areas of the Pisgah SEZ.

Parish's Phacelia (*Phacelia parishii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: California State Rank S1; Nevada State Rank S2; USFWS Species of Concern

Parish's phacelia is a herbaceous annual dicot in the Boraginaceae family that is native and rare in California but also occurs and is rare in Nevada and Arizona. The plant consists of several erect to ascending stems, branched from the base, that are 2- to 6-in. (5- to 15-cm) tall. All of the herbage is covered with soft, short, glandular hairs. The leaves are alternate and mostly basal. These leaves are oval and fleshy with wavy, rounded teeth. Stem leaves are few and similar to the basal leaves. Parish's phacelia blooms from April to July with coiled, spike-like, fuzzy clusters of crowded flowers at the ends of the stems. The flowers are trumpet-shaped with lavender recurved petals and yellowish throats emerging from hairy bases (the calyx). The fruit is a hairy, oblong capsule containing numerous dark colored, finely pitted oval seeds (Jepson 2010; Nature Serve 2010)

Parish's phacelia is rare in all of the locations where it has been found. The plant grows in Mojave Desert scrub communities, dry lake margins, gypsum beds, and playas on alkaline-clay soils at elevations between 1,800 and 3,900 ft (550 and 1,200 m) (California Native Plant Society 2010; Jepson 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Parish's phacelia in California, but because this plant is rare in California, conservation of this species is needed to ensure it remains a part of the state's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Parish's phacelia could occur in the affected area of the following SEZs: Bullard Wash, Dry Lake, and Pisgah.

Pima Indian Mallow (*Abutilon parishii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Arizona)
State Listing Status: Arizona Salvage Restricted (SR)
Rarity: Arizona State Rank S2; USFWS Species of Concern

Pima Indian mallow is a shrubby, herbaceous, perennial dicot in the family Malvaceae that is native and endemic to Arizona. The plant consists of several erect, branching, densely hairy stems that arise from a woody rootstock and are up to 75-in. (190-cm) tall. The stems bear widely separated, alternate, heart-shaped leaves with coarse, irregular teeth. The thick leaves have a corrugated appearance and indented veins, are densely velvety on both surfaces, and are dark green above and nearly white beneath. Pima Indian mallow has a relatively weak spring flowering that is followed by a longer late-summer/fall bloom. Red-orange flowers are borne on flower stalks that arise from leaf bases toward the ends of the stems. The flowers open only for about one hour on sunny afternoons. The fruit is a globose, hairy capsule composed of a group of wedge-shaped carpels. Each carpel has a reflexed, pointed tip and contains one or more brown seeds (AZGFD 2010; Nature Serve 2010).

Pima Indian mallow grows in mesic habitats in full sun within higher elevation Sonoran Desert scrub on rocky hillsides, cliff bases, canyon bottoms, and lower side slopes and ledges of canyons among rocks and boulders. In riparian zones, the plant occurs on flat secondary terraces but typically not in canyon bottoms. It is often found near trails, probably because of the influence of the trail on the light, heat, and water of the microhabitat. Its elevation ranges from 1,720 to 4,900 ft (525 to 1,495 m) (AZGFD 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Pima Indian mallow in Arizona, but because it is endemic to Arizona, conservation of this species is needed to ensure it remains a part of Arizona's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Pima Indian mallow could occur in the affected areas of the Bullard Wash SEZ.

Pioche Blazingstar (*Mentzelia argillicola*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

Pioche blazingstar is a perennial herbaceous dicot in the Loasaceae family that is native and endemic to Nevada. The plant consists of a branching, erect to spreading stem with a semi-woody base that is up to 10-in. (25-cm) tall. All of the herbage is bristly-hairy. The stem bears widely separated, alternate, spatula-shaped to long-ovate leaves that are wavy-edged and have shallow, rounded, irregular teeth. Pioche blazingstar blooms during the spring with yellow flowers on short stalks that arise from leaf bases near the ends of the stems. The fruit is an erect, cylindrical, hairy capsule, tapered to the base, on a short stalk. The capsule has several pointed bracts on its top and contains several oval seeds that are flat at one end (Nevada Natural Heritage Program 2010; Nature Serve 2010).

Pioche blazingstar grows on dry, soft, silty, clay soils on knolls and slopes with sparse vegetation consisting mainly of *Artemisia pygmaea*, *Eriogonum nummulare*, *Gutierrezia sarothrae*, and *Salvia dorrii* var. *dorrii*.

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Pioche blazingstar in Nevada, but because it is endemic, conservation of this species is needed to ensure it remains a part of Nevada's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution.

The Pioche blazingstar may occur in the affected area of the following SEZs: Delamar Valley and Dry Lake Valley North.

Ripley's Milkvetch (*Astragalus ripleyi*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Colorado)
State Listing Status: Not Listed
Rarity: Colorado State Rank S2

Ripley's milkvetch is a tall, robust herbaceous perennial dicot in the family Fabaceae (bean family) that is native to Colorado but also occurs in New Mexico. The plant arises from a woody crown with rhizomes; is 16- to 36-in. (40- to 100-cm) tall; and has erect, branching stems that are covered with long hairs appressed to the stems. The stems bear alternate, pinnately compound leaves that are hairy on one or both surfaces. Large clusters of pea-like flowers are produced from June to July on stalks arising from the leaf bases. The large flowers are pale lemon yellow and hang down from the nodding flower stalks. The fruits are oblong, pointed

legumes (pods) that may be hairy or smooth, remain attached to the plant by long stalks, and contain numerous smooth seeds that are olive, brown, or black (Nature Serve 2010).

Ripley's milkvetch grows in mixed conifer and shrubland habitats on rocky substrates at elevations above 8,000 ft (2,400 m). The plant occurs exclusively on volcanic-derived soils associated with the San Juan volcanic field (*Colorado Rare Plant Field Guide* 2010; Nature Serve 2010).

Ripley's milkvetch is a regional endemic that is restricted to soils derived from volcanic formations. Given its limited range, populations are currently vulnerable to habitat alteration resulting from a variety of potential impacts. There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Ripley's milkvetch in Colorado, but conservation of this species is needed to ensure it remains a part of Colorado's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

Ripley's milkvetch could occur in the affected areas of the following SEZs: Antonito Southeast, Fourmile East, and Los Mogotes East.

Rock Phacelia (*Phacelia petrosa*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S2

Rock phacelia is a herbaceous annual dicot in the Boraginaceae family that is native to Nevada but also occurs in Arizona and Utah. The plant consists of several erect to ascending stems, branched from the base, that are 4- to 12-in. (10- to 31-cm) tall. The stems bear leaves that are alternate and mostly basal. The basal leaves are oval with wavy, rounded teeth. Stem leaves are widely separated, similar to the basal leaves, and become smaller towards the ends of the stems. The leaves are densely covered with spreading, shiny hairs. Rock phacelia blooms in the spring with coiled, spike-like, fuzzy clusters of crowded flowers at the ends of the stems. The flowers are bell-shaped with blue petals that become lighter toward their bases. The fruit is a hairy, globose capsule containing four light brown, oblong seeds that have corrugated surfaces (Nature Serve 2010; Nevada Natural Heritage Program 2010).

Rock phacelia grows on dry limestone and volcanic talus slopes of foothills, washes, and gravelly canyon bottoms on substrates derived from calcareous material. It inhabits mixed desert scrub and creosote bush and blackbrush communities at elevations between 2,500 and 5,800 ft. (760 and 1,763 m) (Nature Serve 2010; Nevada Natural Heritage Program 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of rock phacelia in Nevada, but conservation of

this species is needed to ensure it remains a part of Nevada's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Rock phacelia could occur in the affected areas of the following SEZs: Delmar Valley, Dry Lake and East Mormon Mountain.

Rock Purpusia (*Ivesia arizonica* var. *saxosa*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The rock purpusia is a perennial herb endemic to southern Nevada. It inhabits crevices of cliffs and boulders on volcanic substrates in pinyon-juniper communities at elevations between 4,900 and 6,900 ft (1,490 and 2,100 m). The rock purpusia may occur in the affected area of the following SEZs: Amargosa Valley, Delamar Valley, and Dry Lake Valley North.

Rock-Loving Aletes (*Neoparrya lithophila*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Colorado)
State Listing Status: Not Listed
Rarity: Colorado State Rank S2

Rock-loving aletes is a herbaceous perennial dicot in the Apiaceae (parsley) family that is endemic to south central Colorado. The plants grow in clumps from taproots, with upright stems that are 3- to 11-in. (8- to 29-cm) tall. The stems have alternate pinnately compound leaves that are thick, glossy, and leathery. Rock-loving aletes blooms from May to early July with clusters of pale yellow flowers at the ends of the stems. The fruit consists of two seed-like carpels (a mericarp) that adhere to each other and then separate when ripe (Nature Serve 2010).

The habitat of rock-loving aletes includes igneous outcrops or sedimentary rock derived from extrusive volcanics and north-facing cliffs and ledges within pinyon-juniper woodlands at elevations of 7,000 to 10,000 ft (2,100 to 3,048 m) (*Colorado Rare Plant Field Guide* 2010; Nature Serve 2010).

Rock-loving aletes is known only from Chaffee, Conejos, Fremont, Huerfano, Rio Grande, and Saguache Counties in south central Colorado. There are no data available from which meaningful inferences can be made regarding population trends or changes, but conservation of this species is needed to ensure it remains a part of Colorado's flora. Rock-loving aletes is afforded some protection by the remote, relatively inaccessible location of its

habitat. Major threats are associated with habitat disturbance or destruction, recreation, effects of small population size, global climate change, and pollution (*Colorado Rare Plant Field Guide* 2010; Nature Serve 2010).

Rock-loving aletes could occur in the affected area of the following SEZs: Antonito Southeast, Fourmile East, and Los Mogotes East.

Rosy Two-Tone Beardtongue (*Penstemon bicolor* spp. *roseus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: USFWS Species of Concern

The rosy two-tone beardtongue is a perennial forb that is known from Arizona, California, and Nevada. This species occurs on calcareous, granitic, or volcanic substrates in washes, roadsides, scree and outcrop bases, rock crevices, or similar places receiving enhanced runoff at elevations between 1,800 and 4,850 ft (550 and 1,480 m). The rosy two-tone beardtongue may occur in the affected area of the following SEZs: Dry Lake and East Mormon Mountain.

Rough Dwarf Greasebush (*Glossopetalon pungens* var. *pungens*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S2

The rough dwarf greasebush is a perennial shrub that is endemic to the Spring and Sheep Ranges in southern Nevada. This species inhabits crevices of carbonate cliffs and outcrops, generally within pinyon-juniper and montane coniferous woodlands. The rough dwarf greasebush may occur in the affected area of the Dry Lake SEZ.

Sacramento Prickly Poppy (*Argemone pleitacantha* spp. *pinnatisecta*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Endangered in New Mexico
Rarity: New Mexico State Rank S2

The Sacramento prickly poppy is a robust perennial species that occurs in canyons of the west side of the Sacramento Mountains in New Mexico. The species occurs on disturbed areas that are either semi-riparian or have a reliable seasonal provision of water. The plant is also often

found at springs and permanently wet sites as long as the soils are well-drained and on drier sites, such as terraces above the normal level of flood flows. The Sacramento prickly poppy is known to occur in seven canyon systems: Fresnal, Dry, Alamo, Mule, San Andres, Dog, and Escondido. In total, approximately 80% of the species' range is on National Forest system lands, 18% is on privately owned land, and the remainder is on lands administered by the BLM. The Sacramento prickly poppy is adapted to withstand some scouring by summer floods, which may encourage seed germination. However, loss of riparian vegetation in Alamo Canyon as a result of water diversion has increased the scouring intensity of flood events, rendering much of the active channel either less suitable or unsuitable for the species. Loss of the system's ability to capture fine material also makes the channels drier, reducing the survivability of seedlings that do germinate. Seedlings are readily desiccated, and their survival is limited to sites where moisture levels are higher or to periods when precipitation is above average. As a result of the capture of most perennial flows on the west face of the Sacramento Mountains for use in the valley below, the amount of suitable habitat has been much reduced. Pipeline rights-of-way and roadsides provide the reduced vegetative competition and increased moisture that the plant requires and frequently serve as artificial habitat for a substantial number of plants.

The Sacramento prickly poppy was federally listed as endangered on August 24, 1989 (USFWS 1989). Critical habitat has not been designated for this species.

The greatest ongoing threat to this species is reductions in water flow in the canyon systems. It is likely that most of the remaining plants currently occupy the extreme margins of what can be considered suitable habitat. It is not known how much occupied habitat was depopulated when water was developed for human use. The loss of, at the least, the seasonal flows out of the canyon and across the bajadas of the west slope could have resulted in the loss of at least as many plants as the number that exist today in the degraded conditions of the canyon proper.

The Sacramento prickly poppy may occur in the affected area of the Red Sands SEZ.

Sand Food (*Pholisma sonorae*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Arizona Highly Safeguarded (HS)
Rarity: California State Rank S2; Arizona State Rank S1; USFWS Species of Concern

Sand food is a herbaceous perennial root parasite that lacks chlorophyll and the ability to make its own food, as green plants can. It is a rare and unusual dicot in the Lennoaceae family that is native to California and Arizona. The plant grows in sand dunes and consists of a long, scaly, fleshy stem that extends below the surface to attach to the roots of a nearby desert shrub and draw nourishment from that host plant. The underground stem can be up to 6.5-ft (2-m) long; is grayish, whitish, or brown in color; and has alternate, glandular, scale-like leaves along its surface. Sand food blooms from April to June with a saucer-shaped, fuzzy inflorescence at, or slightly above, the sand surface that is up to 4 in. (10 cm) in diameter. The inflorescence consists

of tightly packed flower buds with hairy bases (the calyx) that are the color of sand. The flower buds open in concentric circles successively from the outer edge of the head to the center. The flowers are star-shaped with purple petals that have white edges. The fruit is a small, dry capsule containing numerous flattened nutlets (AZGFD 2010; California Native Plant Society 2010; Jepson Interchange 2010; Nature Serve 2010).

Sand food grows in loose, sand dune habitats in creosote bush scrub in the Sonoran Desert at elevations below 650 ft (200 m) (AZGFD 2010; California Native Plant Society 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of sand food in California and Arizona, but conservation of this rare species is needed to ensure it remains a part of these state's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution.

Sand food could occur in the affected areas of the Imperial East SEZ.

Sand Prickly-Pear Cactus (*Opuntia arenaria*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Endangered in New Mexico
Rarity: New Mexico State Rank S2: USFWS Species of Concern

Sand prickly-pear cactus (*Opuntia arenaria*) occurs in the Rio Grande River and adjacent valleys in southern New Mexico, western Texas, and northern Mexico. Within New Mexico, populations exist in southern Doña Ana, Luna, and Socorro Counties. It inhabits sandy, rocky, and silty areas, including semi-stabilized sand dunes among open Chihuahuan desert scrub, at elevations ranging from 3,800 to 4,300 ft (1,160 to 1,300 m). The species is often associated with honey mesquite and a sparse cover of grasses (Nature Serve 2010; NMRPTC 2010).

Sand prickly-pear cactus flowers in May to June. Flowers are yellow and may contain pink or red tints. Green fruits change to tan when ripe, and the dry fruit stays on the plant throughout the summer. The species has fewer chromosomes and higher morphological stability than other dry-fruited species of *Opuntia* (NMRPTC 2010).

Much of the cactus's former habitat has been destroyed by urbanization and agricultural development in the Rio Grande Valley. Cactus collectors and road widening also pose a threat to populations. Currently, only seven populations are known in New Mexico (Nature Serve 2010; NMRPTC 2010).

The sand prickly-pear cactus may occur in the affected area of the following SEZs: Afton and Mason Draw.

Sandhill Goosefoot (*Chenopodium cycloides*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (New Mexico)
State Listing Status: Not Listed
Rarity: New Mexico State Rank S2

Sandhill goosefoot (*Chenopodium cycloides*) occurs in south central New Mexico, southern Colorado, Nebraska, Kansas, Oklahoma, and western Texas. It inhabits open, sandy areas with sparse vegetation, especially along the edges of blowouts on sand dunes, sand sage communities, *Quercus havardii* communities, and short-grass prairie communities. Its elevation ranges from 2,600 to 4,900 ft (800 to 1,500 m). It occurs on gentle slopes, with inclines ranging from 0 to 5%, although it may occur on steeper slopes in dune environments. Its distribution is patchy and clumped, and its abundance varies temporally. It is difficult to measure population trends because few sites have been visited more than once (Nature Serve 2010; NMRPTC 2010).

Sandhill goosefoot flowers in late June to August and fruits from early summer to fall. Its fruit is red, ovoid, and minutely tuberculate. The plant may be self- or cross- pollinated, with its pollen dispersed by wind. Seed production varies substantially from year to year depending on factors such as disease, temperature, precipitation, and the herbivory of the flowers. It likely has persistent, large seed banks that exhibit some form of dormancy. Hybridization has not been observed (*Flora of North America* 2010; Nature Serve 2010; NMRPTC 2010).

Eleven occurrences of the sandhill goosefoot have been recorded in New Mexico since 1913. Threats include urbanization; mineral, oil and gas development; agriculture; range conversion; overgrazing by livestock; and invasive species.

The sandhill goosefoot may occur in the affected area of the following SEZs: Afton and Mason Draw.

Sanicle Biscuitroot (*Cymopterus ripleyi* var. *saniculoides*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: USFWS Species of Concern

The sanicle biscuitroot is a perennial herb that is endemic to Nevada from mixed desert scrub and pinyon-juniper woodland communities on sandy to gravelly alkaline substrates and volcanic deposits. The sanicle biscuitroot may occur in the affected area of the Millers SEZ.

Scheer's Pincushion Cactus (*Coryphantha scheeri* var. *valida*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Endangered in New Mexico
Rarity: New Mexico State Rank S2; USFWS Species of Concern

Scheer's pincushion cactus occurs in southern New Mexico in Hidalgo, Luna, Dona Ana, Sierra, Socorro, Otero, and Eddy Counties. Habitat includes desert grassland, Chihuahuan desert scrub communities, and, occasionally, rocky benches, washes, or bajadas at elevations of 3,300 to 3,600 ft (1,000 to 1,100 m). Substrate is deep sandy soil (AZGFD 2010).

Scheer's pincushion cactus flowers in July. Flowers are diurnal and form on new growth and/or the last-produced areoles of the preceding year.

Occurrence of the Scheer's pincushion cactus is estimated to be only 21 to 300 plants. Threats include horticultural collecting and agricultural conversion. The threat is high in immediacy, moderate in scope, and low in severity. This species may occur within the affected regions of the Red Sands SEZ (AZGFD 2010; NatureServe 2010).

Sheep Fleabane (*Erigeron ovinus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S2; USFWS Species of Concern

The sheep fleabane is a perennial forb that is endemic to Mount Irish and the Sheep and Groom Ranges in southern Nevada. This species inhabits crevices of carbonate cliffs and outcrops, generally within pinyon-juniper and montane coniferous woodlands. The sheep fleabane may occur in the affected area of the following Dry Lake SEZ.

Sheep Mountain Milkvetch (*Astragalus amphioxys* var. *musimonum*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Nevada State Rank S2; USFWS Species of Concern

The Sheep Mountain milkvetch is a perennial herb that is restricted to the foothills of the Sheep Mountains in southern Nevada. It occurs on carbonate alluvial gravels, particularly along drainages, roadsides, and in other microsites with enhanced runoff, at elevations between 4,400 and 6,000 ft.

The Sheep Mountain milkvetch may occur in the affected area of the following SEZs: Delamar Valley and Dry Lake.

Silverleaf Sunray (*Enceliopsis argophylla*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The silverleaf sunray is a perennial forb that is primarily known from southern Nevada. This species occurs in dry, open, relatively barren areas on gypsum badlands, volcanic gravels, or loose sands at elevations between 1,200 and 2,400 ft (365 and 730 m). The silverleaf sunray may occur in the affected area of the Dry Lake SEZ.

Sneed's Pincushion Cactus (*Escobaria sneedii* var. *sneedii*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Endangered in New Mexico
Rarity: New Mexico State Rank S2

The Sneed pincushion cactus is restricted to limestone substrates on terraces, ridgetops, hillsides, and ledges in the high Chihuahuan Desert of the Franklin, Guadalupe, and Organ Mountains of Texas and New Mexico. Plants occur primarily in cracks in the limestone substrate or in shallow pockets of loamy soil on hillsides and ridgetops between 3,900 and 7,700 ft (1,190 and 2,345 m) in elevation. The subspecies typically occurs in semi-desert grasslands or woodlands in an agave-juniper association. In the Guadalupe Mountains, it extends upward in elevation to the lower pinyon-juniper woodland. Like the Lee pincushion cactus, it usually occurs in sparsely vegetated areas with shrubby species, but it is rarely under cover. Associated plant species include lechuguilla, sideoats grama, whitecolumn foxtail cactus, common sotol, longleaf joint fir, Apache plume, Pinchot's juniper, Texas sacahuista, cactus apple, oak, and pinyon pine.

The Sneed's pincushion cactus is a long-lived, succulent, perennial species. Reproduction is sexual; although plants can be propagated vegetatively for cutting, they have no natural mechanism for doing so. Sneed cactus plants likely germinate from late May to early June but do not begin blooming until after they have attained 3 to 4 years of age. The plants bud in March and April, flower in mid- to late April, and fruit from August to November.

The Sneed's pincushion cactus was federally listed as endangered on November 7, 1979 (USFWS 1979b). Critical habitat has not been designated. This subspecies is threatened by illegal collecting by cactus enthusiasts. Plants are relatively tough, not being affected by many of the fungi and insect predators that adversely affect other cacti.

The Sneed's pincushion cactus may occur in the affected area of the following SEZs: Afton and Mason Draw.

Spring-Loving Centaury (*Centaurium namophilum*)

ESA Listing Status: Threatened
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2

The spring-loving centaury is an endemic to the Ash Meadows area of Nye County, Nevada. The species occurs along the Amargosa River drainage on open, moist to wet, alkali-crusted soils of seeps, springs, outflow drainages, meadows, and hummocks. It is found at elevations of 2,100 to 2,350 ft (640 to 716 m). The species is aquatic or wetland-dependent and commonly occurs with the following species: saltgrass, goldenweed, Baltic rush, Yerba mansa, western niterwort, saltbush, Tecopa bird's-beak, ash, mesquite, saltcedar, baccharis, and cattail. There are 14 occurrences of this species over a range of 9 mi (14 km) on lands administered by the USFWS and the BLM and on privately owned land. The spring-loving centaury is an annual that flowers from July to September. Fruiting occurs in October. Little else is known about the reproduction and life history of this species.

The spring-loving centaury was federally listed as threatened on May 20, 1985 (USFWS 1985). Critical habitat has been designated in the Ash Meadows area of Nye County, Nevada.

The spring-loving centaury may occur in the affected area of the Amargosa Valley SEZ.

Stephens' Beardtongue (*Penstemon stephensii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S2; USFWS Species of Concern

Stephens' beardtongue is a shrubby perennial dicot in the Plantaginaceae family that is native and endemic to California, where it occurs in the mountains of the Mojave Desert in Inyo and San Bernardino Counties. The plant consists of several erect, smooth stems that are 12- to 60-in. (30- to 150-cm) tall. The stems bear widely spaced, thin, opposite leaves that are oval, with wide triangular tips and sharply serrated edges. Toward the ends of the stems, these leaf pairs become fused at their bases and form a disc around the stem. Stephens' beardtongue blooms from April to July with wide-mouthed tubular flowers in shades of pink or purple in a spike-like inflorescence at the end of the stem. The surfaces of the petals and other flower parts are minutely glandular-hairy. The fruit is an oval capsule that contains numerous seeds (California Native Plant Society 2010; Nature Serve 2010).

Stephens' beardtongue grows in rocky (usually carbonate) areas, including rock crevices, limestone cliffs, rocky slopes, and washes with sandy conglomerate. It occurs predominantly within creosote bush scrub and pinyon-juniper woodland communities, occasionally within shadscale scrub or sagebrush scrub at elevations between 3,900 and 6,550 ft (1,200 and 2,000 m) (California Native Plant Society 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Stephens' beardtongue in California, but because it is endemic to the mountains of the Mojave Desert and is threatened by limestone mining, conservation of this species is needed to ensure it remains a part of California's flora. Other major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution (California Native Plant Society 2010; Nature Serve 2010).

Stephens' beardtongue could occur in the affected areas of the Pisgah SEZ.

Sticky Buckwheat (*Eriogonum viscidulum*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2; USFWS Species of Concern

The sticky buckwheat is a perennial forb that is known only from Clark County, Nevada, and Mohave County, Arizona. This species is dependent on sand dune communities, where it occurs on deep, loose, sandy soils in washes, flats, roadsides, steep aeolian slopes, and stabilized dunes at elevations between 1,200 and 2,200 ft (365 and 670 m). The sticky buckwheat may occur in the affected area of the Dry Lake SEZ.

Straw-Top Cholla (*Opuntia echinocarpa*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Arizona Salvage Restricted (SR)
Rarity: None

Straw-top cholla is a shrubby, perennial, dicot cactus in the Cactaceae family that is native to Arizona but also occurs in California, Nevada, and Utah. The plant is a large, erect to spreading, densely branched, spiny cactus in the form of a shrub or tree that is 1.6- to 6.6-ft (0.5- to 2-m) tall. The trunk and branches are round, segmented, and green or gray-green in color. The stem segments are firmly attached, except for the terminal segments, which are sometimes easily detached and can function as vegetative propagules. The entire plant is armed with clusters of stiff spines arising from wart-like oval tubercles. Each tubercle may bear up to 20 spines. The numerous spines interlace and sometimes obscure the stem. Minute, detachable bristles

(glochids) and fine, yellowish wool form tufts at the base of the spines. Straw-top cholla blooms from March to June with clusters of flowers on the older branches. The flowers are light green to yellow-green, sometimes suffused with maroon or rose. The fruit is a densely spiny, globose, dry berry that is tan when mature and contains numerous pale yellow, angular seeds. *Opuntia echinocarpa* is a synonym for *Cylindropuntia echinocarpa* (AZGFD 2010; *Flora of North America* 2010; Nature Serve 2010).

Straw-top cholla grows on sandy, loamy, alluvial to gravelly substrates in the Mojave and Sonoran Deserts, in creosote-bush/white bur-sage, blackbrush, and saltbush scrub, desert grasslands, juniper and oak-juniper woodlands, flats, bajadas, and canyons at elevations of 164 to 5,575 ft (50 to 1,700 m) (AZGFD 2010; *Flora of North America* 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of straw-top cholla in Arizona, but conservation of this species is needed to ensure it remains a part of Arizona's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution.

Straw-top cholla could occur in the affected areas of the following SEZs: Brenda, Bullard Wash, and Gillespie.

Threecorner Milkvetch (*Astragalus geyeri* var. *triquetrus*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2; USFWS Species of Concern

The threecorner milkvetch is a perennial forb that is known only from Clark County, Nevada, and Mohave County, Arizona. This species inhabits open, deep, sandy soils; desert washes; or dunes, generally stabilized by vegetation and/or a gravel veneer at elevations between 1,500 and 2,500 ft (455 and 760 m). The Threecorner milkvetch may occur in the affected area of the following SEZs: Dry Lake and East Mormon Mountain.

Tiehm Blazingstar (*Mentzelia tiehmii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Tiehm blazingstar is a perennial herb endemic to Nevada. It occurs on hilltops and sparsely vegetated, white, calcareous knolls and bluffs with other scattered perennial plant

species. The Tiehm blazingstar may occur in the affected area of the following SEZs: Delamar Valley and Dry Lake Valley North.

Tonopah Pincushion (*Sclerocactus nyensis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1

The Tonopah pincushion cactus is endemic to Esmeralda and Nye Counties, Nevada. This species occurs on dry rocky soils and low outcrops on gentle slopes in open areas or under shrubs in the upper salt desert and lower sagebrush zones. The Tonopah pincushion may occur in the affected area of the Gold Point SEZ.

Toquima Milkvetch (*Astragalus toquimanus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S2

The Toquima milkvetch is a perennial herb that is endemic to Nevada on sandy to gravelly slopes or flats at elevations between 6,500 and 7,500 ft (1,980 and 2,280 m). The Toquima milkvetch may occur in the affected area of the Millers SEZ.

Tumamoc Globeberry (*Tumamoca macdougalii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Arizona)
State Listing Status: Arizona Salvage Restricted (SR)
Rarity: None

Tumamoc globeberry is a delicate perennial dicot vine in the Cucurbitaceae (squash/gourd) family that is native and endemic to southern Arizona and northern Mexico. The plant is dormant during the winter and early spring. In late spring, slender, smooth, herbaceous stems arise from succulent tuberous roots and climb, by means of tendrils, up to 10 ft (3 m) into nearby shrubs and trees. Growth is stimulated by spring and summer rains. The annual stems bear thin, alternate, three-lobed leaves with clasping tendrils at the leaf bases. Each leaf lobe is further divided into several irregular lobes. Tumamoc globeberry blooms from July to August and fruits from August to September. The plant has separate male and female flowers (monoecious) that are star-shaped, are white to greenish-yellow, and arise from leaf bases. The

fruit is a small, globose, bright red, several-seeded berry that is relished by wildlife (AZGFD 2010; Nature Serve 2010).

Tumamoc globeberry grows in desert scrub and xeric situations, in shady areas of nurse plants along gullies and washes, in rocky to gravelly, sandy, silty, and clayey soils, at elevations of 1,476 to 2,608 ft (450 to 795 m) (AZGFD 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of Tumamoc globeberry in Arizona, but because this species is endemic to Arizona, conservation of this species is needed to ensure it remains a part of Arizona's flora. Major threats are associated with habitat disturbance or destruction, recreation, effects of small population size, exotic species invasion, succession, global climate change, and pollution.

Tumamoc globeberry could occur in the affected areas of the Gillespie SEZ.

Villard Pincushion Cactus (*Escobaria villardii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (New Mexico)
State Listing Status: Endangered in New Mexico
Rarity: New Mexico State Rank S2; USFWS Species of Concern

The Villard pincushion cactus occurs in the northern Franklin and Sacramento Mountains in Otero and Doña Ana Counties, New Mexico. Its characteristic habitat is nearly flat benches above vertical north-facing limestone cliffs in Chihuahuan Desert and black grama grassland. Its substrate is well-developed, loamy soil. Its elevation ranges from 4,500 to 6,500 ft (1,370 to 2,000 m) (NatureServe 2010; NMRPTC 2010).

Villard pincushion cactus is a spiny perennial succulent. Pale yellowish, pinkish, or white flowers appear in April. Fruit is elongate and green to reddish. Seeds are brown, pitted, and roughly 0.04 in (1-mm) long (NatureServe 2010; NMRPTC 2010).

Villard pincushion cactus is common within its area of distribution. Its locations are nearly inaccessible, which severely limits the threat of collection or grazing. Accidental wildfires in grassland habitat pose a threat. It is listed as sensitive by the BLM, listed as endangered by the state of New Mexico, is a USFWS species of concern, and is ranked S2 in New Mexico. This species may occur within the affected regions of the following SEZs: Afton, Mason Draw, and Red Sands (NatureServe 2010; NMRPTC 2010).

White Bearpoppy (*Arctomecon merriamii)*

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)

State Listing Status: Not Listed
Rarity: Not Listed

The white bearpoppy is a perennial herb that is endemic to the desert regions of southeastern California and southern Nevada. It occurs in barren, gravelly areas, rocky slopes, and limestone outcrops at elevations between 2,000 and 5,900 ft (600 and 1,800 m). The white bearpoppy may occur in the affected area of the following SEZs: Amargosa Valley, Delamar Valley, Dry Lake, and East Mormon Mountain.

White River Cat's-Eye (*Cryptantha welshii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: USFWS Species of Concern

The White River cat's-eye is a perennial herb endemic to southern Nevada. It occurs on dry, open, sparsely vegetated outcrops on carbonate substrates at elevations between 4,500 and 6,600 ft (1,370 and 2,010 m). The White River cat's-eye may occur in the affected area of the following SEZs: Delamar Valley and Dry Valley North.

White-Bracted Spineflower (*Chorizanthe xanti* var. *leucotheca*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S2

White-bracted spineflower is an herbaceous annual dicot in the Polygonaceae family that is native and endemic to California. The plant consists of an erect stem that is 2- to 10-in. (5- to 25-cm) tall. All of the herbage is reddish and covered with hairs. The leaves are mostly basal, oblong, and slightly hairy above and densely hairy below. White-bracted spineflower blooms from April to June with an openly branched, spreading, inflorescence that consists of woolly clusters of rose to red flowers. Each flower is surrounded by six reddish, densely white-hairy leaf-like bracts tipped with hooked bristles (awns). The fruit is a smooth, brown achene enclosed by the persistent flower base (*Flora of North America* 2010; Nature Serve 2010).

White-bracted spineflower is known only from the San Bernardino and San Jacinto Mountains and grows in Mojave Desert scrub communities, pinyon-juniper woodlands, and pine-oak woodlands on sandy or gravelly soils at elevations below 3,925 ft (1,200 m) (California Native Plant Society 2010; *Flora of North America* 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of white-bracted spineflower in California, but

because this plant is endemic to California, conservation of this species is needed to ensure it remains a part of the state's flora. Major threats are associated with habitat disturbance or destruction, timber harvest, recreation, fire, grazing, effects of small population size, woody plant encroachment, exotic species invasion, succession, global climate change, and pollution (Nature Serve 2010).

White-bracted spineflower could occur in the affected areas of the Pisgah SEZ.

White-Margined Beardtongue (*Penstemon albomarginatus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Not Listed
Rarity: California State Rank S1; Nevada State Rank S2; USFWS Species of Concern

White-margined beardtongue is a herbaceous perennial dicot in the Plantaginaceae family that is native to California but also occurs in Arizona and Nevada. The plant consists of several erect, smooth stems that are 6- to 14-in. (15- to 35-cm) tall and arise from a long taproot whose crown is buried in the sand. The stems bear widely spaced, opposite leaves that are pale green, oblong-pointed, weakly toothed, and wavy edged and have a distinct white margin. Near the bases of the stems, the leaves tend to be small and scale-like. White-margined beardtongue blooms from March to May with tubular flowers in shades of pink, lavender, or white, with darker purple veins and spots, and with yellow hairs on the inside of the lower petals. The flowers are borne in spike-like inflorescences at the ends of the stems. The fruit is an oval capsule that contains numerous irregularly angled seeds (*Flora of North America* 2010; Nature Serve 2010).

White-margined beardtongue grows in loose, wind-blown, desert, sand dune habitats and Mojave Desert scrub communities at elevations below 3,600 ft (1,100 m) (California Native Plant Society 2010; Nature Serve 2010).

There are no data available from which meaningful inferences can be made regarding population trends or changes in the distribution of white-margined beardtongue in California, but conservation of this species is needed to ensure it remains a part of California's flora. Major threats are associated with habitat disturbance or destruction, recreation, fire, grazing, effects of small population size, exotic species invasion, succession, global climate change, and pollution.

White-margined beardtongue could occur in the affected area of the following SEZs: Amargosa Valley, Iron Mountain, Pisgah, and Riverside East.

Wright's Marsh Thistle (*Cirsium wrightii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (New Mexico)

State Listing Status: Endangered in New Mexico
Rarity: New Mexico State Rank S2; USFWS Species of Concern

Wright's marsh thistle occurs in south central New Mexico, western Texas, and Chihuahua, Mexico. In New Mexico, it is found in Eddy, Chaves, Guadalupe, Otero, Sierra, and Socorro Counties. Within Socorro County, it occurs in the Sacramento Mountains, lower Pecos River Valley, and Alamosa Springs. Wright's marsh thistle inhabits wet, alkaline soils in spring seeps and marshy areas of streams and ponds of otherwise arid or semiarid areas. Its elevation ranges from 3,450 to 8,500 ft (1,130 to 2,600 m) (NatureServe 2010; NMRPTC 2010).

Wright's marsh thistle is a biennial or perennial succulent forb. It flowers from March to October and sets seeds only once before dying. A few hybrids between *C. wrightii and C. vinaceum* have been observed in the Sacramento Mountains (NatureServe 2010: NMRPTC 2010).

Known populations of Wright's marsh thistle are few and widely disjunct. Populations in Roswell, Chavez County, Lake Valley, Sierra County, and San Bernardino Cienega in Arizona have been extirpated. The desert springs and cienegas that this species inhabits are rare and susceptible to drying up or being diverted. Insects introduced as a biological control for nearby weedy thistles may pose a grave threat for nonweedy thistle species like Wright's marsh thistle. The impacts of fire and livestock grazing on this species have not been studied. On September 10, 2009, the USFWS found that a petition to list this species as endangered or threatened under the ESA may be warranted, and it bagan a 12-month review of the species. No ESA listing has yet been issued, but Wright's marsh thistle is listed as sensitive by the BLM, listed as endangered by the state of New Mexico, is a USFWS species of concern, and is ranked S2 in New Mexico. It may occur within the affected regions of the Red Sands SEZ (NatureServe 2010; MRPTC 2010).

Yellow Two-Tone Beardtongue (*Penstemon bicolor* ssp. *bicolor*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S2; USFWS Species of Concern

The yellow two-tone beardtongue is endemic to Clark County, Nevada, on mostly BLM lands in the vicinity of Las Vegas. It occurs on calcerous or carbonate soils in washes, roadsides, rock crevices, or outcrops at elevations between 2,500 and 5,500 ft. The yellow two-tone beardtongue may occur in the affected area of the Dry Lake SEZ.

J.6.1.2 Invertebrates

Amargosa Naucorid *(Pelocoris shoshone amargosa)*

ESA Listing Status: Under Review
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Amargosa naucorid is endemic to the Amargosa Valley in Inyo County, California, and Nye County, Nevada. It inhabits spring-fed aquatic habitats, where it prefers quiet waters among vegetation. The Amargosa naucorid may occur in the affected area of the Amargosa Valley SEZ.

Amargosa Tryonia (*Tryonia variegata*)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Nevada State Rank S2

The Amargosa tryonia is endemic to the Amargosa Valley in Nye County, Nevada. It inhabits spring-fed aquatic habitats where there is an abundance of detritus or aquatic macrophytes. The Amargosa tryonia may occur in the affected area of the Amargosa Valley SEZ.

Anthony Blister Beetle (*Lytta mirifica*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: New Mexico Species of Concern
Rarity: USFWS Species of Concern

The Anthony blister beetle occurs in south central New Mexico, which includes Sierra, Otero, and Doña Ana Counties, although finer-scale distributions have not been specified. It is a terrestrial species that inhabits the flowers and foliage of various plants and agricultural areas, where it may be a pest of certain crops, including tomatoes, potatoes, beets, and clover (NMDGF 2010).

Blister beetles are both plant feeders and parasites, eating grasses and forbs as well as deriving nutrients from living hosts. Larvae parasitize bees by climbing onto flowers and attaching themselves to bees that visit the flowers. The bees carry the larvae to their nest, where they attack bee eggs. They also feed on grasshopper eggs. Adult beetles are plant feeders and can

completely defoliate plants. Blister beetles reproduce by laying eggs. They undergo hypermetamorphosis and appear in several forms throughout their life (NMDGF 2010).

The Anthony blister beetle is affected by the extirpation of blacktailed and Gunnison prairie dogs and other large, burrowing rodents. It was listed in the *Federal Register* as a Category 2 species for consideration to be listed as a threatened or an endangered species on November 15, 1994. In 1996, the USFWS changed the listing status of federal candidate species to eliminate category designations, and it no longer considered Category 2 species like the beetle as candidate species. It was classified as a species of concern in March of 1996. Currently, it is listed as sensitive by the BLM and is a USFWS and New Mexico species of concern. It may occur within the affected regions of the Afton SEZ (NMDGF 2009; NMSU 2010).

Ash Meadows Naucorid (*Ambrysus amargosus*)

ESA Listing Status: Threatened
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Ash Meadows naucorid is a creeping water bug that is restricted to Ash Meadows in Nye County, Nevada. It is less than 0.25-in. (0.6-cm) long and is brownish-green to brownish-black in color. It inhabits a unique desert wetland with a shallow flow of water from the seepage of more than 30 springs in the area. The water bugs are usually found on substrates of gravel and stones covered by warm spring water. The adults and nymphs are predatory and move slowly along submerged aquatic vegetation and the shoreline in search of food. This species feeds on a variety of insects, spiders, centipedes, and millipedes that live in Ash Meadows. The Ash Meadows naucorid is believed to occur at only one location in east central Ash Meadows.

The USFWS reported this species as occurring on the Ash Meadows National Wildlife Refuge. It is listed as one of 24 species of plant and animals that are endemic to the refuge.

The Ash Meadows naucorid was listed as federally threatened on May 20, 1985 (USFWS 1985). Critical habitat has been designated for this species in the Ash Meadows National Wildlife Refuge. Threats to the continued existence of the species have included habitat alteration and fragmentation from agriculture, stream channelization, peat mining, and water diversion.

The Ash Meadows naucorid may occur in the affected area of the Amargosa Valley SEZ.

Ash Meadows Pebblesnail (*Pyrgulopsis erythropoma*)

ESA Listing Status: Under Review
BLM Listing Status: Not Listed

State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Ash Meadows pebblesnail is endemic to the Ash Meadows National Wildlife Refuge, where it is known from only six spring-fed systems. The Ash Meadows pebblesnail may occur in the affected area of the Amargosa Valley SEZ.

Big Dune Miloderes Weevil (*Miloderes* sp. 1)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Big Dune miloderes weevil is endemic to the Big Dune area, approximately 3 mi (5 km) east of the Amargosa Valley SEZ. The Big Dune miloderes weevil may occur in the affected area of the Amargosa Valley SEZ.

Crescent Dunes Aegialian Scarab (*Aegialia crescenta*)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Crescent Dunes aegialian scarab is a sand dune obligates species primarily restricted to the Crescent Dunes, approximately 6 mi (10 km) east of the Millers SEZ. The Crescent Dunes aegialian scarab may occur in the affected area of the Millers SEZ.

Crescent Dunes Serican Scarab (*Serica ammomenisco*)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Crescent Dunes serican scarab is a sand dune obligates species primarily restricted to the Crescent Dunes, approximately 6 mi (10 km) east of the Millers SEZ. The Crescent Dunes serican scarab may occur in the affected area of the Millers SEZ.

Crystal Springsnail (*Pyrgulopsis crystalis*)

ESA Listing Status: Under Review
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The crystal springsnail is a freshwater mollusk endemic to the Ash Meadows region of Nye County, Nevada, where it is known only from Crystal Spring. Within this spring, this species is found clinging to the walls of deep orifices. The Crystal springsnail may occur in the affected area of the Amargosa Valley SEZ.

Distal Gland Springsnail (*Pyrgulopsis nanus*)

ESA Listing Status: Under Review
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The distal gland springsnail is a freshwater mollusk endemic to the Ash Meadows region of Nye County, Nevada. It is found at four small, spring-fed habitats within 6 mi (10 km) from each other. Within these habitats, the species occurs on soft substrates in warmer waters. The distal gland springsnail may occur in the affected area of the Amargosa Valley SEZ.

Elongate Gland Springsnail (*Pyrgulopsis isolata*)

ESA Listing Status: Under Review
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The elongate gland springsnail is a freshwater mollusk endemic to the Ash Meadows region of Nye County, Nevada. It is found only in the spring at Clay Pits. Within these habitats, the species occurs on soft substrates in thermal waters near the spring outflow. The elongate gland springsnail may occur in the affected area of the Amargosa Valley SEZ.

Fairbanks Springsnail (*Pyrgulopsis fairbanksensis*)

ESA Listing Status: Under Review
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Fairbanks springsnail is a freshwater mollusk endemic to the Ash Meadows region of Nye County, Nevada. It is found only in Fairbanks Spring. Within these habitats, the species occurs on soft substrates in thermal waters. The Fairbanks springsnail may occur in the affected area of the Amargosa Valley SEZ.

Giuliani's Dune Scarab Beetle (*Pseudocotalpa giulianii*)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Giuliani's dune scarab beetle is an insect that is endemic to the Big Dune and Lava Dune in Nye County, Nevada. Within these habitats, the species primarily lives beneath the sand surface; adults are active above ground for short periods near sunset. Adults breed on creosote bushes and on sand surfaces; larvae develop beneath the sand surface, where they apparently feed on plant roots. The Giuliani's dune scarab beetle may occur in the affected area of the following Amargosa Valley SEZ.

Grated Tryonia (*Tryonia clathrata*)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Nevada State Rank S2

The grated tryonia is a freshwater mollusk known from the Muddy River system in southern Nevada. The grated tryonia may occur in the affected area of the following SEZs: Delamar Valley and Dry Lake.

Great Basin Silverspot Butterfly (*Speyeria nokomis nokomis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Colorado)
State Listing Status: Not Listed
Rarity: Colorado State Rank S1; New Mexico State Rank S1

The Great Basin silverspot butterfly is known from northeastern Arizona, western Colorado, northern New Mexico, and eastern Utah. Within Colorado, this species occurs in isolated populations in streamside meadows and open seepage areas associated with violets. The Great Basin silverspot butterfly may occur in the affected area of the following SEZs: Antonito Southeast and Los Mogotes.

Hubbs Pyrg (*Pyrgulopsis hubbsi*)

ESA Listing Status: Under Review
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Hubbs pyrg is known only from Hiko Spring and Crystal Spring in the Pahranagat Valley of Lincoln County, Nevada. The species could possibly be extirpated at Hiko Spring. The Hubbs pyrg may occur in the affected area of the Delamar Valley SEZ.

Large Aegialian Scarab Beetle (*Aegialia magnifica*)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The large aegialian scarab beetle is an insect that is endemic to the Big Dune and Lava Dune in Nye County, Nevada, where the species is known to be dependent on deep sand habitats. Little information is known on the ecology of this species. The large aegialian scarab beetle may occur in the affected area of the Amargosa Valley SEZ.

Median Gland Springsnail (*Pyrgulopsis pisteri*)

ESA Listing Status: Under Review
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The median gland springsnail is a freshwater mollusk endemic to the Ash Meadows region of Nye County, Nevada. It is found in only three spring-fed habitats, all within 1 mi (1.6 km) of each other. Within these habitats, the species is found in the outflows of the springs on travertine, aquatic macrophytes or soft substrates. The median gland springsnail may occur in the affected area of the Amargosa Valley SEZ.

Minute Tryonia (*Tryonia ericae*)

ESA Listing Status: Under Review
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The minute tryonia is a freshwater mollusk endemic to the Ash Meadows region of Nye County, Nevada. It is known from fewer than four spring-fed habitats globally. Within these habitats, the species is found on macrophytes in thermal outflow waters. The minute tryonia may occur in the affected area of the Amargosa Valley SEZ.

Moapa Pebblesnail (*Pyrgulopsis avernalis*)

ESA Listing Status: Under Review
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Moapa pebblesnail is an aquatic snail restricted to the Moapa Springs in Clark County, Nevada. The Moapa pebblesnail may occur in the affected area of the Dry Lake SEZ.

Moapa Valley Pebblesnail (*Pyrgulopsis carinifera*)

ESA Listing Status: Under Review
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Moapa Valley pebblesnail is a freshwater mollusk restricted to spring-fed habitats in the Moapa Valley of southern Nevada. The Moapa Valley pebblesnail may occur in the affected area of the Dry Lake SEZ.

Moapa Warm Spring Riffle Beetle (*Stenelmis moapa*)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Moapa Warm Springs riffle beetle is an aquatic insect restricted to the Warm Springs Area of Clark County, Nevada. It occurs in swift, shallow waters of freshwater outlet springs on gravel substrates. It is often found near vegetation and bare tree roots. The Moapa Warm Spring riffle beetle may occur in the affected area of the Dry Lake SEZ.

Mojave Gypsum Bee (*Andrena balsamorhizae*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive

State Listing Status: Not Listed
Rarity: Nevada State Rank S2

The Mojave gypsum bee is an insect that is endemic to Nevada, where the species is restricted to gypsum soils associated with habitats of its single larval host plant, silverleaf sunray. Such habitats include warm desert shrub communities; dry, open, relatively barren areas on gypsum badlands; and volcanic gravels. The Mojave gypsum bee may occur in the affected area of the following SEZs: Dry Lake and East Mormon Mountain.

Mojave Poppy Bee (*Perdita meconis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Nevada State Rank S2

The Mojave poppy bee is an insect known only from Clark County, Nevada, where it is dependent on poppy plants (*Arctemocon* spp.). Such habitats include roadsides, washes, and barren desert areas. The Mojave poppy bee may occur in the affected area of the following SEZs: Delamar Valley, Dry Lake, and East Mormon Mountain.

Oasis Valley Springsnail (*Pyrgulopsis micrococcus*)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Nevada State Rank S2

The Oasis Valley springsnail is a freshwater mollusk endemic to the Amargosa River drainage and the Death, Panamint, and Saline Valleys in Inyo County, California, and Nye County, Nevada. The species occurs in small springs and stream outflows, where it is typically found on stone, travertine, and detritus. The Oasis Valley springsnail may occur in the affected area of the Amargosa Valley SEZ.

Pahranagat Naucorid (*Pelocoris shoshone shoshone*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Pahranagat naucorid is an aquatic insect known to occur only in the Muddy and White River Basins in southern Nevada. It inhabits warm, quiet waters of spring-fed systems.

The Pahranagat naucorid may occur in the affected area of the following SEZs: Delamar Valley and Dry Lake.

Pahranagat Pebblesnail (*Pyrgulopsis merriami*)

ESA Listing Status: Under Review
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Pahranagat pebblesnail is a freshwater mollusk restricted to spring-fed habitats in the White River system of southern Nevada. The Pahranagat pebblesnail may occur in the affected area of the Delamar Valley SEZ.

Point of Rocks Tryonia (*Tryonia elata*)

ESA Listing Status: Under Review
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The Point of Rocks tryonia is a freshwater mollusk endemic to the Ash Meadows region of Nye County, Nevada. It is found at only two localities at Point of Rocks Springs. Within these habitats, the species is found on travertine mounds near spring outflows. The Point of Rocks tryonia may occur in the affected area of the Amargosa Valley SEZ.

Sporting Goods Tryonia (*Tryonia angulata*)

ESA Listing Status: Under Review
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Nevada State Rank S1

The sporting goods tryonia is a freshwater mollusk endemic to the Ash Meadows region of Nye County, Nevada, where it is known from only three springs. Within these habitats, the species is found on soft substrates in thermal waters. The Sporting Goods tryonia may occur in the affected area of the Amargosa Valley SEZ.

Spring Mountains Springsnail (*Pyrgulopsis deaconi*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive

State Listing Status: Not Listed
Rarity: New Mexico State Rank S1; Nevada State Rank S1

The Spring Mountains springsnail is endemic to freshwater springs of the Spring Mountains in southern Nevada. The Spring Mountains springsnail may occur in the affected area of the Dry Lake SEZ.

J.6.1.3 Fish

Ash Meadows Amargosa Pupfish (*Cyprinodon nevadensis mionectes*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2

The Ash Meadows Amargosa pupfish is found in 10 spring areas within the Ash Meadows of Nye County, Nevada. Most of these springs are on public land within the Ash Meadows National Wildlife Refuge (USFWS 2010a). Typical habitat consists of ephemeral pools, headwater spring pools, and outfall drainage and marshes that connect to the spring system. This species feeds mainly on blue-green algae and small invertebrates. It breeds throughout the year, with peaks in spring and early summer (Nature Serve 2010).

The Ash Meadows Amargosa pupfish was listed as federally endangered on September 28, 1983 (USFWS 1983). Critical habitat was also designated on this date within the Ash Meadows National Wildlife Refuge.

Threats to the species include competition and predation from introduced non-native species, channelization, water impoundment and diversion, groundwater pumping, pollution, and elimination of riparian vegetation (Nature Serve 2010).

The Ash Meadows Amargosa pupfish may occur in the affected area of the Amargosa Valley SEZ.

Ash Meadows Speckled Dace (*Rhinichthys osculus nevadensis*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1

The Ash Meadows speckled dace, also known as the Nevada speckled dace, is endemic to spring systems and aquatic habitats formed by spring waters at Ash Meadows, in Nye County, Nevada. Although formerly more widespread in the area, the species is currently restricted to

Jackrabbit Spring, Big Spring, the two westernmost springs of the Bradford Springs group, and the outflows of these springs. This dace is known to occur in headwater spring pools, spring outflow creeks (including areas of the creek up to a mile or more from their spring sources), and marshes formed by spring flows. The subspecies also occurs in irrigation ditches and canals that utilize the spring flows for irrigation. The Ash Meadows speckled dace appears to be rather general in its habitat requirements, utilizing areas with a rather fast stream current as well as quiet spring pools (Nature Serve 2010).

Speckled dace are typically omnivores. They often feed on bottom materials, including aquatic insect larvae, crustaceans, attached diatoms, snails, and algae. Some mid-water foods or even an occasional surface insect will be taken. Terrestrial insects that fall in the water may also be consumed. Speckled dace typically mature in their second summer. Spawning often occurs during the spring, but some spawning may take place all year, especially in spring habitats with a rather narrow range of temperatures. Speckled dace typically spawn on the gravel edge or riffles in stream habitats. Eggs hatch in approximately 6 days.

Human development in the area consists primarily of small, scattered residences with which subsistence gardens, small orchards, or agricultural fields may be associated. During the early 1970s, a large farm began operating in Ash Meadows. Development of the farm involved the extensive removal of natural vegetation; land leveling; the construction of irrigation wells, ditches, and fences; and other activities necessary for commercial farming. The former major threats from dewatering and development were eliminated with the establishment of the Ash Meadows National Wildlife Refuge. However, some of the spring outflows that were diverted into ditches in the past remain today.

The Nevada speckled dace was federally listed as endangered on September 2, 1983 (USFWS 1983). Critical habitat was also designated on this date.

The primary threats to the Nevada speckled dace consist of habitat destruction and the effects of exotic fish introductions. Because of the acquisition of many spring areas by the USFWS, the major threats in the future will most likely consist of additional exotic species introductions rather than physical habitat alteration (Nature Serve 2010).

The Ash Meadows speckled dace may occur in the affected area of the Amargosa Valley SEZ.

Desert Pupfish (*Cyprinodon macularius*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Arizona Wildlife Species of Concern; Endangered in California
Rarity: Arizona State Rank S1; California State Rank S1

The desert pupfish is a small fish that seldom exceeds 3 in. (7.5 cm) in length. Historically, the desert pupfish occupied marshes, desert springs, and tributary streams in the

Lower Colorado and Gila River watersheds in California, Arizona, and Mexico (USFWS 2010b,c). Currently it is known from only two Salton Sea tributaries in California and a few shoreline pools and irrigation drains in Imperial and Riverside Counties. Successful re-introductions have taken place in Riverside and Butte Counties in California and in Pima, Pinal, Maricopa, Graham, Cochise, LaPaz, and Yavapai Counties in Arizona. The desert pupfish can occupy locations where environmental conditions are extreme; namely, areas with dissolved oxygen concentrations of <0.4 mg/L, salinity levels twice as high as those of sea water, and temperatures up to 113°F (45°C) (USFWS 2010c). Shallow water, good clarity, and soft substrates are common features of the desert pupfish habitat. The desert pupfish typically feeds on a variety of algae, plants, aquatic invertebrates, and detritus.

Reproduction occurs during the second summer for most desert pupfish. Spawning occurs throughout late spring and summer, with up to three generations produced in a single season (Nature Serve 2010; USFWS 2010c).

The desert pupfish was listed as federally endangered on March 31, 1986 (USFWS 1986). Critical habitat was also designated on this date. Threats to the species include competition and predation from introduced non-native species, channelization, water impoundment and diversion, groundwater pumping, pollution, and erosion from livestock grazing within the watershed (Nature Serve 2010; USFWS 2010c).

The desert pupfish may occur in the affected area of the Bullard Wash SEZ.

Devil's Hole Pupfish (*Cyprinodon diabolis*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1

The Devil's Hole pupfish is a small species about 1-in. (2.5-cm) long that occurs in Devil's Hole in the Amargosa Valley of Nevada, located about 90 mi northwest of Las Vegas (USFWS 1990). While this species is naturally restricted to Devil's Hole, the species has been introduced in artificial refugia at the Amargosa Pupfish Station in Ash Meadows and in facilities constructed by the Bureau of Reclamation located near the Hoover Dam. It lives only for one year or less and spawns between April and mid-June. Population levels vary from about 125 to 550 individuals (USFWS 1990). The variation between spring and fall counts is a function of severe environmental conditions, low oxygen levels, and low sunlight during the winter months, which is a factor in algal production in the cavern. A population maintained within a refugium seems to survive longer and fluctuate less between spring and fall than does the natural population (USFWS 1990). Food of the pupfish includes algae and detritus obtained from the sides and bottom of the cavern.

The Devil's Hole pupfish was listed as federally endangered on March 11, 1967 (USFWS 1967). Critical habitat has not been designated for this species. The greatest threat to

continued survival of the species is the small numbers existing in Devil's Hole. The presence of non-native snails is a threat if they are not controlled. These snails consume algae that the pupfish feed on and rely on for oxygen production (Nature Serve 2010).

The Devil's Hole pupfish may occur in the affected area of the Amargosa Valley SEZ.

Gila Topminnow (*Poeciliopsis occidentalis occidentalis*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Arizona Wildlife Species of Concern
Rarity: Arizona State Rank S1

The Gila topminnow (*Poecilioposis occidentalis occidentalis*) is a small, live-bearing minnow that occurs in isolated springs in the Santa Cruz River system in New Mexico and Arizona and on the San Carlos Apache Indian Reservation located in southeastern Arizona. The Gila topminnow distribution in New Mexico and Arizona includes Redrock Canyon, Cottonwood Spring, Monkey Spring, upper Sonoita Creek, Fresno Canyon, Coal Mine Canyon, lower Sonoita Creek, Santa Cruz River north of Nogales, Cienega Creek, Sharp Spring, the upper Santa Cruz River, Bylas Spring, Middle Spring, and Salt Creek. Topminnows have fairly broad habitat requirements. They prefer shallow, warm, quiet water but can adjust to a rather wide range of conditions, living in quiet to moderate currents. Topminnows live in a variety of water types: springs, cienegas, marshes, permanent streams, intermittent streams, and, formerly, along the edges of large rivers. Their preferred habitat consists of dense mats of algae and debris, usually along stream margins or below riffles, with sandy substrates, sometimes covered with organic mud and debris (AZGFD 1998; Nature Serve 2010).

The diet of the Gila topminnow is fairly generalized, consisting mostly of bottom debris, vegetable material, and amphipod crustaceans. The topminnows feed voraciously upon aquatic insect larvae, such as mosquitoes, when available. The breeding season for this species lasts from January to August, but a few pregnant females are present throughout the year, and young are produced even in winter. Sexual maturity may occur in a few weeks to many months after birth, depending largely on the time of year the individual is born. Topminnows are not expected to live longer than a year under natural conditions (Nature Serve 2010).

The Gila topminnow was federally listed as endangered on March 11, 1967 (USFWS 1967). Critical habitat has not been designated. The decline of this subspecies is attributable to several factors: the construction of dams; the introduction of non-native predatory and competitive fish; the drainage of wetlands and cienegas; and the desiccation of streams, springs, and cienegas. Today, because of the presence of barriers to movement, Gila topminnows can no longer re-distribute from their remaining isolated and widely separated populations to colonize formerly occupied habitats, even during years with above average rainfall (AZGFD 1998; Nature Serve 2010).

The Gila topminnow may occur in the affected area of the Bullard Wash SEZ.

Hiko White River Springfish (*Crenichthys baileyi grandis*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1

The Hiko White River springfish is a subspecies of White River springfish (*C. b. baileyi*) that occurs only in the Hiko Springs and Crystal Spring of the White River, located north of Alamo, Nevada. It has also been introduced into Blue Link Spring in Mineral County, Nevada. In the mid 1990s, the populations of the Hiko Springs and Blue Link Springs totaled about 5,500 and 12,000 fish, respectively. The Crystal Spring population was <125 and in danger of extirpation.

The life history of the HikoWhite River springfish is poorly understood but is generally considered to be similar to that of the White River springfish. Adults prefer water depths of about 1 m (3.5 ft), while larval fish are most often in shallow areas at depths of 0 to 0.6 m (0 to 2 ft). Spawning occurs between April and August, with the timing of spawning related to primary production in the pools.

The white river springfish was listed as federally endangered on September 27, 1985 (USFWS 1985). Critical habitat was also designated on that date. Agricultural and municipal use of Hiko Spring continues to limit the water available for the Hiko White River springfish. The only surface water remaining is a small spring impoundment and seepage from this pool. The Crystal Spring site is also affected by water withdrawal for agriculture (Nature Serve 2010).

The Hiko White River springfish may occur in the affected area of the Delamar Valley SEZ.

Moapa Dace (*Moapa coriacea*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1

The Moapa dace is endemic to the warm spring area at the headwaters of the Moapa (Muddy) River, in northern Clark County, southeastern Nevada. It is restricted to 10 warm springs, their outflows, and the warm waters of the upper mainstream Muddy River. The velocity of the water flow is variable, but in many areas, it can be swift. Streamside vegetation is dense throughout most of the Moapa dace habitat, frequently forming a complete canopy over the stream and filling the channel with snags and brush. Streamside vegetation consists of ash, cottonwood, screwbean mesquite, willow, tamarisk, grape vines, and a variety of shrubs, grasses, and herbs (Nature Serve 2010). The Moapa dace appears to be predominantly carnivorous, feeding on invertebrates, and on lesser amounts of detritus and filamentous algae. Observation of

feeding indicates that the species feeds relatively indiscriminately on organisms drifting with the current. Fish tend to congregate at dawn and dusk in swift water near snags and dash up into the current to pick off drift material passing by. Moapa dace will consume benthic invertebrates directly off the bottom in pool habitats. Larvae living in shallower, more slowly moving water probably feed on smaller micro-crustaceans.

Moapa dace can reproduce throughout the year in the nearly constant temperatures of their habitat. Peak reproduction probably occurs from February to April, followed by peak emigration of the young in May. This species has been observed spawning on sandy substrate in a water depth of 6 to 7.5 in. (15 to 19 cm) and a near-bed velocity of 0.1 to 0.3 ft/s (3 to 9 cm/s).

The Moapa dace was federally listed as endangered on March 11, 1967 (USFWS 1967). Critical habitat has not been designated.

The most important factor limiting the distribution and abundance of the Moapa dace within its former range was probably the turbidity caused by irrigation return flows into the formerly clear water. The feeding ability of the Moapa dace may have been severely curtailed by this increased turbidity. Other apparent reasons for the decline of the species include competitive interactions with introduced exotic species, parasites (commonly associated with aquarium fishes and introduced through these exotic fish), and declining water quality (chemical parameters and physical parameters) from channelization and irrigation for agricultural development. Future threats to the species include additional water development for irrigation or any activity that would increase the water turbidity, reduce the low gene pool, channelize the stream course, or add exotic species to the stream in the headwaters of the Muddy River (Nature Serve 2010).

The Moapa dace may occur in the affected area of the Dry Lake SEZ.

Moapa Speckled Dace (*Rhinichthys osculus moapae*)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1

The Moapa speckled dace is endemic to Clark County, Nevada, where it is restricted to the Moapa (Muddy) River system. It utilizes stream bottoms in shallow, cobble riffles. These fish occur in low-velocity areas behind rocks. Spawning habitat consists of small patches of bare rocks and pebbles. The Moapa speckled dace may occur in the affected area of the Dry Lake SEZ.

Moapa White River Springfish (*Crenichthys baileyi moapae)*

ESA Listing Status: Under Review
BLM Listing Status: Not Listed

State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2

The Moapa White River springfish is endemic to southern Nevada, where it is restricted to five warm-water springs in the upper Muddy River. Preferred habitat includes spring pools and backwaters in spring outflows. The species is more abundant in and near the springs than in the river. The Moapa White River springfish may occur in the affected area of the Dry Lake SEZ.

Mohave Tui Chub (*Gila bicolor mohavensis*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Endangered in California (California Fully Protected)
Rarity: California State Rank S2

The Mohave tui chub is a medium-sized to large subspecies that ranges from 2 to 3.5 in. (5.2 to 9.2 cm) in length and can reach lengths of 6.5 in. (17 cm). It occurred historically in the Mohave River from the union of the east and west forks at the base of the San Bernardino Mountains downstream to Soda Dry Lake in San Bernardino County, California. The existing Mohave tui chub populations occur at four sites: Soda Springs, the California Department of Fish and Game's Camp Cady Wildlife Area, China Lake Naval Air Weapons Center, and the Barstow Desert Information Center (USFWS 2009a).

Habitat for the Mohave tui chub consists of deep pools and slough-like areas. Ditch-grass (*Ruppia maritima*) in the sloughs likely provides spawning habitat and cover for juvenile fish, protecting them from airborne predators (USFWS 2009a). Mohave tui chub typically spawn from March/April to October. Females lay approximately 4,000 to 50,000 eggs over aquatic vegetation. Once hatched, the fry will school in the shallows, while medium-sized (1 to 3 in. or 2.5 to 7.5 cm) tui chub school in water that is 1- to 2-in. (2.5- to 5-cm) deep. Large chub are typically solitary and found in deeper water. Foods consumed include plankton, beetle larvae, chironomid larvae, and organic debris (USFWS 2009a).

The Mohave tui chub was listed as federally endangered on October 13, 1970 (USFWS 1970). Critical habitat has not been designated for this species.

The greatest threat to continued survival of this species is lack of vegetation management in the ponds and sloughs. Overgrown areas are filled with decomposing vegetation, which lowers the dissolved oxygen in quiet, shallow habitats. Because of the isolated habitats in Soda Springs, the species is subject to decreased genetic variability from inbreeding. Other threats include introduction of other exotic species, habitat alteration, water diversion, and pollution (Nature Serve 2010; USFWS 2009a).

The Mohave tui chub may occur in the affected area of the Pisgah SEZ.

Oasis Valley Speckled Dace (*Rhinichthys osculus* ssp. 6)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1; USFWS Species of Concern

The Oasis Valley speckled dace is a small fish species that is restricted to spring-fed habitats in the Oasis Valley, Nye County, Nevada. The Oasis Valley speckled dace may occur in the affected area of the Amargosa Valley SEZ.

Pahranagat Roundtail Chub (*Gila robusta jordani*)

ESA Listing Status: Endangered
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1

The Pahranagat roundtail chub is a species that is about 10-in. (25-cm) long. It is found only in Ash Springs, located in the Pahranagat Valley, Lincoln County, Nevada, and in about 7,400 ft (2,250 m) of its outflow. The Pahranagat roundtail chub is usually quite rare in the upper 6,400 ft (1,950 m) of the outflow stream but maintains good numbers of adults in a single microhabitat in the lower portion of the natural channel. The lower section of the natural channel from about 6,400 to 7,400 ft (1,950 to 2,250 m) below Ash Springs is a generally broad, straight channel. There are scattered, dense stands of willow and grape along the stream margin, with some ash and cottonwood. Root projections, fallen branches (and logs), and overhanging branches provide aquatic cover. The substrate is sand, silt, and mud. Runs and pools make up about 92% and 8%, respectively, of the available habitat. The relative scarcity of deep, slow run/pool habitats with associated cover may impose some limitation on population size in this last remaining habitat available to the species.

Reproduction occurs in the outflow of Ash Spring during February and March, when adults leave their sheltered pool. This period coincides with annual thermal minimum temperatures. Juveniles have been observed in the outflow from March through September, disappearing rapidly from the population during October through January. Juveniles are primarily insectivorous, while adults consume mostly plant material.

The Pahranagat roundtail chub was federally listed as endangered on October 13, 1970 (USFWS 1970). Critical habitat has not been designated for this subspecies. Threats to the existence of this subspecies include habitat loss, predation, and competition with introduced exotic species. The species was extirpated from Crystal Spring, possibly as a result of the introduction of largemouth bass into the system. The subspecies appears to be presently threatened by having lost most of its stream habitats, adverse consequences of interaction with exotic fishes and snails, and loss of young to downstream intermittent habitats (Nature Serve 2010).

The Pahranagat roundtail chub may occur in the affected area of the Delamar Valley SEZ.

Pahranagat Speckled Dace (*Rhinichthys osculus velifer)*

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1

The Pahranagat speckled dace is endemic to Nevada where it is restricted to the White River Valley system. It inhabits rivers, streams, tributaries, springs, brooks, marshes, lakes, and reservoirs. The Pahranagat speckled dace may occur in the affected area of the Delamar Valley SEZ.

Pahrump Poolfish (*Empetrichthys latos*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1

The Pahrump poolfish is a small omnivore that is about 2-in. (5-cm) long at maturity. It is endemic to the Pahrump Valley in southern Nye County, Nevada. After nearly becoming extinct, three populations were re-established at the following locations: Corn Creek Spring on the Desert National Wildlife Refuge north of Las Vegas, Nevada; Shoshone Springs southeast of Ely, Nevada; and an irrigation reservoir located on the Spring Mountains Ranch State Park west of Las Vegas. No information was found on reproduction in this species.

Prior to the loss of the Manse Spring population, the habitat consisted of water with a constant temperature of 76°F (24°C), with emergent vegetation in the shallow areas. Larger fish used the open, deeper waters of the spring; juveniles were in the shallows with emergent vegetation.

The Pahrump poolfish was listed as federally endangered on March 11, 1967 (USFWS 1967). Critical habitat has not been designated for this species. The greatest threat to the re-introduced populations is competition and predation from other fish.

The Pahrump poolfish may occur in the affected area of the Dry Lake SEZ.

Rio Grande Chub (*Gila pandora)*

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Colorado Species of Concern
Rarity: Colorado State Rank S1; New Mexico State Rank S2

The Rio Grande chub is restricted to streams of the Rio Grande Basin. It inhabits clear, cool, fast-flowing water over rubble or gravel substrates. The Rio Grande chub may occur in the affected area of the following SEZs: Antonito Southeast, De Tilla Gulch, and Los Mogotes East.

Rio Grande Sucker (*Catostomus plebeius*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Endangered in Colorado
Rarity: Colorado State Rank S1; New Mexico State Rank S2

The Rio Grande sucker is restricted to streams of the Rio Grande Basin, from south central Colorado to southern New Mexico. It is found in channels and backwaters near rapidly flowing waters. The Rio Grande sucker may occur in the affected area of the following SEZs: Antonito Southeast, De Tilla Gulch, and Los Mogotes East.

Roundtail Chub (*Gila robusta*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Arizona Wildlife Species of Concern
Rarity: Nevada State Rank S1, Arizona State Rank S2; Utah State Rank S2;
USFWS Species of Concern

The roundtail chub is known from larger tributaries in the Colorado Basin, from Wyoming south to Arizona and New Mexico. It occupies cool to warm water streams and rivers consisting of pools adjacent to riffles and runs. The roundtail chub may occur in the affected area of the Gillespie SEZ.

Warm Springs Pupfish (*Cyprinodon nevadensis pectoralis*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1

The warm springs pupfish occupies six springs, outflow drainages, and marsh habitats in Ash Meadows, Nye County, Nevada. These springs are North Scruggs Springs, South Scruggs Springs, Marsh Springs, North Indian Springs, South Indian Springs, and School Springs. The characteristics of the habitat of the springs are fairly constant. Temperatures in the springs range from 86 to 91°F (30 to 33°C), and the pools are less than 4-ft (1.3-m) deep. *Chara* and *Spirogyra* are the common submerged plants; *Scirpus* and *Typha* make up most of the emergent vegetation. Salinity in these habitats is generally low. Little is known of the food habits of the warm springs pupfish, but it is thought to feed primarily on algae and detritus throughout the year.

Reproduction occurs throughout the year at some springs and from February through September in both Indian Springs. Several generations may be produced in a given year. Spawning habitat is in open water with soft silt or sandy substrate. Fry occupy shallow areas where algal growth is high.

The warm springs pupfish was listed as federally endangered on October 13, 1970 (USFWS 1970). No critical habitat is designated for this species. Threats to the species include competition and predation from introduced non-native fish species. Bullfrogs and crayfish are potential predators in much of the pupfish's habitat (Nature Serve 2010).

The warm springs pupfish may occur in the affected area of the Amargosa Valley SEZ.

White River Desert Sucker (*Catostomus clarkii intermedius*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1

The White River desert sucker is a small fish endemic to Nevada, where it is restricted to remnant streams of the White River system. The White River desert sucker may occur in the affected area of the Delmar Valley SEZ.

White Sands Pupfish (*Cyprinodon tularosa*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Threatened in New Mexico
Rarity: New Mexico State Rank S1; USFWS Species of Concern

The White Sands pupfish is endemic to the Tularosa Basin in southern New Mexico. It occurs in Malpais Spring and Lost River in Otero County, Salt Creek in Sierra County, and Mound Springs in Lincoln County. Characteristic habitat is clear, shallow, strongly alkaline pools and calm spring runs. Breeding adults prefer water temperatures of 59 to 70°F (15 to 21°C), although the habitat they occupy is characterized by high daily temperature fluctuations,

and they can tolerate temperatures of 30 to 100°F (–1 to 38°C). Salinity ranges from 2,000 to 100,000 mg/L total dissolved solids (TDS). Water depth utilized is less than 1 ft (0.3 m). Substrate is mud-silt and sand-gravel. Associated species include salt grass (*Distchlis stricta*), salt cedar (*Tamarix chinensis*), *Scirpus* spp., *Ruppia* spp., *Eleocharis* spp., Characeae, and pondweed (*Potamogeton* spp.) (NMDGF 2010).

Feeding mainly on algae and mosquito larvae, the White Sands pupfish will also consume its own eggs and fry. It is omnivorous, feeding most heavily on Culicidae, although it will eat other invertebrates, algae, juveniles of its own species, plant matter, and aquatic insects. Spawning begins at 64°F (18°C) in early April and continues through mid-September, peaking in July. Males establish breeding territories in the shallow periphery of their habitat and entice females to mate by using ritualized movements. Females possess up to 338 mature ova and spawn several times each season. Pupfish grow rapidly in their first year of life, their mean longevity is 2 years, and their maximum is 5 years.

In 1998, the White Sands pupfish was abundant and reasonably secure in its limited habitat. The population remained stable in 1990, 1991, 1994, and 1996. Its abundance varies seasonally, with the highest densities occurring in summer and autumn. Its abundance is directly correlated with the extent of wetted habitats.

The White Sands pupfish was a federal "Notice of Review" species for possible listing as endangered or threatened in 1985. It was identified as a Category 2 candidate on November 21, 1991, and listed as a species for consideration to be listed as threatened or endangered on November 15, 1994. In 1996, the USFWS eliminated this category designation, and the species was listed as a species of concern. It is listed as threatened by the state of New Mexico and is ranked S1 in the state. Threats include invasive species, its extremely limited range, chemical contamination, and water diversion (NMDGF 2010).

J.6.1.4 Amphibians

Amargosa Toad (*Bufo nelsoni*)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2

The Amargosa toad is a small toad that is endemic to a very small range (<40 mi^2 [100 km^2]) in the Amargosa Valley in Nye County, Nevada. The species is confined to isolated riparian and spring-fed habitats along the Amargosa River. It is usually observed near water at the outflow of warm springs. The Amargosa Toad may occur in the affected area of the Amargosa Valley SEZ.

Lowland Leopard Frog (*Lithobates yavapaiensis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Arizona)
State Listing Status: Arizona Wildlife Species of Concern
Rarity: California Species of Concern; USFWS Species of Concern

Lowland leopard frogs (*Lithobates yavapaiensis)* occur in a variety of natural and manmade aquatic systems. General habitat associations include small to medium-sized streams, rivers, channels, springs, ponds, and stock ponds within desert scrub, grassland, woodland, and pinyon-juniper habitats dominated by bulrushes, cattails (*Typha* sp.), and riparian grasses near or under an overstory of Fremont cottonwoods (*Populus fremonti*) and willows (*Salix* sp.) and mesquite *(Prosopis* sp.). Selected sites are characterized as having a semi-permanent to permanent hydrological cycle, a salinity range of 6.0% to 9.0%, and a thermal range of 51.8 to 84.2°F (11 to 29°C) (AmphibiaWeb 2010). Within these communities, individuals select daily basking sites close to refugia in the form of emergent and perimeter vegetation, deep water, root masses, undercut banks, and debris piles. Foraging is also conducted within these sites, since a wide variety of insects and other arthropods make up this frog's diet (Nature Serve 2010).

The historic distribution of the lowland leopard frogs once extended discontinuously from Arizona and New Mexico in the south, west to California, and north to Nevada and Utah. Recent studies, however, indicate that habitat changes associated with agriculture, livestock grazing, development, reservoir construction, and exotic predatory species have caused this range to contract by nearly 50%. Populations of lowland leopard frogs are currently limited to Arizona and New Mexico at an elevation ranging from sea level to 5,961 ft (0 to 1,817 m).

The lowland leopard frog was formerly a Category 2 candidate species under the ESA until the classification system was modified and subsequently removed from the list.

Lowland leopard frog populations could potentially occur in the affected areas of the following SEZs: Brenda, Bullard Wash, and Gillespie.

Northern Leopard Frog (*Lithobates pipiens*)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: California State Rank S2; Nevada State Rank S2; New Mexico State Rank S2; Colorado Species of Concern

Northern leopard frogs (*Lithobates pipiens)* require a broad range of habitats in close proximity because of their complicated life histories (Smith and Keinath 2007). Critical habitat types vary by season and life stage, and they tend to exhibit a high degree of site fidelity (Jennings and Hayes 1994). Breeding habitat consists of a variety of aquatic habitats, with preferred sites characterized as having a semi-permanent to seasonal hydrological cycle; a

shallow water depth (<2 m); an areal extent of less than 20 ac (8 ha); abundant emergent vegetation dominated by cattails (*Typha spp.*); an unconsolidated bottom; a low canopy cover (<30%); low salinity; and an absence of predatory fish (Smith and Keinath 2007). Following reproduction, adult and juvenile northern leopard frogs disperse into adjacent riparian habitat that is dominated by dense, relatively tall grasses or forbs and has a moist substrate, where they forage opportunistically for insects, arachnids, worms, and crustaceans (Jennings and Hayes 1994). Overwintering occurs beneath leaf litter or below logs or within ponds or flowing streams.

The size of the home range of northern leopard frog populations is determined by the spatial configuration of breeding and nonbreeding habitats across the landscape. This area typically encompasses a relatively small areal extent of 161 to 6,458 ft^2 (15 to 600 m^2). Within these territories, individuals disperse from 16 to 26,247 ft (5 to 8,000 m) from natal ponds into terrestrial habitat, with juveniles making larger movements (>2,625 ft or >800 m) than adults (<328 ft or <100 m) (Jennings and Hayes 1994).

Historically, the northern leopard frog was one of the most common and widespread anurans in North America, occurring from southern Canada, south to Pennsylvania and Kentucky, and west to the Pacific states. However, since the 1970s, this species has experienced significant declines and local extirpations throughout most of its range, particularly in the western states of California, Colorado, Montana, Idaho, eastern Washington, and Arizona (Smith and Keinath 2007).

The western population of the northern leopard frog, including populations within California, Arizona, Colorado, Idaho, Iowa, Minnesota, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Texas, Utah, Washington, Wisconsin, and Wyoming, was petitioned for listing under the ESA on July 9, 2009. In response to that petition, the USFWS has initiated a status review for this species to determine whether listing is warranted on October 28, 2009 (USFWS 2009b).

Northern leopard frog populations could potentially occur in the affected areas of the following SEZs: Antonito Southeast, Delamar Valley, and Los Mogotes East.

Southwestern Toad (*Bufo microscaphus*)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive
State Listing Status: Utah Species of Concern
Rarity: Nevada State Rank S2; Utah State Rank S2; USFWS Species of Concern

The southwestern toad is an amphibian that occupies scattered habitats in Arizona, Nevada, New Mexico, and Utah. It occurs in woodlands and low-elevation riparian habitats in association with permanent or semi-permanent water bodies. The **s**outhwestern toad may occur in the affected area of the following SEZs: Bullard Wash, Delmar Valley, Dry Lake, and Gillespie.

J.6.1.5 Reptiles

Arizona Skink (*Eumeces gilberti arizonensis*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Arizona Wildlife Species of Concern
Rarity: Arizona State Rank S1; USFWS Species of Concern

The Arizona skink is a subspecies of Gilbert's skink (*Eumeces gilberti*) that is known only from west central Arizona. It occurs among rocks, logs, and leaf litter areas near permanent or semi-permanent streams and riparian drainages up through oak-pine woodlands. The Arizona skink may occur in the affected area of the Bullard Wash SEZ.

Colorado Desert Fringe-Toed Lizard (*Uma notata*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Arizona)
State Listing Status: Not Listed
Rarity: California State Rank S2

The Colorado Desert fringe-toed lizard (*Uma notats*), an aeolian sand specialist, is restricted to sparsely vegetated areas with fine, loose, windblown sand, including dunes, flats, and riverbanks and washes of very arid desert (Nature Serve 2010). Individuals establish home ranges that extend from 0.2 to 0.5 ac (0.10 to 0.2 ha) within areas that provide critical habitat components, including (1) access to sands on windward ends of small accretion dunes and (2) sparse shrubs and annual vegetation that provide primary dietary resources (e.g., ants, beetles, true bugs, grasshoppers, and caterpillars) (Mayhew 1964). Preferred habitats generally occur within creosote scrub desert communities at elevations ranging from sea level to 1,600 ft (0 to 490 m).

The geographic distribution of the Colorado Desert fringe-toed lizard extends from extreme southeast California in the Colorado Desert from the Salton Sea and Imperial sand hills east to the Colorado River, south to the Colorado River delta, and on into extreme northeastern Baja California. The lizard's range extends west as far as the east base of Borrego Mountain.

Specific estimates of population size are not known, but the lizard's status is considered relatively stable range-wide. However, recent investigations have suggested that many populations are vulnerable to, or have already undergone, local extirpation as a result of disruption to dune formation processes, off-highway vehicles, and increased predator populations (CaliforniaHerps 2010; Murphy et al. 2006; Nature Serve 2010).

Colorado Desert fringe-toed lizard populations may potentially occur within the affected area of the Imperial East SEZ.

Desert Tortoise (*Gopherus agassizii*)

ESA Listing Status: Threatened (Mojave Desert populations);
Under Review (Sonoran populations)
BLM Listing Status: Listed as Sensitive (Arizona)
State Listing Status: Arizona Wildlife Species of Concern; Threatened in California
Rarity: None

The desert tortoise occurs in desert regions of the southwestern United States and northwestern Mexico. Within the six-state solar energy study region, it occurs in portions of Arizona, California, Nevada, and Utah. Populations of this species are found in the Mojave and Sonoran Deserts. The Mojave population, which includes desert tortoises north and west of the Colorado River, is currently listed as threatened under the ESA. The Sonoran population, which occurs south and east of the Colorado River, is currently under review for ESA listing.

Within the varied plant communities of the Mojave and Sonoran Desert regions, desert tortoises can potentially survive and reproduce where their basic habitat requirements are met. These requirements include sufficient suitable plants for forage and cover and suitable substrates for burrow and nest sites. Desert tortoises occur primarily on flats and bajadas that have soils ranging from sand to sandy-gravel and that are characterized by scattered shrubs and abundant inter-shrub space for growth of herbaceous plants. Desert tortoises are also found on rocky terrain and slopes in parts of the Mojave and Sonoran Desert regions. There is substantial geographic variation in the way tortoises use available resources. Desert tortoises spend much of their lives in burrows, emerging to feed and mate during late winter and early spring. They typically remain active through the spring, and they sometimes emerge again after summer storms. During these activity periods, desert tortoises eat a wide variety of herbaceous plants, particularly grasses and the flowers of annual plants. Desert tortoises exhibit delayed maturity and live a long life. Females typically create a nest under a large shrub or at a burrow entrance and lay from 2 to 14 eggs from May to July (Utah Division of Wildlife Resources 2010). Adults are well-protected against most predators (apart from humans) and other environmental hazards. During hibernation, several individuals often occupy the same burrow (Utah Division of Wildlife Resources 2010). Their longevity helps compensate for their variable annual reproductive success, which is correlated with environmental conditions.

Several factors have led to declining populations of the desert tortoise. Reductions in tortoise numbers have been attributed to direct and indirect human-caused mortality, coupled with the inadequacy of existing regulatory mechanisms to protect desert tortoises and their habitat. Impacts, such as the destruction, degradation, and fragmentation of habitat, result from urbanization, agricultural development, livestock grazing, mining, and roads. In addition, an upper respiratory tract disease is an additional major cause of mortality and population decline, particularly in the western Mojave Desert. Predators that prey on adult desert tortoises include the coyote (*Canis latrans*), kit fox (*Vulpes macrotis*), raccoon (*Procyon lotor*), bobcat (*Felis rufus*), badger (*Taxidea taxus)*, and feral dog (*Canis familiaris*). Predators of tortoise eggs and young include the common raven (*Corvus corax*), gila monster (*Heloderma suspectum*), snakes, roadrunner (*Geococcyx californianus*), red-tailed hawk (*Buteo jamaicensis*), and badger (USFWS 2008a).

The Mojave population of desert tortoise (including any Sonoran Desert tortoises that are outside their normal range) was federally listed as threatened on April 2, 1990. On February 8, 1994, the USFWS designated approximately 6.4 million ac (25,900 km^2) of desert as critical habitat for this species. The Mojave population was listed in response to precipitous declines in desert tortoise numbers in many areas.

Mojave populations of the desert tortoise, listed as threatened under the ESA, may occur in the affected areas of the following SEZs: Amargosa Valley, Delamar Valley, Dry Lake, Dry Lake Valley North, East Mormon Mountain, Iron Mountain, Pisgah, and Riverside East. Sonoran populations of the desert tortoise, currently under review for ESA listing, may occur in the affected areas of the following SEZs: Brenda, Bullard Wash, and Gillespie.

Flat-Tailed Horned Lizard (*Phrynosoma mcallii*)

ESA Listing Status: Proposed
BLM Listing Status: Listed as Sensitive (California)
State Listing Status: Arizona Wildlife Species of Concern
Rarity: Arizona State Rank S2; California State Rank S2

The flat-tailed horned lizard (*Phrynosoma mcallii*) is confined to dunes, sandy hills and washes, badlands, and salt flats within desert scrub communities. It occurs at an elevational range of 0 to 1,606 ft (0 to 520 m) primarily on fine, windblown silica sand deposits, with gravelly soils utilized to a lesser extent. White bursage (*Ambrosia dumosa*), indigo bush (*Dalea emoryi*), saltbush (*Atriplex canescens* and *A. polycarpa*), and big galleta grass (*Pleuraphis rigida*) are highly correlated to high species density, presumably for their ability to trap windblown sand and provide shade for thermal cover (Flat-Tailed Horned Lizard Interagency Coordinating Committee 2003). Home ranges encompass a spatial extent of 0.5 to 8.8 ac (0.2 to 3.6 ha) and coincide closely with the presence of the lizard's primary prey item, harvester ants (*Pogonomyrex californicus*).

The geographic distribution of the flat-tailed lizard is the most limited of any horned lizard species in the United States; its range is in the extreme southwestern corner of Arizona, the southeastern corner of California, and adjoining portions of Sonora and Baja California, Mexico. Populations occur in (1) southwestern Yuma County south of the Gila River and west of the Butler and Gila Mountains of Arizona and (2) Imperial, Riverside, and San Diego Counties in California, where they are experiencing slight to moderate declines, respectively (AGFD 2010; CaliforniaHerps 2010; NatureServe 2010).

The USFWS originally proposed listing the flat-tailed horned lizard as a threatened species on November 29, 1993. The proposal was withdrawn in 1997, challenged, and later reinstated in 2002. After an extensive comment period and data review, the USFWS again withdrew the proposed listing in 2003. Following additional challenges against the withdrawal of the proposed rule, the USFWS reinstated the proposed rule to list this species as threatened under the ESA on March 2, 2010 (USFWS 2010d).

Flat-tailed horned lizard populations could potentially occur in the affected area of the Imperial East SEZ.

Gila Monster (*Heloderma suspectum*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: California State Rank S1; Utah State Rank S1; Nevada State Rank S2; USFWS Species of Concern

The Gila monster is a desert lizard with a scattered distribution in the Mojave and Sonoran Deserts. This species inhabits areas of rocky, deeply incised topography, including canyon bottoms, rocky bajadas, washes, desert scrub, desert riparian areas, oak woodlands, and semiarid grasslands. The Gila monster may occur in the affected area of the following SEZs: Brenda, Bullard Wash, Dry Lake and Gillespie.

Milk Snake (*Lampropeltis triangulum*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Colorado)
State Listing Status: Not Listed
Rarity: Not Listed

The milk snake, *Lampropeltis triangulum*, is a widely distributed species with a total of 25 subspecies known from the snake's geographical range. Each is distinguished by slight color variations and habitat affinities. Of these subspecies, two occur in Colorado: *L. t. taylori* and *L. t. gentilis*. Milk snakes of these sub-specific groups use a variety of rocky grassland and shrubland habitat types, including scrub, shortgrass prairie, sagebrush desert, and pinyon-juniper woodland communities. Individuals select microhabitats with limestone or igneous outcroppings on hillsides, canyons, river valleys, and high plains at elevations primarily below 8,000 ft (2,440 m), where they generally remain concealed within rock crevices or beneath debris.

Geographically, milk snakes range throughout much of the continental United States, with a species presence in Colorado that occurs in Conjenos County in the west. Accurate information on its population status within the states is not known because of the snake's fossorial and nocturnal behavior.

Milk snake populations could potentially occur in the affected areas of the following SEZs: Antonito Southeast and Los Mogotes.

Mojave Fringe-Toed Lizard (*Uma scoparia*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Arizona and California)
State Listing Status: Arizona Wildlife Species of Concern
Rarity: Arizona State Rank S1

The Mojave fringe-toed lizard (*Uma scoparia*), an aeolian sand specialist, is restricted to sparsely vegetated areas with fine, loose, windblown sand, including dunes, flats, and riverbanks and washes of very arid desert (Nature Serve 2010). Individuals establish home ranges that extend from 0.2 to 0.5 ac (0.10 to 0.2 ha) within areas that provide critical habitat components, including (1) access to sands affording adequate nesting opportunities as well as a gradient of solar and temperature conditions needed to maintain an optimal thermal preferenda of 99.5°F (37.5°C) and (2) sparse shrubs and annual vegetation that provide primary dietary resources (e.g., seeds, flowers, grasses, and insects) (Mayhew 1964). Preferred habitats generally occur within creosote scrub desert communities at an elevation ranging from sea level to 3,002 ft (0 to 915 m).

The geographic distribution of the Mojave fringe-toed lizard ranges discontinuously in the Mojave Desert, from Death Valley south to the Colorado River near Blythe, California, and extreme southwestern Arizona, where it occurs as small, scattered populations. Specific estimates of population size are not known; however, recent investigations have suggested that many populations are vulnerable to, or have already undergone, local extirpation (Murphy et al. 2006).

The Amargosa River Population of the Mojave fringe-toed lizard, which occurs in portions of San Bernardino County, California, was petitioned for listing under the ESA on April 10, 2006. In response to that petition, the USFWS initiated a status review for this species to determine whether listing is warranted on January 10, 2008 (USFWS 2008b). However, populations under review for listing under the ESA do not occur in the vicinity of any of the SEZs.

The Mojave fringe-toed lizard could occur in the affected areas of the following SEZs: Iron Mountain, Pisgah, and Riverside East.

Rosy Boa (*Charina trivirgata*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Arizona and California)
State Listing Status: Not Listed
Rarity: California State Rank S2

The rosy boa (*Charina trivirgata*) is one of two boid species native to the United States. It is a heavy-bodied snake with smooth, shiny scales and a blunt but tapered tail that is primarily crepuscular in nature. As a saxicolous species, the rosy boa is strongly associated with rocky

habitats, including deserts, canyons, and arid scrublands. Individuals have well-defined, stable home ranges averaging 4.0 ac (1.6 ha) in size, and a moderate level of site fidelity is displayed (Diffendorfer et al. 2005). Within these areas, microhabitats characterized as having a moderate to high density of vegetation and rocks, available intermittent or permanent water, and a southern exposure at elevations from sea level to 6,791 ft (0 to 2,070 m) are preferred. The diet of the rosy boa includes such prey items as rodents, small birds, lizards, snakes, and amphibians (Nature Serve 2010).

The geographic distribution of the rosy boa extends from southern California and southwestern Arizona, where it occurs in scattered populations. There are two special status subspecies of rosy boa that may occur within the affected areas of the SEZs: desert rosy boa (*C. t. gracia*) and Mexican rosy boa (*C. t. trivirgata*). Specific estimates of population size are not known because of the boa's fossorial and nocturnal tendencies, but its status is apparently secure range-wide, although over-collection and road mortality have resulted in some local population declines.

Desert rosy boa populations may potentially occur within the affected area of the Riverside East SEZ. Mexican rosy boa populations may occur within the affected area of the Gillespie SEZ.

Texas Horned Lizard (*Phrynosoma cornutum*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Not Listed

The Texas horned lizard occurs in New Mexico, Texas, and Arizona. Within New Mexico, it is common in Doña Ana and Otero Counties. Its preferred habitat is flat, open, generally dry country with little plant cover other than desert scrub, bunchgrass, and cactus. The lizard buries itself in loose sandy, loamy, or rocky soils and seeks shelter under rocks (NMDGF 2010).

Texas horned lizards consume primarily harvester ants, although beetles and other small invertebrates can also be consumed. Juvenile foods are probably similar to those of adults. Mating occurs in May or June. Females lay 18 to 30 eggs and bury the clutch in holes in the ground about 6-in. (15-cm) deep. Eggs hatch in 1 or 2 months. The young receive no parental care, and reach sexual maturity in about 2 years (NMDGF2010).

In 1994, the Texas horned lizard was listed as a Category 2 species for consideration to be listed as a threatened or endangered species. In 1996, the USFWS eliminated the categories and reclassified the species as a species of concern. It was delisted as a species of concern in 2003. Threats include trenches, cattle guards, pitfalls, and pesticides. It may occur within the affected regions of the following SEZs: Mason Draw and Red Sands (NMDGF 2010).

Tucson Shovel-Nosed Snake (*Chionactis occipitalis klauberi*)

ESA Listing Status: Candidate
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Arizona State Rank S1

The Tucson shovel-nosed snake is a fairly small snake that is one of three subspecies of the western shovel-nosed snake known to occur in Arizona. The Tucson shovel-nosed snake occupies the easternmost portion of the species' range in Maricopa and Pinal Counties. The species is found in low desert regions, where it inhabits creosote-mesquite communities with soft sandy substrates. The species is usually found near sandy washes, dunes, or bajadas. The Tucson shovel-nosed snake may occur in the affected area of the Gillespie SEZ.

J.6.1.6 Birds

American Peregrine Falcon (*Falco peregrinus anatum*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Arizona Wildlife Species of Concern; Threatened in New Mexico
Rarity: Colorado State Rank S2; New Mexico State Rank S2;
Colorado and USFWS Species of Concern

American peregrine falcon populations have reoccupied much of their historic habitat in New Mexico, California, and Arizona, where they occur in mountainous regions in the summer or year-round. The falcons breed throughout North America south of the arctic tundra, in the Sea of Cortez region and the Central Plateau in Mexico, and in the southern Appalachian Mountains. They migrate to the Caribbean and South America in winter. The falcons nest along cliffs in forested areas near water and bluffs and in urban areas on buildings next to large grasslands, meadows, and lakes, where these predators can hunt. They use a side variety of habitat and may be found at elevations ranging from 3,500 to 9,000 ft (1,070 to 2,740 m) (NMDGF 2010).

American peregrine falcons are carnivores, eating primarily birds like jays, woodpeckers, swifts, mourning doves, and pigeons. They also occasionally feed on bats, small mammals, and reptiles. Reproduction begins at 3 years of age. The falcons are monogamous and mate for life, performing elaborate courtship displays from April to June. Clutches of three to four eggs are incubated for 28 days and fledged 35 to 42 days after hatching, with fledgling success ranging from 0.7 to 1.5 young (NMDGF 2010).

The American peregrine falcon was federally listed as endangered in 1970 following drastic population declines coinciding with the spread of DDT application. Populations rebounded following bans on the use of DDT, and the species was delisted in 1999. It was listed

as a federal species of concern by the USFWS in 2007. Present threats include pesticide poisoning, low breeding density, reproductive isolation, lack of gene flow between isolated populations, and reduction in foraging habitat and the availability of avian prey. The species may occur within the affected regions of the following SEZs: Afton, Antonito Southeast, Brenda, Bullard Wash, De Tilla Gulch, Fourmile East, Los Mogotes East, Mason Draw, and Red Sands (NMDGF 2010).

American White Pelican (*Pelecanus erythrorhynchos*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Colorado State Rank S1; Utah State Rank S1; Nevada State Rank S2; USFWS Species of Concern

The American white pelican occurs on larger lakes and reservoirs. It may occur in the affected area of the following SEZs: Fourmile East and Milford Flats South.

Baird's Sparrow (*Ammodramus bairdii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Threatened in New Mexico
Rarity: New Mexico State Rank S1; USFWS Species of Concern

The Baird's sparrow is a winter nonbreeding resident in the southwestern United States and northern Mexico. Within New Mexico, it occurs primarily in the eastern plains and southern lowlands. It also occurs in Hidalgo County, the San Juan Mountains, and the Sangre de Cristo Mountains at elevations up to 11,800 ft (3,600 m). Nonbreeding habitat includes open desert grasslands, prairies, mountain fields, and overgrown fields at elevations from 2,800 to 5,500 ft (850 to 1,680 m) (NMDGF 2010).

The Baird's sparrow feeds on spiders, grass, and forb seeds. Grasses are the most important food item to adults, while the young feed only on insects. It nests in tallgrass prairie habitats. Migration occurs from August to November (NMDGF 2010).

The Baird's sparrow is currently listed as sensitive by the BLM, listed as threatened and ranked S1 in New Mexico, and considered a species of concern by the USFWS. Threats include habitat alterations due to agriculture and the plowing of native prairies, loss of cover, and grazing. Baird's sparrow may occur within the affected regions of the Red Sands SEZ (NMDGF 2010).

Bald Eagle *(Haliaeetus leucocephalus)*

ESA Listing Status: Threatened (Sonoran populations); Delisted elsewhere
BLM-Sensitive Status: Listed as Sensitive
State Status: Arizona Wildlife Species of Concern; Threatened in Colorado; Threatened in New Mexico; Protected in Nevada
Rarity: Colorado State Rank S1; New Mexico State Rank S1; Nevada State Rank S1; Utah State Rank S1; USFWS Species of Concern (all populations but Sonoran); Utah Species of Concern

The bald eagle ranges throughout much of North America, nesting on both coasts: from Florida to Baja California, Mexico, in the south; and from Labrador to the western Aleutian Islands, Alaska, in the north. Within this range, bald eagles are absent as breeding birds in most of the Great Basin, the prairie and plains region, and the eastern United States west of the Appalachian Mountains. It occurs in all states in the six-state solar energy region.

The bald eagle is a bird of aquatic ecosystems, frequenting estuaries, large lakes, major rivers, and some seacoast habitats. The species may also use prairies if adequate food is available. To support bald eagles, these areas must provide an adequate food base, perching areas near the shoreline, and suitable nesting sites. Fish is the major component of the bald eagle's diet, but waterfowl, seagulls, and carrion are also eaten. In winter (defined as the non-nesting period), bald eagles often congregate at specific wintering sites that are close to open water and offer good perch trees, night roosts, and an abundance of shallow-water fish or waterfowl as prey. Large concentrations of eagles are often observed at salmon spawning rivers.

Nest sites are usually in large trees along shorelines, in relatively remote areas that are free of disturbance. Trees must be sturdy and open to support bald eagle nests, which are often 5-ft (1.5-m) wide and 3-ft (0.9-m) deep. The nesting season lasts about 6 months. Breeding times for bald eagles vary by elevation as well as by latitude; mating occurs in late September through November in the south, in January through March in the central states, and in late March to early April in Alaska. Adults tend to use the same breeding areas year after year, and often use the same nest, although a breeding area may include one or more alternate nest(s).

The decline of bald eagles in most of the United States was caused by a combination of hunting, a decline in major prey species, and DDT usage. Since a recovery program for the species was established in the mid-1970s, the bald eagle population has increased in number and expanded in range. This improvement is attributable to the banning of DDT and other persistent organochlorides, habitat protection, and other recovery efforts.

The bald eagle was once federally listed as endangered in all of the lower 48 states (March 11, 1967), with the exception of Michigan, Minnesota, Wisconsin, Washington, and Oregon, where it was designated as threatened. It has since been delisted due to recovery in all populations except the Sonoran populations occurring in Arizona (72 FR 37345, 73 FR 23966). Currently, only the Sonoran population in Arizona is listed under the ESA. However, a recent finding by the USFWS indicated that listing for this population may not be warranted (75 FR 8601). Critical habitat for this species has not been designated.

Sonoran populations of the bald eagle, currently listed as threatened under the ESA, may occur in the affected areas of the following SEZs: Brenda, Bullard Wash, and Gillespie. Populations of bald eagle that are delisted from the ESA may occur in the affected areas of the following SEZs: Afton, Antonito Southeast, De Tilla Gulch, Escalante Valley, Fourmile East, Los Mogotes East, Mason Draw, Milford Flats South, Red Sands, and Wah Wah Valley.

Barrow's Goldeneye (*Bucephala islandica*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Colorado)
State Listing Status: Threatened in New Mexico
Rarity: Colorado State Rank S2; New Mexico State Rank S2

The Barrow's goldeneye is a winter nonbreeding resident in the southwestern United States and northern Mexico. Nonbreeding habitat includes open grasslands and overgrown fields. The Barrow's goldeneye may occur in the affected area of the following SEZs: Antonito Southeast, De Tilla Gulch and Fourmile East.

Bell's Vireo (*Vireo bellii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (New Mexico)
State Listing Status: Threatened in New Mexico
Rarity: New Mexico State Rank S2; USFWS Species of Concern

The Bell's vireo breeds from southern California, the Southwest, and the central Great Plains and adjacent Midwest to northern Mexico. Within New Mexico, it occurs in the lower Gila Valley, Guadalupe Canyon, lower San Francisco Valley, and Hidalgo and Eddy Counties. It winters in central and South America. Its habitat includes dense shrublands or woodlands along lower-elevation riparian areas among willows, scrub oak, and mesquite; annual grasslands; desert scrub; and marshes. The species may potentially nest in any successional stage with dense understory vegetation (NMDGF 2010).

The Bell's vireo feeds mostly on hemipterans, lepidopterans, orthopterans, coleopterans, and hymenopterans, although the birds will consume lesser amounts of snails, spiders, dipterans, and plants. They breed from May to July, laying three to five eggs per clutch (NMDGF 2010).

Natural threats include heavy cowbird parasitism, severe weather, and predation. Anthropogenic threats include livestock grazing, agricultural pesticides, and loss of habitat from urbanization, flood control, and reservoir construction. Populations have declined in New Mexico, likely due to extensive habitat destruction. Currently, the species is listed as threatened by the state of New Mexico and ranked S2 in New Mexico and is a USFWS species of concern. It may occur within the affected regions of the following SEZs: Afton and Red Sands (NMDGF 2010).

Bendire's Thrasher (*Toxostoma bendirei*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Not Listed

The Bendire's thrasher is a small, neotropical migrant bird that is a summer breeding resident in southern California. This species inhabits desert succulent shrub and Joshua tree (*Yucca brevifolia*) habitats in the Mojave Desert, where it is associated with sagebrush (*Artemisia* sp.), pinyon-juniper woodlands, cholla (*Opuntia* sp.) cactus, Joshua tree, palo verde (*Cercidium* sp.), mesquite (*Prosopis* sp.), and agave species. The Bendire's thrasher may occur in the affected area of the following SEZs: Iron Mountain, Pisgah, and Riverside East.

Black Tern (*Chlidonias niger*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: USFWS Species of Concern

The black tern is a migratory transient in the southwestern United States. Within New Mexico, it is common in Chaves and Quay Counties. It inhabits wet grasslands, marshes, flooded agricultural fields, playa margins, and open water habitats in desert lowland areas. Associated vegetation includes wild oat (*Avena* spp.), ripgut brome (*Bromus rigidus*), soft chess (*Bromus mollis*), bur clover (*Medicago hispida*), and filaree (*Erodium* spp.). Its elevation ranges from 2,900 to 7,500 ft (880 to 2,300 m) (NMDGF 2010).

Breeding in late May to August, black terns are monogamous for each breeding season, and both parents care for the young after hatching. Females lay three eggs and incubate them for 21 days. Young are precocial at hatching (NMDGF 2010).

Threats to the black tern include habitat loss and degradation, partially due to wetland drainage. The black tern was listed as a Category 2 federal candidate in the *Federal Register* on November 15, 1994. Currently, it is a USFWS species of concern and is designated as sensitive by the BLM. It may occur within the affected regions of the Red Sands SEZ (NMDGF 2010).

California Black Rail (*Laterallus jamaicensis coturniculus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Arizona Wildlife Species of Concern; Threatened in California (California Fully-Protected)
Rarity: Arizona State Rank S1; California State Rank S1; USFWS Species of Concern

The California black rail is a small, wetland bird that inhabits coastal and freshwater marshes of southern California and western Arizona. This species is threatened under the California Endangered Species Act (CESA) and is a California fully protected species. In the SEZ region, the species is associated with marsh habitats containing dense vegetation, such as cattail (*Typha* sp.), bulrush (*Scirpus* sp.), or reeds (*Phragmites* spp.). The California black rail may occur in the affected area of the Imperial East SEZ.

Ferruginous Hawk (*Buteo regalis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Arizona Wildlife Species of Concern
Rarity: Arizona State Rank S2; California State Rank S2; New Mexico State Rank S2; Nevada State Rank S2; Utah State Rank S2; Colorado Species of Concern; USFWS Species of Concern

The ferruginous hawk inhabits grasslands, sagebrush, and saltbrush habitats, as well as the periphery of pinyon-juniper woodlands. The species nests in tall trees or on rock outcrops along cliff faces. It may forage in various desert shrubland habitats. The ferruginous hawk may occur in the affected area of the following SEZs: Afton, Amargosa Valley, Antonito Southeast, Brenda, Bullard Wash, De Tilla Gulch, Delamar Valley, Dry Lake, Dry Lake Valley North, East Mormon Mountain, Escalante Valley, Fourmile East, Gillespie, Gold Point, Imperial East, Iron Mountain, Los Mogotes East, Mason Draw, Milford Flats South, Millers, Pisgah, Red Sands, Riverside East, and Wah Wah Valley.

Gila Woodpecker (*Melanerpes uropygialis*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Endangered in California
Rarity: California State Rank S1

The Gila woodpecker is listed as an endangered species under CESA. It is a fairly uncommon resident in southern California and southwestern Arizona, where it occurs in desert riparian and wash habitats along the lower Colorado River Basin. The Gila woodpecker may occur in the affected area of the Riverside East SEZ.

Gray Vireo (*Vireo vicinior*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Threatened in New Mexico

Rarity: California State Rank S2; Colorado State Rank S2; New Mexico State Rank S2; USFSW Species of Concern

The gray vireo is an uncommon summer resident in arid pinyon-juniper and chaparral habitats of southern California, New Mexico, Texas, Colorado, Utah, and Arizona. Within New Mexico, gray vireos summer in the Guadalupe Mountains and Doña and Otero Counties in arid juniper woodlands on foothills and mesas with a well-developed grass component. Nonforest habitat is open to dense stands of shrubs and low trees. Associated vegetation includes juniper (*Juniperus* spp.), oak (*Quercus* spp.), big sagebrush (*Artemisia tridentata*), saltbush (*Atriplex confertifolia*), greasewood (*Sarcobatus vermiculatus*), and creosote bush (*Larrea divaricata*). Its elevation ranges from 2,000 to 6,500 ft (600 to 2,000 m) (NMDGF 2010).

Gray vireos are insectivores, eating mainly Lepidopterans. They also feed on the fruits of the elephant tree (*Bursera microphylla*). The species incubates clutches of three to five eggs for 14 to 15 days. Nests are parasitized frequently by cowbirds (NMDGF 2010; Nature Serve 2010).

The gray vireo was listed as endangered in New Mexico on July 22, 1983. It was ranked S2 in New Mexico in 2006. Currently, it is listed as sensitive by the BLM; listed as threatened in New Mexico; ranked S2 in Colorado, California, and New Mexico; and is a USFWS species of concern. Threats include old-growth forest, fire exclusion, loss and alteration of quality juniper-grassland habitat, and cowbird nest parasitism. The species is unlikely to occur in the affected area of any SEZ due to lack of suitable habitat; however, it may occur within the affected regions of the following SEZs: Afton, Mason Draw, and Red Sands (NMDGF 2010).

Great Egret (*Ardea alba*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Arizona Wildlife Species of Concern
Rarity: Arizona State Rank S1

The great egret is considered to be a year-round resident in the lower Colorado River Valley in southwestern Arizona and southeastern California. This species is primarily associated with open water areas such as marshes, lakes, ponds, and reservoirs. The great egret may occur in the affected area of the following SEZs: Brenda and Gillespie.

Greater Sage-Grouse (*Centrocercus urophasianus*)

ESA Listing Status: Candidate
BLM Listing Status: Listed as Sensitive
State Listing Status: Utah Species of Concern
Rarity: Utah State Rank S2

The greater sage-grouse inhabits plains, foothills, and mountain valleys dominated by sagebrush (*Artemisia* sp.). Lek sites are located in relatively open areas surrounded by sagebrush or in areas where sagebrush density is low. Nesting usually occurs on the ground, where sagebrush density is higher. Some populations may travel up to 60 mi (96 km) between summer and winter habitats. The greater sage-grouse may occur in the affected area of the following SEZs: Escalante Valley, Gold Point, Milford Flats South, Millers, and Wah Wah Valley.

Gunnison Sage-Grouse (*Centrocercus minimus*)

ESA Listing Status: Under Review
BLM Listing Status: Listed as Sensitive (Colorado)
State Listing Status: Not Listed
Rarity: Colorado State Rank S1; Colorado Species of Concern

The status of the Gunnison sage-grouse is under review by the USFWS to determine whether it should be listed as endangered or threatened under the ESA (USFWS 2009c). The Gunnison sage-grouse is considered a distinct species of sage-grouse on the basis of morphological, genetic, behavioral, and geographical characteristics. The species is about one-third smaller than the greater sage-grouse (*Centrocercus urophasianus*). The geographic range for the Gunnison sage-grouse is restricted to those portions of Colorado and Utah that are south of the Colorado River. The greatest concentration of this species (estimated between 2,000 and 3,000 birds) exists within the Gunnison Basin in southwestern Colorado. The total adult (breeding) population is estimated to be fewer than 4,000 (Nature Serve 2010).

The mating behavior of sage-grouse is perhaps one of the most complex and stereotyped behaviors known among birds. From mid-march to early June, males will exhibit a display on leks, which are open areas that provide good visibility for acoustics and predator detection. The male mating display is characterized by the male inflating its esophageal air sac in a strut behavior with the wings held stiffly at either side. During this period, the air sac is evident through the apteria (area of bare skin) on the male's neck. These skin patches inflate repeatedly to create an acoustic and visual display to attract females. The strutting display of the Gunnison sage-grouse is distinct from other sage-grouse species. During a typical strutting display, Gunnison sage-grouse inflate the apteria of their necks nine times, as compared to twice for the greater sage-grouse (USFWS 2009c).

Following courtship, females will select nests in tall and dense stands of shrubs—usually sagebrush (*Artemisia* spp.)—from about 650 ft (200 m) to 5 mi (8 km) from the leks. Clutches average seven to nine eggs that will hatch after a 27- or 28-day incubation period (American Bird Conservancy 2010).

The Gunnison sage-grouse utilizes a variety of habitats throughout the year but it is mostly associated with sagebrush ecosystems. Sagebrush provides shelter for nests and supports diverse insect and forb communities that serve as food sources for young and adult individuals. During the winter, Gunnison sage-grouse become dependent on sagebrush leaves as their sole

food source (American Bird Conservancy 2010). During the spring and summer months, the species may also utilize healthy grasslands and riparian ecosystems.

Population declines and range contractions of the Gunnison sage-grouse are attributable to a number of anthropogenic factors. As identified in the *Gunnison Sage-Grouse Conservation Plan* (Gunnison Sage-Grouse Rangewide Steering Committee 2005), these factors were grouped into three major categories that may contribute to the continued decline of the species. These factors include (1) degradation in sagebrush-steppe habitat quality and composition; (2) loss or fragmentation of sagebrush-steppe habitats from agricultural, energy, residential, and transportation infrastructure developments; and (3) physical disturbance of individuals through predation, diseases, invasive species, and recreational activities, such as hunting, bird watching, and off-highway vehicle use.

The Gunnison sage-grouse may occur in the affected area of the De Tilla Gulch SEZ.

Interior Least Tern (*Sterna antillarum athalassos*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Endangered in Colorado and New Mexico
Rarity: Colorado State Rank S1; New Mexico State Rank S1

The interior least tern breeds from California, South Dakota, and Maine to Chiapas and the Caribbean, although the major inland population occurs in the Mississippi Basin. It winters from Mexico's Pacific Coast and the U.S. Gulf Coast southward. Within New Mexico, it breeds near Roswell, migrates in Eddy County, and exists in Chaves, DeBaca, and Socorro Counties. Breeding habitat includes dry, flat, sparsely vegetated sandbars and gravel bars within a wide, unobstructed, water-filled river channel that supports a forage fish supply, alkali flats, beaches, and spits (NMDGF 2010).

Interior least terns arrive on breeding grounds from April to early June and begin to establish feeding and nesting territories. During the breeding season, the terns' home range is generally limited to a 2-mi (3-km) stretch of river associated with the nesting colony. Interior least terns nesting at sandpits along rivers use the adjoining river as well as the sandpit lake itself for foraging. Interior least terns are semi-colonial nesters that benefit from the anti-predator behavior exhibited by the entire colony when the nesting territory is invaded. Nesting activity is initiated after spring and early summer flows recede and dry areas on sandbars are exposed, usually on higher elevations away from the water's edge. Artificially created nesting sites (e.g., sand and gravel pits, dredge islands, reservoir shorelines, and power plant ash disposal areas) are also used. After pair formation, both sexes make many shallow nest scrapes dispersed in open, gravelly or sandy areas. After the female selects a suitable scrape, two or three eggs are laid on consecutive days. If a first clutch of eggs is lost, interior least terns will re-nest up to two times, each re-nesting attempt taking place at a new site. After 14 to 16 days of incubation, the eggs begin to hatch on consecutive days. The nesting season ends by early August, and departure from breeding areas is usually complete by early September. Following the breeding season,

interior least terns gather in small flocks along rivers to feed and prepare for migration. Individuals are sexually mature at 1 year (NMDGF 2010).

Interior least terns are opportunistic feeders, eating minnows and other small, non-spiny fish less than 4 in. (10 cm) in length, crustaceans, and insects. Chicks eat fish less than 0.6-in. (1.5-cm) long (NMDGF 2010).

The interior least tern was listed as endangered in New Mexico on May 21, 1976. It was federally listed as endangered on May 28, 1985 (50 FR 21784). Currently, it is also listed as endangered by the states of New Mexico and Colorado, and it is ranked as S1 in both states. Threats include the loss of sandbar habitat from river channelization, irrigation diversions, and dam construction and disturbance from foot traffic, unleashed pets, swimmers, canoeists, and off-highway vehicles. The tern may occur within the affected regions of the Red Sands SEZ (NMDGF 2010).

LeConte's Thrasher (*Toxostoma lecontei*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2; USFWS Species of Concern

The LeConte's thrasher is an uncommon year-round resident in Arizona, southern California, and southern Nevada. This species inhabits saltbush-cholla scrub communities in desert flats, dunes, or alluvial fans. The LeConte's thrasher may occur in the affected area of the Dry Lake SEZ.

Loggerhead Shrike (*Lanius ludovicianus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (New Mexico)
State Listing Status: Not Listed
Rarity: California Species of Concern; USFWS Species of Concern

The loggerhead shrike is a migratory bird known to occur as a year-round resident in the southwestern United States. This species inhabits open country with scattered trees and shrubs, such as savannas, desert shrublands, and open woodlands. Individuals are often observed perching on poles, wires, or fence posts. Nesting occurs in shrubs or small trees on grasslands or pasture areas. The loggerhead shrike may occur in the affected area of the Red Sands SEZ.

Long-Billed Curlew (*Numenius americanus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Utah Species of Concern
Rarity: Colorado State Rank S2; Utah State Rank S2; Nevada State Rank S2

The long-billed curlew inhabits shortgrass grasslands near standing water. Suitable migratory habitat for this species may occur anywhere in the solar project area where intermittent standing water is present. The long-billed curlew may occur in the affected area of the following SEZs: Escalante Valley, Milford Flats South, and Wah Wah Valley.

Mountain Plover (*Charadrius montanus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Colorado)
State Listing Status: Not Listed
Rarity: Utah State Rank S1; California State Rank S2; California Species of Concern; Utah Species of Concern

The mountain plover inhabits prairie grasslands and arid plains and fields. It nests in shortgrass prairies associated with prairie dogs, bison, and cattle. More than 50% of the global population nests in the states of Colorado and New Mexico. The species may be a winter resident in southern California. The mountain plover may occur in the affected area of the following SEZs: Antonito Southeast, De Tilla Gulch, Fourmile East, and Los Mogotes East.

Northern Aplomado Falcon (*Falco femoralis septentrionalis*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Endangered in New Mexico
Rarity: New Mexico State Rank S1

The northern aplomado falcon inhabits the desert grasslands and savannas of Latin America. In the United States, the subspecies historically inhabited desert grasslands with mesquite and yucca, riparian woodlands in open grasslands, and sand ridges with yuccas on the coastal prairies of Texas, New Mexico, and southeastern Arizona. In general, open landscapes with scattered trees and shrubs provide good habitat. Other necessary habitat components include moderately low ground cover, an abundance of small to medium-sized birds, and a supply of nesting platforms. There are a total of 22 grassland areas within the historical range of the species in southeastern Arizona and southern New Mexico that offer suitable habitat conditions for the aplomado falcon (NMDGF 2010; Nature Serve 2010).

Aplomado falcons prey primarily on other birds (e.g., cuckoos, doves, woodpeckers, blackbirds, flycatchers, and thrushes), supplementing their diet with insects, small mammals, reptiles, and amphibians (e.g., grasshoppers, butterflies, crickets, wasps, frogs, lizards, bats, and rodents). Aplomado falcons do not construct their own nests and are thus dependent on nesting platforms constructed by other species, such as the stick nests of Swainson's hawks, crested caracaras, and Chihuahuan ravens. In desert habitats, nest availability is determined by the presence of species that build large nests, such as crows, kites, ravens, or hawks. The breeding season lasts for 6 to 8 months, with most eggs laid between March and May. Clutches consist of two to three eggs, and the incubation period (both parents tending) lasts 32 days. Nestlings fledge after approximately 35 days and remain in the vicinity of the nest for another month (Nature Serve 2010).

The northern aplomado falcon was federally listed as endangered on February 25, 1986. Critical habitat has not been designated. At the time of listing, the falcon was no longer breeding in the United States. Recently, however, there have been sightings of falcons in New Mexico, suggesting that the subspecies is dispersing from breeding locations in Mexico back into the southwestern United States.

The northern aplomado falcon previously experienced large population declines because of pesticides, especially DDT applied in Mexico. It has also lost large areas of suitable habitat through brush encroachment and agriculture clearing (Nature Serve 2010).

The northern Aplomado falcon may occur in the affected area of the following SEZs: Afton, Mason Draw, and Red Sands.

Northern Goshawk (*Accipiter gentilis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Arizona Wildlife Species of Concern; Protected in Nevada
Rarity: New Mexico State Rank S2; Nevada State Rank S2;
New Mexico Species of Concern; USFWS Species of Concern

The northern goshawk inhabits mature mountain forest and riparian zone habitats. It nests in trees in mature deciduous, coniferous, and mixed forests. It forages in both heavily forested and relatively open shrubland habitats. The Northern goshawk may occur in the affected area of the following SEZs: Afton, Amargosa Valley, Escalante Valley, Mason Draw, Milford Flats South, Red Sands, and Wah Wah Valley.

Phainopepla (*Phainopepla nitens*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2; USFWS Species of Concern

The phainopepla occurs in the southwestern United States and Mexico in desert scrub, mesquite, and pinyon-juniper woodland communities as well as desert riparian areas and orchards. Nests are typically constructed in trees and shrubs from 3 to 45 ft (1 to 15 m) above the ground. The phainopepla may occur in the affected area of the following SEZs: Amargosa Valley, Delamar Valley, Dry Lake, and East Mormon Mountain.

Prairie Falcon (*Falco mexicanus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Not Listed
Rarity: Not Listed

The prairie falcon is known to occur throughout the western United States. The species occurs in open habitats in mountainous areas, sagebrush-steppe, grasslands, or cultivated areas. Nests are typically constructed in well-sheltered ledges of rocky cliffs and outcrops. The prairie falcon may occur in the affected area of the following SEZs: Amargosa Valley, Delamar Valley, Dry Lake Valley North, Gold Point, and Millers.

Short-Eared Owl (*Asio flammeus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Utah Species of Concern; Colorado State Rank S2; Utah State Rank S2; New Mexico State Rank S2

The short-eared owl inhabits grasslands, shrublands, and other open habitats. It is nomadic, often selecting unique breeding sites each year, depending on local rodent densities. It nests on the ground near shrubs. The short-eared owl may occur in the affected area of the following SEZs: Antonito Southeast, De Tilla Gulch, Escalante Valley, Fourmile East, Los Mogotes East, Milford Flats South, and Wah Wah Valley.

Snowy Egret (*Egretta thula*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Wildlife Species of Concern in Arizona
Rarity: Arizona State Rank S1; Colorado State Rank S2

The snowy egret is considered to be a year-round resident in the lower Colorado River Valley in southwestern Arizona and southeastern California. This species is primarily associated with open water areas such as marshes, lakes, ponds, and reservoirs. The snowy egret may occur in the affected area of the following SEZs: Bullard Wash and Gillespie.

Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Arizona Wildlife Species of Concern; Endangered in California; Endangered in Colorado; Endangered in New Mexico; Protected in Nevada
Rarity: Arizona State Rank S1; California State Rank S1; Nevada State Rank S1; Utah State Rank S1; New Mexico State Rank S2

The southwestern willow flycatcher is a subspecies of willow flycatcher that breeds in southern California, southern Nevada, southern Utah, Arizona, New Mexico, western Texas, and extreme northwest Mexico. It may also breed in southwestern Colorado, but nesting records are lacking. All willow flycatchers are migratory.

The southwestern willow flycatcher occurs in riparian habitats along rivers, streams, or other wetlands, where there are dense growths of willows, baccharis, cottonwood, buttonbush, and other deciduous shrubs and trees. Flycatchers nest in thickets of trees and shrubs that are approximately 13 to 23 ft (4 to 7 m) or more in height, have dense foliage from approximately 13 feet (7 m) above the ground, and often have a high percentage of canopy cover. The diversity of nest site plant species may be low or comparatively high, and nest site vegetation may be even- or uneven-aged, but it is usually dense and structurally homogeneous. Although the southwestern willow flycatcher historically nested in native plant communities, and it still does so when such vegetation is available, the species is now known to nest in thickets dominated by the non-native species tamarisk and Russian olive. The subspecies virtually always nests near surface water or saturated soil. At some nest sites, surface water may be present early in the breeding season, but by late June or early July, only damp soil is present. Ultimately, a water table close enough to the surface to support riparian vegetation is necessary (Nature Serve 2010).

The southwestern willow flycatcher is an insectivore. It forages within and above dense riparian vegetation, taking insects on the wing or gleaning them from foliage. It also forages in areas adjacent to nest sites, which may be more open. No information is available on specific prey species.

Southwestern willow flycatchers arrive at breeding sites and begin singing by mid-May, and they build nests in late May and early June. Birds construct a cup-shaped nest in a fork or horizontal branch of a medium-sized bush or small tree, approximately 3.2 to 15 ft (1 to 4.5 m) above the ground. Typically, there is dense vegetation above and around the nest. The subspecies fledges young in early to mid-July. Some variations in these dates have been observed; they may be related to altitude, latitude, and re-nesting.

The southwestern willow flycatcher was federally listed as endangered on February 27, 1995 (60 FR 10693). On July 22, 1997, approximately 599 river mi (960 km) of waterways and their adjacent riparian habitats in Arizona, California, and New Mexico were designated as critical habitat.

Threats to continued existence have primarily included habitat loss and degradation. Extensive loss of the habitat of this subspecies has occurred through the conversion of floodplains to agriculture, flood-control projects, and urban development. Other threats include overgrazing and brood-parasitism by the brown-headed cowbird (Nature Serve 2010).

The southwestern willow flycatcher may occur in the affected area of the following SEZs: Antonito Southeast, Bullard Wash, De Tilla Gulch, Delamar Valley, Dry Lake, Fourmile East, Gillespie, and Los Mogotes East.

Swainson's Hawk (*Buteo swainsoni*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Nevada)
State Listing Status: Protected in Nevada
Rarity: California State Rank S2; Nevada State Rank S2; USFWS Species of Concern

The Swainson's hawk occurs throughout the southwestern United States. It inhabits desert, savanna, open pine-oak woodland, grassland, and cultivated habitats. Nests are typically constructed in solitary trees, bushes, or small groves; sometimes the hawks nests near urban areas. The Swainson's hawk may occur in the affected area of the following SEZs: Amargosa Valley, Bullard Wash, Delamar Valley, Dry Lake Valley North, East Mormon Mountain, Gold Point, and Millers.

Western Burrowing Owl (*Athene cunicularia hypugaea*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Threatened in Colorado
Rarity: Species of Concern in Arizona, California, New Mexico, and Utah;
Arizona State Rank S2; California State Rank S2; USFWS Species of Concern

The western burrowing owl is a year-round resident throughout the solar project area. It forages in grasslands, shrublands, and open disturbed areas, and it nests in burrows usually constructed by mammals. It forages on invertebrates and small mammals. The western burrowing owl may occur in the affected area of the following SEZs: Afton, Amargosa Valley, Antonito Southeast, Brenda, Bullard Wash, De Tilla Gulch, Delamar Valley, Dry Lake, Dry Lake Valley North, East Mormon Mountain, Escalante Valley, Fourmile East, Gillespie, Gold Point, Imperial East, Iron Mountain, Los Mogotes East, Mason Draw, Milford Flats South, Millers, Pisgah, Red Sands, Riverside East, and Wah Wah Valley.

Western Least Bittern (*Ixobrychus exilis hesperis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Arizona Wildlife Species of Concern; Protected in Nevada; Species of Concern in California
Rarity: California State Rank S1; Nevada State Rank S2; USFWS Species of Concern

The least bittern is a common summer resident in suitable habitats of the lower Colorado River in southwestern California and southwestern Arizona. The species inhabits freshwater marsh habitats containing dense, emergent vegetation, such as cattail (*Typha* sp.) and reeds (*Phragmites* sp.). The western least bittern may occur in the affected area of the Imperial East SEZ.

Western Snowy Plover (*Charadrius alexandrinus nivosus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Arizona Wildlife Species of Concern; Protected in Nevada
Rarity: Species of Concern in Colorado; Arizona State Rank S1; Colorado State Rank S1; USFWS Species of Concern

The western snowy plover breeds on alkali flats around reservoirs and sandy shorelines. This species is a known summer breeder and winter resident in portions of the six-state solar energy region. The western snowy plover may occur in the affected area of the following SEZs: Dry Lake Valley North, Fourmile East, and Gillespie.

Western Yellow-Billed Cuckoo (*Coccyzus americanus occidentalis*)

ESA Listing Status: Candidate
BLM Listing Status: Not Listed
State Listing Status: Arizona Wildlife Species of Concern; Endangered in California; Protected in Nevada

Rarity: California State Rank S1; Nevada State Rank S1; Utah State Rank S1;
New Mexico Species of Concern

The western yellow-billed cuckoo is considered by the USFWS as a Distinct Population Segment (DPS) (subspecies *occidentalis*) of the yellow-billed cuckoo. Populations of the yellow-billed cuckoo are more common in the central and eastern United States; the western yellow-billed cuckoo DPS, however, has experienced significant population declines. This species is a medium-sized, insectivorous, migratory bird species that occupies scattered, isolated habitats west of the Rocky Mountains in Arizona, California, Colorado, Nevada, and New Mexico.

Typical breeding habitats for the western yellow-billed cuckoo are deciduous riparian woodlands, particularly cottonwood and willow. Dense riparian understory foliage is an important factor in nest site selection in some areas. Nests are commonly created in dense covers of trees and shrubs. The species does not appear to select specific habitats types during the nonbreeding season, as they are known to inhabit various types of forest, woodland, and shrub-scrub habitats.

The USFWS determined the yellow-billed cuckoo as a candidate for federal listing under the ESA of 1973 on July 25, 2001 (66 FR 38611). Primary threats to the western yellow-billed cuckoo DPS include habitat destruction and pesticide application. Most habitat loss results from the conversion of riparian habitats to agriculture (including livestock grazing) and water development infrastructure. The spread of invasive non-native species, particularly tamarisk, has also contributed to the decline of suitable breeding habitats.

The Western yellow-billed cuckoo may occur in the affected area of the following SEZs: Afton, Delamar Valley, and Gillespie.

White-Faced Ibis (*Plegadis chihi*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: New Mexico Species of Concern; California State Rank S1;
Arizona State Rank S2; Colorado State Rank S2; New Mexico State Rank S2;
USFWS Species of Concern

The white-faced ibis is a migratory wading bird with distinct breeding and wintering areas. Breeding primarily occurs in temperate areas of western North America in marshes, swamps, and riverine systems. Wintering occurs in marshes, meadows, riverine systems, and meadows from southern California and Arizona, to coastal Texas and Louisiana, and south to Central and South America. The white-faced ibis may occur in the affected area of the following SEZs: Imperial East and Red Sands.

Yuma Clapper Rail (*Rallus longirostris yumanensis*)

ESA Listing Status: Endangered
BLM Listing Status: Not Listed
State Listing Status: Arizona Wildlife Species of Concern; Threatened in California; Protected in Nevada
Rarity: California State Rank S1; Nevada State Rank S1

The Yuma clapper rail is a subspecies that occurs in inland habitats in the southwestern United States. Yuma clapper rails are found in shallow, freshwater marshes containing dense stands of cattails and bulrushes, along the Colorado River from California, southern Nevada, and Arizona south into Mexico. They also occur in dense, near-monotypic stands of cattail at the Salton Sea in Imperial County, California, and in marshes and riparian habitats in western Arizona and southern Nevada. Unlike other clapper rails, which are associated with tidal marshes, the Yuma clapper rail occupies freshwater marshes during the breeding season. Until recently, most of the population was thought to retreat to Mexico during the winter; it is now estimated that more than 70% of the breeding population winters along the Lower Colorado River.

The Yuma clapper rail feeds on crayfish and other crustaceans, and it is believed that the abundance of food animals at a particular site is a better predictor of rail population densities than is vegetation. Yuma clapper rails breed from March through July. Nests are built in three major microhabitats: at the base of living clumps of cattail or bulrush, under wind-thrown bulrush, or on the top of dead cattails remaining from the previous year's growth. Nesting materials and cover are obtained from mature cattail/bulrush stands. Clutch size is typically six to eight eggs, and most eggs hatch during the first week of June (Nature Serve 2010).

The Yuma clapper rail was federally listed as endangered on March 11, 1967 (USFWS 1967). Critical habitat for this subspecies has not been designated. Threats to continued survival of the Yuma clapper rail include loss and degradation of habitat by activities such as water projects and the draining or filling of marshes for development or agriculture. Other threats to this species include catastrophic flooding, invasion of non-native plant species such as tamarisk, and pollution from urban runoff, industrial discharges, and sewage effluent. Although population numbers of the species appear to be stable, habitat throughout its range is not secure (Nature Serve 2010).

The Yuma clapper rail may occur in the affected area of the following SEZs: Gillespie and Imperial East.

J.6.1.7 Mammals

Allen's Big-Eared Bat (*Idionycteris phyllotis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Nevada Protected
Rarity: Nevada State Rank S1; Utah State Rank S2; USFWS Species of Concern

The Allen's big-eared bat is known from isolated locations throughout the southwestern United States and is considered to be a year-round resident in the East Mormon Mountain SEZ region. Its habitat is primarily mountainous, wooded areas composed of ponderosa pine, pinyon-juniper, Mexican woodland, and oak brush as well as cottonwood riparian woodland. The species occurs within the range of Mohave Desert scrub of the low desert ranges to white fir forest zones, with summer ranges occurring at higher elevations. This species roosts in caverns, rock fissures, and mines. The Allen's big-eared bat may occur in the affected area of the East Mormon Mountains SEZ.

Arizona Myotis (*Myotis occultus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: New Mexico Species of Concern; California State Rank S2;
USFWS Species of Concern

The Arizona myotis is known from extreme southeastern California and southern Arizona and New Mexico, where it occurs along river lowlands and in adjacent desert mountain ranges. It inhabits ponderosa pine and oak-pine woodlands in close proximity to water; it also occurs in riparian forests within desert areas along the Colorado River. The Arizona myotis may occur in the affected area of the following SEZs: Iron Mountain, Red Sands, and Riverside East.

Big Free-Tailed Bat (*Nyctinomops macrotis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: California Species of Concern; Nevada State Rank S1; California State Rank S2;
New Mexico State Rank S2; Utah State Rank S2; USFWS Species of Concern

The big free-tailed bat is associated with bare rock/talus/scree, cliff, shrub desert, hardwood woodland, and riparian communities. This species roosts in rock crevices on cliff faces or in buildings. It forages primarily in coniferous forests and arid shrublands to feed on

moths. The big free-tailed bat may occur in the affected area of the following SEZs: Antonito Southeast, De Tilla Gulch, Dry Lake, Fourmile East, Los Mogotes East, and Red Sands.

Brazilian Free-Tailed Bat *(Tadarida brasiliensis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: Not Listed

The Brazilian free-tailed bat is known from isolated locations throughout the southwestern United States. The species forages in desert grassland, old field, savanna, shrubland, and woodland habitats as well as in urban areas. It roosts in old buildings, caves, mines, and hollow trees. The Brazilian free-tailed bat may occur in the affected area of the following SEZs: Dry Lake, East Mormon Mountain, and Gold Point.

California Leaf-Nosed Bat (*Macrotus californicus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Arizona Wildlife Species of Concern
Rarity: California State Rank S2; California Species of Concern;
USFWS Species of Concern

The California leaf-nosed bat (*Macrotus californicus*) is confined to lowland Sonoran Desert habitats, including desert riparian, desert wash, desert scrub, desert succulent shrub, alkali desert scrub, and palm oasis. Since this species neither migrates nor hibernates, it relies on the availability of suitable roost sites that afford precise season-specific microclimatic conditions in order to successfully exploit temperate zone deserts. Such roost sites occur almost exclusively within mines or caves and have the following characteristics: They are a source of geothermal heat; have a stable temperature of about 84°F (29°C); have high humidity (>50%); have no air circulation; have high ceilings; and are at least 300 ft (100 m) in length. The proximal occurrence of desert wash vegetation is an additional critical habitat component, because it provides California leaf-nosed bats with a local source of their primary prey; this resource is necessary to minimize winter foraging excursions (Nature Serve 2010; Western Bat Working Group 2010).

California leaf-nosed bats are purely insectivorous, with moths (sphingid, noctuid, and cossid), butterflies, grasshoppers, and katydids making up the majority of their diet. Foraging occurs close to the ground (<2 ft or <6 m), where prey items are gleaned from vegetation. The sizes of the home ranges of California leaf-nosed bat populations are determined by the spatial distribution of roosting and resources. Seasonally, movements between summer and winter roosts are typically less than 2 mi (2.6 km), with core activity occurring up to 1 mi (1.3 km) from roosts sites (CDFG 2010; Nature Serve 2010; Western Bat Working Group 2010).

California leaf-nosed bats are the most northerly representative of the family Phyllostomidae (Western Bat Working Group 2010). Historically, their geographic range extended across southern California, Arizona, and southern Nevada. However, studies suggest that during the recent century, this species has disappeared from the coastal basins of California and is currently limited to the eastern portion of its former range (CDFG 2010; Nature Serve 2010; Western Bat Working Group 2010). Such rapid range contraction has been attributed to roost disturbance, renewed mining in historic districts, mine closures, and destruction of foraging habitat. Moreover, the restrictive roosting requirements, limited distribution, and tendency to form large but relatively few roosting aggregations that are characteristics of California leaf-nosed bats act to further exasperate the effects incurred by these threats.

The California leaf-nosed bat was formerly a Candidate 2 (C2) species under the ESA and is now considered a species of concern (nonstatutory ranking) by the USFWS.

The California leaf-nosed bat may occur in the affected area of the following SEZs: Brenda, Bullard Wash, Gillespie, Imperial East, Iron Mountain, and Riverside East.

Cave Myotis (*Myotis velifer*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: California State Rank S1; USFWS Species of Concern

The cave myotis (*Myotis velifer*) is generally within the Sonoran and Transition life zones, particularly desert scrub, desert succulent shrub, desert wash, desert riparian, and pine-oak communities. Creosote bush, palo verde, brittlebush, and cactus are dominant vegetative components of utilized sites (Western Bat Working Group 2005). Within these communities, this crevice-dwelling species requires cavern-like structures for roosting during all the stages of its life cycle in which it exhibits a high level of site fidelity (CDFG 2010). Preferred roost sites are typically caves; however, mines, bridges, or buildings may also be utilized if characterized as having a thermal range of 46 to52°F (8 to 11°C), a high relative humidity (>50%), and low air circulation.

The diet of the cave myotis consists primarily of lepidopterans and coleopterans, but weevils, antlions, and other flying insects may also be taken opportunistically. Foraging occurs over dense riparian vegetation and in drier desert washes at heights of 12 to 50 ft (4 to 12 m) (Western Bat Working Group 2010).

The sizes of the home ranges of cave myotis populations are determined by the spatial distribution of roost sites and prey resources. Because this species tends to make extensive daily movements between summer roosting areas and foraging habitat, home ranges may encompass areas as large as 618 mi (1,600 km^2) (AZGFD 2010).

The geographic distribution of the cave myotis extends from Kansas, Oklahoma, and western Texas, to southern Nevada and to southeastern California (along the Colorado River only), south through Mexico to the Honduras at elevations of 300 to 8,800 ft (92 to 2,684 m). In California, this species has experienced significant declines as result of roost disturbance, loss of riparian vegetation, and pesticides, and it is currently restricted to lowlands of the Colorado River and adjacent mountain ranges (CDFG 2000).

The cave myotis was formerly a Candidate 2 (C2) species under the ESA and is now considered a species of concern (nonstatutory ranking) by the USFWS.

Cave myotis populations could potentially occur in the affected areas of the following SEZs: Brenda, Bullard Wash, Gillespie, and Riverside East.

Dark Kangaroo Mouse (*Microdiposops megacephalus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Utah Species of Concern; Utah State Rank S2

The dark kangaroo mouse occurs in the Great Basin region within the project area, in sagebrush-dominated areas with sandy soils. Nocturnally active during warm weather, the species remains in underground burrows during the day and cold winter months. The dark kangaroo mouse may occur in the affected area of the following SEZs: Milford Flats South and Wah Wah Valley.

Desert Bighorn Sheep (*Ovis canadensis mexicana*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Endangered in New Mexico
Rarity: New Mexico Species of Concern; New Mexico State Rank S1

The desert bighorn sheep (*Ovis canadensis mexicana*) is currently listed as threatened in the state of New Mexico. It is one of several subspecies of bighorn sheep that is known to occur in the southwestern United States. This subspecies is known to occur in eastern Arizona, New Mexico, and Texas. Within New Mexico, desert bighorn sheep inhabit visually open, rocky, desert, mountain ranges in the southern portion of the state. The species rarely uses desert lowlands and valleys, but these areas may be occasionally used as movement corridors between mountain ranges. The desert bighorn sheep may occur in the affected area of the following SEZs: Afton and Mason Draw.

Desert Valley Kangaroo Mouse (*Microdipodops megacephalus albiventer*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2; USFWS Species of Concern

The Desert Valley kangaroo mouse is endemic to central Nevada where it inhabits desert areas at playa margins and in dune habitats. The Desert Valley kangaroo mouse may occur in the affected area of the following SEZs: Delamar Valley and Dry Lake Valley North.

Fringed Myotis (*Myotis thysanodes*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: Utah Species of Concern; Nevada State Rank S2; USFWS Species of Concern

The fringed myotis inhabits a wide range of habitats, including lowland riparian, desert shrub, pinyon-juniper, and sagebrush habitats. Roost sites have been reported in buildings and caves. This species may be a summer or year-round resident throughout the six-state solar energy region. The fringed myotis may occur in the affected area of the following SEZs: Afton, Amargosa Valley, Delamar Valley, Dry Lake Valley North, East Mormon Mountain, Escalante Valley, Gold Point, Mason Draw, Milford Flats South, Millers, and Red Sands.

Gunnison's Prairie Dog (*Cynomys gunnisoni*)

ESA Listing Status: Candidate
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: New Mexico State Rank S2

The Gunnison's prairie dog occurs in grasslands and shrublands in two separate range portions: those that inhabit montane habitats (higher elevation, moister climate), and those that inhabit prairie habitats (lower elevation, drier climate). Gunnison's prairie dogs are diurnal herbivores that live in colonies and spend much of their time underground. The diet of the Gunnison's prairie dog includes grasses, forbs, sedges, and shrubs. Invertebrates make up a small portion of the diet. They are inactive or torpid during in severe winter weather (Nature Serve 2010). Adults emerge from their burrows in March or early April. Reproduction occurs in spring, but the timing of reproduction varies somewhat by latitude, elevation, and year. Following birth, the young stay underground for about 1 month.

Gunnison's prairie dog colonies are often smaller than those of other species and may consist of fewer than 50 individuals (NatureServe 2009). Colonial groups are organized into

territories that generally contain one adult male and several adult females and nonbreeding juveniles. Survivorship is low. The Gunnison's prairie dog is an important prey species for raptors. Range-wide, habitats occupied by the species have declined by nearly 98% between 1916 and the present (Nature Serve 2010).

Montane Gunnison's prairie dog populations are more vulnerable to the sylvatic plague because in the montane region, colonies are fewer in number, smaller, and more scattered. These factors would make it more difficult for individuals to recolonize sites that were extirpated as a result of the disease (73 FR 6660). Compared to the lower-elevation prairie habitat regions, moister montane areas may have more hospitable climates for fleas and, in turn, plague outbreaks. Although plague outbreaks have occurred in the drier prairie portions of the Gunnison's prairie dog range, populations in these habitats can recover much more quickly because of the availability of nearby colonies.

Gunnison's prairie dog populations within montane habitats in central and south central Colorado and north central New Mexico were listed as candidates for federal protection under the ESA on February 5, 2008 (73 FR 6660). Threats to the continued existence of Gunnison's prairie dog are primarily related to the spread of sylvatic plague. Sylvatic plague is a bacterial disease that is generally transmitted among rodents by fleas. The disease is not native to North America and has been known in the United States since 1900. The disease can severely reduce or extirpate populations within a short time frame (3 to 10 years).

Gunnison prairie dog populations could potentially occur in the affected areas of the following SEZs: Antonito Southeast, De Tilla Gulch, and Los Mogotes East.

Kit Fox (*Vulpes macrotis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Utah)
State Listing Status: Not Listed
Rarity: Not Listed

The kit fox (*Vulpes macrotis*) occurs in desert and semiarid communities, including mixed-grass shrublands, shrublands, grasslands, and margins of pinyon-juniper woodlands. It occurs at an elevational range of 4,800 to 6,000 ft (1,463 to 1,829 m) on sites of sandstone or shale derivation with a high clay to clay-loam content and generally avoids areas with with gravelly substrates (Meaney et al. 2006). Diurnal den sites—because they ameliorate extreme temperatures, reduce heat loads, conserve water, and protect against predators—are a critical habitat component for this semi-fossorial species. As such, overlapping home ranges that are 620 to 2,866 ac (251 to 1,160 ha) in size are established in areas that provide adequate den site availability and high densities of primary prey items, including lagomorphs, prairie dogs, and kangaroo rats (Meaney et al. 2006; Nature Serve 2010).

The geographic distribution of the kit fox extends from northern Baja California, north through western Texas, west of the Rocky Mountains, to southwestern Idaho and southeastern

Oregon, and it is in portions of California, Arizona, Nevada, Utah, New Mexico, and western Colorado, where it tends to occur in small, isolated populations. Despite maintaining the majority of its historical range, this species is declining in many of the states in which it occurs, including Utah.

Kit fox populations could potentially occur in the affected areas of the following SEZs: Escalante Valley, Milford Flats South, and Wah Wah Valley.

Long-Legged Myotis (*Myotis volans*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: Not Listed

The long-legged myotis primarily inhabits montane coniferous forests; it also occurs in riparian and desert habitats. This species uses caves and mines as hibernacula, but its winter habits are poorly known. It roosts in abandoned buildings, rock crevices, and under the bark of trees. The long-legged myotis may occur in the affected area of the following SEZs: Afton and Red Sands.

Mohave Ground Squirrel (*Spermophilus mohavensis*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Threatened in California
Rarity: California State Rank S2

The Mohave ground squirrel is known from the Mojave Desert in San Bernardino County, California. It inhabits open desert scrub, grasslands, and Joshua tree woodlands at elevations between 1,800 and 5,000 ft (500 and 1,525 m). It utilizes burrows at the bases of shrubs. The Mohave ground squirrel may occur in the affected area of the Pisgah SEZ.

Nelson's Bighorn Sheep (*Ovis canadensis nelsoni*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Threatened in California
Rarity: USFWS Species of Concern

Nelson's bighorn sheep (also called desert bighorn sheep) are a subspecies of bighorn sheep known to occur in the southwestern United States. This species occurs in desert mountain ranges in Arizona, California, Nevada, Oregon, and Utah. Nelson's bighorn sheep primarily use

montane shrubland, forest, and grassland habitats, and they may utilize desert valleys as corridors for travel between range habitats. Nelson's bighorn sheep may occur in the affected area of the following SEZs: Amargosa Valley, Delamar Valley, Dry Lake, Dry Lake Valley North, East Mormon Mountain, Gold Point, Iron Mountain, Millers, Pisgah, and Riverside East.

Pahranagat Valley Montane Vole (*Microtus montanus fucosus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2; USFWS Species of Concern

The Pahranagat Valley montane vole is endemic to Lincoln County, Nevada, where it is restricted to springs in the Pahranagat Valley. Within that area, isolated populations utilize mesic montane and desert riparian habitat. The Pahranagat Valley montane vole may occur in the affected area of the following SEZs: Delamar Valley and Dry Lake Valley North.

Pale Kangaroo Mouse (*Microdipodops pallidus*)

ESA Listing Status: Not Listed
BLM Listing Status: Not Listed
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S2

The pale kangaroo mouse is a rodent that is endemic to southwestern Nevada and southeastern California. This species inhabits fine sands in alkali sink and desert scrub habitats dominated by shadscale (*Atriplex confertifolia*) or big sagebrush (*Artemisia tridentata*). The species often burrows in areas of soft, windblown sand piled at the bases of shrubs. The pale kangaroo mouse may occur in the affected area of the Gold Point SEZ.

Pallid Bat (*Antrozous pallidus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: California Species of Concern; USFWS Species of Concern

The pallid bat (*Antrozous pallidus*) occurs in a variety of woodland, grassland, riparian, wetland, and agricultural habitats but is most abundant in xeric communities, such as deserts and canyon lands. Within these habitat types, this species requires rocky outcrops, cliffs, crevices, mines, or buildings for roosting . Tree cavities in oak, ponderosa pine, coastal redwood, or giant Sequoia also serve as roost sites. Preferred characteristics of roost sites are relatively cool and stable thermal conditions and unobstructed entrances that occur high above the ground surface.

In addition, water resources are a critical habitat component, since pallid bats often drink immediately after emergence (Nature Serve 2010; Western Bat Working Group 2010).

Pallid bats are opportunistic generalists that glean a variety of invertebrate prey—including beetles, moths, and crickets—from surfaces. Foraging occurs in and among the vegetation of open shrub-steppe grasslands, oak savannah grasslands, open Ponderosa pine forests, talus slopes, gravel roads, lava flows, fruit orchards, and vineyards (Nature Serve 2010; Western Bat Working Group 2010).

The sizes of the home ranges of pallid bat populations are determined by the spatial distribution of roosting, prey, and water resources. Seasonal migration between summer ranges and hibernacula as well as daily movements from night roosts and foraging areas are local, ranging from 1 to 3 mi (0.5 to 2.5 km) (Nature Serve 2010; Western Bat Working Group 2010).

The geographic distribution of the pallid bat extends throughout western North America, from southern British Columbia, south to Latin America, and east to Texas, at elevations of 6,000 to 7,000 ft (1,830 to 2,100 m). In California, this species is locally common within the Great Basin, Mojave, and Sonoran Deserts. Current population trends are unknown, however, because the loss of critical roost sites has resulted in a general decline in the abundance of cave-dwelling bat species throughout North America, and concern over the status of pallid bat populations has increased.

The pallid bat could potentially occur in the affected area of the following SEZs: Amargosa Valley, Dry Lake, Gold Point, Iron Mountain, Pisgah, and Riverside East.

Palm Springs Pocket Mouse (*Perognathus longimembris bangsi*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: California State Rank S2

The Palm Springs pocket mouse is a pocket mouse subspecies known to occur only in Riverside County within the Coachella Valley in California. This species inhabits desert scrub and grassland communities on sandy soils. The Palm Springs pocket mouse may occur in the affected area of the Riverside East SEZ.

Pygmy Rabbit (*Brachylagus idahoensis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (Utah)
State Listing Status: Protected in Nevada
Rarity: Utah State Rank S2; Utah Species of Concern

The pygmy rabbit (*Brachylagus idahoensis*) is a sagebrush (*Artemisia* sp.) obligate, restricted to sagebrush-steppe areas of the Great Basin and adjacent intermountain regions. Within these sagebrush-dominated communities, individuals establish relatively small home ranges encompassing an areal extent of 1.1 to 4.9 ac (2.8 to 12.0 ha). These home ranges are characterized as having relatively high sagebrush cover (21–36%) and being centered around burrow systems constructed on loose, alluvial soils. Together, these habitat properties serve to minimize the risk of predation risk and provide adequate forage as well, since big sagebrush constitutes 51–99% of their diet (Lee 2008; Nature Serve 2010).

Beyond being considered a keystone species within big sagebrush habitat, pygmy rabbits are also considered to be unique among leporids, which enhances their ecological importance. Distinctive behaviors include these: scurrying locomotion, emission of distress vocalization, and high fossoriality (Lee 2008; Nature Serve 2010; Oliver 2004).

Historically, the geographic range of pygmy rabbits has been limited in the north to the Great Basin and adjacent intermountain areas of eastern Washington and southwestern Montana, and in the south to California and eastern Utah. Current studies suggest that this species has suffered rapid declines over this last century, likely because of its high susceptibility to anthropogenic changes, which has resulted in a patchy distribution of disjunct population segments (Lee 2008; Nature Serve 2010; Oliver 2004).

The Great Basin populations of the pygmy rabbit were petitioned for listing under the ESA in 2003, but no federal protective status was received. However, Columbia populations in the state of Washington are listed as endangered under the ESA (Oliver 2004).

The pygmy rabbit could potentially occur in the affected areas of the following SEZs: Dry Lake Valley North, Escalante Valley, Milford Flats South, and Wah Wah Valley.

Silver-Haired Bat (*Lasionycteris noctivagans*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: USFWS Species of Concern

The silver-haired bat is known from forested areas at high elevations of 1,600 to 8,500 ft (488 to 2,590 m), composed of aspen, cottonwood, white fir, pinyon-juniper, subalpine fir, willow, and spruce communities. Roost and nursery sites occur in tree foliage or cavities or under loose bark. This species rarely hibernates in caves. The silver-haired bat may occur in the affected area of the following SEZs: Delamar Valley, Dry Lake, East Mormon Mountain, and Gold Point.

Spotted Bat (*Euderma maculatum*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada; Threatened in New Mexico
Rarity: California State Rank S2; Colorado State Rank S2; New Mexico State Rank S2; Utah State Rank S2; Utah Species of Concern; UFWS Species of Concern

The spotted bat (*Euderma maculatum*) occurs in a wide variety of arid habitat types, including desert shrub habitat, subalpine meadows, pinyon juniper woodlands, cliffs, riparian areas, and coniferous forests. Black oak (*Quercus velutina*), ponderosa pine, incense cedar (*Calocedrus decurrens*), giant sequoia (*Sequoiadendron giganteum*), red fir (*Abies magnifica*), lodgepole pine (*Pinus contorta*), and white fir are common vegetative associations of utilized sites. Within these communities, this species requires rocky cliff features for roosting during all stages of its life cycle. It exhibits a high level of site fidelity. Roost sites typically occur in crevices of high, steep, cliffs composed of granite, basalt, limestone, sandstone, or other sedimentary rock; site selection appears to be determined by its thermal conditions and protective ability. In addition, water resources in the form of rivers, lakes, marshes, or man-made bodies of water are another critical habitat component, since spotted bats are highly susceptible to water loss (Luce and Keinath 2007; Nature Serve 2010; Western Bat Working Group 2010).

Spotted bats are lepidopteran specialists, with more than 97% of their diet consisting of moths (Luce and Keinath 2007). Foraging occurs in the open-air space along linear landscape elements within woodlands, canopy gaps, stream corridors, and edges of riparian zones.

The sizes of the home ranges of spotted bat populations are determined by the spatial distribution of roosting, prey, and water resources. The migratory behavior of this species is restricted to daily movements of 6 to 24 mi (10 to 38.5 km) between roost sites and foraging habitat, since both the hibernating range and summer range occur within the same area (Luce and Keinath 2007).

The spotted bat is widely distributed across western North America, from the southern Canadian province of British Columbia; south through eastern Oregon, Idaho, south central Montana, central and western Wyoming, western Colorado and Nevada; to southern California, southwestern Arizona, New Mexico and west Texas; to central Mexico at elevations of 187 ft below sea level to 9,800 ft (–57 to 3,000 m). Within its range, this species occurs at low densities as localized subpopulations; thus, both its distribution and its abundance are constrained by the availability of suitable roost sites (Luce and Keinath 2007; Nature Serve 2010; Western Bat Working Group 2010).

The spotted bat was formerly a candidate species under the ESA until the classification system was modified and subsequently removed from the list. Currently, this species is considered a species of concern (nonstatutory ranking) by the USFWS.

The spotted bat could potentially occur in the affected areas of the following SEZs: Amargosa Valley, Antonito Southeast, De Tilla Gulch, Delamar Valley, Dry Lake, Dry Lake

Valley North, Escalante Valley, Gold Point, Los Mogotes East, Milford Flats South, Millers, Pisgah, Red Sands, Riverside East, and Wah Wah Valley.

Townsend's Big-Eared Bat (*Corynorhinus townsendii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Protected in Nevada
Rarity: California State Rank S2; Colorado State Rank S2; Nevada State Rank S2; California, Colorado, Utah, and USFWS Species of Concern

The Townsend's big-eared bat (*Corynorhinus townsendii*) is widespread throughout the western United States and occurs in each of the six states in the solar PEIS region. The pale Townsend's big-eared bat (*C. t. pallescens)*, a subspecies of the Townsend's big-eared bat, occurs primarily in Colorado and New Mexico. The Townsend's big-eared bat is generally associated with dry upland habitats, particularly desert scrub, mixed conifer forest, and pinion-juniper forest habitat, but it will also utilize mesic coniferous and deciduous forests. Within these communities, this species requires spacious, cavern-like structures for roosting during all stages of its life cycle, in which it exhibits a high level of site fidelity. Limestone caves, mines, lava tubes, bridges, or buildings may serve as such roosting structures. Roosting site selection seems to be determined by a combination of the site's internal complexity, dimensions, and opening aperture, since these features regulate and maintain the temperature and humidity. Preferred structural characteristics of maternal roosts include an internal thermal range of 64 to 86ºF (18 to 30ºC) and an entrance with a diameter of at least 6 by 12 in. (15 by 31 cm) occurring at a height of 8 to 16 ft (2.4 to 4.9 m); whereas hibernacula have a thermal range of 30.2 to 52.0ºF (–1.0 to 11.2 2ºC), moderate airflow, and low disturbance (CDFG 2010; Nature Serve 2010; Western Bat Working Group 2010).

Townsend's big-eared bats are lepidopteran specialists, with more than 90% of their diet consisting of moths. Foraging occurs along linear landscape elements within woodlands, canopy gaps, stream corridors, and edges of riparian zones dominated by Douglas-fir, California bay, and willow species, where the bats glean insects from vegetation. Such habitat areas also provide a critical source of drinking water (CDFG 2010; Nature Serve 2010; Western Bat Working Group 2010).

The sizes of the home ranges of Townsend's big-eared bat populations are determined by the spatial distribution of roosting, prey, and water resources. Seasonally, movements between summer roosting areas to hibernacula range from 2 to 40 mi (3.1 to 64 km), whereas in summer areas, which encompass a roosting and foraging habitat, migratory movements may extend as far as 6.5 mi (10.5 km) from roost sites.

The geographic distribution of the Townsend's big-eared bat extends from the Pacific Coast east to Nevada and Idaho and north from central Mexico to southern British Columbia and at elevations of 4,501 to 10,459 ft (1,372 to 3,188 m). Within its range, this species is apparently not very abundant; such rarity likely results from the limited availability of suitable roosting

habitat. Disturbance to, as well as loss of, this critical habitat component has led to rapid declines throughout the western United States (CDFG 2010; Nature Serve 2010; Western Bat Working Group 2010).

The Townsend's big-eared bat was formerly a Candidate 2 (C2) species under the ESA, and it is now considered a species of concern (nonstatutory ranking) by the USFWS.

The Townsend's big-eared bat could potentially occur in the affected areas of the following SEZs: Afton, Amargosa Valley, Antonito Southeast, Brenda, Bullard Wash, De Tilla Gulch, Delamar Valley, Dry Lake, East Mormon Mountain, Escalante Valley, Fourmile East, Gold Point, Imperial East, Iron Mountain, Los Mogotes East, Mason Draw, Milford Flats South, Millers, Pisgah, Red Sands, Riverside East, and Wah Wah Valley.

Utah Prairie Dog (*Cynomys parvidens*)

ESA Listing Status: Threatened
BLM Listing Status: Not Listed
State Listing Status: Not Listed
Rarity: Utah State Rank S1

The Utah prairie dog is endemic to southwestern Utah, where it occurs in grasslands, level mountain valleys, and areas with deep, well-drained soils and low-growing vegetation that allows for good visibility. It is one of three prairie dog species in the state of Utah. Utah prairie dogs are diurnal herbivores that live in colonies and spend much of their time underground. They are inactive or torpid in severe winter weather. Adults emerge from mid-March to early April. Breeding occurs in the spring, and young emerge from the burrows during May and early June. Adults are often dormant from mid-July to mid-August and are not often seen above ground during this period. Juveniles enter dormancy during October and November (Nature Serve 2010; USFWS 2010e).

The Utah prairie dog feeds primarily on grasses and various seeds and flowers of shrubs and insects when available. Common plant species consumed include alfalfa, leafy aster, European glorybind, and wild buckwheat seeds. The size of the home range of the Utah prairie dog varies, depending on the quality of the habitat, from 3 to 20 ac (1.2 to 8.2 ha). Available habitat for the Utah prairie dog has declined from an estimated 448,000 ac (1,813 km^2) to less than 7,000 ac (28 km^2) at the present time (Nature Serve 2010; USFWS 2010e).

The size of its population has varied considerably during historic times. In 1920, before programs to control the Utah prairie dog, its total population was estimated at 95,000. Shooting and poisoning of the species by ranchers (and likely periodic reductions from the plague) led to a decrease in the size of the population; it was estimated to be about 3,700 by 1984. By the spring of 1989, the adult population reached 9,200. The USFWS, in its report to Congress, reported that at this size, the population was considered as being at risk of a crash from a plague outbreak (Nature Serve 2010; USFWS 2010e).

The Utah prairie dog was first listed as federally endangered on June 4, 1973 (USFWS 1973). In 1984, it was reclassified as threatened by the USFWS (USFWS 1984b). A recovery plan that was prepared in 1991 and revised in 2010 (USFWS 2010e) described the current extent of the existing populations and laid out management goals for ensuring the continued survival of the species. A major goal was to improve the chances of long-term survival of the species in the following areas: West Desert in southern Beaver and Iron Counties; Paunsaugunt in western Garfield County, eastern Iron County, and extreme northwestern Kane County; and the Awapa Plateau, which extends from Sevier County southward through western Wayne and Piute Counties into northern Garfield County. No updated information on the population sizes or the success and locations of transplanted populations has been found. The recovery plan also described plans to transplant Utah prairie dogs to unoccupied habitats, and it defined procedures for monitoring the transplants.

The Utah prairie dog could potentially occur in the affected areas of the following SEZs: Escalante Valley, Milford Flats South, and Wah Wah Valley.

Western Mastiff Bat (*Eumops perotis californicus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive (California and Nevada)
State Listing Status: Protected in Nevada
Rarity: Nevada State Rank S1; USFWS Species of Concern

The western mastiff bat (*Eumops perotis californicus*) is the largest native bat in the Unites States. This cliff-dwelling species occurs in a wide variety of open, semiarid to arid habitats, including conifer and deciduous woodlands, coastal scrub, annual and perennial grasslands, palm oases, chaparral, desert scrub, and urban locations of the Upper and Lower Sonoran zone. Low-growing California buckwheat (*Eriogonum fasciculatum*), greasewood (*Adenostoma fasciculatum*), black sage (*Salvia mellifera*), white sage (*Salvia apiana*), and coastal sagebrush (*Artemisia califomica*) are common vegetative components of utilized sites. Within these communities, the western mastiff bat requires rocky cliffs or outcrops for roosting. Roosting site selection is based on vegetative structure as well as entrance height, orientation, and aperture. Preferred roost sites are characterized as having the following features: (1) little vegetation; (2) a clear, vertical drop of at least 9.8 ft (3 m) from the entrance; (3) entrances with a bottom access that are oriented horizontally and face downward; and (4) an aperture of 10 by 6 in. (25 by 15 cm); all of these accommodate specific flight requirements. These diurnal refugia typically occur in deep crevices that are 12 to 24 in. (30 to 60 cm) in width within granitic rocks and consolidated sandstone substrates. In addition, water resources in the form of large bodies of water longer than 100 ft (30 m) are another critical habitat component, since western mastiff bats are highly susceptible to water loss (CDFG 2010; Nature Serve 2010; Western Bat Working Group 2010).

Western mastiff bats are insectivorous, feeding on small to large insects of soft to intermediate hardness characterized as having a low and weak flight pattern. Foraging occurs near ground level within the open-air space along linear landscape elements within woodlands,

canopy gaps, stream corridors, and edges of riparian zones (CDFG 2010; Nature Serve 2010; Western Bat Working Group 2010).

The western mastiff bat exhibits nocturnal activity year-round. Unlike most molossids, this species is nonmigratory; the migratory behavior of this species is restricted to daily movements of 6 to 15 mi (10 to 25 km) between roost sites and foraging habitat as well as alternate day roosts.

The geographic distribution of the western mastiff bat extends from central Mexico across the southwestern United States, including southern California, southern Nevada, Arizona, southern New Mexico, and western Texas, at elevations of 197 ft below sea level to 1,230 ft (–60 to 375 m). Within its range, it has experienced severe declines as a result of the loss and disturbance of roost sites, pest control operations, and grazing and pesticide applications in foraging areas (Nature Serve 2010; Western Bat Working Group 2010).

The western mastiff bat could potentially occur in the affected area of the following SEZs: Dry Lake, Imperial East, Iron Mountain, Pisgah, and Riverside East.

Western Red Bat (*Lasiurus blossevillii*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Arizona Wildlife Species of Concern; Protected in Nevada
Rarity: Nevada State Rank S1; Utah State Rank S1; New Mexico State Rank S2; USFWS Species of Concern

The western red bat is an uncommon year-round resident in the southwestern United States. It forages in riparian and other wooded areas. It roosts primarily in cottonwood trees along riparian areas and in fruit orchards. The western red bat may occur in the affected area of the following SEZs: Afton, Bullard Wash, Gillespie, and Mason Draw.

Western Small-Footed Myotis (*Myotis ciliolabrum*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: California State Rank S2; USFWS Species of Concern

The western small-footed myotis (*Corynorhinus townsendii*) is generally associated with semiarid to arid upland habitats, particularly desert scrub, grasslands, sagebrush steppe, pinyon-juniper forests, and pine-fir forests, but it prefers more mesic areas with increasing elevation. Within these communities, this species requires the availability of suitable roost sites. Crevices and cracks of canyon walls serve as day roosts, whereas limestone caves and mines are commonly utilized for hibernation. A combination of internal depth, dimensions, and opening

aperture appears to determine the roost sites selected by western small-footed myotis, because these features regulate and maintain temperature and humidity. Preferred structural characteristics of roosts include an internal thermal range of 79 to 84ºF (26 to 29ºC), high humidity, an average entrance diameter of 1.4 in. (3.5 cm), and a shallow depth ranging from 1 to 8 in. (2.5 to 20.5 cm). In addition, water resources are a critical habitat component, because individuals often drink immediately after emergence (CDFG 2010; Nature Serve 2010).

The western small-footed myotis is an aerial feeder that preys on a variety of flying insects, particularly Lepidoptera. Foraging occurs along woodland margins or over water bodies at a range of 3 ft (1 m) above ground level to treetop height. Such habitat areas also provide a critical source of drinking water.

The sizes of the home ranges of western small-footed myotis populations are determined by the spatial distribution of roosting, prey, and water resources. Seasonal migration between summer ranges and hibernacula, as well as daily movements from day roosts and foraging areas, are local, since summer and winter ranges apparently coincide (CDFG 2010).

The western small-footed myotis inhabits most of western North America, where its geographic distribution extends from the southwestern Canada to central Mexico. In California, it occurs along the southern coast as well as along the Sierra Nevada at elevations from sea level to 8,900 ft (0 to 2,700 m).

The western small-footed myotis could potentially occur in the affected area of the following SEZs: Afton, Amargosa Valley, Delamar Valley, Dry Lake, Dry Lake Valley North, East Mormon Mountain, Gold Point, Mason Draw, Millers, Red Sands, and Riverside East.

Western Yellow Bat (*Lasiurus xanthinus*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Arizona Wildlife Species of Concern
Rarity: Arizona State Rank S2; California Species of Concern

The Western yellow bat (*Lasiurus xanthinus*) occurs in a variety of habitat types throughout its range, from dry tropical forests to semi-tropical wet forests. This species is especially associated with Washington fan palm trees (*Washingtonia filifera*), because they provide critical roosting sites for this foliage rooster. However, sites composed of other broad-leaved, deciduous species (e.g., sycamores, hackberries, and cottonwoods) are also utilized. Roost sites are almost exclusively in the skirts of palm trees, where the dense frond cover modifies the microclimate and protects individuals from severe weather and predators (AZGFD 2010; Nature Serve 2010; Western Bat Working Group 2010).

Western yellow bats are insectivorous, feeding on a variety of medium-sized, night-flying Hymenoptera, Dipterans, Lepidoptera, and Coleoptera. Foraging occurs above water features

within open grassland, scrub, and canyon and riparian locations (Nature Serve 2010; Western Bat Working Group 2010).

The distribution of the western yellow bat is primarily in Mexico and Central America, with its range restricted to the southern portions of California, Arizona, New Mexico, and possibly southwestern Texas at elevations of 550 to 6,000 ft (168 to 1,830 m).

The western yellow bat could potentially occur in the affected areas of the following SEZs: Brenda, Bullard Wash, Gillespie, and Riverside East.

Yuma Myotis (*Myotis yumanensis*)

ESA Listing Status: Not Listed
BLM Listing Status: Listed as Sensitive
State Listing Status: Not Listed
Rarity: USFWS Species of Concern

The Yuma myotis is a widespread, year-round resident throughout much of the southwestern United States. It is uncommon in the Mojave and Sonoran Desert regions, except for mountain ranges bordering the Colorado River and the San Bernardino Mountains. It prefers montane forest habitats at elevations between 2,000 and 8,000 ft (600 and 2,400 m). It roosts in buildings, mines, caves, and crevices. The Yuma myotis may occur in the affected area of the following SEZs: Antonito Southeast, Bullard Wash, and Los Mogotes East.

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APPENDIX K:

GOVERNMENT-TO-GOVERNMENT AND CULTURAL RESOURCE CONSULTATIONS

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APPENDIX K:

GOVERNMENT-TO-GOVERNMENT AND CULTURAL RESOURCE CONSULTATIONS

K.1 TRIBAL CONSULTATION

This section provides detailed information on the status of government-to-government consultation for the "Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern Western States" (Solar PEIS).

K.1.1 Introduction

Government-to-government consultation under Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments" (*Federal Register*, Volume 65, pages 67249–67252, Nov. 9, 2000), was initiated in 2008 with the submission of letters to 253 Tribes, Chapters, and Bands, notifying them of the forthcoming Solar PEIS, inviting them to be cooperating parties, and offering government-to-government consultation (BLM 2008; see Section K.1.2). On July 1, 2009, with the expansion of the PEIS to include 24 specific solar energy study areas, a second letter was sent to 316 Tribes, Chapters, and Bands identified by the U.S. Department of the Interior (DOI) Bureau of Land Management (BLM), seeking comments on the proposed action and solar energy study areas, and indicating that the Section 106 consultation process of the National Historic Preservation Act (NHPA) would be done concurrently with the National Environmental Policy Act (NEPA) process and government-to-government consultation requirements. The BLM has followed up with additional letters, phone calls, e-mails, and meetings for Tribes whose traditional use areas are closest to the proposed study areas. The status of this information is provided in Table K-1.

To summarize tribal response as of August 2010, 36 Tribes have responded by letter (see Section K.1.2), e-mail, or telephone, or met with local BLM personnel. Written responses were received from 15 Tribes or Tribal organizations either directly in response to the BLM letters or through the NEPA scoping process for the PEIS. Three tribes contacted the BLM Washington Office directly by telephone. Five Tribes (Quechan, Soboba Band of Luiseño Indians, Pueblo of Zuni, Cheyenne-Arapaho Tribes of Oklahoma, and Paiute Indian Tribes of Utah) requested either consultation or further information on the PEIS. Three inquiries were also made about becoming a cooperating agency or party for the PEIS by the Agua Caliente Band of Cahuilla Indians, Cabazon Band of Cahuilla Mission Indians, and the Cheyenne-Arapaho Tribes of Oklahoma.

Consultation between the BLM and the Tribes is ongoing and this Appendix will be updated as much as possible prior to the public Draft release and again between Draft and Final.

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TABLE K-1 Status of Tribal Consultations

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
AZ	Ak Chin Indian Community Council	Maricopa	AZ	+	AZ		
AZ	Cocopah Tribal Council	Somerton	AZ, CA	+	AZ	+	
AZ	Colorado River Indian Tribes Museum	Parker		+	AZ	+	
AZ	Colorado River Tribal Council	Parker	AZ, CA	+	AZ	+	
AZ	Fort McDowell Yavapai Tribal Council	Fountain Hills	AZ	+	AZ	+	
AZ	Fort Yuma Quechan Tribe	Yuma	AZ, CA	+	AZ		**2009/09/03:** Letter from Mike Jackson, Sr., President Quechan Indian Tribe. The letter states the Tribe's concerns/comments regarding cultural resource protection and preservation and concerns about impairment of the quantity and quality of their water resources. Mr. Jackson states that the Quechan people and their ancestors have inhabited the area surrounding the confluence of the Colorado and Gila Rivers for centuries. The Indian Claims Commission found that the Quechan Tribe's historic lands extended well beyond the boundaries of the present day Fort Yuma Indian Reservation and includes certain lands to the north and west of the Fort Yuma Indian Reservation that fall within the solar energy study areas. Also that these areas are rich in cultural resources that could be impacted by large-scale solar development projects. The Tribe is aware of numerous applications for solar development within or nearby the area known as Indian Pass, which is a Traditional Cultural Property area that is considered sacred to the Tribe. The Tribe opposes solar development in areas that have

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
							been identified as specific TCPs of the Tribe, such as Indian Pass. Moreover, that the Tribe has diversion rights of 71,616 acre-feet per year in California and diversion rights of 6,350 acre-feet per year in Arizona. Mr. Jackson requests to meet with officials at the local BLM offices to discuss the Tribe's concerns in more detail.
AZ	Gila River Indian Community Council	Sacaton	AZ, CA	+	NM - AZ		
AZ	Havasupai Tribal Council	Supai	AZ	+	AZ	+	
AZ	Hopi Tribal Council	Kykotsmovi	AZ, CO, UT, NM	+	UT	+	
AZ	Hualapai Tribal Council	Peach Springs	AZ	+	AZ	+	
AZ	Kaibab Paiute Tribal Council	Fredonia	AZ, NV, UT	+	AZ	+	
AZ	Navajo Fish & Wildlife, Natural Heritage Program	Window Rock		+			
AZ	Navajo Nation	Window Rock	AZ, CO, UT	+	AZ		**2008/07/03:** From Judy Martin for Mr. Tony Joe, Program Manager, Historic Preservation Department-Traditional Culture Program. The letter is in response to a BLM request for information and offering tribal consultation to evaluate solar energy development on BLM lands. After reviewing the consultation documents of the HPD-TCP the proposed undertaking of the project would not impact any Navajo traditional cultural properties or historical properties. The Navajo Nation requests that if there are any inadvertent discoveries made during the course of the project, the agency shall cease

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
							all operations, notify the HPD-TCP within 24 hours, along with a formal letter sent within 72 hours. **2009/08/07:** From Judy Martin for Mr. Tony H. Joe, Jr., Supervisory Anthropologist, Historic Preservation Department-Traditional Culture Program. After reviewing BKM's consultation documents, HPD-TCP, on behalf of the Navajo Nation has no concerns at this time. However, the determination made by the HPD-TCP does not necessarily mean that the Navajo Nation has no interest or concerns with the proposed project. If the proposed project inadvertently discovers habitation sites, plant gathering areas, human remains and objects of cultural patrimony the HDP-TCP request that we be notified respectively in accordance with the Native American Graves Protection and Repatriation Act (NAGPRA). Following with contact information for Tony Joe. With a side note that Mr. Kelly Francis will be taking over all Section 106 Consultations soon within the near future.
AZ	Navajo Nation Council	Window Rock	AZ	+			
AZ	Navajo Nation, Birdsprings Chapter	Winslow	AZ	+		+	
AZ	Navajo Nation, Black Mesa Chapter	Pinon	AZ	+		+	
AZ	Navajo Nation, Blue Gap/Tachee Chapter	Blue Gap	AZ	+		+	
AZ	Navajo Nation, Bodaway-Gap Chapter	Gap	AZ	+		+	

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
AZ	Navajo Nation, Cameron Chapter	Cameron	AZ	+		+	
AZ	Navajo Nation, Chilchinbeto Chapter	Kayenta	AZ	+	AZ		
AZ	Navajo Nation, Chinle Chapter	Chinle	AZ	+		+	
AZ	Navajo Nation, Coalmine Canyon Chapter	Tuba City	AZ	+			
AZ	Navajo Nation, Coppermine Chapter	Page	AZ	+		+	
AZ	Navajo Nation, Cornfields Chapter	Ganado	AZ	+		+	
AZ	Navajo Nation, Cove Chapter	Red Valley	AZ	+		+	
AZ	Navajo Nation, Dennehotso Chapter	Dennehotso	AZ	+		+	
AZ	Navajo Nation, Dilkon Chapter	Winslow	AZ	+		+	
AZ	Navajo Nation, Forest Lake Chapter	Pinon	AZ	+		+	
AZ	Navajo Nation, Fort Defiance Chapter	Fort Defiance	AZ	+		+	
AZ	Navajo Nation, Ganado Chapter	Ganado	AZ	+		+	
AZ	Navajo Nation, Greasewood Springs Chapter	Ganado	AZ	+		+	
AZ	Navajo Nation, Hardrock Chapter	Kykotsmovi	AZ	+		+	
AZ	Navajo Nation, Houck Chapter	Houck	AZ	+		+	
AZ	Navajo Nation, Indian Wells Chapter	Indian Wells	AZ	+		+	

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
AZ	Navajo Nation, Inscription House Chapter	Tonalea	AZ	+		+	
AZ	Navajo Nation, Jeddito Chapter	Keams Canyon	AZ	+		+	
AZ	Navajo Nation, Kaibeto Chapter	Kaibeto	AZ	+		+	
AZ	Navajo Nation, Kayenta Chapter	Kayenta	AZ	+		+	
AZ	Navajo Nation, Kinlichee Chapter	St. Michael	AZ	+		+	
AZ	Navajo Nation, Klagetoh Chapter	Ganado	AZ	+			
AZ	Navajo Nation, LeChee Chapter	Page	AZ	+		+	
AZ	Navajo Nation, Leupp Chapter	Leupp	AZ	+		+	
AZ	Navajo Nation, Low Mountain Chapter	Blue Gap	AZ	+		+	
AZ	Navajo Nation, Lukachukai Chapter	Lukachukai	AZ	+		+	
AZ	Navajo Nation, Lupton Chapter	Lupton	AZ	+		+	
AZ	Navajo Nation, Many Farms Chapter	Many Farms	AZ	+		+	
AZ	Navajo Nation, Mexican Water Chapter	Teecnospos	AZ	+		+	
AZ	Navajo Nation, Nahata Dzill Chapter	Sanders	AZ	+		+	
AZ	Navajo Nation, Navajo Mountain Chapter	Tonalea	AZ	+		+	
AZ	Navajo Nation, Nazlini Chapter	Nazlini	AZ	+		+	
AZ	Navajo Nation, Oak Springs Chapter	Window Rock	AZ	+		+	

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
AZ	Navajo Nation, Pinon Chapter	Pinon	AZ	+		+	
AZ	Navajo Nation, Red Valley Chapter	Red Valley	AZ	+		+	
AZ	Navajo Nation, Rock Point Chapter	Rock Point	AZ	+		+	
AZ	Navajo Nation, Rough Rock Chapter	Chinle	AZ	+		+	
AZ	Navajo Nation, Round Rock Chapter	Round Rock	AZ	+		+	
AZ	Navajo Nation, Sawmill Chapter	Ft. Defiance	AZ	+		+	
AZ	Navajo Nation, Shonto Chapter	Shonto	AZ	+		+	
AZ	Navajo Nation, St. Michael Chapter	St. Michael	AZ	+		+	
AZ	Navajo Nation, Steamboat Chapter	Ganado	AZ	+		+	
AZ	Navajo Nation, Sweetwater Chapter	Teecnospos	AZ	+		+	
AZ	Navajo Nation, Teec Nos Pos Chapter	Teec Nos Pos	AZ	+		+	
AZ	Navajo Nation, Teesto Chapter	Winslow	AZ	+		+	
AZ	Navajo Nation, Toh Nanees Dizi Chapter	Tuba City	AZ	+		+	
AZ	Navajo Nation, Tolani Lake Chapter	Winslow	AZ	+		+	
AZ	Navajo Nation, Tonalea Chapter	Tonalea	AZ	+		+	
AZ	Navajo Nation, Tsaile/Wheatfields Chapter	Tsaile	AZ	+		+	

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
AZ	Navajo Nation, Tselani/Cottonwood Chapter	Chinle	AZ	+		+	
AZ	Navajo Nation, Whippoorwill Chapter	Pinon	AZ	+		+	
AZ	Navajo Nation, Wide Ruins Chapter	Chambers	AZ	+		+	
AZ	Pascua Yaqui Tribal Council	Tucson	AZ	+	AZ		
AZ	Salt River Pima-Maricopa Indian Community Council	Scottsdale	AZ, NM	+	AZ	+	
AZ	San Carlos Tribal Council	San Carlos	AZ, NM	+	AZ		
AZ	San Juan Southern Paiute Council	Tuba City	AZ, UT	+	AZ		
AZ	Tohono O'odham Nation	Sells	AZ, NM	+	AZ		
AZ	Tonto Apache Tribal Council	Payson	AZ	+	AZ	+	
AZ	White Cone Chapter	Indian Wells	AZ	+		+	
AZ	White Mountain Apache Tribe	Whiteriver	AZ, NM	+	AZ	+	
AZ	Yavapai-Apache Nation Tribal Council	Camp Verde	AZ	+	AZ	+	
AZ	Yavapai-Prescott Board of Directors	Prescott	AZ	+	AZ	+	
CA	Agua Caliente Band of Cahuilla Indians	Palm Springs	CA	+	CA	+	
CA	Alturas Rancheria	Alturas	CA	+			
CA	Augustine Band of Mission Indians	Coachella	CA	+	CA	+	**2010/02/22:** Email from Thomas Gallagher, Augustine Band. Argonne follow-up e-mail and attachments were given to Chairperson Green for her review.

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
CA	Barona Group of the Capitan Grande	Lakeside	CA	+	CA	+	
CA	Bear River Band of Rohnerville Rancheria	Loleta	CA	+			
CA	Benton Paiute Reservation	Benton	CA	+		+	
CA	Berry Creek Rancheria	Oroville	CA	+			
CA	Big Lagoon Rancheria	Trinidad	CA	+			
CA	Big Pine Paiute Tribe of the Owens Valley	Big Pine	CA	+			**2009/09/14:** Letter from Virgil Moose, Tribal Chairperson. The letter was submitted as a scoping comment regarding Solar PEIS, the scoping maps, and to request the Draft EIS as soon as it is released. Mr. Moose states that the Big Pine Paiute Tribe of the Owens Valley is a federally recognized Tribe located in Owens Valley, California. The tribe encourages the BLM to focus evaluations for possible solar development on lands recently disturbed and to avoid lands showing no evidence of recent disturbance. The tribe regrets that prior disturbance does not appear to have been a criterion in selecting lands for solar energy development. If the details of a particular resource on a given area of land are unknown, then it should be assumed that noteworthy or valuable resources may be present. If there is no known history of disturbance for an area, then it should be presumed intact and the goal should be to preserve it intact. The tribe finds the following statement from the PEIS public web site problematic "Environmental protection and energy production are both desirable and necessary objectives of sound land management practices and are not considered

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
							mutually exclusive priorities." The Tribe feels protection of public lands should be a higher priority, and questions leasing lands to private entities. Even though the maps do not include the Owens Valley region, an important issue in the Tribe's area has been export of water to fuel distant economies and energy generation, taking resources from one area to develop resources in another should be avoided. If solar energy development sites cannot be fully restored, plans should be in place to compensate for the lost resources, goods, services, and values. The tribe recommends a fund for mitigation be established for each developed site, and that considerable thought be given to the long term and currently unquantifiable impacts such development will cause.
CA	Big Sandy Rancheria	Auberry	CA	+		+	
CA	Big Valley Rancheria	Lakeport	CA	+			
CA	Bishop Paiute Tribe	Bishop	CA	+		+	
CA	Blue Lake Rancheria	Blue Lake	CA	+			**2009/07/09:** Email from Janet P. Eidsness, Tribal Heritage Preservation Officer. The letter thanks BLM for contacting Chairperson, Claudia Brundin, on July 1, 2009. The California study area is located well outside the Blue Lake Rancheria Tribe's cultural area of geographical concern, and the Tribe does not wish consultation.
CA	Bridgeport Indian Colony	Bridgeport	CA	+		+	
CA	Buena Vista Rancheria	Sacramento	CA	+			
CA	Cabazon Band of Cahuilla Mission Indians	Indio	CA	+	CA	+	

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
CA	Cahto Tribal Executive Committee	Laytonville	CA	+			
CA	Cahuilla Band of Mission Indians	Anza	CA	+	CA	+	
CA	California Valley Miwok Tribe	Stockton	CA	+			
CA	Campo Band of Mission Indians	Campo	CA	+	CA	+	
CA	Cedarville Rancheria	Alturas	CA	+		+	
CA	Chemehuevi Tribal Council	Havasu Lake	CA	+	CA	+	
CA	Chicken Ranch Rancheria	Jamestown	CA	+			
CA	Cloverdale Rancheria	Cloverdale	CA	+			
CA	Cold Springs Rancheria	Tollhouse	CA	+			
CA	Colusa Rancheria	Colusa	CA	+			
CA	Cortina Rancheria	Williams	CA	+			
CA	Coyote Valley Reservation	Redwood Valley	CA	+			
CA	Dry Creek Rancheria	Geyserville	CA	+			
CA	Elem Indian Colony	Clearlake Oaks	CA	+			
CA	Elk Valley Rancheria	Crescent City	CA	+			
CA	Enterprise Rancheria	Oroville	CA	+			
CA	Ewiiaapaayp Band of Kumeyaay Indians	Alpine	CA	+	CA	+	
CA	Federated Indians of Graton Rancheria	Rohnert Park	CA	+			
CA	Fort Bidwell Reservation	Fort Bidwell	CA	+		+	
CA	Fort Independence Indian Reservation	Independence	CA	+		+	
CA	Fort Mojave Tribal Council	Needles	AZ, CA	+	AZ, CA	+	

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
CA	Greenville Rancheria	Greenville	CA	+			
CA	Grindstone Rancheria	Elk Creek	CA	+			
CA	Guidiville Rancheria	Talmage	CA	+			
CA	Habematolel Pomo of Upper Lake	Upper Lake	CA	+			
CA	Hoopa Valley Tribal Council	Hoopa	CA	+			
CA	Hopland Reservation	Hopland	CA	+			
CA	Inaja-Cosmit Reservation	Escondido	CA	+		+	
CA	Ione Band of Miwok Indians	Ione	CA	+			
CA	Jackson Rancheria	Jackson	CA	+			
CA	Jamul Indian Village	Jamul	CA	+			
CA	Karuk Tribe of California	Happy Camp	CA	+			
CA	Kern Valley Indian Community	Caliente	CA	+			
CA	Kwaaymii Laguna Band of Indians	Pine Valley	CA	+			
CA	La Jolla Band of Luiseño Indians	Pauma Valley	CA	+	CA		
CA	La Posta Band of Mission Indians	Boulevard	CA	+	CA	+	
CA	Lone Pine Paiute Shoshone Reservation	Lone Pine	CA	+		+	
CA	Los Coyotes Band of Cahuilla & Cupeno Indians	Warner Springs	CA	+	CA	+	
CA	Lower Lake Rancheria	Santa Rosa	CA	+			
CA	Lytton Rancheria	Santa Rosa	CA	+			
CA	Manchester - Point Arena Band of Pomo Indians	Point Arena	CA	+			

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
CA	Manzanita Band of Mission Indians	Boulevard	CA	+	CA	+	
CA	Mechoopda Indian Tribe of the Chico Rancheria	Chico	CA	+			
CA	Mesa Grande Band of Mission Indians	Santa Ysbel	CA	+			
CA	Middletown Rancheria	Middletown	CA	+			
CA	Mooretown Rancheria	Oroville	CA	+			
CA	Morongo Band of Mission Indians	Banning	CA	+	CA	+	
CA	Native American Heritage Commission	Sacramento	-	-	-		
CA	North Fork Rancheria	North Fork	CA	+		+	
CA	Pala Band of Mission Indians	Pala	CA	+	CA	+	
CA	Paskenta Band of Nomlaki Indians	Orland	CA	+			
CA	Pauma/Yuima Band of Mission Indians	Pauma Valley	CA	+	CA	+	
CA	Pechanga Band of Mission Indians	Temecula	CA	+	CA	+	
CA	Picayune Rancheria of Chukchansi Indians	Coarsegold	CA	+		+	
CA	Pinoleville Reservation	Ukiah	CA	+			
CA	Pit River Tribal Council	Burney	CA	+			
CA	Potter Valley Tribe	Ukiah	CA	+			
CA	Quartz Valley Reservation	Fort Jones	CA	+			
CA	Ramona Band of Mission Indians	Anza	CA	+	CA	+	
CA	Redding Rancheria	Redding	CA	+			
CA	Redwood Valley Reservation	Redwood Valley	CA	+			

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
CA	Resighini Rancheria	Klamath	CA	+			
CA	Rincon Band of Mission Indians	Valley Center	CA	+			
CA	Robinson Rancheria	Nice	CA	+			
CA	Round Valley Reservation	Covelo	CA	+			
CA	Rumsey Rancheria	Brooks	CA	+			
CA	San Luis Rey Band of Mission Indians	Poway	CA	+			
CA	San Manuel Band of Mission Indians	Patton	CA	+	CA	+	
CA	San Pasqual Band of Mission Indians	Valley Center	CA	+	CA	+	
CA	Santa Rosa Band of Mission Indians	Hemet	CA	+	CA	+	
CA	Santa Rosa Rancheria	Lemoore	CA	+			
CA	Santa Ynez Band of Mission Indians	Santa Ynez	CA	+			
CA	Santa Ysabel Band of Diegueno Indians	Santa Ysabel	CA	+	CA	+	
CA	Scotts Valley Rancheria	Lakeport	CA	+			
CA	Sherwood Valley Rancheria	Willits	CA	+			
CA	Shingle Springs Rancheria	Shingle Springs	CA	+			
CA	Smith River Rancheria	Smith River	CA	+			

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
CA	Soboba Band of Luiseño Indians	San Jacinto	CA	+	CA		**2010/03/08:** Letter from Joseph Ontiveros, Soboba Cultural Resource Department. The Soboba find that the proposed action does fall within the Tribe's traditional use area and requests that tribe participate in government-to-government consultation in accordance with Section 106; be a lead participant in consultation; provide monitors for any ground-disturbing activity; and that the tribe's procedural requests be honored. The Developer should follow NAGPRA and agree to return all Native American ceremonial items and items of cultural patrimony that may be found on the project site to the Soboba Band. Upon completion of authorized and mandatory archeological analysis, the Developer should return said artifacts to the Soboba Band within a reasonable time period agreed to by the Parties. If human remains are encountered, the Soboba Band should be allowed, to (1) inspect the site of the discovery and (2) make determinations as to how the human remains and grave goods shall be treated and disposed of with appropriate dignity. The Developer should accommodate on-site reburial in a location mutually agreed upon by the Parties.
CA	Stewarts Point Rancheria	Santa Rosa	CA	+			
CA	Susanville Indian Rancheria	Susanville	CA	+			
CA	Sycuan Band of the Kumeyaay Nation	El Cajon	CA	+		+	**2010/03/04:** From Sid Morris, Planning and Development. The letter includes the contact information for Sid Morris.

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
CA	Table Bluff Reservation	Loleta		+			
CA	Table Mountain Rancheria	Friant	CA	+			
CA	Timbi-sha Shoshone Tribe	Death Valley	CA, NV	+	CA		
CA	Torres-Martinez Desert Cahuilla Indians	Thermal	CA	+	CA	+	
CA	Trinidad Rancheria	Trinidad	CA	+			
CA	Tubatulabals of Kern Valley	Lake Isabella	CA	+			
CA	Tule River Reservation	Porterville	CA	+			
CA	Tuolumne Rancheria	Tuolumne	CA	+			
CA	Twenty-Nine Palms Band of Mission Indians	Coachella	CA	+	CA	+	
CA	United Auburn Indian Community	Auburn	CA	+			
CA	Viejas Band of Mission Indians	Alpine	CA	+	CA	+	**2010/03/04:** From Jenny Rothrauff, Project Manager Office of Chairman Bobby Barrett. The area referenced is not something Viejas would typically comment on since the project appears to be outside of the boundaries of San Diego limits.
CA	Wiyot Tribe	Loleta	CA	+			
CA	Woodfords Community Council	Markleeville	CA - NV	+			
CA	Yurok Tribe	Klamath	CA	+			
CO	Southern Ute Tribe	Ignacio	CO - UT	+	CO	+	
CO	Ute Mountain Ute Tribe	Towaoc	CO - UT	+	CO		
DC	National Association of Tribal Historic Preservation Officers	Washington		+			
ID	Shoshone-Bannock Tribes	Fort Hall	CO, UT	+			

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
MT	Blackfeet Tribal Business Council	Browning		+			
MT	Chippewa Cree Business Committee	Box Elder		+			
MT	Confederated Salish & Kootenai Tribes, Tribal Council	Pablo		+			
MT	Crow Tribal Council	Crow Agency		+			
MT	Fort Belknap Community Council	Harlem		+			
MT	Fort Peck Tribal Executive Board	Poplar		+			
MT	Northern Cheyenne Tribal Council	Lame Deer	CO	+	CO	+	
ND	Standing Rock Sioux Tribal Council	Fort Yates	CO	+	CO		**2008/07/21:** Letter from Ron His Horse Is Thunder, Chairman of Standing Rock Sioux Tribal Council. The letter requests that before any ground disturbance begins that there be a Class III archeological survey, in order to locate any potential Native American artifacts and/or items of cultural significance. Also, a request to utilize Native Americans who have been specifically trained to conduct these types of ground surveys.
NM	All Indian Pueblo Council	Albuquerque		+		+	
NM	Eight Northern Indian Pueblos Council	San Juan Pueblo		+		+	**2010/03/04:** From Michael G. Miller. The letter updates contact information.
NM	Five Sandoval Indian Pueblos	Bernalillo		+		+	
NM	Jicarilla Apache Nation	Dulce	CO	+	CO	+	
NM	Mescalero Apache Tribe	Mescalero	NM	+	NM		
NM	Navajo Nation, Alamo Chapter	Magdalena		+		+	

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
NM	Navajo Nation, Baahaali Chapter	Gallup		+		+	
NM	Navajo Nation, Baca/Prewitt Chapter	Prewitt		+		+	
NM	Navajo Nation, Becenti Chapter	Crownpoint		+		+	
NM	Navajo Nation, Beclabito Chapter	Shiprock		+		+	
NM	Navajo Nation, Casamero Lake Chapter	Prewitt		+		+	
NM	Navajo Nation, Chichiltah Chapter	Gallup		+		+	
NM	Navajo Nation, Churchrock Chapter	Churchrock		+		+	
NM	Navajo Nation, Counselor Chapter	Counselor		+			
NM	Navajo Nation, Coyote Canyon Chapter	Brimhall		+		+	
NM	Navajo Nation, Crownpoint Chapter	Crownpoint		+		+	
NM	Navajo Nation, Crystal Chapter	Navajo		+		+	
NM	Navajo Nation, Gadii'ahi/To'koi Chapter	Shiprock		+		+	
NM	Navajo Nation, Huerfano Chapter	Bloomfield		+		+	
NM	Navajo Nation, Iyanbito Chapter	Fort Wingate		+		+	
NM	Navajo Nation, Lake Valley Chapter	Crownpoint		+		+	
NM	Navajo Nation, Little Water Chapter	Crownpoint		+		+	
NM	Navajo Nation, Manuelito Chapter	Manuelito		+		+	

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
NM	Navajo Nation, Mariano Lake Chapter	Smith Lake		+		+	
NM	Navajo Nation, Mexican Springs Chapter	Mexican Springs		+		+	
NM	Navajo Nation, Nageezi Chapter	Nageezi		+		+	
NM	Navajo Nation, Nahodishgish Chapter	Crownpoint		+		+	
NM	Navajo Nation, Naschitti Chapter	Sheep Springs		+		+	
NM	Navajo Nation, Nenahnezad Chapter	Fruitland		+		+	
NM	Navajo Nation, Newcomb Chapter	Newcomb		+		+	
NM	Navajo Nation, Ojo Encino Chapter	Cuba		+		+	
NM	Navajo Nation, Pinedale Chapter	Churchrock		+		+	
NM	Navajo Nation, Pueblo Pintado Chapter	Cuba		+		+	
NM	Navajo Nation, Red Lake #18 Chapter	Navajo		+		+	
NM	Navajo Nation, Red Rock Chapter	Gallup		+			
NM	Navajo Nation, Rock Springs Chapter	Yatahey		+		+	
NM	Navajo Nation, San Juan Chapter	Fruitland		+		+	
NM	Navajo Nation, Sanostee Chapter	Sanostee		+		+	
NM	Navajo Nation, Sheep Springs Chapter	Sheep Springs		+		+	
NM	Navajo Nation, Shiprock Chapter	Shiprock		+		+	

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
NM	Navajo Nation, Smith Lake Chapter	Smith Lake		+		+	
NM	Navajo Nation, Standing Rock Chapter	Crownpoint		+		+	
NM	Navajo Nation, Thoreau Chapter	Thoreau		+		+	
NM	Navajo Nation, Tiis Tsoh Sikaad Chapter	Newcomb		+		+	
NM	Navajo Nation, Toadlena/Two Grey Hills Chapter	Newcomb		+		+	
NM	Navajo Nation, Tohatchi Chapter	Tohatchi		+		+	
NM	Navajo Nation, Torreon Chapter	Cuba		+		+	
NM	Navajo Nation, Tsayatoh Chapter	Mentmore		+		+	
NM	Navajo Nation, Tse Daa K'aan Chapter	Shiprock		+		+	
NM	Navajo Nation, Twin Lakes Chapter	Yatahey		+		+	
NM	Navajo Nation, Upper Fruitland Chapter	Fruitland		+		+	
NM	Navajo Nation, White Rock Chapter	Crownpoint		+		+	**2010/03/05:** From Lucinda Henry, President states in her letter that after viewing the Solar Energy PEIS, it sounded good and interesting.
NM	Navajo Nation, Whitehorse Lake Chapter	Cuba		+		+	
NM	Ohkay Owingeh	San Juan Pueblo	NM, CO	+		+	
NM	Pueblo of Acoma	Acoma	NM, CO	+	CO	+	
NM	Pueblo of Cochiti	Cochiti	NM, CO	+		+	
NM	Pueblo of Isleta	Isleta	NM, CO	+	NM		

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
NM	Pueblo of Jemez	Jemez Pueblo	NM, CO	+		+	
NM	Pueblo of Laguna	Laguna	NM, CO	+			**2009/08/14:** Letter from John E. Antonio, Sr., Governor of the Pueblo of Laguna. The Pueblo of Laguna has determined that the undertaking will not have a significant impact at this time. However, the governor requests to be notified if Native American artifacts are discovered at the sites. He also requests photographs of these items. According to the tribe's unpublished migration history, tribal ancestors journeyed from the north through the areas under discussion and settled for periods of a time before traveling to their present location, increasing the chances that possible findings exist.
NM	Pueblo of Nambe	Santa Fe	NM, CO	+		+	
NM	Pueblo of Pecuris	Penasco	NM, CO	+		+	
NM	Pueblo of Pojoaque	Santa Fe	NM, CO	+	NM	+	
NM	Pueblo of San Felipe	San Felipe Pueblo	NM, CO	+		+	
NM	Pueblo of San Ildefonso	Santa Fe	NM, CO	+		+	
NM	Pueblo of Sandia	Bernalillo	NM, CO	+		+	
NM	Pueblo of Santa Ana	Santa Ana Pueblo	NM, CO	+		+	
NM	Pueblo of Santa Clara	Espanola	NM, CO	+		+	
NM	Pueblo of Santo Domingo	Santo Domingo Pueblo	NM, CO	+		+	
NM	Pueblo of Taos	Taos	NM, CO	+		+	
NM	Pueblo of Tesuque	Santa Fe	NM, CO	+	NM	+	
NM	Pueblo of Zia	Zia Pueblo	NM, CO	+		+	
NM	Pueblo of Zuni	Zuni	NM, CO	+	NM		
NM	Ramah Navajo Chapter	Ramah		+		+	

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
NM	Tohajiilee Navajo Chapter	Tohajiilee		+		+	
NV	Battle Mountain Band Council	Battle Mountain	NV	+		+	
NV	Carson Community Council	Carson City	NV, CA	+			
NV	Dresslerville Community Council	Gardnerville	NV, CA	+			
NV	Duckwater Tribal Council	Duckwater	NV, CA	+		+	
NV	Elko Band Council	Elko	NV	+		+	
NV	Ely Shoshone Tribe	Ely	NV	+	NV	+	
NV	Fallon Paiute Shoshone Tribal Business Council	Fallon	NV	+	NV	+	
NV	Fort McDermitt Tribal Council	McDermitt	NV	+	NV	+	
NV	Inter-Tribal Council of Nevada	Sparks		+		+	
NV	Las Vegas Tribal Council	Las Vegas	NV, CA	+	NV	+	
NV	Lovelock Tribal Council	Lovelock	NV	+	NV		
NV	Moapa Business Council	Moapa	NV	+	NV	+	
NV	Pahrump Paiute Tribe	Pahrump	NV	+			
NV	Pyramid Lake Paiute Tribal Council	Nixon	NV	+	NV	+	
NV	Reno-Sparks Tribal Council	Reno	NV	+	NV	+	
NV	Shoshone-Paiute Business Council	Owyhee	NV	+		+	
NV	South Fork Band Council	Lee	NV	+		+	
NV	Stewart Community	Gardnerville	NV	+	NV	+	

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
	Council c/o Washoe Tribe of Nevada/California						
NV	Summit Lake Paiute Tribal Council	Sparks	NV	+	NV	+	
NV	Te-Moak Tribe of Western Shoshone Tribal Council	Elko	NV	+		+	
NV	Walker River Paiute Tribal Council	Schurz	NV, CA	+	NV	+	
NV	Washoe Tribal Council	Gardnerville	NV, CA	+	NV		**2009/07/28:** Email from Darrel Cruz, Tribal Historic Preservation Officer. The letter states that the areas of interest for the SEZs are out of their boundary and will not pursue the matter.
NV	Wells Indian Colony Band Council	Wells	NV	+		+	
NV	Winnemucca Tribal Council	Winnemucca	NV	+	NV		
NV	Yerington Paiute Tribe	Yerington	NV	+	NV	+	
NV	Yomba Tribal Council	Austin	NV	+		+	
OK	Apache Tribe of Oklahoma	Anadarko	CO	+	CO	+	
OK	Cheyenne-Arapaho Tribes of Oklahoma	Concho	CO		CO		**2009/10/07:** Letter from Gordon Yellowman, Cultural Heritage Program. The letter requests that the tribe will participate as a consulting and cooperating party.
OK	Comanche Nation	Lawton	CO, NM	+	CO	+	
OK	Fort Sill Apache Tribe of Oklahoma	Apache	CO, NM	+	NM		
OK	Kiowa Tribe of Oklahoma	Carnegie	CO, NM	+	CO	+	
OK	Pawnee Nation of Oklahoma	Pawnee	CO	+	CO	+	

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
SD	Cheyenne River Lakota Sioux Tribe	Eagle Butte	CO	+	CO	+	
SD	Crow Creek Sioux Tribal Council	Fort Thompson	CO	+	CO	+	
SD	Lower Brule Sioux Tribal Council	Lower Brule		+			
SD	Oglala Sioux Tribal Council	Pine Ridge	CO	+	CO	+	
SD	Rosebud Sioux Tribal Council	Rosebud	CO	+	CO	+	**2010/02/03:** From Rodney Bordeaux, President writes in his letter that he will forward the letter to the Tribal Historic Preservation Office for them to follow up on the PEIS.
SD	Sisseton-Wahpeton Sioux Tribe	Agency Village		+			
SD	Yankton Sioux Tribe	Marty		+			
TX	Ysleta del Sur Pueblo	El Paso	TX	+		+	**2010/02/23:** From Javier Lorea, War Captain/Tribal Historic and Preservation Officer. The letter states the tribe has no comments on the proposed study and believes that the project will not adversely affect their traditional, religious, or culturally significant sites of the Pueblos. Although, they request consultation should any human remains or artifacts unearthed during this project be determined to fall under NAGPRA guidelines.
UT	Goshute Business Council	Ibapah	NV, UT	+		+	
UT	Navajo Nation, Aneth Chapter	Montezuma Creek	UT	+		+	
UT	Navajo Nation, Oljato Chapter	Monument Valley	UT	+		+	
UT	Navajo Nation, Red Mesa Chapter	Montezuma Creek	UT	+		+	
UT	Navajo Utah	Montezuma	UT	+			

TABLE K-1 (Cont.)

State	Organization	City	2008 Letter	July 2009 Letter	Field Office Follow-up	Argonne Follow-up	Response Letter
	Commission	Creek					
UT	Northwestern Band of Shoshone Nation	Brigham City	UT	+		+	
UT	Paiute Indian Tribe of Utah Tribal Council	Cedar City	NV, UT	+	UT	+	**2010/03/02:** From Jeanine Borchardt, Chairwoman requesting more information about the project.
UT	Paiute Indian Tribe of Utah, Cedar Band	Cedar City	NV, UT	+	UT		
UT	Paiute Indian Tribe of Utah, Indian Peak Band	Cedar City	NV, UT	+	UT	+	
UT	Paiute Indian Tribe of Utah, Kanosh Band	Kanosh	UT	+			
UT	Paiute Indian Tribe of Utah, Koosharem Band	Cedar City	UT	+			
UT	Paiute Indian Tribe of Utah, Shivwits Band	Ivins	NV, UT	+	UT		**2010/03/18:** From Shanan Martineau, Cultural Resources Manager. The Shivwits have been contacted by a private developer regarding a solar energy facility on Shivwits land. Therefore the tribe is interested in the PEIS and requests more information and government-to-government consultation on what the Solar PEIS is all about.
UT	Skull Valley Band of Goshute Indians General Council	Grantsville	UT	+		+	
UT	Ute Indian Tribe	Ft. Duchesne	CO, UT	+	CO	+	
UT	White Mesa Ute Tribe	Blanding		+		+	
WY	Eastern Shoshone Business Council	Fort Washakie	CO, UT	+	CO	+	
WY	Northern Arapaho Business Council	Fort Washakie	CO	+	CO	+	

TABLE K-2 Index of Agencies, Organizations, and Tribal Governments

Date	Originating Agency/Tribal Government	Recipient Organization	Page
June 5, 2008	New Mexico BLM	Various	K-28
June 6, 2008	Colorado BLM	Various	K-31
June 9, 2008	Arizona BLM	Various	K-35
June 19, 2008	Nevada BLM	Various	K-43
June 23, 2008	Utah BLM	Various	K-47
June 24, 2008	California BLM	Various	K-52
July 1, 2009	California BLM	Various	K-58
July 3, 2008	Navajo Nation, Historic Preservation Dept.–Traditional Culture Program	BLM	K-84
July 9, 2009	Blue Lake Rancheria Tribe	BLM	K-85
July 13, 2009	Navajo Nation, Klagetoh Chapter	BLM	K-86
July 21, 2009	Standing Rock Sioux Tribe	BLM, California Desert District	K-87
July 28, 2009	Washoe Tribe of California and Nevada	BLM	K-89
	Moapa Band of Paiutes	Argonne National Laboratory	K-90
Aug. 7, 2009	Navajo Nation, Historic Preservation Dept.–Traditional Culture Program	BLM, California Desert District	K-91
Aug. 14, 2009	Pueblo of Laguna	BLM, California Desert District	K-92
	Pueblo of Zuni	BLM, New Mexico State Office	K-93
Sept. 3, 2009	Quechan Indian Tribe	Argonne National Laboratory	K-94
Sept. 8, 2009	Moapa Band of Paiutes, Dept. of Environmental Protection	BLM	K-99
Sept. 11, 2009	Native American Land Conservancy	Argonne National Laboratory	K-100
Sept. 14, 2009	National Trust for Historic Preservation	Argonne National Laboratory	K-106
	Big Pine Paiute Tribe of the Owens Valley	Argonne National Laboratory	K-112
Sept. 17, 2009	Timbisha Shoshone Tribe	BLM, Pahrump Field Office	K-115
	Navajo Nation, Chilchinbeto Chapter	BLM	K-116
Oct. 7, 2009	Cheyenne and Arapaho Tribes	BLM	K-117
Feb. 23, 2010	Ysleta del Sur Pueblo	BLM, California Desert District	K-118
March 2, 2010	Paiute Indian Tribe of Utah	Argonne National Laboratory	K-120
March 4, 2010	Kumeymaay Nation, Sycuan Band	Argonne National Laboratory	K-123
	Kumeymaay Nation, Sycuan Band	Argonne National Laboratory	K-124
	Kumeymaay Nation, Viejas Band	Argonne National Laboratory	K-125
March 5, 2010	Navajo Nation, White Rock Chapter	Argonne National Laboratory	K-127
March 8, 2010	Soboba Band of Luiseño Indians	BLM	K-129
March 18, 2010	Shivwits Band of Paiutes	BLM	K-132
March 30, 2010	Navajo Nation, Low Mountain Chapter	BLM	K-133

K.1.2 Letters

United States Department of the Interior
BUREAU OF LAND MANAGEMENT
New Mexico State Office
1474 Rodeo Rd.
P.O. Box 27115
Santa Fe, New Mexico 87502-0115
www.nm.blm.gov

IN REPLY REFER TO:
2800 (932)

June 5, 2008

Governor Chandler Sanchez
Pueblo of Acoma
P.O. Box 309
Acoma, NM 87034

Dear Governor Sanchez:

As part of the Bureau of Land Management's (BLM's) ongoing government-to-government consultation with the Acoma Pueblo, we are writing to let you know that the BLM and the Department of Energy (DOE) have initiated the preparation of a joint Programmatic Environmental Impact Statement (PEIS) to evaluate solar energy development on BLM-administered lands in Arizona, California, Colorado, New Mexico, Nevada, and Utah.

The Energy Policy Act of 2005 establishes a goal for the BLM to approve 10,000 megawatts of nonhydropower renewable energy on BLM-administered lands by the year 2015. The DOE and BLM have identified utility-scale solar energy development, along with wind and geothermal power, as critical components in meeting this goal and the Nation's energy needs. Utility-scale solar energy projects generate electricity that is distributed to consumers through the electric power transmission grid.

The study area has been limited to six states based on initial resource assessment showing that these states encompass the most prospective solar energy resources suitable for utility-scale development over the next 20 years. The BLM has already received a large number of utility-scale solar energy project proposals for BLM-administered lands, mainly in Arizona, southern California, and Nevada.

In addition to government-to-government consultation on this topic, we would also like to offer you an opportunity to partner with us in a cooperating agency relationship for this PEIS and potential plan amendments. The Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) (40 CFR 1500-1508) emphasize the use of such arrangements as a means of ensuring timely coordination with Tribal, State, Federal, and local agencies in preparation of NEPA analyses and documentation. The BLM places great importance on working effectively with its governmental partners through the cooperating agency relationship. For further information, please see our cooperating agency Web site: http://www.blm.gov/planning/cadg/.

Cooperating agency status is available to government entities with jurisdiction by law or special expertise. The cooperating agency must sign a Memorandum of Understanding with the Federal agency and must fund its own participation. Other governmental entities who may be invited to be cooperating agencies on this PEIS include the States of Arizona, California, Colorado, New Mexico, Nevada, and Utah; county governments; and several local town and city governments.

Preparation of the PEIS is a multistep process that will be completed in approximately 22 months and will include the preparation of a draft PEIS, a final PEIS, and Records of Decision by the BLM and the DOE. As such, we anticipate very short, concurrent review time frames for both us and our cooperating agencies. Cooperating agencies may negotiate the level of their involvement consistent with their available staffing and resources.

Gaining your Tribe's expertise and perspective is important to the success of the PEIS and subsequent management strategies. We value your knowledge, concerns, and perspectives relating to the planning area. Please note that the Tribe's participation, as a cooperating agency, does not replace BLM's obligation to consult on a government-to-government basis. Therefore, regardless of your Tribe's decision to participate or not as a cooperating agency, our government-to-government consultation will continue.

If you would like to participate as a cooperating agency, please contact Cynthia Sandoval or Debby Lucero at the above address or by phone at 505-438-7602 or 505-438-7593, respectively. Also, please allow me to direct you to our Web site where you can gain further information and sign up for Web news and updates. The Web site address is: http://solareis.anl.gov.

Thank you for your consideration. We look forward to our interaction and discussions with you.

Sincerely,

Linda S.C. Rundell
State Director

Same Letter Sent To:
See Attached List

932:DLucero:jp:6/5/08:x7593:Letter_to_Tribes

1
2

Same Letter Sent To:

Governor Robert Benavides
Pueblo of Isleta
P.O. Box 1270
Isleta Pueblo, NM 87022

Governor John Antonio, Sr.
Pueblo of Laguna
P.O. Box 194
Laguna Pueblo, NM 87026

Governor Earl Salazar
OHKAY OWINGEH
P.O. Box 1099
San Juan Pueblo, NM 87566

Governor Ernest Suina
Pueblo of Cochiti
P.O. Box 70
Cochiti Pueblo, NM 87072

Governor Paul Chinana
Pueblo of Jemez
P.O. Box 100
Jemez Pueblo, NM 87024

Governor Ernest Mirabal
Pueblo of Nambe
Route 1, Box 117-BB
Santa Fe, NM 87506

Governor Craig Quanchello
Pueblo of Picuris
P.O. Box 127
Penasco, NM 87553

Governor George Rivera
Pueblo of Pojoaque
78 Cities of Gold Road
Santa Fe, NM 87506

Governor Ulysses Leon
Pueblo of Santa Ana
2 Dove Road
Santa Ana Pueblo, NM 87004

Governor Ronald L. Tenorio
Pueblo of San Felipe
P.O. Box 4339
San Felipe Pueblo, NM 87001

Governor Sisto Quintana
Pueblo of Santo Domingo
P.O. Box 99
Santo Domingo Pueblo, NM 87052

Governor Robert Mora
Pueblo of Tesuque
Route 42, Box 360-T
Santa Fe, NM 87506

Governor Robert Montoya
Pueblo of Sandia
481 Sandia Loop
Bernalillo, NM 87004

Governor J. Michael Chavarria
Pueblo of Santa Clara
P.O. Box 580
Espanola, NM 87532

Governor Leon T. Roybal
Pueblo of San Ildefonso
Route 5, Box 315-A
Santa Fe, NM 87506

Governor Paul T. Martinez
Pueblo of Taos
P.O. Box 1846
Taos, NM 87571

Governor Ivan Pino
Pueblo of Zia
135 Capitol Square Dr.
Zia Pueblo, NM 87053-6013

Governor Norman Cooeyate
Pueblo of Zuni
P.O. Box 339
Zuni, NM 87327

1
2

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Colorado State Office
2850 Youngfield Street
Lakewood, Colorado 80215-7093
www.co.blm.gov

TAKE PRIDE IN AMERICA

JUN 6 2008

In Reply Refer To:
1793 (CO-923)

Chairman Ivan Posey
Shoshone Business Council
Shoshone Tribe
P.O. Box 538
Fort Washakie, WY 82514

Dear Chairman Posey:

As part of the Bureau of Land Management's (BLM's) ongoing government-to-government consultation with the Shoshone Tribe, the Washington Office of the Bureau of Land Management (BLM) are co-leads and the Department of Energy (DOE) have initiated the preparation of a joint Programmatic Environmental Impact Statement (PEIS) to evaluate solar energy development on BLM-administered lands in Arizona, California, Colorado, New Mexico, Nevada, and Utah.

The Energy Policy Act of 2005 establishes a goal for the BLM to approve 10,000 megawatts of non-hydropower renewable energy on BLM-administered lands by the year 2015. The DOE and BLM have identified utility-scale solar energy development, along with wind and geothermal power, as critical components in meeting this goal and the Nation's energy needs. Utility-scale solar energy projects generate electricity that is distributed to consumers through the electric power transmission grid.

The study area has been limited to six states based on initial resource assessment showing that these states encompass the most prospective solar energy resources suitable for utility-scale development over the next 20 years. The BLM has already received a large number of utility-scale solar energy project proposals for BLM-administered lands mainly in Arizona, southern California, and Nevada.

In addition to government-to-government consultation on this topic, we would also like to offer you an opportunity to partner with us in a cooperating agency relationship for this PEIS and potential plan amendments. The Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) 40 C.F.R. 1500-1508 emphasize the use of such arrangements as a means of ensuring timely coordination with Tribal, State, Federal, and local agencies in preparation of NEPA analyses and

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documentation. The BLM places great importance on working effectively with its governmental partners through the cooperating agency relationship. For further information, please see our cooperating agency web site: http://www.blm.gov/planning/cadg/.

Cooperating agency status is available to government entities with jurisdiction by law or special expertise. The cooperating agency must sign a Memorandum of Understanding with the Federal agency and must fund its own participation. Other governmental entities who may be invited to be cooperating agencies on this PEIS include the States of Arizona, California, Colorado, New Mexico, Nevada, and Utah; county governments; and several local town and city governments.

Preparation of the PEIS is a multistep process that will be completed in approximately 22 months and will include the preparation of a draft PEIS, a final PEIS, and Records of Decision by the BLM and the DOE. We anticipate very short concurrent review timeframes for both us and our cooperating agencies. Cooperating agencies may negotiate the level of their involvement consistent with their available staffing and resources.

Gaining your Tribe's expertise and perspective is important to the success of the PEIS and subsequent management strategies. We value your knowledge, concerns and perspectives relating to the planning area. Please note that the Tribe's participation as a cooperating agency does not replace BLM's obligation to consult on a government-to-government basis. Therefore, regardless of your Tribe's decision to participate or not as a cooperating agency, our government-to-government consultation will continue.

If you would like to participate as a cooperating agency, please contact Maryanne Kurtinaitis at (303) 239-3708. Also, please allow me to direct you to our web site where you can gain further information and sign up for web news and updates. The web site address is: http://solareis.anl.gov.

Thank you for your consideration. We look forward to our interaction and discussions with you.

Sincerely,

Sally Wisely

Sally Wisely
State Director

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Chairman Ivan Posey
Shoshone Business Council
Shoshone Tribe
P.O.Box 538
Fort Washakie, WY 82514

Ms. Glenda Trosper
Director, Shoshone Tribe Cultural Center
P.O. Box 1008
Fort Washakie, WY 82514

Chairman Richard Brannan
Northern Arapaho Business Council
P.O. Box 396
Fort Washakie, WY 82514

Mr. Robert J. Goggles (NAGPRA Contact)
328 17 Mile Road
Arapaho, WY 82510

Ms. Jo Ann White
THPO Director
P.O. Box 396
Ft. Washakie, WY 82514

Chairman Clement Frost
Southern Ute Indian Tribe
356 Ouray Drive, P.O. Box 737
Ignacio, CO 81137

Mr. Neil Cloud
NAGPRA Representative, Southern Ute Indian Tribe
P.O. Box 737
Ignacio, CO 81137

Chairman Ernest House, Sr.
Ute Mountain Ute Tribe
P.O. Box JJ
Towoac, CO 81334

Mr. Terry Knight, Sr.
NAGPRA Representative, Ute Mountain Ute Tribe
P.O. Box 468
Towoac, CO 81334

Colorado Commission of Indian Affairs
Ernest House, Jr., Executive Secretary
130 State Capitol
Denver, CO 80203

Governor Bill Ritter
Ken Weil, Dir. Office Policy & Initiatives
136 State Capital
Denver, CO 80203-1792

The Governor's Energy Office
Morey Wolfson
1580 Logan St., Suite 100
Denver, CO 80203

Chairman Alonzo Chalepah
Apache Tribe of Oklahoma
P.O. Box 1220
Anadarko, OK 73005

Governor Darrell Flyingman
Cheyenne & Arapaho Tribes of Oklahoma
P.O. Box 38
Concho, OK 73022

Chairman Joseph J. Brings Plenty, Sr.
Cheyenne River Sioux Tribe
P.O. Box 590
Eagle Butte, SD 57625

Chairman Wallace Coffey
Comanche Tribal Business Committee
P.O. Box 908
Lawton, OK 73502

Chairman Lester Thompson, Jr.
Crow Creek Sioux Tribe
P.O. Box 50
Fort Thompson, SD 57325

Chairman Jeff Houser
Fort Sill Apache Business Committee
Fort Sill Apache Tribe
Route 2, Box 121
Apache, OK 73006

Chairman Ben Nuvamsa
The Hopi Tribe
P.O. Box 123
Kykotsmovi, AZ 86039

President Levi Pesata
Jicarilla Apache Tribal Council
P.O. Box 507
Dulce, NM 87528

Chairman Billy Evans Horse
Kiowa Business Committee,
Kiowa Tribe of Oklahoma
P.O. Box 369
Carnegie, OK 73015

President Joe Shirley
Navajo Nation, P.O. Box 9000
Window Rock, AZ 86515

President Eugene Little Coyote
Northern Cheyenne Tribal Council
P.O. Box 128
Lame Deer, MT 59043

President John Yellow Bird Steele
Oglala Sioux Tribal Council
P.O. Box 2070
Pine Ridge, SD 57770

Governor Earl Salizar
Ohkay Owingeh
P.O. Box 1099
San Juan, NM 87566

President George Howell
Pawnee Nation of Oklahoma
881 Little Dee Drive
Pawnee, OK 74058

Governor Jason Johnson
Pueblo of Acoma
P.O. Box 309
Pueblo of Acoma, NM 87034

Governor Ray H. Trujillo
Pueblo de Cochiti
P.O. Box 70
Cochiti, NM 87072

Governor Robert Benavides
Pueblo of Isleta
P.O. Box 1270
Isleta, NM 87022

Governor Raymond Gachupin
Pueblo of Jemez
P.O. Box 100
Jemez Pueblo, NM 87024

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Governor John Antonio, Sr.
Pueblo of Laguna
P.O. Box 194
Laguna, NM 87026

Governor Dennis F. Vigil
Pueblo of Nambe
Route 1, Box 117-BB
Santa Fe, NM 87506

Governor Richard Mermejo
Pueblo of Picuris
P.O. Box 127
Penasco, NM 87553

Governor George Rivera
Pueblo of Pojoaque
78 Cities of Gold Road
Santa Fe, NM 87506

Governor Michael T. Sandoval
Pueblo of San Felipe
P.O. Box 4339
San Felipe Pueblo, NM 87001

Governor James Mountain
San Ildefonso Pueblo
Route 5, Box 315-A
Santa Fe, NM 87506

Governor Victor Montoya
Pueblo of Sandia
Box 6080
Bernalillo, NM 87004

Governor Ulysses G. Leon
Pueblo of Santa Ana
Two Dove Road
Bernalillo, NM 87004

Governor Joseph Michael Chavarria
Santa Clara Pueblo
P.O. Box 580
Espanola, NM 87532

Governor Nelson Pacheco
Santo Domingo Pueblo
P.O. Box 99
Santo Domingo Pueblo, NM 87052

Governor Gilbert Suazo, Sr.
Taos Pueblo
P.O. Box 1846
Taos, NM 87571

Governor Charles Dorame
Tesuque Pueblo
Route 42, Box 360-T
Santa Fe, NM 87506

Governor Rudy Shije
Pueblo of Zia
135 Capitol Square Drive
Zia Pueblo, NM 87053

President Rodney Bordeaux
Rosebud Sioux Tribe
P.O. Box 430
Rosebud, SD 57570

Chairman Alonzo Coby
Fort Hall Business Council
Shoshone-Bannock Tribes
P.O. Box 306
Fort Hall, ID 83203

Chairman Ron His-Horse-Is-Thunder
Standing Rock Sioux Tribal Council
P.O. Box D
Fort Yates, ND 58538

Chairman Curtis Cesspooch
Uintah & Ouray Tribal Business Committee
P.O. Box 190
Ft. Duchesne, UT 84026

Governor Norman Cooeyate
Zuni Pueblo
P.O. Box 339
Zuni, NM 87327

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Tribal Letter

June 9, 2008

In Reply Refer To:
8160/1793 (AZ-912)

«Title» «First_Name» «Last_Name»
«Title_2»
«Company_Name»,
«Company_Name_2»
«Address_Line_1»
«City», «State» «ZIP_Code»

Dear «Title_2» «Last_Name»:

As part of the Bureau of Land Management's (BLM's) ongoing government-to-government consultation with the «Company_Name», «Company_Name_2», I am writing to let you know that the Bureau of Land Management (BLM) and the Department of Energy (DOE) have initiated the preparation of a joint Programmatic Environmental Impact Statement (PEIS) to evaluate solar energy development on BLM-administered lands in Arizona, California, Colorado, New Mexico, Nevada, and Utah.

The Energy Policy Act of 2005 establishes a goal for the BLM to approve 10,000 megawatts of non-hydropower renewable energy on BLM-administered lands by the year 2015. The DOE and BLM have identified utility-scale solar energy development, along with wind and geothermal power, as critical components in meeting this goal and the Nation's energy needs. Utility-scale solar energy projects generate electricity that is distributed to consumers through the electric power transmission grid.

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If you would like to participate as a cooperating agency, please contact Angela Mogel at 602-417-9536. Also, please allow me to direct you to our web site where you can gain further information and sign up for web news and up-dates. The web site address is: http://solareis.anl.gov.

Thank you for your consideration. We look forward to our interaction and discussions with you.

Sincerely,

Elaine Y. Zielinski

Elaine Y. Zielinski
State Director

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First	Last	Suffix	Title	Organization	Address	Mode	City	State	Zip	Phone No.
Delia M.	Carlyle		Chairperson	Ak Chin Indian Community	42507 W. Peters & Nall Road		Maricopa	AZ	85239	
Sherry	Cordova		Chairperson	Cocopah Tribe	County 15th & Avenue G	Fed Ex	Somerton	AZ	85350	928-503-2291
Daniel	Eddy	Jr.	Chairman	Colorado River Indian Tribes	Rt. 1, Box 23-B		Parker	AZ	85344	
Michael	Tsosie		Director	Colorado River Indian Tribes Museum	26600 Mohave Rd.		Parker	AZ	85344	928-669-1339
Raphael	Bear		President	Fort McDowell Yavapai Nation	P.O. Box 17779		Fountain Hills	AZ	85268	
Timothy	Williams		Chairman	Fort Mojave Indian Tribe	500 Merriman Avenue		Needles	CA	92363	760-629-4591
Linda	Otero		Director	Aha Makav Cultural Society	500 Merriman Avenue		Needles	CA	92363	
William Roy	Rhodes		Governor	Gila River Indian Community	P.O. Box 97		Sacaton	AZ	85247	
Don	Watahomigie	Sr.	Chairman	Havasupai Tribe	P.O. Box 10		Supai	AZ	86435-0010	
Benjamin	Nuvamsa		Chairman	Hopi Tribe	P.O. Box 123		Kykotsmovi	AZ	86039	
Charles	Vaughn	Sr.	Chairman	Hualapai Tribe	P.O. Box 179	893 Highway 66 -Fed Ex	Peach Springs	AZ	86434	928-769-2216
Ona	Segundo		Chairperson	Kaibab Paiute Tribe	HC65, Box 2	250 N Pipe Springs - Fed Ex	Fredonia	AZ	86022	928-643-8311
Peter	Yucupicio		Chairperson	Pascua Yaqui Tribe	7474 S. Camino de Oeste	Fed Ex	Tucson	AZ	85746	520-879-6337
Mike	Jackson	Sr.	President	Fort Yuma Quechan Tribe	P.O. Box 1899	**MAIL**	Yuma	AZ	85366	619-572-0213
Diane	Enos		President	Salt River Pima-Maricopa Indian Community	10005 E. Osborn		Scottsdale	AZ	85256	
Wendsler	Nosie	Sr.	Chairperson	San Carlos Apache Tribe	P.O. Box "0"		San Carlos	AZ	85550	
Mary Lou	Boone		President	San Juan Southern Paiute Tribe	P.O. Box 2710		Tuba City	AZ	86045	

First	Last	Suffix	Title	Organization	Address	Mode	City	State	Zip	Phone No.
Ned	Norris	Jr.	Chairman	Tohono O'odham Nation	P.O. Box 837		Sells	AZ	85634	
Ivan	Smith		Chairman	Tonto Apache Tribe	Tonto Apache Reservation #30		Payson	AZ	85541	
Ronnie	Lupe		Chairman	White Mountain Apache Tribe	P.O. Box 700		Whiteriver	AZ	85941	
Thomas	Beauty		Chairman	Yavapai-Apache Nation	2400 W. Datsi Rd.		Camp Verde	AZ	86322	
Ernest	Jones	Sr.	President	Yavapai-Prescott Indian Tribe	530 E. Merritt		Prescott	AZ	86301-2038	
Alan	Downer		Tribal Preservation (	Navajo Nation Historic Preservation Department	P.O. Box 4950		Window Rock	AZ	86515	928- 871-7148
Joe	Shirley	Jr.	President	Navajo Nation	P.O Box 7440	Fed Ex	Window Rock	AZ	86515	928-871-7003
George	Arthur		Chairperson	Navajo Nation Council	200 Parkway Administration Bldg 3	Fed Ex	Window Rock	AZ	86515	928-871-6381
Andy	Ayze		Chairperson	Navajo Nation Council	200 Parkway Administration Bldg 3	Fed Ex	Window Rock	AZ	86515	928-871-6381
LoRenzxo C.	Bates		Chairperson	Navajo Nation Council	200 Parkway Administration Bldg 3	Fed Ex	Window Rock	AZ	86515	928-871-6381
Kee Allen	Begay	Jr.	Chairperson	Navajo Nation Council	200 Parkway Administration Bldg 3	Fed Ex	Window Rock	AZ	86515	928-871-6381
Sampson	Begay		Chairperson	Navajo Nation Council	200 Parkway Administration Bldg 3	Fed Ex	Window Rock	AZ	86515	928-871-6381
Ervin M.	Keeswood	Sr.	Chairperson	Navajo Nation Council	200 Parkway Administration Bldg 3	Fed Ex	Window Rock	AZ	86515	928-871-6381
Hope	MacDonald-LoneTree		Chairperson	Navajo Nation Council	200 Parkway Administration Bldg 3	Fed Ex	Window Rock	AZ	86515	928-871-6381

First	Last	Suffix	Title	Organization	Address	Mode	City	State	Zip	Phone No.
Lawrence T.	Morgan		Speaker	Navajo Nation Council	200 Parkway Administration Bldg 1	Fed Ex	Window Rock	AZ	86515	
Larry	Noble		Chairperson	Navajo Nation Council	200 Parkway Administration Bldg 3	Fed Ex	Window Rock	AZ	86515	928-871-6381
Lawrence R.	Platero		Chairperson	Navajo Nation Council	200 Parkway Administration Bldg 3	Fed Ex	Window Rock	AZ	86515	928-871-6381
Francis	Redhouse		Chairperson	Navajo Nation Council	200 Parkway Administration Bldg 3	Fed Ex	Window Rock	AZ	86515	928-871-6381
Thomas	Walker		Chairperson	Navajo Nation Council	200 Parkway Administration Bldg 3	Fed Ex	Window Rock	AZ	86515	928-871-6381
			President	Navajo Nation, Birdsprings Chapter	HC 61, Box K		Winslow	AZ	86047	
			President	Navajo Nation, Black Mesa Chapter	P.O. Box 97		Pinon	AZ	86510	
Joe J.	Jim		President	Navajo Nation, Blue Gap/Tachee Chapter	P.O. Box 4427		Blue Gap	AZ	86520	
Billy	Arizona	Jr.	President	Navajo Nation, Bodaway-Gap Chapter	P.O. Box 1546		Gap	AZ	86020	
Jack	Colorado		President	Navajo Nation, Cameron Chapter	P.O. Box 85		Cameron	AZ	86020	
Lee J.	Gambler		President	Navajo Nation, Chilchinbeto Chapter	P.O. Box 1681		Kayenta	AZ	86033	
Dwayne	Billsie		President	Navajo Nation, Chinle Chapter	P.O. Box 1809		Chinle	AZ	86503	
Charlie	McCabe		President	Navajo Nation, Coalmine Canyon Chapter	P.O. Box 1464		Tuba City	AZ	86045	
Sid	Whitehair		President	Navajo Nation, Coppermine Chapter	P.O. Box 1323		Page	AZ	86040	
Jimmie	Taliman	Sr.	President	Navajo Nation, Cornfields Chapter	P.O. Box 478		Ganado	AZ	86505	
Irvin	Tsosie	Sr.	President	Navajo Nation, Cove Chapter	P.O. Box 276		Red Valley	AZ	86544	
Chester	Begay		President	Navajo Nation, Dennehotso Chapter	P.O. Box 301		Dennehotso	AZ	86535	

First	Last	Suffix	Title	Organization	Address	Mode	City	State	Zip	Phone No.
Manuel W.	Shirley		President	Navajo Nation, Dilkon Chapter	HCR 63 Box E		Winslow	AZ	86047	
Donald T.	Chee		President	Navajo Nation, Forest Lake Chapter	P.O. Box 441		Pinon	AZ	86510	
Lorraine	Wauneka-Nelson		President	Navajo Nation, Fort Defiance Chapter	P.O. Box 366		Fort Defiance	AZ	86504	
Martin	Begay		President	Navajo Nation, Ganado Chapter	P.O. Box 188		Ganado	AZ	86505	
Franklin	Gishey	Sr.	President	Navajo Nation, Greasewood Springs Chapter	P.O. Box 1260		Ganado	AZ	86505	
Percy	Deal		President	Navajo Nation, Hardrock Chapter	P.O. Box 20		Kykotsmovi	AZ	86039	
Anderson H.	Morgan		President	Navajo Nation, Houck Chapter	P.O. Box 127		Houck	AZ	86506	
Laverne	Yazzie-Benally		President	Navajo Nation, Indian Wells Chapter	P.O. Box 3042		Indian Wells	AZ	86031	
Larry	Goodman		President	Navajo Nation, Inscription House Chapter	P.O. Box 5205		Tonalea	AZ	86044	
Bahe	Jackson		President	Navajo Nation, Jeddito Chapter	P.O. Box 798		Keams Canyon	AZ	86034	
Frieda	Sage		President	Navajo Nation, Kaibeto Chapter	P.O. Box 1761		Kaibeto	AZ	86053	
Albert	Bailey		President	Navajo Nation, Kayenta Chapter	P.O. Box 1088		Kayenta	AZ	86033	
Christine	Wallace		President	Navajo Nation, Kinlichee Chapter	P.O. Box 860		St. Michael	AZ	86511	
Nancy Y.	Chee		President	Navajo Nation, Klagetoh Chapter	P.O. Box 1019		Ganado	AZ	86505	
Yvonne	Bigman		President	Navajo Nation, LeChee Chapter	P.O. Box 4720		Page	AZ	86040	
Thomas	Cody		President	Navajo Nation, Leupp Chapter	CPO Box 5085		Leupp	AZ	86035	
Gerald	Ahasteen		President	Navajo Nation, Low Mountain Chapter	P.O. Box 4407		Blue Gap	AZ	86520	

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2

First	Last	Suffix	Title	Organization	Address	Mode	City	State	Zip	Phone No.
Samual	Yazzie		President	Navajo Nation, Lukachukai Chapter	P.O. Box 248		Lukachukai	AZ	86507	
Paul	Begay		President	Navajo Nation, Lupton Chapter	P.O. Box 403		Lupton	AZ	86508	
Aljerino	Tsedah		President	Navajo Nation, Many Farms Chapter	P.O. Box 185		Many Farms	AZ	86538	
Jerry	Tsosie		President	Navajo Nation, Mexican Water Chapter	HC 61 Box 38		Teecnospos	AZ	86514	
Arnold R.	Begay		President	Navajo Nation, Nahata Dzill Chapter	P.O. Box 400		Sanders	AZ	86512	
			President	Navajo Nation, Navajo Mountain Chapter	P.O. Box 10070		Tonalea	AZ	86044	
Johnson	Claw		President	Navajo Nation, Nazlini Chapter	P.O. Box 7387		Nazlini	AZ	86505	
			President	Navajo Nation, Oak Springs Chapter	P.O. Box 486		Window Rock	AZ	86515	
Bessie S.	Allen		President	Navajo Nation, Pinon Chapter	P.O. Box 127		Pinon	AZ	86510	
Phillip	Harrison	Jr.	President	Navajo Nation, Red Valley Chapter	P.O. Box 304		Red Valley	AZ	86544	
Clarence Ce	Begay		President	Navajo Nation, Rock Point Chapter	P.O. Box 190		Rock Point	AZ	86545	
Alfred L.	Yazzie		President	Navajo Nation, Rough Rock Chapter	P.O. Box 633-RRDS		Chinle	AZ	86503	
Ruth	Roessel		President	Navajo Nation, Round Rock Chapter	P.O. Box 10		Round Rock	AZ	86547	
Herman	Begay	Sr.	President	Navajo Nation, Sawmill Chapter	P.O. Box 1786		Ft. Defiance	AZ	86504	
Jones	Grass		President	Navajo Nation, Shonto Chapter	P.O. Box 7800		Shonto	AZ	86054	
Albert Edisc	Ross	Jr.	President	Navajo Nation, St. Michael Chapter	P.O. Box 829		St. Michael	AZ	86511	
Jack	Whitehorse	Jr.	President	Navajo Nation, Steamboat Chapter	P.O. Box 117		Ganado	AZ	86505	

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2

First	Last	Suffix	Title	Organization	Address	Mode	City	State	Zip	Phone No.
Lena	Clark		President	Navajo Nation, Sweetwater Chapter	P.O. Box 105		Teecnospos	AZ	86514	
Rodger D.	Joe		President	Navajo Nation, Teecnospos Chapter	P.O. Box 106		Teecnospos	AZ	86514	
Virgil D.	Nez		President	Navajo Nation, Teesto Chapter	P.O. Box 7166		Winslow	AZ	86047	
Frank	Bilagody		President	Navajo Nation, Toh Nanees Dizi Chapter	P.O. Box 727		Tuba City	AZ	86045	
Keith	Begay		President	Navajo Nation, Tolani Lake Chapter	P.O. Box HC61-SR- Box 3001		Winslow	AZ	86047	
Chester	Claw		President	Navajo Nation, Tonalea Chapter	P.O. Box 207		Tonalea	AZ	86044	
Wesley L.	Begay		President	Navajo Nation, Tsaile/Wheatfields Chapter	P.O. Box 667		Tsaile	AZ	86556	
Harrison	Kee		President	Navajo Nation, Tselani/Cottonwood Chapter	P.O. Box 1139		Chinle	AZ	86503	
Phyllis A.	Begay		President	Navajo Nation, Whippoorwill Chapter	P.O. Box 279		Pinon	AZ	86510	
Robert E.	Salabye		President	Navajo Nation, Whitecone Chapter	P.O. Box 338		Indian Wells	AZ	86031	
Shawnevan	Dale		President	Navajo Nation, Wide Ruins Chapter	P.O. Box 208		Chambers	AZ	86503	

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Nevada State Office
P.O. Box 12000 (1340 Financial Blvd.)
Reno, Nevada 89520-0006
www.blm.gov/nv/

TAKE PRIDE IN AMERICA

In Reply Refer To:
1610 (NV-912)

JUN 19 2008

Ft. McDermitt Paiute-Sho Tribes
Arlo Crutcher
P.O. Box 457
McDermitt, NV 89421

See list attached

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LRS
10

Dear Chairperson:

As part of the Bureau of Land Management's (BLM's) ongoing government-to-government consultation, I am writing to let you know that the Bureau of Land Management (BLM) and the Department of Energy (DOE) have initiated the preparation of a joint Programmatic Environmental Impact Statement (PEIS) to evaluate solar energy development on BLM-administered lands in Arizona, California, Colorado, New Mexico, Nevada, and Utah.

The Energy Policy Act of 2005 establishes a goal for the BLM to approve 10,000 megawatts of non-hydropower renewable energy on BLM-administered lands by the year 2015. The DOE and BLM have identified utility-scale solar energy development, along with wind and geothermal power, as critical components in meeting this goal and the Nation's energy needs. Utility-scale solar energy projects generate electricity that is distributed to consumers through the electric power transmission grid.

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Preparation of the PEIS is a multi-step process that will be completed in approximately 22 months and will include the preparation of a draft PEIS, a final PEIS, and Records of Decision by the BLM and the DOE. As such, we anticipate very short, concurrent review timeframes for both our cooperating agencies and us. Cooperating agencies may negotiate the level of their involvement consistent with their available staffing and resources.

Gaining your Tribe's expertise and perspective is important to the success of the PEIS and subsequent management strategies. We value your knowledge, concerns and perspectives relating to the planning area. Please note that the tribe's participation as a cooperating agency does not replace BLM's obligation to consult on a government-to-government basis. Therefore, regardless of your tribe's decision to participate or not as a cooperating agency, our government-to-government consultation will continue.

If you would like to participate as a cooperating agency, please call Jackie Gratton at (775) 861-6532. There is additional information on our web site: http://solareis.anl.gov.

Thank you for your consideration. We look forward to our interaction and discussions with you.

Sincerely,

Ron Wenker
State Director, Nevada

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Battle Mountain Band Council	Carson Colony Council	Dresslerville Community Council
Chairperson: Mike Young 37 Mountain view Drive Battle Mountain, NV 89820 Ph: (775)635-2004 Fx: (775)635-8016	Chairperson: Chad Malone 2900 South Curry Street Carson City, NV 89703 Ph: (775)883-6459 Fx: (775)883-6467	Chairperson: Mark Kizer 1585 Watasheamu South Gardnerville, NV 89410 Ph: (775)265-4191 Fx: (775)265-6240
Duck Valley Sho-Pai Tribes	**Duckwater Shoshone Tribe**	**Elko Band Council**
Chairperson: Nancy Egan P.O. Box 219 Owyhee, NV 89832 Ph: (208)759-3100 Fx: (208)759-3102	Chairperson: Jerry Millett P.O. Box 140068 Duckwater, NV 89314 Ph: (775)863-0227 Fx: (775)863-0301	Chairperson: Lynette Piffero 1745 Silver Eagle Drive Elko, NV 89801 Ph: (775)738-8889 Fx: (775)753-5439
Ely Shoshone Council	**Fallon Paiute Shoshone Tribes**	**Ft. McDermitt Pai-Sho Tribes**
Chairperson: Diana Buckner 16 Shoshone Circle Ely, NV 89301 Ph: (775)289-3031 Fx: (775)289-3237	Chairperson: Alvin Moyle 565 Rio Vista Road Fallon, NV 89406 Ph: (775)423-6075 Fx: (775) 432-5202	Chairperson: Arlo Critcher Crutcher P.O. Box 457 McDermitt, NV 89421 Ph: (775)532-8259 Fx: (775)532-8487/8060
Goshute Business Council	**Las Vegas Paiute Tribe**	**Lovelock Paiute Tribe**
Chairperson: Rupert Steele P.O. Box 6140 Ibapah, UT 84034 Ph: (435)234-1138 Fx: (435)234-1162	Chairperson: Benny Tso One Paiute Drive Las Vegas, NV 89106 Ph: (702)386-3926 Fx: (702)383-4019	Chairperson: Clark Rhondes P.O. Box 878 Lovelock, NV 89419 Ph: (775)273-7861 Fx: (775)273-3802
Moapa Business Council	**Pyramid Lake Paiute Tribe**	**Reno-Sparks Indian Colony**
Chairperson: Philbert Waim P.O. Box 340 Moapa, NV 89025-0340 Ph: (702)865-2787 Fx: (702)865-2875	Chairperson: Mervin Wright P.O. Box 256 Nixon, NV 86424 Ph: (775)574-1000 Fx: (755)574-1008	Chairperson: Arlan Melendez 98 Colony Road Reno, NV 89506 Ph: (775)329-2936 Fx: (775)329-8710

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South Fork Band Council	Stewart Community Council	Summit Lake Paiute Tribe
Chairperson: Cheryl Mose-Temoke 21 Lee B-13 Spring Creek, NV 89815 Ph: (775)744-4273 Fx: (775)744-4523	Chairperson: Wanda E. Batchelor 5300 Snyder Avenue Carson City, NV 89701 Ph: (775)883-7794 Fx: (775)883-5679	Chairperson: Warner Barlese 3690 Grant Drive Suite K Reno, NV 89509 Ph: (775)827-9670 Fx:
Te-Moak Tribal Council	**Walker River Paiute Tribe**	**Washoe Tribal Council**
Chairperson: Davis Gonzales 525 Sunset Street Elko, NV 89801 Ph:(775) 738-9251 Fx:(775) 752-2345	Chairperson: Edmund Raymus P.O. Box 220 Schurz, NV 89427 Ph: (775)772-2306/884-3751 Fx: (775)773-2585	Chairperson: Waldo Walker 919 Highway 395 South Gardnerville, NV 89410 Ph: (775)265-4191/883-1446 Fx: (775)265-6240
Wells Band Council	**Winnemucca Colony Council**	**Woodfords Community Council**
Chairperson: Julie Stevens P.O. Box 809 Wells, NV 89835 Ph: (775)752-3045 Fx: (775)752-2179	Chairperson: Linda Ayer P.O. Box 1370 Winnemucca, NV 89446 Ph: (775)623-0888 Fx: (775)623-6918	Chairperson: DeAnn Roberts 96 Washoe Blvd Markleeville, CA 96120 Ph: (530)694-2170 Fx: (530)694-1890
Yerington Paiute Tribe	**Yomba Tribal Council**	**Timbisha Shoshone Tribe**
Chairperson: Vince Conway 171 Cambell Lane Yerington, NV 89447 Ph: (775)463-3301/883-3895 Fx: (775)463-2416	Chairperson: Wayne Dyer HC 61 Box 6275 Austin, NV 89310 Ph: (775)964-2463 Fx: (775)964-2443	Chairperson: Joseph Kennedy 785 N. Main St. Suite Q Bishop, CA 93514 Ph: (760)873-9003 Fx: (760)873-9004

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Utah State Office
P.O. Box 45155
Salt Lake City, UT 84145-0155
http://www.blm.gov/ut/st/en.html

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Sandra 6-17-08
M. DeKegel 06-18-08
M Crosslock 6-18-08
K. Hoffman 6/18/08
D. Bauer 6/19/08

IN REPLY REFER TO:
1790
(UT-921)

JUN 23 2008

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Dear :

As part of the Bureau of Land Management's (BLM's) ongoing government-to-government consultation with Tribes, I am writing to let you know that the Bureau of Land Management (BLM) and the Department of Energy (DOE) have initiated the preparation of a joint Programmatic Environmental Impact Statement (PEIS) to evaluate solar energy development on BLM-administered lands in Arizona, California, Colorado, New Mexico, Nevada, and Utah.

The Energy Policy Act of 2005 establishes a goal for the BLM to approve 10,000 megawatts of non-hydropower renewable energy on BLM-administered lands by the year 2015. The DOE and BLM have identified utility-scale solar energy development, along with wind and geothermal power, as critical components in meeting this goal and the Nation's energy needs. Utility-scale solar energy projects generate electricity that is distributed to consumers through the electric power transmission grid.

The study area has been limited to six states based on an initial resource assessment showing that these states encompass the most prospective solar energy resources suitable for utility-scale development over the next 20 years. The BLM has already received a large number of utility-scale solar energy project proposals for BLM-administered lands, mainly in Arizona, southern California, and Nevada.

In addition to government-to-government consultation on this topic, we would also like to offer you an opportunity to partner with us in a cooperating agency relationship for this PEIS and potential BLM land use plan amendments. The Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) (40 CFR 1500-1508) emphasize the use of such arrangements as a means of ensuring timely coordination with Tribal,

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State, Federal, and local agencies in preparation of NEPA analyses and documentation. The BLM places great importance on working effectively with its governmental partners through the cooperating agency relationship. For further information, please see our cooperating agency web site: http://www.blm.gov/planning/cadg.

Cooperating agency status is available to government entities with jurisdiction by law or special expertise. The cooperating agency must sign a Memorandum of Understanding with the Federal agency and must fund its own participation. Other governmental entities who may be invited to be cooperating agencies on this PEIS include the States of Arizona, California, Colorado, New Mexico, Nevada, and Utah; county governments; and several local town and city governments.

Preparation of the PEIS is a multi-step process that will be completed in approximately 22 months and will include the preparation of a draft PEIS, a final PEIS, and Records of Decision by the BLM and the DOE. As such, we anticipate very short, concurrent review timeframes for both us and our cooperating agencies. Cooperating agencies may negotiate the level of their involvement consistent with their available staffing and resources.

We are starting the PEIS with public scoping which runs from May 29, 2008, through July 15, 2008. Public scoping meetings will be held beginning at 6:00 PM on the dates and in the cities listed below:

June 16, 2008 -- Riverside, CA	June 19, 2008 -- Sacramento, CA	June 25, 2008 -- Salt Lake City, UT
June 17, 2008 -- Barstow, CA	June 23, 2008 -- Denver, CO	June 26, 2008 -- Albuquerque, NM
June 18, 2008 -- Las Vegas, NV	June 24, 2008 -- Phoenix, AZ	July 8, 2008—Tucson, AZ

The Wednesday June 25, 2008 public scoping meeting in Salt Lake City will be held at the Hampton Inn & Suites, SLC Airport, 307 North Admiral Byrd Road, Salt Lake City, Utah 84114. We have developed a web site specific to this project where users can gain further information, sign up for web news and up-dates, as well as submit comments.

Gaining your Tribe's expertise and perspective is important to the success of the PEIS and subsequent management strategies. We value your knowledge, concerns and perspectives relating to the planning area. Please note that the tribe's participation as a cooperating agency does not replace BLM's obligation to consult on a government-to-government basis. Therefore, regardless of your Tribe's decision to participate or not as a cooperating agency, our government-to-government consultation will continue.

If you would like to participate as a cooperating agency, please contact Mike DeKeyrel at the above address or at (801) 539-4105. Also, please allow me to direct you to our web site where you can gain further information and sign up for web news and up-dates. The web site address is: http://solareis.anl.gov.

Thank you for your consideration. We look forward to our interaction and discussions with you.

Sincerely,

/s/ Jeff Rawson

Selma Sierra
State Director

SolarPeis\LettersMD-SA-6-1708

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Solar Energy Programmatic EIS
Tribal Contact List – Scoping

Southern Ute Tribe
Southern Ute Tribal Council
Clement Frost, Chairman
P.O. Box 737
Ignacio, Colorado 81137

Ute Mountain Ute Tribe
Manuel Hart, Acting Chairman
P.O. Box JJ
1 Mike Wash Road
Towaoc, Colorado 81334

White Mesa Ute Tribe
Elayne Atcitty, Councilwoman
P. O. Box 7096
Blanding, Utah 84511

Ute Indian Tribe (Uintah & Ouray Reservation)
Curtis Cesspooch, Chairman
P.O. Box 190
Fort Duchesne, Utah 84026

cc: Betsy Chapoose
Director, Cultural Rights and Protection

Eastern Shoshone
Mr. Ivan Posey, Chair
Shoshone Business Council
P.O. Box 538
Ft. Washakie, Wyoming 82514

Shoshone-Bannock
Mr. Blaine Edmo, Chair
Fort Hall Business Council
Shoshone-Bannock Tribes
P.O. Box 306
Fort Hall, Idaho 83203-0306

Northwest Band of Shoshone
Mr. Bruce Perry
707 North Main
Brigham City, UT 84302

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2

Goshute Indian Tribe (Confederated Tribes of the Goshute Res.)
Mr. Rupert Steele, Chair
P.O. Box 6104
Ibapah, Utah 84034-6104

Skull Valley Band of Goshute Indians
Lawrence Bear, Chairman
2480 South Main, Suite 110
Salt Lake City, UT 84115-4443

Paiute Tribe of Utah
Ms. Lora Tom, Chair
440 North Paiute Drive
Cedar City, Utah 84720

cc: Dorena Martineau
Cultural Resources Coordinator

Kanosh Band of Paiutes
Mr. Phil Pikyavit, Band Chairman
P.O. Box 116
Kanosh, Utah 84637

Koosharem Band of Paiutes
Ms. Cyndi Charles, Band Chair
223 East 575 North
Cedar City, UT 84720

Shivwits Band of Paiutes
Mr. Glenn Rogers, Band Chair
370 North 400 West #2
St. George, Utah 84770

Indian Peaks Band of Paiutes
Mrs. Jeanine Borchardt, Band Chair
440 North Paiute Drive
Cedar City, Utah 84720

Cedar Band of Paiutes
Alex Shepherd, Band Chair
5267 West 3700 South
Cedar City, UT 84720

Kaibab Band of Paiute Indians
Ona Segundo, Chair
HC 65 Box 2
Pipe Spring, AZ 86022

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San Juan Southern Paiute Tribe
Ms. Mary Lou Boone, President
P.O. Box 2656
Tuba City, AZ 86045

Hopi Tribe
Ben Nuvamsa, Chairman
Hopi Tribal Council
P.O. Box 123
Kykotsmovi, AZ 86039

cc: Leigh Kuwanwisiwma
Director, Hopi Cultural Preservation Office

Navajo Nation
Mr. Tony Joe
Supervisory Anthropologist
Traditional Culture Program
PO Box 4950
Window Rock, AZ 86515

Aneth Chapter
P.O. Box 430
Montezuma Creek, UT 84534

Oljato Chapter
P.O. Box 360455
Monument Valley, UT 84531

Red Mesa Chapter
P.O. Box 422
Montezuma Creek, UT 84534

Navajo Utah Commission
Clarence Rockwell, Director
P.O. Box 570
Montezuma Creek, UT 84534

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United States Department of the Interior
BUREAU OF LAND MANAGEMENT
California Desert District
22835 Calle San Juan de los Lago
Moreno Valley, CA 92553
www.ca.blm.gov/cdd

In Reply Refer To:
2800/8100/CA610.25 (P)

June 24, 2008

Chairperson
Rumsey Rancheria
P.O. Box 18
Brooks, CA 95606

Dear Chairperson:

As part of the Bureau of Land Management's (BLM's) ongoing government-to-government consultation with the Rumsey Rancheria, I am writing to let you know that the Bureau of Land Management (BLM) and the Department of Energy (DOE) have initiated the preparation of a joint Programmatic Environmental Impact Statement (PEIS) to evaluate solar energy development on BLM-administered lands in Arizona, California, Colorado, New Mexico, Nevada, and Utah.

The Energy Policy Act of 2005 establishes a goal for the BLM to approve 10,000 megawatts of non-hydropower renewable energy on BLM-administered lands by the year 2015. The DOE and BLM have identified utility-scale solar energy development, along with wind and geothermal power, as critical components in meeting this goal and the Nation's energy needs. Utility-scale solar energy projects generate electricity that is distributed to consumers through the electric power transmission grid.

The study area has been limited to six states based on initial resource assessment showing that these states encompass the most prospective solar energy resources suitable for utility-scale development over the next 20 years. The BLM has already received a large number of utility-scale solar energy project proposals for BLM-administered lands, mainly in Arizona, southern California, and Nevada.

In addition to government-to-government consultation on this topic, we would also like to offer you an opportunity to partner with us in a cooperating agency relationship for this PEIS and potential plan amendments. The Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) (40 CFR 1500-1508) emphasize the use of such arrangements as a means of ensuring timely coordination with Tribal, State, Federal, and local agencies in preparation of NEPA analyses and documentation. The BLM places great importance on working effectively with its governmental partners through the cooperating agency relationship. For further information, please see our cooperating agency web site:

http://www.blm.gov/planning cadg/

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If you would like to participate as a cooperating agency, please contact Gregory Miller, Renewable Energy Program Manager, California Desert District Office, at (951) 697-5200. Also, please allow me to direct you to our web site where you can gain further information and sign up for web news and up-dates. The web site address is:

http://solareis.anl.gov

Thank you for your consideration. We look forward to our interaction and discussions with you.

Sincerely,

Steven J. Borchard
District Manager
California Desert District

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Chairman
Agua Caliente Band of Cahuilla Indians
5401 Dinah Shore Drive
Palm Springs, CA 92264

Chairperson
Barona Band of Diegueno Indians
1095 Barona Road
Lakeside, CA 92040

Chairman
Berry Creek Rancheria
5 Tyme Way
Oroville, CA 95966

Chairman
Big Sandy Rancheria
P.O. Box 337
Auberry, CA 93602

Chairperson
Blue Lake Rancheria
P.O. Box 428
Blue Lake, CA 95525

Chairman
Cabazon Band of Mission Indians
84-245 Indio Springs Drive
Indio, CA 92203-3449

Chairwoman
Campo Kumeyaay Nation
36190 Church Road, Suite 1
Campo, CA 91906

Chairman
Chemehuevi Indian Tribe
P.O. Box 1976
Havasu Lake, CA 92363

Chairwoman
Cocopah Indian Tribe
Avenue G and County 15th Street
Somerton, AZ 85350

Chairperson
Colusa Rancheria
3730 Highway 45
Colusa, CA 95932

Chairman
Alturas Rancheria
P.O. Box 340
Alturas, CA 96101

Chairman
Bear River Band of Rohnerville Rancheria
32 Bear River Drive
Loleta, CA 95551

Chairman
Big Lagoon Rancheria
P.O. Drawer 3060
Trinidad, CA 95570

Chairperson
Big Valley Rancheria
2726 Mission Rancheria Road
Lakeport, CA 95453

Chairperson
Bridgeport Indian Colony
P.O. Box 37
Bridgeport, CA 93517

Chairman
Cahuilla Band of Mission Indians
P.O. Box 391760
Anza, CA 92539-1760

Chairman
Carson Community Council
2900 S. Curry Street
Carson City, NV 89703

Chairperson
Chicken Ranch Rancheria
P.O. Box 1159
Jamestown, CA 95327

Chairperson
Cold Springs Rancheria
P.O. Box 209
Tollhouse, CA 93667

Chairperson
Cortina Rancheria
P.O. Box 1630
Williams, CA 95987

Chairwoman
Augustine Band of Mission Indians
P.O. Box 846
Coachella, CA 92236

Chairperson
Benton Paiute Reservation
567 Yellow Jacket Rd
Benton, CA 93512

Chairman
Big Pine Paiute Tribe of the Owens Valley
P.O. Box 700
Big Pine, CA 93513

Chairperson
Bishop Paiute Tribe
50 Tu Su Lane
Bishop, CA 93514

Chairperson
Buena Vista Rancheria
P.O. Box 162283
Sacramento, CA 95816

Chairperson
California Valley Miwok Tribe
10601 Escondido Place
Stockton, CA 95212

Chairperson
Cedarville Rancheria
200 South Howard Street
Alturas, CA 96101

Chairperson
Cloverdale Rancheria
555 S. Cloverdale Blvd., Suite 1
Cloverdale, CA 95425

Chairman
Colorado River Indian Tribes
Rt. 1, Box 23-B
Parker, AZ 85344

Chairperson
Coyote Valley Reservation
P.O. Box 39
Redwood Valley, CA 95470

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Chairman
Dresslerville Community Council
919 Hwy 395 South
Gardnerville, NV 89410

Chairperson
Elem Indian Colony
P.O. Box 989
Clearlake Oaks, CA 95423

Chairman
Ewiiaapaayp Band of Kumeyaay Indians
P.O. Box 2250
Alpine, CA 91903-2250

Tribal Council Chair
Fort Independence Paiute Tribe
P.O. Box 67
Independence, CA 93526

Governor
Gila River Indian Community Council
P.O. Box 97
Sacaton, AZ 85247

Chairwoman
Guidiville Rancheria
P.O. Box 339
Talmage, CA 95481

Chairperson
Hopland Reservation
3000 Shanel Rd.
Hopland, CA 95449

Chairperson
Jackson Rancheria
P.O. Box 1090
Jackson, CA 95642

Chairman
Kern Valley Indian Community
P.O. Box 147
Caliente, CA 93518

Chairperson
La Posta Band of Kumeyaay Indians
P.O. Box 1120
Boulevard, CA 91905

Chairperson
Dry Creek Rancheria
P.O. Box 607
Geyserville, CA 95441

Chairman
Elk Valley Rancheria
2332 Howland Hill Rd.
Crescent City, CA 95531

Spokesperson
Federated Indians of Graton Rancheria
320 Tesconi Circle, Suite G
Santa Rosa, CA 95401

Chairman
Fort Mojave Indian Tribe
500 Merriman Avenue
Needles, CA 92363

Chairperson
Greenville Rancheria
P.O. Box 279
Greenville, CA 95947

Chairperson
Habematolel Pomo of Upper Lake
P.O. Box 516
Upper Lake, CA 95485

Chairperson
Inaja-Cosmit Band of Mission Indians
309 S. Maple Street
Escondido, CA 92025

Chairperson
Jamul Indian Village
P.O. Box 612
Jamul, CA 91935

Tribal Administrator
Kwaaymii Laguna Band of Indians
P.O. Box 775
Pine Valley, CA 91962

Chairman
Las Vegas Tribal Council
One Paiute Drive
Las Vegas, NV 89106

Chairperson
Duckwater Shoshone Tribe
P.O. Box 140068
Duckwater, NV 89314

Chairperson
Enterprise Rancheria
1940 Feather River Blvd., Suite 2
Oroville, CA 95965

Chairwoman
Fort Bidwell Reservation
P.O. Box 155
Fort Bidwell, CA 96112

President
Fort Yuma Quechan Tribe
P.O. Box 1899
Yuma, AZ 85366-1899

Chairperson
Grindstone Rancheria
P.O. Box 63
Elk Creek, CA 95939

Chairman
Hoopa Valley Tribal Council
P.O. Box 1348
Hoopa, CA 95546

Chairwoman
Ione Band of Miwok Indians
P.O. Box 1190
Ione, CA 95640

Chairman
Karuk Tribe of California
P.O. Box 1016
Happy Camp, CA 96039

Chairman
La Jolla Band of Luiseno Indians
22000 Highway 76
Pauma Valley, CA 92061

Chairperson
Laytonville Rancheria
P.O. Box 1239
Laytonville, CA 95454

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Chairman
Lone Pine Paiute-Shosone Ttribe
P.O. Box 747
Lone Pine, CA 93545

Chairperson
Lytton Rancheria
1300 N. Dutton Ave, Suite A
Santa Rosa, CA 95401

Chairman
Mechoopda Indian Tribe of the Chico Rancheria
125 Mission Ranch Blvd.
Chico, CA 95926

Chairperson
Mooretown Rancheria
1 Alverda Drive
Oroville, CA 95966

Chairman
Pala Band of Mission Indians
35008 Pala Temecula Road
Pala, CA 92059

Chairman
Pechanga Band of Mission Indians
P.O. Box 1477
Temecula, CA 92593

Chairman
Pit River Tribal Council
37014 Main Street
Burney, CA 96013

Chairman
Ramona Band of Mission Indians
P.O. Box 391372
Anza, CA 92539

Chairman
Resighini Rancheria
P.O. Box 529
Klamath, CA 95548

President
Round Valley Reservation
P.O. Box 448
Covelo, CA 95428

Chairwoman
Los Coyotes Band of Cahuilla and Cupeno Indians
P.O. Box 189
Warner Springs, CA 92086

Chairperson
Manchester - Point Arena Band of Pomo Indians
P.O. Box 623
Point Arena, CA 95468

Chairman
Mesa Grande Band of Mission Indians
P.O. Box 270
Santa Ysabel, CA 92070

Chairman
Morongo Band of Mission Indians
11581 Potrero Road
Banning, CA 92220-2965

Chairperson
Paskenta Band of Nomlaki Indians
1012 South Street
Orland, CA 95963

Chairperson
Picayune Rancheria of Chukchansi Indians
46575 Road 417
Coarsegold, CA 93614

Chairperson
Potter Valley Tribe
2251 South State St.
Ukiah, CA 95482

Chairman
Redding Rancheria
2000 Redding Rancheria Road
Redding, CA 96001

Chairman
Rincon Luiseno Band of Indians
P.O. Box 68
Valley Center, CA 92082

Chairperson
Rumsey Rancheria
P.O. Box 18
Brooks, CA 95606

Chairman
Lower Lake Rancheria Koi Nation
P.O. Box 3132
Santa Rosa, CA 95402

Chairman
Manzanita Band of Kumeyaay Indians
P.O. Box 1302
Boulevard, CA 91905

Chairman
Middletown Rancheria
P.O. Box 1035
Middletown, CA 95461

Chairperson
North Fork Rancheria
P.O. Box 929
North Fork, CA 93643-0929

Chairman
Pauma/Yuima Band of Mission Indians
P.O. Box 369
Pauma Valley, CA 92061

Chairperson
Pinoleville Reservation
367 No. State Street, Suite 204
Ukiah, CA 95482

Chairman
Quartz Valley Reservation
P.13601 Quartz Valley Rd.
Fort Jones, CA 96032

Chairperson
Redwood Valley Reservation
3250 Road I
Redwood Valley, CA 95470

Chairperson
Robinson Rancheria
1545 E Highway 20
Nice, CA 95464

Chairman
San Luis Rey Band of Mission Indians
12064 Old Pomerado Road
Poway, CA 92064

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Chairman
San Manuel Band of Mission Indians
26569 Community Center Dr.
Highland, CA 92346

Chairman
Santa Rosa Rancheria
P.O. Box 8
Lemoore, CA 93245

Chairperson
Scotts Valley Rancheria
301 Industrial Ave.
Lakeport, CA 95453

Chairperson
Smith River Rancheria
140 Rowdy Creek Rd.
Smith River, CA 95567

Chairman
Susanville Indian Rancheria
745 Joaquin St.
Susanville, CA 96130

Chairperson
Table Mountain Rancheria
P.O. Box 410
Friant, CA 93626

Chairperson
Trinidad Rancheria
P.O. Box 630
Trinidad, CA 95570

Chairperson
Tuolumne Rancheria
P.O. Box 699
Tuolumne, CA 95379

Chairman
Viejas Band of Kumeyaay Indians
P.O. Box 908
Alpine, CA 91903-0908

Chairman
Woodfords Community Council
96 Washoe Blvd.
Markleeville, CA 96120

Chairman
San Pasqual Band of Diegueno Indians
P.O. Box 365
Valley Center, CA 92082

Chairman
Santa Ynez Band of Mission Indians
P.O. Box 517
Santa Ynez, CA 93460

Chairperson
Sherwood Valley Rancheria
190 Sherwood Hill Drive
Willits, CA 95490

Spokesman
Soboba Band of Luiseno Indians
P.O. Box 487
San Jacinto, CA 92581

Chairman
Sycuan Band of Kumeyaay Nation
5459 Sycuan Road
El Cajon, CA 92019

Chairman
Timbisha Shoshone Tribe
P.O. Box 206
Death Valley, CA 92328-0206

Chairperson
Tubatulabals of Kern Valley
P.O. Box 226
Lake Isabella, CA 93240

Chairman
Twenty-nine Palms Band of Mission Indians
46-200 Harrison Place
Coachella, CA 92236

Chairman
Walker River Paiute Tribal Council
P.O. Box 220
Schurz, NV 89427

Chairperson
Yurok Tribe
P.O. Box 1027
Klamath, CA 95548

Tribal Chairman
Santa Rosa Band of Mission Indians
P.O. Box 609
Hemet, CA 92546

Chairman
Santa Ysabel Band of Diegueno Indians
P.O. Box 130
Santa Ysabel, CA 92070

Chairman
Shingle Springs Rancheria
P.O. Box 1340
Shingle Springs, CA 95682

Chairperson
Stewarts Point Rancheria
3535 Industrial Dr., Suite B-2
Santa Rosa, CA 95403

Chairperson
Table Bluff Reservation
1000 Wiyot Drive
Loleta, CA 95551

Chairman
Torres-Martinez Desert Cahuilla Indians
P.O. Box 1160
Thermal, CA 92274

Chairperson
Tule River Reservation
P.O. Box 589
Porterville, CA 93258

President
United Auburn Indian Community
575 Menlo Dr., Suite 2
Rockin, CA 95765

Chairman
Washoe Tribal Council
919 Highway 395 South
Gardnerville, NV 89410

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
California Desert District
22835 Calle San Juan de los Lagos
Riverside, CA 92553
www.ca.blm.gov/cdd

In Reply Refer To:
CR CA610-09-01/8100 (CA610.25)

July 1, 2009

The Honorable «First» «Last»«Suffix», «Title»
«Organization»
«Address»
«City», «State» «Zip»

Dear «Title» «Last»:

In the summer of 2008, you received a letter from the Bureau of Land Management (BLM) announcing that the BLM and the Department of Energy (DOE) were beginning to work on a joint Programmatic Environmental Impact Statement for Solar Energy Development (PEIS) in six southwestern states: Arizona, California, Colorado, Nevada, New Mexico, and Utah. In that letter, we invited you to become a cooperating party and offered government-to-government consultation for this federal action.

On June 30, 2009, we published a notice in the Federal Register announcing that the BLM and the DOE were also going to be doing an in-depth environmental analysis of 24 specific tracts of land, called solar energy study areas, as part of the ongoing PEIS effort to determine whether these tracts are well suited for solar energy development. Public scoping for the PEIS has been reopened until July 30, 2009, in order to give individuals and groups an opportunity to comment on any environmental issues or concerns associated with the solar energy study areas. Copies of the Federal Register notice and maps depicting the solar energy study areas are enclosed with this letter and are also available on the PEIS project Web site at:

http://solareis.anl.gov/eis/maps/index.cfm

We are seeking your views and comments on the PEIS and the proposed solar energy study areas. Please contact us if you have any questions or concerns about the solar energy study areas or if you would like to enter into government-to-government consultation on the Solar PEIS.

We would also like to take this opportunity to update you on the status of the PEIS and solar energy development on public lands. The BLM and the DOE held 11 public scoping meetings for the PEIS in June and July 2008 in which nearly 600 people participated. During the initial scoping period we received about 16,000 comments from the public. The transcripts from those meetings and the comments received are now available through the PEIS project Web site: http://solareis.anl.gov/. Comments from the second scoping period will be added to the Web site as they are received.

As the BLM and the DOE work together on the PEIS, the BLM continues to receive new solar energy applications for public lands. Although the BLM had announced that we would not accept new applications while the PEIS was underway, the public voiced many concerns about that decision in light of the Nation's energy needs, and we changed our initial policy. As of June 19, 2009, the BLM had received about 225 applications covering nearly 1.8 million acres. Most of those applications are for BLM-administered lands located in California, Nevada and Arizona.

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Until the PEIS results in a new BLM program for solar energy development, solar energy development applications will continue to be processed under BLM's Solar Energy Development policy of 2007. That policy established a framework for BLM land managers to process right-of-way applications for solar energy development projects on public lands. That policy directs BLM field offices to be proactive in responding to demands for solar energy projects while protecting the environment. Solar energy development proposals will be evaluated within BLM's land use planning process. Lands designated as wilderness and wilderness study areas are off limits to solar energy development, but other lands will be considered on a case-by-case basis. In evaluating solar energy applications, the BLM will comply with the requirements of the Endangered Species Act and the National Historic Preservation Act (NHPA), along with other laws and regulations, including consultation with Indian tribes. In addition, BLM will cooperate with state regulators in evaluating these applications. At the conclusion of the PEIS, the BLM expects to implement a new solar development program that includes best management practices and mitigation measures for solar energy development on public lands and that may designate some or all of the solar energy study areas as solar energy zones where solar energy development will have priority over other land uses.

The types of solar energy development being proposed for public lands require hundreds and, in some cases, thousands of acres for each facility. The BLM recognizes that the number of applications and size of the proposed projects have the potential to dramatically affect the public lands. During the review and analysis of individual projects, the BLM intends to actively seek the involvement of Indian tribes as early as possible through all available avenues, including the commenting process of the National Environmental Policy Act (NEPA), the Section 106 consultation process of the NHPA, and our general responsibilities to actively engage Indian tribes in consultation on a government-to-government basis.

In addition, the BLM will consult the State Historic Preservation Office (SHPO) and other interested parties in compliance with Section 106 of the NHPA. BLM has entered into consultation with the Advisory Council on Historic Preservation (ACHP) and the SHPOs of the six western states covered by the PEIS and has determined that our section 106 responsibilities may be best met by developing a Programmatic Agreement (PA) for the new solar energy program. It is our hope that such an agreement will provide a clear roadmap and understanding of how the affected parties will effectively and efficiently address section 106 for the solar energy program through the various stages leading toward development. The BLM intends to provide more information about the proposed PA as we move forward in our consultations.

If you would like more information about solar energy development or about a specific project, please contact either your local BLM field office or the tribal liaison listed on the attached BLM Tribal Contact List. You may also contact Linda Resseguie, BLM's project manager for the Solar PEIS, by email at linda_resseguie@blm.gov or by telephone at (202) 452-7774.

Sincerely,

Steven J. Borchard
California Desert District Manager

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Enclosures

Federal Register Notice of 6/30/2009
Map Page Explanation Sheet
Map: Solar Energy Study Areas in Arizona
Map: Solar Energy Study Areas in California
Map: Solar Energy Study Areas in Colorado
Map: Solar Energy Study Areas in Nevada
Map: Solar Energy Study Areas in New Mexico
Map: Solar Energy Study Areas in Utah
BLM State Tribal Liaison and Deputy Preservation Officer Contact List

cc electronically

Robin Burgess, WO240
Linda Resseguie, WO350
Reid Nelson (Nancy Brown), ACHP
Linda Jorgenson, DOE
Byron Loosle, UT934
Dan Haas, CO931
Michael Johnson, AZ931
Tom Burke, NV933
Signa Larralde, NM930
Charlotte Hunter, CA930
SHPO (AZ, CA, NV, NM, CO, UT)

Tribal staff will be contacted and provided electronic copies of this letter by BLM Field Offices in the affected States.

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ADDRESSES: Submit comments related to the project by any of the following methods:

- *E-mail:* *Nextlight_Primm_NV_SEP@blm.gov*
- *Fax:* (702) 515–5010, attention Gregory Helseth.
- *Mail:* BLM, Las Vegas Field Office, Attn: Gregory Helseth, 4701 North Torrey Pines Drive, Las Vegas, NV 89130–2301.

FOR FURTHER INFORMATION CONTACT: For further information and/or to have your name added to the mailing list, contact Gregory Helseth, Renewable Energy Project Manager, at (702) 515–5173; or e-mail at *Nextlight_Primm_NV_SEP@blm.gov.*

SUPPLEMENTARY INFORMATION: NextLight Renewable Power, LLC, has submitted two applications for rights-of-way for the construction, operation, maintenance, and termination of two solar energy generation sites. The two applications are identified as NVN–085077 Silver State South Solar Project, and NVN–085801 Silver State North Solar Project. The proposed projects would consist of photovoltaic panels and related right-of-way appurtenances, including a substation and switchyard facilities. The proposed projects, combined, would produce approximately 400 megawatts of electricity, and would be located on approximately 7,840 acres of public lands east of Primm, Nevada.

Issues that are anticipated to be addressed in this EIS include threatened and endangered species impacts, visual impacts, socioeconomic impacts, and cumulative impacts. The EIS will analyze the site-specific impacts on air quality, biological resources, cultural resources, water resources, geological resources and hazards, hazardous materials handling, land and airspace use, noise, paleontological resources, public health, socioeconomics, soils, traffic and transportation, visual resources, waste management, worker safety, and fire protection, as well as facility design engineering, efficiency, reliability, transmission system engineering, transmission line safety, and nuisance. Native American Tribal consultations will be conducted in accordance with policy, and Tribal concerns will be given due consideration, including impacts on Indian trust assets. Federal, State, and local agencies, as well as individuals or organizations that may be interested in or affected by the BLM's decision on this project are invited to participate in the scoping process and, if eligible, may request or be requested by the BLM to participate as a cooperating agency.

Documents pertinent to this project may be examined at the Las Vegas Field Office. Additional opportunities for public participation will be provided upon publication of the draft EIS.

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

(Authority: 43 CFR Part 2800)

Robert B. Ross Jr.,

Las Vegas Field Manager.

[FR Doc. E9–15470 Filed 6–29–09; 8:45 am]

BILLING CODE 4310–HC–P

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

[LLWO350000.L14300000]

Notice of Availability of Maps and Additional Public Scoping for Programmatic Environmental Impact Statement To Develop and Implement Agency-Specific Programs for Solar Energy Development; Bureau of Land Management Approach for Processing Existing and Future Solar Applications

AGENCY: Bureau of Land Management, Interior.

ACTION: Notice of Availability.

SUMMARY: The Department of Energy (DOE) and the Bureau of Land Management (BLM) (the Agencies) are announcing the availability of maps depicting solar energy study areas to be analyzed in their joint Programmatic Environmental Impact Statement to Develop and Implement Agency-Specific Programs for Solar Energy Development (Solar PEIS) and the opportunity for additional public scoping. The BLM is issuing this Notice to inform the public of the availability of the solar energy study area maps; to solicit public comments for consideration in identifying environmental issues, existing resource data, and industry interest with respect to the solar energy study areas in particular; and to explain how the BLM will address existing and future solar energy development applications on BLM-administered lands.

DATES: The time period for public comments starts with the publication of this notice in the **Federal Register** and will continue through July 30, 2009. Comments received or postmarked after that date will be considered to the extent practicable.

ADDRESSES: You may submit written comments by the following methods:

- Electronically, using the online comment form available on the project Web site: *http://solareis.anl.gov.* This is the preferred method of commenting.
- In writing, addressed to: Solar Energy PEIS, Argonne National Laboratory, 9700 S. Cass Avenue—EVS/900, Argonne, IL 60439.

Availability of Maps: Maps of the solar energy study areas are available electronically from the project Web site: *http://solareis.anl.gov.* The maps may also be obtained from the following BLM offices:

Arizona State Office, One North Central Avenue, Suite 800, Phoenix, AZ 85004.

California State Office, 2800 Cottage Way, Suite W–1623, Sacramento, CA 95825.

Colorado State Office, 2850 Youngfield Street, Lakewood, CO 80215.

Nevada State Office, 1340 Financial Blvd., Reno, NV 89520.

New Mexico State Office, 1474 Rodeo Road, Santa Fe, NM 87505.

Utah State Office, 440 West 200 South, Suite 500, Salt Lake City, UT 84101.

FOR FURTHER INFORMATION CONTACT: For further information contact: Linda Resseguie, BLM Washington Office, *linda_resseguie@blm.gov,* 202–452–7774; or Lisa Jorgensen, Department of Energy, Golden Field Office, *lisa.jorgensen@go.doe.gov,* 303–275–4906. You may also visit the Solar PEIS Web site at *http://solareis.anl.gov.*

SUPPLEMENTARY INFORMATION: On May 29, 2008, the Agencies published a Notice of Intent to Prepare a Programmatic Environmental Impact Statement to Evaluate Solar Energy Development (73 FR 30908). Subsequently, the Agencies held a series of public scoping meetings, received public comments, and published a scoping summary report, available at *http://solareis.anl.gov.*

On March 11, 2009, the Secretary of the Interior issued Secretarial Order No. 3285, which announced a policy goal of identifying and prioritizing specific locations best suited for large-scale production of solar energy. Also, the BLM received funding from the American Recovery and Reinvestment Act to accelerate permitting of renewable energy projects on public lands. A portion of that funding is being used to enhance the Solar PEIS by enabling in-depth environmental analysis of 24 specific tracts of public

lands which have excellent solar development potential and limited resource conflicts.

The Solar PEIS will help BLM identify lands appropriate for solar energy development and establish a comprehensive list of mitigation requirements applicable to all future solar energy development on BLM-administered lands. As part of the Solar PEIS, the Agencies will conduct in-depth environmental analyses of 24 solar energy study areas for the purpose of determining whether such areas should be designated as Solar Energy Zones (SEZs), specific locations determined best suited for large-scale production of solar energy.

The solar energy study areas were identified based on preliminary results of California's Renewable Energy Transmission Initiative, the Western Governors' Association Western Renewable Energy Zone and Transmission Study, and existing BLM resource information. Criteria used to identify solar energy study areas include requirements that the area: be a minimum size of 2,000 acres, be near existing roads and existing or designated transmission line routes, and have a slope of less than 5%. Sensitive resource areas were also removed from consideration, including the following categories of lands:

(1) National Landscape Conservation System lands (except that lands within the California Desert Conservation Area that have no other special designation may be included in a solar energy study area);

(2) Threatened and endangered species designated critical habitat;

(3) Back-country byways;

(4) Areas of known Tribal concern;

(5) Areas of known high cultural site density; and

(6) Areas designated for right-of-way avoidance or right-of-way exclusion in BLM land use plans. Such areas include BLM areas of critical environmental concern, areas with important visual resources, special recreation management areas, areas allocated to maintain wilderness characteristics, wildlife movement corridors, and areas where the BLM has made a commitment to take certain actions with respect to sensitive species habitat.

Some or all of the solar energy study areas may be found appropriate for designation as SEZs as described above. The Agencies are making the maps of the solar energy study areas available to the public and soliciting written comments to provide an opportunity for public input as part of the ongoing Solar PEIS analysis. Specifically, the Agencies request information and comments on the potential for significant impacts of solar energy development on known resources within a solar energy study area and the economic viability of solar energy development within specific areas. No additional public meetings are planned prior to the release of the draft Solar PEIS; however, the public will have additional opportunities to comment when the draft Solar PEIS is released.

The BLM's objective for the Solar PEIS is to create a more efficient process for authorizing solar energy development on public lands that would also:

- Facilitate near-term utility-scale solar energy development on public lands;
- Minimize potential environmental, social, and economic impacts;
- Provide the solar industry flexibility in proposing and developing solar energy projects (location, facility size, technology, etc.);
- Optimize existing transmission corridors; and
- Standardize the authorization process for solar energy development on BLM-administered lands.

The BLM will continue to accept new solar applications. The BLM is in the process of considering alternative procedures, such as non-competitive and competitive, application fees, and diligent development requirements, for solar energy development applications within the solar energy study areas. Any entity with an existing application for lands within the solar energy study areas received by the BLM prior to June 30, 2009 will continue to be processed under the BLM's current procedures. Applications received after June 30, 2009 for lands inside the solar energy study areas will be subject to the Record of Decision (ROD) for the Solar PEIS and any alternative procedures developed by BLM for non-competitive and competitive processes. All applications received for lands outside of the solar energy study areas will be processed under the BLM's current procedures. Any right-of-way grant for a solar energy application issued after the BLM's ROD for the Solar PEIS may be issued subject to the requirements adopted in the ROD.

The Agencies invite interested Federal and State agencies, organizations, Native American tribes and members of the public to submit written comments to assist in identifying significant environmental issues, existing resource data, and industry interest with respect to the solar energy study areas. You may submit comments in writing using one of the methods listed in the "**ADDRESSES**" section above. Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comments—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Mike Pool,

Acting Director, Bureau of Land Management.

[FR Doc. E9–15471 Filed 6–29–09; 8:45 am]

BILLING CODE 4310–84–P

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

[LLWO350000.L14300000]

Notice of Proposed Withdrawal and Opportunity for Public Meeting; Arizona, California, Colorado, Nevada, New Mexico, and Utah

AGENCY: Bureau of Land Management, Interior.

ACTION: Notice.

SUMMARY: The Secretary of the Interior proposes to withdraw approximately 676,048 acres of public lands from settlement, sale, location, or entry under the general land laws, including the mining laws, on behalf of the Bureau of Land Management (BLM) to protect and preserve solar energy study areas for future solar energy development. This notice segregates the lands for up to 2 years from surface entry and mining while various studies and analyses are made to support a final decision on the withdrawal application. The lands will remain open to the mineral leasing laws.

DATES: Comments and requests for a public meeting must be received by September 28, 2009.

ADDRESSES: Comments and meeting requests should be sent to the BLM Director, 1849 C Street NW. (WO350), Washington, DC, 20240.

FOR FURTHER INFORMATION CONTACT: Linda Resseguie, BLM, 202–452–7774, or one of the following BLM State Offices.

SUPPLEMENTARY INFORMATION: The applicant is the Bureau of Land Management at the address above and its petition requests the Secretary of the Interior to withdraw, subject to valid existing rights, approximately 676,048 acres of public lands located in the States of Arizona, California, Colorado, Nevada, New Mexico, and Utah from

MAPS OF SOLAR ENERGY STUDY AREAS
FOR IN-DEPTH STUDY

The U.S. Department of Energy (DOE) and the Bureau of Land Management (BLM (the Agencies) are preparing a draft Programmatic Environmental Impact Statement (PEIS) pursuant to the National Environmental Policy Act to evaluate utility-scale solar energy development in six Western states: Arizona, California, Colorado, Nevada, New Mexico, and Utah. In the course of the PEIS analyses, the Agencies have identified a number of tracts of BLM-administered land for in-depth study for solar development.

Three study areas have been identified in Arizona: Brenda (4,321 acres), Bullard Wash (8,201 acres), and Gillespie (3,970 acres).

Four study areas have been identified in California: Imperial East (12,830 acres), Iron Mountain (109,642 acres), Pisgah (26,282 acres), and Riverside East (202,295 acres).

Four study areas have been identified in Colorado: Antonito Southeast (9,598 acres), De Tilla Gulch (1,522 acres), Fourmile East (3,882 acres), and Los Mogotes East (5,909 acres).

Three study areas have been identified in New Mexico: Afton (55,810 acres), Mason Draw (17,984 acres), and Red Sand (47,666 acres).

Seven study areas have been identified in Nevada: Amargosa Valley (32,699 acres), Dry Lake (16,516 acres), Delamar Valley (17,932 acres), Dry Lake Valley North (49,775 acres), East Mormon Mountain (7,418 acres), Gold Point (5,830 acres), and Miller's (19,205 acres).

Three study areas have been identified in Utah: Escalante Valley (6,648 acres), Milford Flats South (6,440 acres), and Wah Wah Valley (3,676 acres).

The attached maps show the locations of these solar energy study areas.

About the Solar Energy PEIS

The Agencies are preparing the Solar Energy PEIS to reach goals established by Congress, as set forth in Title II, Section 211 of the Energy Policy Act of 2005, and in accordance with Executive Order 13212, Actions to Expedite Energy-Related Projects, and in response to the Secretary of the Interior's Secretarial Order No. 3285 issued March 11, 2009. On the basis of the information and analyses developed in the PEIS, the Agencies will develop and implement agency-specific programs that would establish environmental policies and environmental impact mitigation strategies for solar energy development.

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Public Comment Solicitation

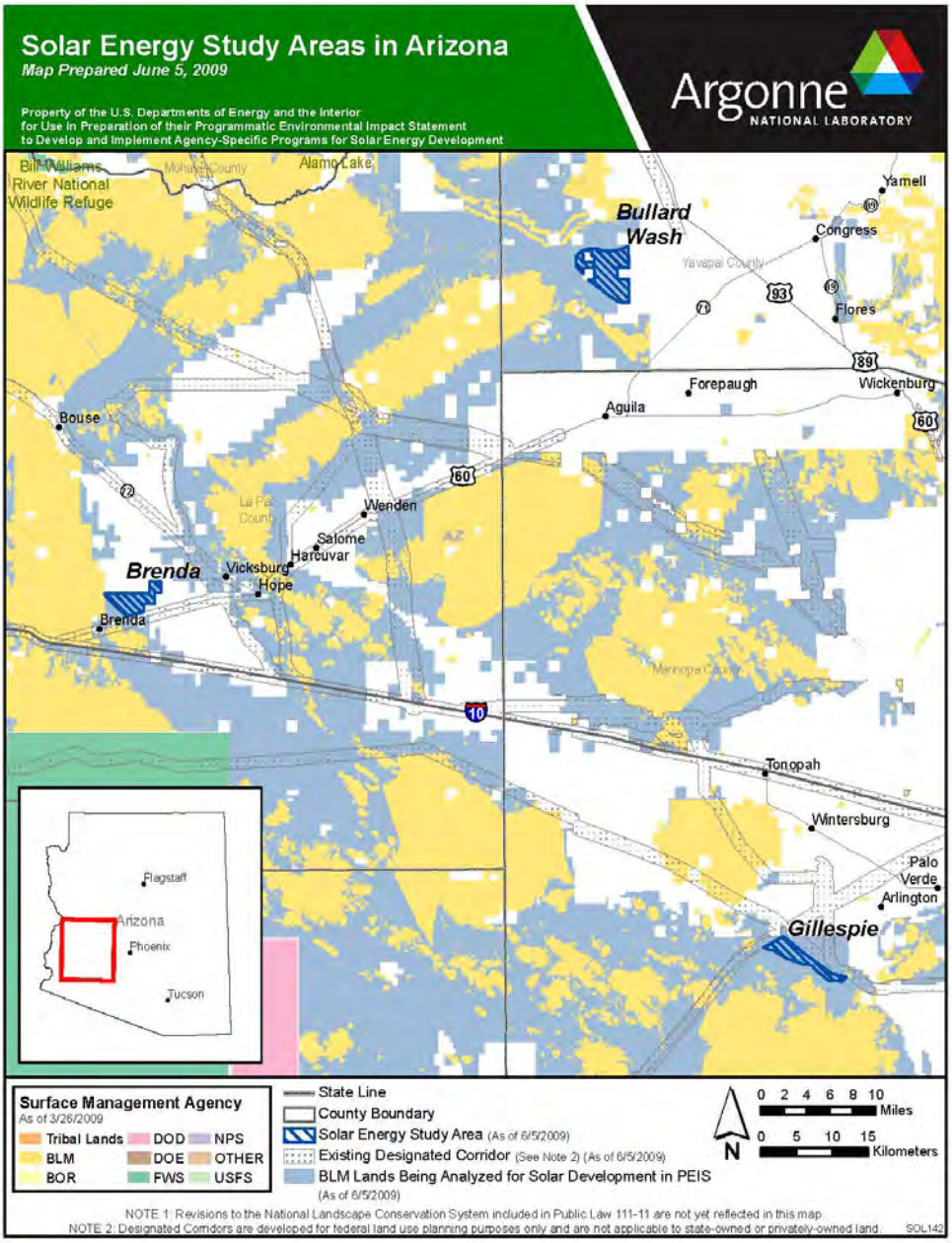
On June 30, 2009, the Agencies issued a Federal Register Notice of Availability informing the public of the availability of the solar energy study area maps, and soliciting public comments for consideration in identifying environmental issues, existing resource data, and industry interest with respect to the proposed study areas. Some or all of the proposed solar energy study areas may be found appropriate for designation as solar energy zones in the future. Criteria for identifying the study areas are listed in the Notice of Availability.

The public comment period ends July 30, 2009. Comments on the solar energy study areas may be submitted electronically through the public comment form on the Solar Energy Development Programmatic EIS Information Center Web site at http://solareis.anl.gov. Written comments can also be mailed to Solar Energy PEIS, Argonne National Laboratory, 9700 S. Cass Avenue--EVS/900, Argonne, IL 60439.

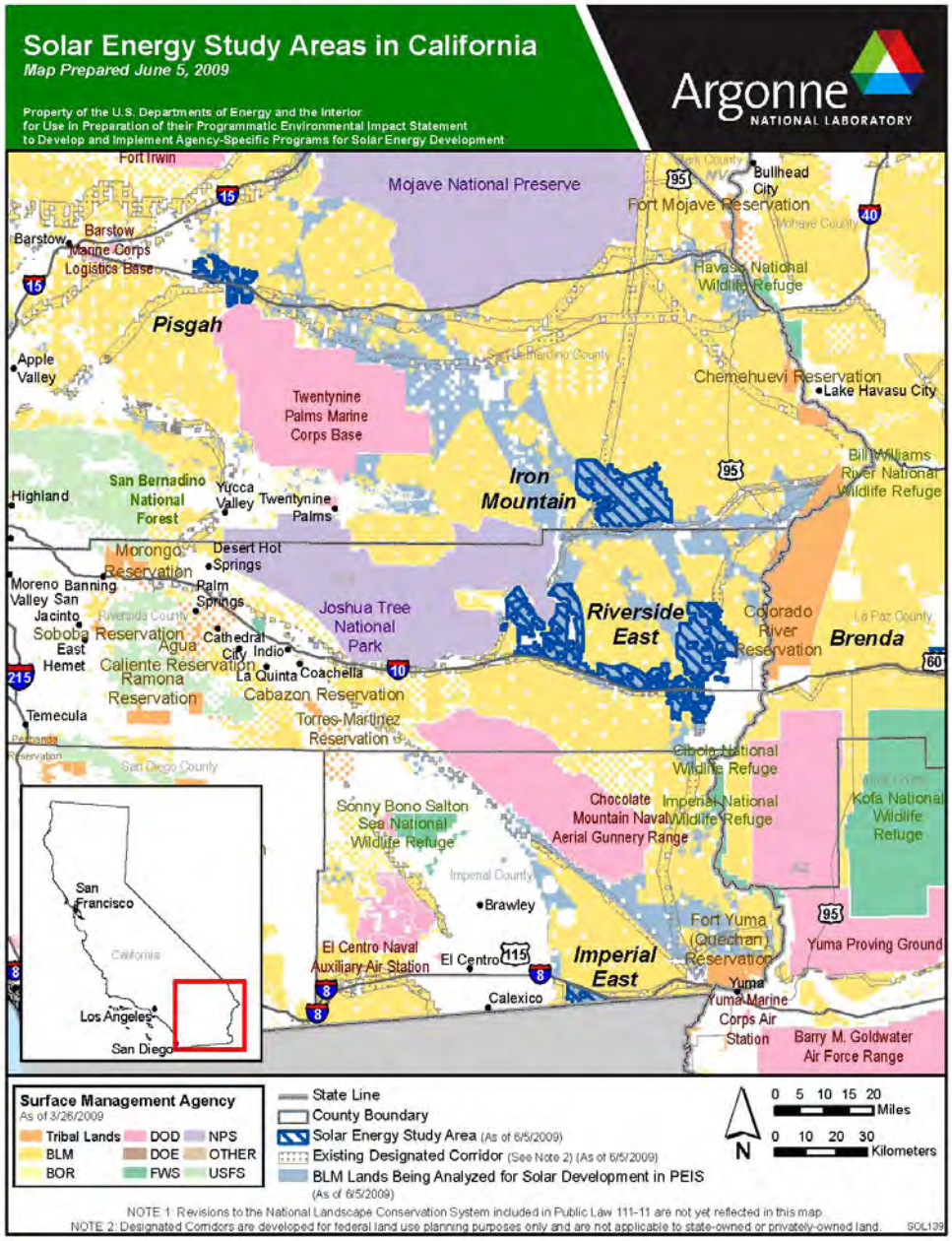
For More Information

Copies of the solar energy study area maps, Federal Register notice, and other information about the solar energy study area maps and the Solar Energy PEIS are available on the Web site at http://solareis.anl.gov. For questions regarding map content, please contact Linda Resseguie, BLM Washington Office, linda_resseguie@blm.gov, 202-452-7774. For questions regarding use of the GIS data or GIS-enabled maps, please contact Brian Cantwell, Argonne National Laboratory, bcantwell@anl.gov, 630-252-6802.

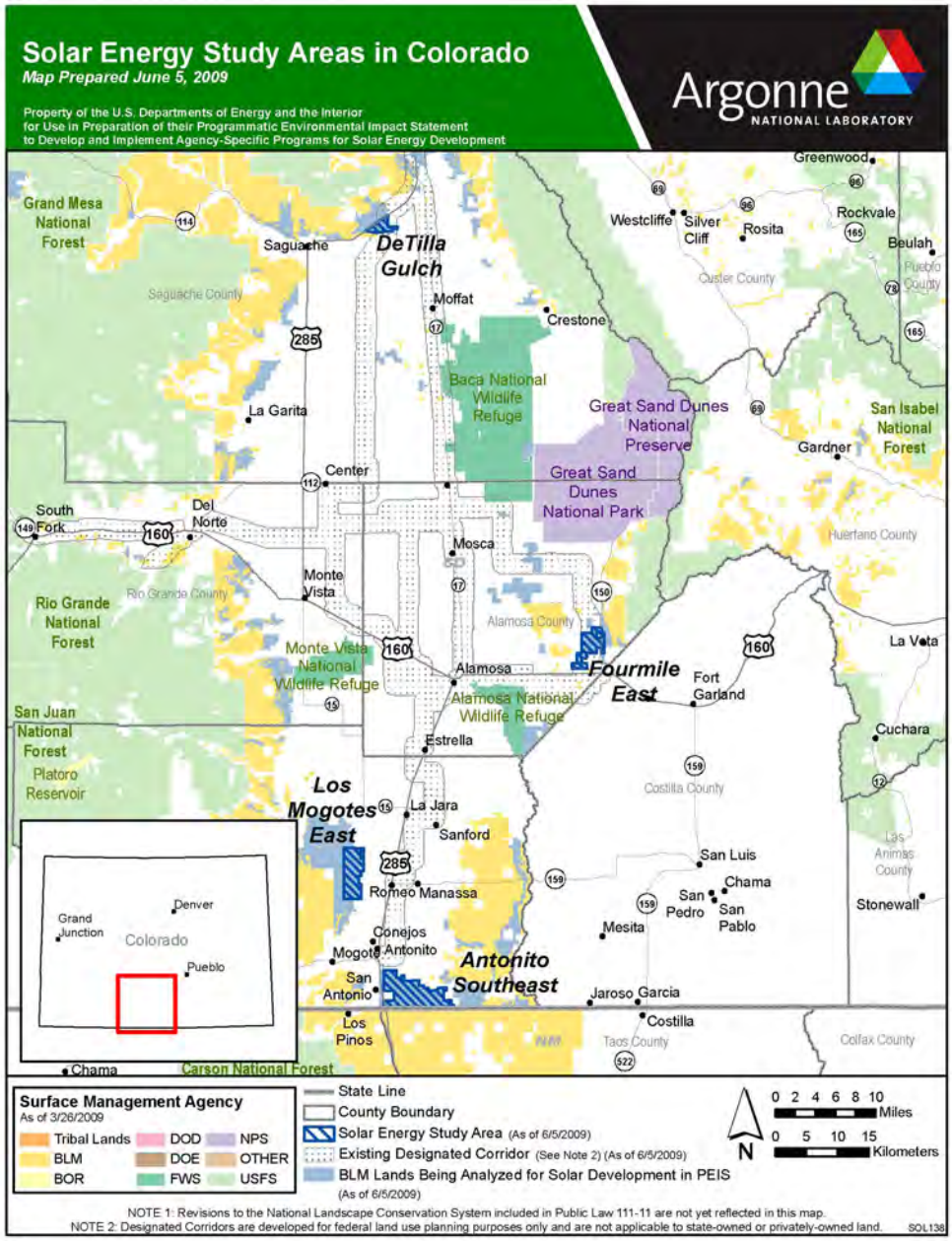
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Solar Energy Study Areas in Arizona
Map Prepared June 5, 2009
Property of the U.S. Departments of Energy and the Interior
for Use in Preparation of their Programmatic Environmental Impact Statement
to Develop and Implement Agency-Specific Programs for Solar Energy Development
Argonne NATIONAL LABORATORY
Bill Williams River National Wildlife Refuge
Mohave County
Alamo Lake
Bullard Wash
Yavapai County
Yarnell
Congress
Flores
Forepaugh
Wickenburg
Aguila
Bouse
La Paz County
Wenden
Salome
Harcuvar
Vicksburg
Hope
Brenda
Maricopa County
Tonopah
Wintersburg
Palo Verde
Arlington
Gillespie
Flagstaff
Arizona
Phoenix
Tucson
Surface Management Agency
As of 3/26/2009
Tribal Lands
BLM
BOR
DOD
DOE
FWS
NPS
OTHER
USFS
State Line
County Boundary
Solar Energy Study Area (As of 6/5/2009)
Existing Designated Corridor (See Note 2) (As of 6/5/2009)
BLM Lands Being Analyzed for Solar Development in PEIS
(As of 6/5/2009)
0 2 4 6 8 10 Miles
0 5 10 15 Kilometers
N
NOTE 1: Revisions to the National Landscape Conservation System included in Public Law 111-11 are not yet reflected in this map.
NOTE 2: Designated Corridors are developed for federal land use planning purposes only and are not applicable to state-owned or privately-owned land.
SOL142

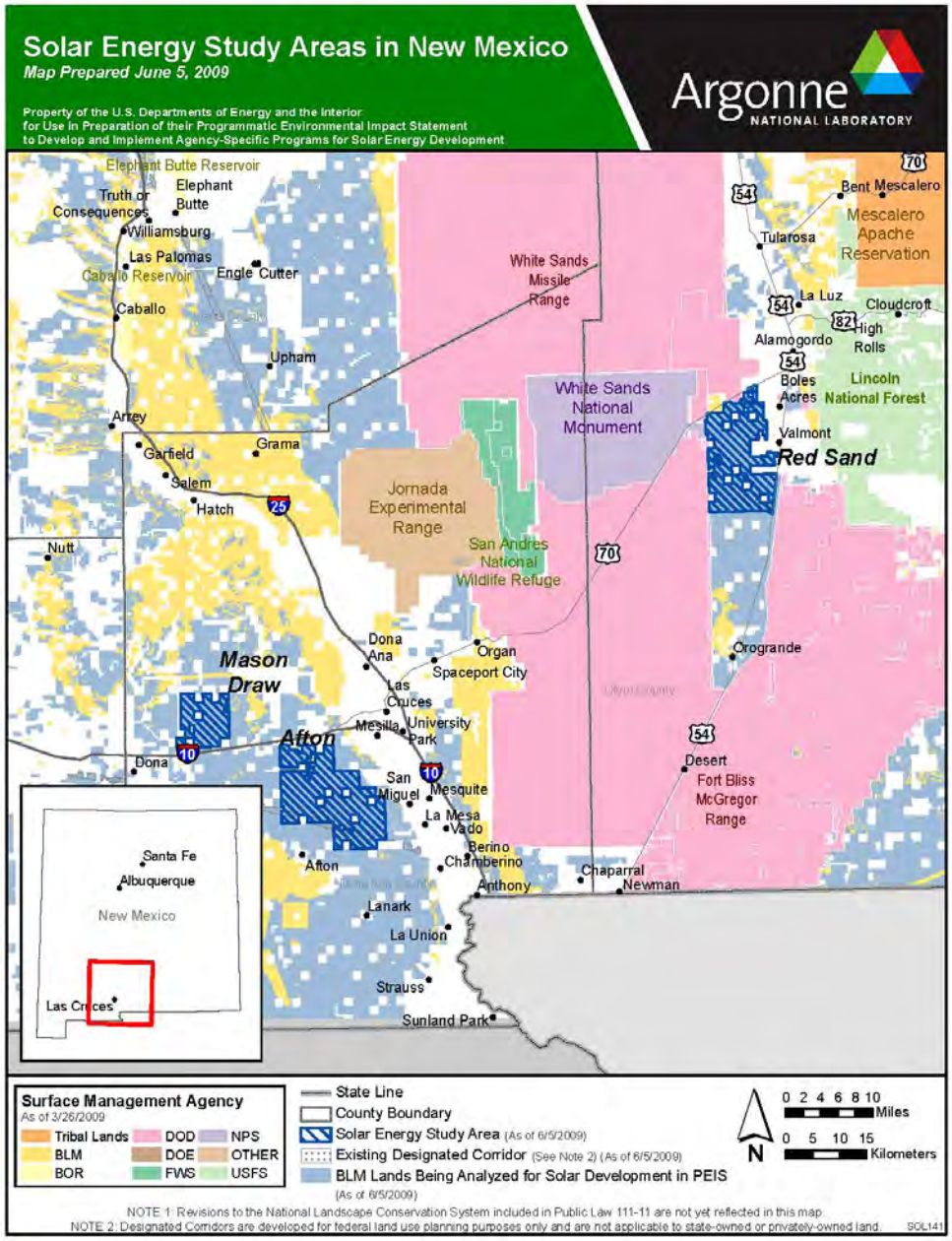
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Solar Energy Study Areas in California
Map Prepared June 5, 2009
Property of the U.S. Departments of Energy and the Interior
for Use in Preparation of their Programmatic Environmental Impact Statement
to Develop and Implement Agency-Specific Programs for Solar Energy Development
Argonne NATIONAL LABORATORY
Fort Irwin
Mojave National Preserve
Bullhead City
Fort Mojave Reservation
Barstow
Barstow Marine Corps Logistics Base
Havasu National Wildlife Refuge
Pisgah
Apple Valley
Chemehuevi Reservation
Lake Havasu City
Twentynine Palms Marine Corps Base
Bill Williams River National Wildlife Refuge
Iron Mountain
Highland
San Bernadino National Forest
Yucca Valley
Twentynine Palms
Morongo Reservation
Desert Hot Springs
Moreno Valley
Banning
San Jacinto
Palm Springs
Joshua Tree National Park
Riverside East
Colorado River Reservation
Brenda
Soboba Reservation
Agua Caliente Reservation
Cathedral City
Indio
Hemet
La Quinta
Coachella
Ramona Reservation
Cabazon Reservation
Temecula
Torres-Martinez Reservation
Cibola National Wildlife Refuge
Sonny Bono Salton Sea National Wildlife Refuge
Chocolate Mountain Naval Aerial Gunnery Range
Imperial National Wildlife Refuge
Kofa National Wildlife Refuge
Brawley
Fort Yuma (Quechan) Reservation
Yuma Proving Ground
El Centro Naval Auxiliary Air Station
El Centro
Imperial East
Calexico
Yuma
Yuma Marine Corps Air Station
Barry M. Goldwater Air Force Range
San Francisco
Los Angeles
San Diego
Surface Management Agency
As of 3/26/2009
Tribal Lands
BLM
BOR
DOD
DOE
FWS
NPS
OTHER
USFS
State Line
County Boundary
Solar Energy Study Area (As of 6/5/2009)
Existing Designated Corridor (See Note 2) (As of 6/5/2009)
BLM Lands Being Analyzed for Solar Development in PEIS (As of 6/5/2009)
0 5 10 15 20 Miles
0 10 20 30 Kilometers
N
NOTE 1: Revisions to the National Landscape Conservation System included in Public Law 111-11 are not yet reflected in this map.
NOTE 2: Designated Corridors are developed for federal land use planning purposes only and are not applicable to state-owned or privately-owned land.
SOL139

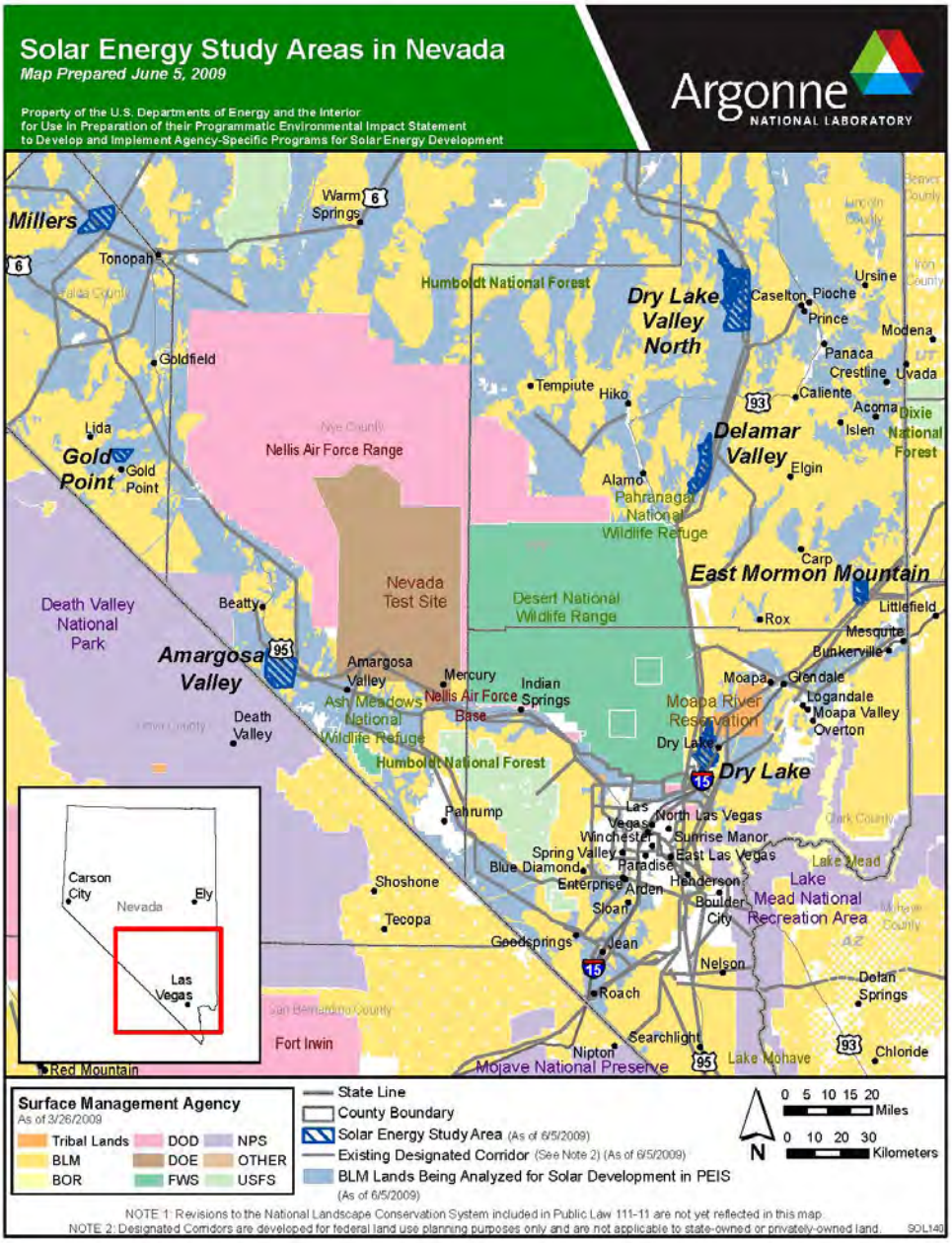
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Solar Energy Study Areas in Colorado
Map Prepared June 5, 2009
Property of the U.S. Departments of Energy and the Interior
for Use in Preparation of their Programmatic Environmental Impact Statement
to Develop and Implement Agency-Specific Programs for Solar Energy Development
Argonne NATIONAL LABORATORY
Grand Mesa National Forest
Saguache
Saguache County
DeTilla Gulch
Moffat
Crestone
Greenwood
Westcliffe
Silver Cliff
Rosita
Rockvale
Beulah
Custer County
Pueblo County
Baca National Wildlife Refuge
Great Sand Dunes National Preserve
Great Sand Dunes National Park
San Isabel National Forest
Gardner
La Garita
Center
South Fork
Del Norte
Mosca
Huerfano County
Monte Vista
Rio Grande County
Rio Grande National Forest
Alamosa County
Monte Vista National Wildlife Refuge
Alamosa
Fourmile East
Fort Garland
La Veta
Alamosa National Wildlife Refuge
San Juan National Forest
Platoro Reservoir
Estrella
Cuchara
Costilla County
Los Mogotes East
La Jara
Sanford
San Luis
Las Animas County
Chama
San Pedro
San Pablo
Romeo
Manassa
Stonewall
Mesita
Conejos
Mogote
Antonito
Antonito Southeast
San Antonio
Jaroso
Garcia
Los Pinos
Costilla
Taos County
Colfax County
Carson National Forest
Grand Junction
Denver
Colorado
Pueblo
Surface Management Agency
As of 3/26/2009
Tribal Lands
DOD
NPS
BLM
DOE
OTHER
BOR
FWS
USFS
State Line
County Boundary
Solar Energy Study Area (As of 6/5/2009)
Existing Designated Corridor (See Note 2) (As of 6/5/2009)
BLM Lands Being Analyzed for Solar Development in PEIS
(As of 6/5/2009)
0 2 4 6 8 10 Miles
0 5 10 15 Kilometers
N
NOTE 1: Revisions to the National Landscape Conservation System included in Public Law 111-11 are not yet reflected in this map.
NOTE 2: Designated Corridors are developed for federal land use planning purposes only and are not applicable to state-owned or privately-owned land.
SOL138

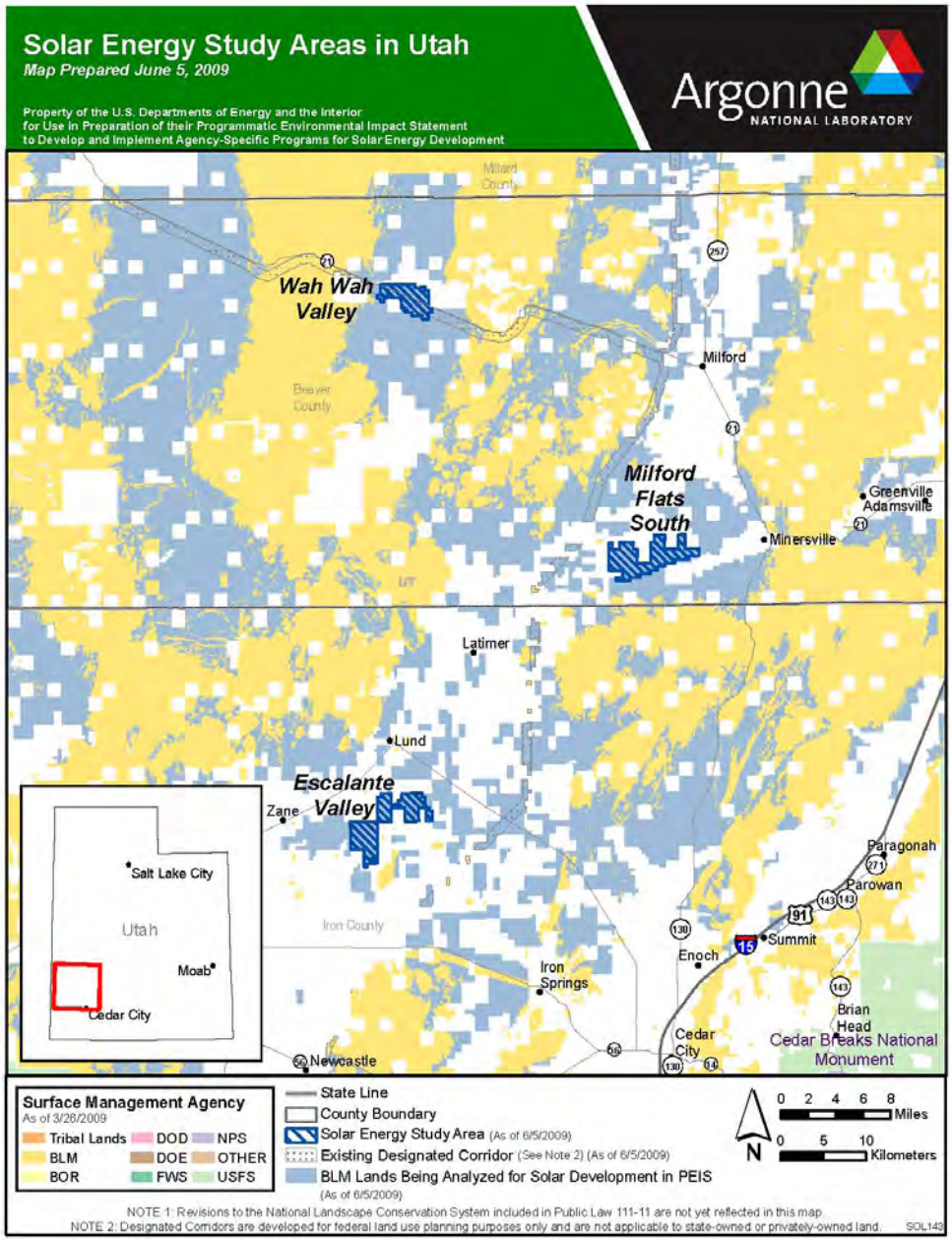
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Solar Energy Study Areas in New Mexico
Map Prepared June 5, 2009
Property of the U.S. Departments of Energy and the Interior
for Use in Preparation of their Programmatic Environmental Impact Statement
to Develop and Implement Agency-Specific Programs for Solar Energy Development
Argonne NATIONAL LABORATORY
Elephant Butte Reservoir
Truth or Consequences
Elephant Butte
Williamsburg
Las Palomas
Caballo Reservoir
Engle
Cutter
Caballo
Upham
Arrey
Garfield
Grama
Salem
Hatch
Nutt
Dona Ana
Mason Draw
Las Cruces
Mesilla
University Park
Afton
Dona
San Miguel
Mesquite
La Mesa
Vado
Berino
Chamberino
Anthony
Chaparral
Newman
Lanark
La Union
Strauss
Sunland Park
White Sands Missile Range
White Sands National Monument
Jornada Experimental Range
San Andres National Wildlife Refuge
Organ
Spaceport City
Orogrande
Desert
Fort Bliss McGregor Range
Bent
Mescalero
Mescalero Apache Reservation
Tularosa
La Luz
Cloudcroft
High Rolls
Alamogordo
Boles Acres
Lincoln National Forest
Valmont
Red Sand
Santa Fe
Albuquerque
New Mexico
Las Cruces
Surface Management Agency
As of 3/26/2009
Tribal Lands
BLM
BOR
DOD
DOE
FWS
NPS
OTHER
USFS
State Line
County Boundary
Solar Energy Study Area (As of 6/5/2009)
Existing Designated Corridor (See Note 2) (As of 6/5/2009)
BLM Lands Being Analyzed for Solar Development in PEIS
(As of 6/5/2009)
0 2 4 6 8 10 Miles
0 5 10 15 Kilometers
N
NOTE 1: Revisions to the National Landscape Conservation System included in Public Law 111-11 are not yet reflected in this map.
NOTE 2: Designated Corridors are developed for federal land use planning purposes only and are not applicable to state-owned or privately-owned land.
SOL141

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2


Solar Energy Study Areas in Nevada
Map Prepared June 5, 2009
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to Develop and Implement Agency-Specific Programs for Solar Energy Development
Argonne NATIONAL LABORATORY
Millers
Tonopah
Warm Springs
Goldfield
Lida
Gold Point
Gold Point
Nellis Air Force Range
Humboldt National Forest
Dry Lake Valley North
Caselton
Pioche
Prince
Ursine
Modena
Panaca
Crestline
Uvada
Caliente
Acoma
Islen
Dixie National Forest
Tempiute
Hiko
Delamar Valley
Elgin
Alamo
Pahranagat National Wildlife Refuge
Carp
East Mormon Mountain
Littlefield
Mesquite
Bunkerville
Rox
Nevada Test Site
Desert National Wildlife Range
Death Valley National Park
Beatty
Amargosa Valley
Amargosa Valley
Mercury
Nellis Air Force Base
Indian Springs
Ash Meadows National Wildlife Refuge
Death Valley
Moapa River Reservation
Moapa
Glendale
Logandale
Moapa Valley
Overton
Dry Lake
Dry Lake
Humboldt National Forest
Pahrump
Las Vegas
North Las Vegas
Winchester
Sunrise Manor
Spring Valley
East Las Vegas
Paradise
Blue Diamond
Enterprise
Arden
Henderson
Boulder City
Lake Mead
Lake Mead National Recreation Area
Shoshone
Tecopa
Sloan
Goodsprings
Jean
Nelson
Roach
Dolan Springs
Searchlight
Nipton
Mojave National Preserve
Lake Mohave
Chloride
Fort Irwin
San Bernardino County
Clark County
Mohave County
AZ
Carson City
Nevada
Ely
Las Vegas
Red Mountain
Surface Management Agency
As of 3/26/2009
Tribal Lands
BLM
BOR
DOD
DOE
FWS
NPS
OTHER
USFS
State Line
County Boundary
Solar Energy Study Area (As of 6/5/2009)
Existing Designated Corridor (See Note 2) (As of 6/5/2009)
BLM Lands Being Analyzed for Solar Development in PEIS
(As of 6/5/2009)
0 5 10 15 20
Miles
0 10 20 30
Kilometers
N
NOTE 1: Revisions to the National Landscape Conservation System included in Public Law 111-11 are not yet reflected in this map.
NOTE 2: Designated Corridors are developed for federal land use planning purposes only and are not applicable to state-owned or privately-owned land.
SOL140

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2


Solar Energy Study Areas in Utah
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Millard County
Wah Wah Valley
Milford
Beaver County
Milford Flats South
Greenville
Adamsville
Minersville
Latimer
Lund
Escalante Valley
Zane
Salt Lake City
Utah
Moab
Cedar City
Iron County
Iron Springs
Newcastle
Paragonah
Parowan
Summit
Enoch
Brian Head
Cedar City
Cedar Breaks National Monument
Surface Management Agency
As of 3/26/2009
Tribal Lands
DOD
NPS
BLM
DOE
OTHER
BOR
FWS
USFS
State Line
County Boundary
Solar Energy Study Area (As of 6/5/2009)
Existing Designated Corridor (See Note 2) (As of 6/5/2009)
BLM Lands Being Analyzed for Solar Development in PEIS
(As of 6/5/2009)
0 2 4 6 8 Miles
0 5 10 Kilometers
N
NOTE 1: Revisions to the National Landscape Conservation System included in Public Law 111-11 are not yet reflected in this map.
NOTE 2: Designated Corridors are developed for federal land use planning purposes only and are not applicable to state-owned or privately-owned land.
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2

Bureau of Land Management
Solar Energy Programmatic Environmental Impact Statement
State Tribal Liaison and Deputy Preservation Officers

Michael Johnson
Deputy Preservation Officer
Bureau of Land Management
Arizona State Office
One North Central Ave #800
Phoenix, AZ 85004
Phone: 602-417-9236
Email: Michael_D_Johnson@blm.gov

Signa Larralde
Deputy Preservation Officer
Bureau of Land Management
New Mexico State Office
1474 Rodeo Road
Santa Fe, NM 87508
Phone: 505-438-7637
Email: Signa_Larralde@blm.gov

Charlotte Hunter
Deputy Preservation Officer
Bureau of Land Management
California State Office
2800 Cottage Way, W-1834
Sacramento, CA 95825
Phone: 916-978-4677
Email: Charlotte_Hunter@blm.gov

Tom Burke
Deputy Preservation Officer
Bureau of Land Management
Nevada State Office
PO Box 12000
Reno, NV 89520
Phone: 775-861-6415
Email: Tom_Burke@blm.gov

Dan Haas
Deputy Preservation Officer
Bureau of Land Management
Colorado State Office
2850 Youngfield Street
Lakewood, CO 80226
Phone: 303-239-3647
Email: Dan_Haas@blm.gov

Byron Loosle
Deputy Preservation Officer
Bureau of Land Management
Utah State Office
440 W. 200 St., Suite 500
Salt Lake City, UT 84175-0155
Phone: 801-539-4276
Email: Byron_Loosle@blm.gov

1
2

SOLAR ENERGY PROGRAMMATIC ENVIRONMENTAL IMPACTS STATEMENT

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TRIBAL CONSULTATION LETTERS – JULY 1, 2009

President
Navajo Nation, Oak Springs Chapter
P.O. Box 486
Window Rock, AZ 86515

President
Navajo Nation, Navajo Mountain Chapter
P.O. Box 10070
Tonalea, AZ 86044

President
Navajo Nation, Birdsprings Chapter
HC 61, Box K
Winslow, AZ 86047

President
Navajo Nation, Black Mesa Chapter
P.O. Box 97
Pinon, AZ 86510

Gerald Ahasteen, President
Navajo Nation, Low Mountain Chapter
P.O. Box 798
Keams Canyon, AZ 86034

Bessie S. Allen, President
Navajo Nation, Pinon Chapter
P.O. Box 127
Pinon, AZ 86510

Billy Arizona, Jr., President
Navajo Nation, Bodaway-Gap Chapter
P.O. Box 1546
Gap, AZ 86020

Albert Bailey, President
Navajo Nation, Kayenta Chapter
P.O. Box 1088
Kayenta, AZ 86033

Thomas Beauty, Chairman
Yavapai-Apache Nation Tribal Council
2400 W. Datsi Rd.
Camp Verde, AZ 86322

Phyllis A. Begay, President
Navajo Nation, Whippoorwill Chapter
P.O. Box 279
Pinon, AZ 86510

Herman Begay, Sr., President
Navajo Nation, Sawmill Chapter
P.O. Box 1786
Ft. Defiance, AZ 86504

Chester Begay, President
Navajo Nation, Dennehotso Chapter
P.O. Box 301
Dennehotso, AZ 86535

Wesley L. Begay, President
Navajo Nation, Tsaile/Wheatfields Chapter
P.O. Box 667
Tsaile, AZ 86556

Paul Begay, President
Navajo Nation, Lupton Chapter
P.O. Box 403
Lupton, AZ 86508

Clarence Cecil Begay, President
Navajo Nation, Rock Point Chapter
P.O. Box 190
Rock Point, AZ 86545

Keith Begay, President
Navajo Nation, Tolani Lake Chapter
P.O. Box HC61-SR-Box 3001
Winslow, AZ 86047

Arnold R. Begay, President
Navajo Nation, Nahata Dzill Chapter
P.O. Box 400
Sanders, AZ 86512

Martin Begay, President
Navajo Nation, Ganado Chapter
P.O. Box 188
Ganado, AZ 86505

Yvonne Bigman, President
Navajo Nation, LeChee Chapter
P.O. Box 4720
Page, AZ 86040

Frank Bilagody, President
Navajo Nation, Toh Nanees Dizi Chapter
P.O. Box 727
Tuba City, AZ 86045

Dwayne Billsie, President
Navajo Nation, Chinle Chapter
P.O. Box 1809
Chinle, AZ 86503

Mary Lou Boone, Vice President
San Juan Southern Paiute Council
P.O. Box 2710
Tuba City, AZ 86045

Nancy Y. Chee, President
Navajo Nation, Klagetoh Chapter
HC58 Box 90, Unit 42
Ganado, AZ 86505

Donald T. Chee, President
Navajo Nation, Forest Lake Chapter
P.O. Box 441
Pinon, AZ 86510

Lena Clark, President
Navajo Nation, Sweetwater Chapter
P.O. Box 105
Teecnospos, AZ 86514

Chester Claw, President
Navajo Nation, Tonalea Chapter
P.O. Box 207
Tonalea, AZ 86044

Johnson Claw, President
Navajo Nation, Nazlini Chapter
P.O. Box 7387
Nazlini, AZ 86505

Thomas Cody, President
Navajo Nation, Leupp Chapter
CPO Box 5085
Leupp, AZ 86035

Jack Colorado, President
Navajo Nation, Cameron Chapter
P.O. Box 85
Cameron, AZ 86020

Sherry Cordova, Chairperson
Cocopah Tribal Council
County 15th & Avenue G
Somerton, AZ 85350

1
2

Shawnevan Dale, President
Navajo Nation, Wide Ruins Chapter
P.O. Box 208
Chambers, AZ 86503

Diane Enos, President
Salt River Pima-Maricopa Indian Community Council
10005 E. Osborn
Scottsdale, AZ 85256

Larry Goodman, President
Navajo Nation, Inscription House Chapter
P.O. Box 5205
Tonalea, AZ 86044

Bahe Jackson, President
Navajo Nation, Jeddito Chapter
P.O. Box 798
Keams Canyon, AZ 86034

Rodger D. Joe, President
Navajo Nation, Teecnospos Chapter
P.O. Box 106
Teecnospos, AZ 86514

Ronnie Lupe, Chairman
White Mountain Apache Tribe
P.O. Box 700
Whiteriver, AZ 85941

Charlie McCabe, President
Navajo Nation, Coalmine Canyon Chapter
P.O. Box 1464
Tuba City, AZ 86045

Virgil D. Nez, President
Navajo Nation, Teesto Chapter
P.O. Box 7166
Winslow, AZ 86047

Benjamin Nubamsa, Chairman
Hopi Tribal Council
P.O. Box 123
Kykotsmovi, AZ 86039

Ruth Roessel, President
Navajo Nation, Round Rock Chapter
P.O. Box 10
Round Rock, AZ 86547

Percy Deal, President
Navajo Nation, Hardrock Chapter
P.O. Box 20
Kykotsmovi, AZ 86039

Lee J. Gambler, President
Navajo Nation, Chilchinbeto Chapter
P.O. Box 1681
Kayenta, AZ 86033

Jones Grass, President
Navajo Nation, Shonto Chapter
P.O. Box 7800
Shonto, AZ 86054

Mike Jackson, Sr., President
Fort Yuma Quechan Tribe
P.O. Box 1899
Yuma, AZ 85366

Ernest Jones, Sr., President
Yavapai-Prescott Board of Directors
530 E. Merritt Street
Prescott, AZ 86301-2038

Roy W. Malacki, Chairman
Navajo Fish & Wildlife, Natural Heritage Program
P.O. Box 1480
Window Rock, AZ 86515

Anderson H. Morgan, President
Navajo Nation, Houck Chapter
P.O. Box 127
Houck, AZ 86506

Ned Norris, Jr., Chairman
Tohono O'odham Nation
P.O. Box 837
Sells, AZ 85634

Clinton Pattea, President
Fort McDowell Yavapai Tribal Council
P.O. Box 17779
Fountain Hills, AZ 85268

Albert Edison Ross, Jr., President
Navajo Nation, St. Michael Chapter
P.O. Box 829
St. Michael, AZ 86511

Eldred Enas, Chairman
Colorado River Tribal Council
26600 Mohave Rd.
Parker, AZ 85344

Franklin Gishey, Sr., President
Navajo Nation, Greasewood Springs Chapter
P.O. Box 1260
Ganado, AZ 86505

Phillip Harrison, Jr., President
Navajo Nation, Red Valley Chapter
P.O. Box 304
Red Valley, AZ 86544

Joe J. Jim, President
Navajo Nation, Blue Gap/Tachee Chapter
P.O. Box 4427
Blue Gap, AZ 86520

Harrison Kee, President
Navajo Nation, Tselani/Cottonwood Chapter
P.O. Box 1139
Chinle, AZ 86503

Louis Manuel, Jr., Chairperson
Ak Chin Indian Community Council
42507 W. Peters & Nall Road
Maricopa, AZ 85239

Lawrence T. Morgan, Speaker
Navajo Nation Council
200 Parkway Administration Bldg 1
Window Rock, AZ 86515

Wendsler Nosie, Sr., Chairperson
San Carlos Tribal Council
P.O. Box 0
San Carlos, AZ 85550

William Roy Rhodes, Governor
Gila River Indian Community Council
P.O. Box 97
Sacaton, AZ 85247

Frieda Sage, President
Navajo Nation, Kaibeto Chapter
P.O. Box 1761
Kaibeto, AZ 86053

1
2

Robert E. Salabye, President
Navajo Nation, Whitecone Chapter
P.O. Box 338
Indian Wells, AZ 86031

Manuel W. Shirley, President
Navajo Nation, Dilkon Chapter
HCR 63 Box E
Winslow, AZ 86047

Aljerino Tsedah, President
Navajo Nation, Many Farms Chapter
P.O. Box 185
Many Farms, AZ 86538

Christine Wallace, President
Navajo Nation, Kinlichee Chapter
P.O. Box 860
St. Michael, AZ 86511

Wilfred Whatanome, Sr., Chairman
Hualapai Tribal Council
P.O. Box 179
Peach Springs, AZ 86434

Alfred L. Yazzie, President
Navajo Nation, Rough Rock Chapter
P.O. Box 633-RRDS
Chinle, AZ 86503

Peter Yucupicio, Chairperson
Pascua Yaqui Tribal Council
7474 S. Camino de Oeste
Tucson, AZ 85746

Donald Arnold, Chairperson
Scotts Valley Rancheria
301 Industrial Avenue
Lakeport, CA 95453

Bobby Barrett, Chairman
Viejas Band of Mission Indians
P.O. Box 908
Alpine, CA 91903

Harold Bennett, Chairman
Quartz Valley Reservation
13601 Quartz Valley Road
Fort Jones, CA 96032

Ona Segundo, Chairperson
Kaibab Paiute Tribal Council
HC 65, Box 2
Fredonia, AZ 86022

Ivan Smith, Chairman
Tonto Apache Tribal Council
Tonto Apache Reservation #30
Payson, AZ 85541

Jerry Tsosie, President
Navajo Nation, Mexican Water Chapter
HC 61 Box 38
Teecnospos, AZ 86514

Don Watahomigie, Sr., Chairman
Havasupai Tribal Council
P.O. Box 10
Supai, AZ 86435-0010

Sid Whitehair, President
Navajo Nation, Coppermine Chapter
P.O. Box 1323
Page, AZ 86040

Samual Yazzie, President
Navajo Nation, Lukachukai Chapter
P.O. Box 248
Lukachukai, AZ 86507

Gary Archuleta, Chairman
Mooretown Rancheria
1 Alverda Drive
Oroville, CA 95966

Clarence Atwell, Jr., Chairman
Santa Rosa Rancheria
P.O. Box 8
Lemoore, CA 93245

Daniel D. Beltran, Chairman
Lower Lake Rancheria
P.O. Box 3162
Santa Rosa, CA 95402

Carlino Bettga, President
Round Valley Reservation
P.O. Box 448
Covelo, CA 95428

Joe Shirley, Jr., President
Navajo Nation
P.O Box 7440
Window Rock, AZ 86515

Jimmie Taliman, Sr., President
Navajo Nation, Cornfields Chapter
P.O. Box 478
Ganado, AZ 86505

Irvin Tsosie, Sr., President
Navajo Nation, Cove Chapter
P.O. Box 276
Red Valley, AZ 86544

Lorraine Wauneka-Nelson, President
Navajo Nation, Fort Defiance Chapter
P.O. Box 366
Fort Defiance, AZ 86504

Jack Whitehorse, Jr., President
Navajo Nation, Steamboat Chapter
P.O. Box 117
Ganado, AZ 86505

Laverne Yazzie-Benally, President
Navajo Nation, Indian Wells Chapter
P.O. Box 3049
Indian Wells, AZ 86031

Vincent Armenta, Chairman
Santa Ynez Band of Mission Indians
P.O. Box 517
Santa Ynez, CA 93460

Tracey Avila, Chairperson
Robinson Rancheria
1545 E. Highway 20
Nice, CA 95464

Monty J. Bengochia, Chairman
Bishop Paiute Tribe
50 Tu Su Lane
Bishop, CA 93514

Leonard Bowman, Chairman
Bear River Band of Rohnerville Rancheria
27 Bear River Drive
Loleta, CA 95551

1
2

Claudia Brundin, Chairperson
Blue Lake Rancheria
P.O. Box 428
Blue Lake, CA 95525

Roman Carrillo, Jr., Chairperman
Hopland Reservation
3000 Shanel Road
Hopland, CA 95449

Kevin Day, Chairman
Tuolumne Rancheria
P.O. Box 699
Tuolumne, CA 95379

Stacy Dixon, Chairman
Susanville Indian Rancheria
Drawer U
Susanville, CA 96130

Leroy J. Elliott, Chairman
Manzanita Band of Mission Indians
P.O. Box 1302
Boulevard, CA 91905

Michael Fitzgerral, Chairman
Sherwood Valley Rancheria
190 Sherwood Hill Drive
Willits, CA 95490

Everett Freeman, Chairman
Paskenta Band of Nomlaki Indians
P.O. Box 398
Orland, CA 95963

Mary Ann Green, Chairperson
Augustine Band of Mission Indians
P.O. Box 846
Coachella, CA 92236

Patricia Hermosillo, Chairperson
Cloverdale Rancheria
555 S. Cloverdale Blvd., Suite I
Cloverdale, CA 95425

Carmella Icay-Johnson, Interim Chairperson
Habematolel Pomo of Upper Lake
P.O. Box 516
Upper Lake, CA 95485

Silvia Burley, Chairperson
California Valley Miwok Tribe
10601 Escondido Place
Stockton, CA 95212

Carl A. Dahlberg, Chairman
Fort Independence Reservation
P.O. Box 67
Independence, CA 93526

Phillip Del Rosa, Chairman
Alturas Rancheria
P.O. Box 340
Alturas, CA 96101

Rick S. Dowd, President
Resighini Rancheria
P.O. Box 529
Klamath, CA 95548

John Feliz, Jr., Chairman
Coyote Valley Reservation
P.O. Box 39
Redwood Valley, CA 95470

Nicholas H. Fonseca, Chairman
Shingle Springs Rancheria
P.O. Box 1340
Shingle Springs, CA 95682

Ryan Garfield, Chairperson
Tule River Reservation
P.O. Box 589
Porterville, CA 93258

Joseph Hamilton, Chairman
Ramona Band of Mission Indians
P.O. Box 391372
Anza, CA 92539

Johnny Hernandez, Chairperson
Santa Ysabel Band of Diegueno Indians
P.O. Box 130
Santa Ysabel, CA 92070

Valentino Jack, Chairperson
Big Valley Rancheria
2726 Mission Rancheria Road
Lakeport, CA 95453

Richard Button, Chairperson
Lone Pine Paiute Shoshone Reservation
P.O. Box 747
Lone Pine, CA 93545

Margaret Dalton, Chairperson
Jackson Rancheria
P.O. Box 1090
Jackson, CA 95642

Christobal C. Devers, Sr., Chairman
Pauma/Yuima Band of Mission Indians
P.O. Box 369
Pauma Valley, CA 92061

James Edwards, Chairman
Berry Creek Rancheria
5 Tyme Way
Oroville, CA 95966

Judy E. Fink, Chairperson
North Fork Rancheria
P.O. Box 929
North Fork, CA 93643-0929

Mathew Franklin, Chairman
Ione Band of Miwok Indians
P.O. Box 1190
Ione, CA 95640

Gail Green, Chairperson
Wiyot Tribe
1000 Wiyot Drive
Loleta, CA 95551

Elizabeth Hansen, Chairperson
Redwood Valley Reservation
3250 Road I
Redwood Valley, CA 95470

Harvey Hopkins, Chairman
Dry Creek Rancheria
P.O. Box 607
Geyserville, CA 95441

John A. James, Chairman
Cabazon Band of Cahuilla Mission Indians
84-245 Indio Springs Drive
Indio, CA 92201

1
2

Geraldine Johnson, Chairman
Elem Indian Colony
P.O. Box 989
Clearlake Oaks, CA 95423

Elizabeth Kipp, Chairperson
Big Sandy Rancheria
P.O. Box 337
Auberry, CA 93602

Monique La Chappa, Chairwoman
Campo Band of Mission Indians
36190 Church Road, Suite 1
Campo, CA 91906

John Marcus, Vice-Chairman
Santa Rosa Band of Mission Indians
P.O. Box 609
Hemet, CA 92546

Robert Martin, Chairman
Morongo Band of Mission Indians
11581 Potrero Road
Banning, CA 92220

Marshall McKay, Chairperson
Rumsey Rancheria
P.O. Box 18
Brooks, CA 95606

Darrell Mike, Chairperson
Twenty-Nine Palms Band of Mission Indians
46-200 Harrison Place
Coachella, CA 92236

Kara L. Miller, Chairperson
Smith River Rancheria
140 Rowdy Creek Road
Smith River, CA 95567

Virgil Moose, Chairperson
Big Pine Paiute Tribe of the Owens Valley
P.O. Box 700
Big Pine, CA 93513

Larriann Musick, Chairperson
La Jolla Band of Luiseno Indians
22000 Highway 76
Pauma Valley, CA 92061

Mike Keller, Chairman
Benton Paiute Reservation
567 Yellow Jacket Rd
Benton, CA 93512

Ronald Kirk, Chairman
Grindstone Rancheria
P.O. Box 63
Elk Creek, CA 95939

Allen Lawson, Spokesman
San Pasqual Band of Mission Indians
P.O. Box 365
Valley Center, CA 92082

Robert Marquez, Chairman
Cold Springs Rancheria
P.O. Box 209
Tollhouse, CA 93667

Lloyd Mathieson, Chairman
Chicken Ranch Rancheria
P.O. Box 1159
Jamestown, CA 95327

Marjorie Mejia, Chairperson
Lytton Rancheria
1300 N. Dutton, Suite A
Santa Rosa, CA 95401

Richard Milanovich, Chairman
Agua Caliente Band of Cahuilla Indians
600 East Tahquitz Canyon Way
Palm Springs, CA 92262

Wayne Mitchum, Chairman
Colusa Rancheria
3730 Highway 45
Colusa, CA 95932

Rhonda L. Morningstar Pope, Chairwoman
Buena Vista Rancheria
P.O. Box 162283
Sacramento, CA 95816

Glenda Nelson, Chairperson
Enterprise Rancheria
1940 Feather River Blvd., Suite B
Oroville, CA 95965

Joe Kennedy, Chairman
Timbi-sha Shoshone Tribe
785 N. Main Street, Suite Q
Bishop, CA 93514

Francine Kupsch, Chairwoman
Los Coyotes Band of Cahuilla & Cupeno Indians
P.O. Box 189
Warner Springs, CA 92086

Mark Macarro, Chairman
Pechanga Band of Mission Indians
P.O. Box 1477
Temecula, CA 92593

Clifford Lyle Marshall, Chairman
Hoopa Valley Tribal Council
P.O. Box 1348
Hoopa, CA 95546

Frederick Mazzetti, Chairman
Rincon Band of Mission Indians
P.O. Box 68
Valley Center, CA 92082

Kenneth Meza, Sr., Chairman
Jamul Indian Village
P.O. Box 612
Jamul, CA 91935

Dale A. Miller, Chairman
Elk Valley Rancheria
2332 Howland Hill Road
Crescent City, CA 95531

Virgil Moorehead, Chairman
Big Lagoon Rancheria
P.O. Drawer 3060
Trinidad, CA 95570

Barbara Murphy, Chairman
Redding Rancheria
2000 Redding Rancheria Road
Redding, CA 96001

Rebecca Osuna, Chairperson
Inaja-Cosmit Reservation
309 S. Maple Street
Escondido, CA 92025

1
2

Gwendolyn Parada, Chairperson
La Posta Band of Mission Indians
P.O. Box 1120
Boulevard, CA 91905

Robert Pinto, Sr., Chairman
Ewiiaapaayp Band of Kumeyaay Indians
P.O. Box 2250
Alpine, CA 91903-2250

Morris Reid, Chairperson
Picayune Rancheria of Chukchansi Indians
46575 Road 417
Coarsegold, CA 93614

DeAnn Roberts, Chairperson
Woodfords Community Council
96 Washoe Blvd.
Markleeville, CA 96120

Salvador Rosales, Chairman
Potter Valley Tribe
2251 South State Street
Ukiah, CA 95482

Joseph Sam, Chairperson
Bridgeport Indian Colony
P.O. Box 37
Bridgeport, CA 93517

Kyle Self, Chairperson
Greenville Rancheria
P.O. Box 279
Greenville, CA 95947

Robert Smith, Chairman
Pala Band of Mission Indians
35008 Pala Temecula Road
Pala, CA 92059

Jessica Tavares, President
United Auburn Indian Community
575 Menlo Drive, Suite 2
Rocklin, CA 95765

Aaron Townsend, Chairman
Fort Bidwell Reservation
P.O. Box 129
Fort Bidwell, CA 96112

Elaine Patterson, Chairperson
Cortina Rancheria
P.O. Box 1630
Williams, CA 95987

Dennis Ramirez, Chairman
Mechoopda Indian Tribe of the Chico Rancheria
125 Mission Ranch Blvd.
Chico, CA 95926

Cherie Rhoades, Chairperson
Cedarville Rancheria
200 South Howard Street
Alturas, CA 96101

Edwin Romero, Chairman
Barona Group of the Capitan Grande
1095 Barona Rd
Lakeside, CA 92040

Luther Salgado, Jr., Chairman
Cahuilla Band of Mission Indians
P.O. Box 391760
Anza, CA 92539-1760

Merlene Sanchez, Acting Chairperson
Guidiville Rancheria
P.O. Box 339
Talmage, CA 95481

Ralph Sepulveda, Chairman
Stewarts Point Rancheria
3535 Industrial Drive, Suite B-2
Santa Rosa, CA 95403

Garth Sundberg, Sr., Chairperson
Trinidad Rancheria
P.O. Box 630
Trinidad, CA 95570

Cristy Taylor, Chairperson
Cahto Tribal Executive Committee
P.O. Box 1239
Laytonville, CA 95454

Maria Tripp, Chairperson
Yurok Tribe
P.O. Box 1027
Klamath, CA 95548

Nelson Pinola, Chairman
Manchester - Point Arena Band of Pomo Indians
P.O. Box 623
Point Arena, CA 95468

James Ramos, Chairman
San Manuel Band of Mission Indians
P.O. Box 266
Patton, CA 92369

Ida Riggins, Chairperson
Pit River Tribal Council
37014 Main Street
Burney, CA 96013

Mark Romero, Chairman
Mesa Grande Band of Mission Indians
P.O. Box 270
Santa Ysbel, CA 92070

Robert Salgado, Sr., Chairman
Soboda Band of Mission Indians
P.O. Box 487
San Jacinto, CA 92581

Greg Sarris, Chairman
Federated Indians of Graton Rancheria
320 Tesconi Circle, Suite G
Santa Rosa, CA 95401

Jose Simon, III, Chairman
Middletown Rancheria
P.O. Box 1035
Middletown, CA 95461

Arch Super, Chairman
Karuk Tribe of California
P.O. Box 1016
Happy Camp, CA 96039

Raymond Torres, Chairman
Torres-Martinez Desert Cahuilla Indians
P.O. Box 1160
Thermal, CA 92274

Danny Tucker, Spokesman
Sycuan Band of Mission Indians
5459 Sycuan
El Cajon, CA 92021

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2

Leanne Walker-Grant, Chairperson
Table Mountain Rancheria
P.O. Box 410
Friant, CA 93626

Charles Wood, Chairman
Chemehuevi Tribal Council
P.O. Box 1976
Havasu Lake, CA 92362

Alonzo A. Coby, Chairman
Shoshone-Bannock Tribes
Fort Hall Business Council
Fort Hall, ID 83203-0306

Willie Sharp, Chairman
Blackfeet Tribal Business Council
P.O. Box 850
Browning, MT 59417

James Steele, Jr., Chairman
Confederated Salish & Kootenai
Tribes, Tribal Council
Box 278
Pablo, MT 59855

President
Navajo Nation, Nahodishgish Chapter
P.O. Box 369
Crownpoint, NM 87313

Terry Aquilar, Chairman
Eight Northern Indian Pueblos
Council
P.O. Box 969
San Juan Pueblo, NM 87566

Wilbert C. Begay, President
Navajo Nation, San Juan Chapter
P.O. Box 1636
Fruitland, NM 87416

Pauleen A. Billie, President
Navajo Nation, Becenti Chapter
P.O. Box 708
Crownpoint, NM 87313

Joe L. Cayaditto, Jr., President
Navajo Nation, Torreon Chapter
P.O. Box 1024
Cuba, NM 87013

Timothy Williams, Chairperson
Fort Mojave Tribal Council
500 Merriman Avenue
Needles, CA 92363

Matthew Box, Chairman
Southern Ute Tribe
P.O. Box 737
Ignacio, CO 81137

Julia Doney, President
Fort Belknap Community Council
RR 1, Box 66
Harlem, MT 59526

Leroy Spang, Chairman
Northern Cheyenne Tribal Council
P.O. Box 128
Lame Deer, MT 59043

Carl Venne, Chairman
Crow Tribal Council
P.O Box 159
Crow Agency, MT 59022

President
Navajo Nation, Nenahnezad Chapter
P.O. Box 438
Fruitland, NM 87416

Kellywood Begay, President
Navajo Nation, Sheepsprings Chapter
P.O. Drawer 1
Sheep Springs, NM 87364

Emil Benally, Jr., President
Navajo Nation, Sanostee Chapter
P.O. Box 219
Sanostee, NM 87461-0219

Anselm Bitsoi, President
Navajo Nation, Mexican Springs
Chapter
P.O. Box 93
Mexican Springs, NM 87320

J. Michael Chavarria, Governor
Pueblo of Santa Clara
P.O. Box 580
Espanola, NM 87532

Leona Williams, Chairperson
Pinoleville Reservation
500 Pinoleville Road, Suite A
Ukiah, CA 95492-7121

Ernest House, Sr., Chairman
Ute Mountain Ute Tribe
P.O. Box 248
Towaoc, CO 81334-0248

John Chance Houle, Chairman
Chippewa Cree Business Committee
RR 1, P.O. Box 544
Box Elder, MT 59521

A.T. Stafne, Chairman
Fort Peck Tribal Executive Board
P.O. Box 1027
Poplar, MT 59255

Ron His Horse is Thunder, Chairman
Standing Rock Sioux Tribal Council
P.O. Box D
Fort Yates, ND 58538

John E. Antonio, Sr., Governor
Pueblo of Laguna
P.O. Box 194
Laguna, NM 87026

John Nez Begay, President
Navajo Nation, Whiterock Chapter
P.O. Box 660
Crownpoint, NM 87313

Robert J. Benavides, Governor
Pueblo of Isleta
P.O. Box 1270
Isleta, NM 87022

Hoskie Bryant, President
Navajo Nation, Naschitti Chapter
Drawer D
Sheep Springs, NM 87364

Paul Chinana, Governor
Pueblo of Jemez
P.O. Box 100
Jemez Pueblo, NM 87024

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2

Norman Cooeyate, Governor
Pueblo of Zuni
P.O. Box 339
Zuni, NM 87327

Harry Descheenie, President
Navajo Nation, Gadii ahi (Cudeii) Chapter
P.O. Box 1318
Shiprock, NM 87420

David M. Emerson, President
Navajo Nation, Breadsprings Chapter
P.O. Box 3008
Gallup, NM 87301

Stanley Hardy, President
Navajo Nation, Toadlena/Two Grey Hills Chapter
P.O. Box 7950
Newcomb, NM 87455

George Jim, President
Navajo Nation, Little Water Chapter
P.O. Box 1898
Crownpoint, NM 87313

Johnny Johnson, President
Navajo Nation, Standing Rock Chapter
P.O. Box 247
Crownpoint, NM 87313

Raymond L. Lancer, Sr., President
Navajo Nation, Chichiltah Chapter
P.O. Box 1336
Gallup, NM 87305

Johnny Livingston, President
Navajo Nation, Churchrock Chapter
P.O. Box 549
Churchrock, NM 87311

Paul T. Martinez, Sr., Governor
Pueblo of Taos
P.O. Box 1846
Taos, NM 87571

Jonas Mastach, President
Navajo Nation, Red Lake #18 Chapter
P.O. Box 130
Navajo, NM 87328

Milton Davidson, President
Navajo Nation, Manuelito Chapter
P.O. Box 69
Manuelito, NM 86505

Jamison DeVore, President
Navajo Nation, Crownpoint Chapter
P.O. Box 336
Crownpoint, NM 87313

Joe Garcia, Chairman
All Indian Pueblo Council
2101 12th St., NW
Albuquerque, NM 87103

Tulley Haswood, President
Navajo Nation, Rock Springs Chapter
P.O. Box 4608
Yatahey, NM 87375

Frank John, Sr., President
Navajo Nation, Beclabito Chapter
Beclabito Trading Post
Shiprock, NM 87420

Charlie Jones, Jr., President
Navajo Nation, Hogback Chapter
P.O. Box 1288
Shiprock, NM 87420

David Lee, President
Navajo Nation, Tseyatoh Chapter
P.O. Box 86
Mentmore, NM 87319

Joe M. Lujan, Governor
Pueblo of Sandia
481 Sandia Loop
Bernalillo, NM 87004

David Bronco Martinez, President
Navajo Nation, Mariano Lake Chapter
P.O. Box 1770
Gallup, NM 87305

Tommy McDonald, President
Navajo Nation, Casamero Lake Chapter
P.O. Box 549
Prewitt, NM 87045

Albert Davis, President
Navajo Nation, Burnham Chapter
P.O. Box 7359
Newcomb, NM 87455

David M. Emerson, President
Navajo Nation, Baahaali Chapter
P.O. Box 108
Vanderwagon, NM 87326

Calvert Garcia, President
Navajo Nation, Nageezi Chapter
P.O. Box 100
Nageezi, NM 87037

Andrew Jim, President
Navajo Nation, Whitehorse Lake Chapter
HCR 79 Box 4069
Cuba, NM 87013

Chavez John, President
Navajo Nation, Coyote Canyon Chapter
P.O. Box 257
Brimhall, NM 87310

Karl Katenay, President
Navajo Nation, Iyanbito Chapter
P.O. Box 498
Fort Wingate, NM 87316

Ulysses Leon, Governor
Pueblo of Santa Ana
2 Dove Road
Santa Ana Pueblo, NM 87004

Roger Madalena, Chairman
Five Sandoval Indian Pueblos
1043 Highway 313
Bernalillo, NM 87004

James Mason, President
Navajo Nation, Upper Fruitland Chapter
P.O. Box 1257
Fruitland, NM 87416

Buddy Mexicano, President
Navajo Nation, Alamo Chapter
P.O. Box 827
Magdalena, NM 87825

1
2

Beth B. Miller, President
Navajo Nation, Thoreau Chapter
P.O. Box 779
Thoreau, NM 87323

Anselm Morgan, President
Navajo Nation, Pinedale Chapter
P.O. Box 3
Churchrock, NM 87311

Tony Padilla, Jr., President
Navajo Nation, Lake Valley Chapter
P.O. Box 190
Crownpoint, NM 87313

Ivan Pino, Governor
Pueblo of Zia
135 Capitol Square Drive
Zia Pueblo, NM 87053-6013

Wilson Ray, Sr., President
Navajo Nation, Huerfano Chapter
P.O. Box 968
Bloomfield, NM 87413

Samuel Sage, President
Navajo Nation, Counselor Chapter
P.O. Box 209
Counselor, NM 87018

Bob Sandoval, President
Navajo Nation, Twin Lakes Chapter
P.O. Box 4424
Yatahey, NM 87375

Ronald L. Tenorio, Governor
Pueblo of San Felipe
P.O. Box 4339
San Felipe Pueblo, NM 87001

Gary Vandever, President
Navajo Nation, Baca/Prewitt Chapter
P.O. Box 562
Prewitt, NM 87045

Perry Wilson, President
Navajo Nation, Crystal Chapter
P.O. Box 775
Navajo, NM 87328

Ernest Mirabal, Governor
Pueblo of Nambe
Route 1, Box 117-BB
Santa Fe, NM 87501

Herman R. Morris, President
Navajo Nation, Tohatchi Chapter
P.O. Box 1236
Tohatchi, NM 87325

Levi Pesata, President
Jicarilla Apache Nation
P.O. Box 507
Dulce, NM 87528

Craig Quanchello, Governor
Pueblo of Picuris
P.O. Box 127
Penasco, NM 87553

George Rivera, Governor
Pueblo of Pojoaque
17746 US Highway 84/285
Santa Fe, NM 87506

Earl Salazar, Governor
Ohkay Owingeh
P.O. Box 1099
San Juan Pueblo, NM 87566

Tony Secatero, President
Canoncito Navajo Band, Tohajiilee Chapter
P.O. Box 3398
Tohajiilee, NM 87026

Roger Toledo, President
Navajo Nation, Ojo Encino Chapter
HCR 79 Box 1500
Cuba, NM 87013

Frank Chee Willetto, Sr., President
Navajo Nation, Pueblo Pintado Chapter
HCR 79 Box 3026
Cuba, NM 87013

Thomas Joe Yazzie, President
Navajo Nation, Newcomb Chapter
P.O. Box 7982
Newcomb, NM 87455

Robert Mora, Governor
Pueblo of Tesuque
RR 42, Box 360-T
Santa Fe, NM 87506-2632

Carlton Naiche-Palmer, President
Mescalero Apache Tribe
P.O. Box 227
Mescalero, NM 88340

Leo L. Pino, President
Ramah Navajo Chapter
Route 2, Box 13
Ramah, NM 87321

Sisto Quintana, Governor
Pueblo of Santo Domingo
P.O. Box 99
Santo Domingo Pueblo, NM 87052

Leon Roybal, Governor
Pueblo of San Ildefonso
Route 5, Box 315-A
Santa Fe, NM 87501

Chandler Sanchez, Governor
Pueblo of Acoma
P.O. Box 309
Acoma, NM 87034

Ernest Suina, Governor
Pueblo of Cochiti
P.O. Box 70
Cochiti, NM 87072

Martha Tom, President
Navajo Nation, Red Rock Chapter
P.O. Box 2548
Gallup, NM 87301

Bobby J. Willie, President
Navajo Nation, Smith Lake Chapter
P.O. Box 60
Smith Lake, NM 87365

Duane H. Yazzie, President
Navajo Nation, Shiprock Chapter
P.O. Box 3810
Shiprock, NM 87420

1
2

Richard Arnold, Tribal Chair
Pahrump Paiute Tribe
P.O. Box 3411
Pahrump, NV 89041

Wanda Batchelor, Chairperson
Stewart Community Council c/o
Washoe Tribe of Nevada/California
919 Highway 395 South
Gardnerville, NV 89410

Daryl Crawford, Chairman
Inter-Tribal Council of Nevada
680 Greenbrae Drive
Sparks, NV 89431

Nancy Egan, Chairman
Shoshone-Paiute Business Council
P.O. Box 219
Owyhee, NV 89832

Chad Malone, Chairman
Carson Community Council
2900 S. Curry Street
Carson City, NV 89703

Cheryl Mose-Temoke, Chairman
South Fork Band Council
Box B-13
Lee, NV 89829

Edmund Raymus, Chairperson
Walker River Paiute Tribal Council
P.O. Box 220
Schurz, NV 89427

Phil Swain, Chairman
Moapa Business Council
P.O. Box 340
Moapa, NV 89025

Mervin Wright, Jr., Chairman
Pyramid Lake Paiute Tribal Council
P.O. Box 256
Nixon, NV 89424

Wallace Coffey, Chairman
Comanche Nation
P.O. Box 908
Lawton, OK 73502

Linda Ayer, Chairman
Winnemucca Tribal Council
P.O. Box 1370
Winnemucca, NV 89446

Diana Buckner, Chairperson
Ely Shoshone Tribe
16 Shoshone Circle
Ely, NV 89301

Arlo Crutcher, Chairperson
Fort McDermitt Tribal Council
P.O. Box 457
McDermitt, NV 89421

David Gonzales, Chairman
Te-Moak Tribe of Western Shoshone
Tribal Council
525 Sunset Street
Elko, NV 89801

Arlan D. Melendez, Chairman
Reno-Sparks Tribal Council
98 Colony Road
Reno, NV 89502

Alvin Moyle, Chairman
Fallon Paiute Shoshone Tribal
Business Council
565 Rio Vista Road
Fallon, NV 89406-9159

Clark Rhondes, Sr., Chairman
Lovelock Tribal Council
P.O. Box 878
Lovelock, NV 89419

Benny Tso, Chairperson
Las Vegas Tribal Council
Number One Paiute Drive
Las Vegas, NV 89106

Michael Young, Chairman
Battle Mountain Band Council
37 Mountain View Drive
Battle Mountain, NV 89820

Darrell Flyingman, Chairman
Cheyenne-Arapaho Tribes of
Oklahoma
P.O. Box 38
Concho, OK 73022

Warner Barlese, Chairman
Summit Lake Paiute Tribal Council
1708 H. St.
Sparks, NV 89431-4337

Vince Conway, Chairman
Yerington Paiute Tribe
171 Campbell Lane
Yerington, NV 89447

Wayne Dyer, Chairman
Yomba Tribal Council
HC61, Box 6275
Austin, NV 89310

L. Mark Kizer, Chairman
Dresslerville Community Council
1585 Watasheamu
Gardnerville, NV 89410

Jerry Millett, Chairperson
Duckwater Tribal Council
P.O. Box 140068
Duckwater, NV 89314

Lynette Piffero, Chairperson
Elko Band Council
1745 Silver Eagle Drive
Elko, NV 89801

Julie Stevens, Chairperson
Wells Indian Colony Band Council
P.O. Box 809
Wells, NV 89835

Waldo W. Walker, Chairman
Washoe Tribal Council
919 Highway 395 South
Gardnerville, NV 89410

Alonzo Chalepah, Tribal
Administrator
Apache Tribe of Oklahoma
P.O. Box 1220
Anadarko, OK 73005

Jeff Houser, Chairman
Fort Sill Apache Tribe of Oklahoma
Route 2, Box 121
Apache, OK 73006

1
2

George Howell, President
Pawnee Nation of Oklahoma
P.O. Box 470
Pawnee, OK 74058

Joseph Brings Plenty, Chairman
Cheyenne River Lakota Sioux Tribe
P.O Box 590
Eagle Butte, SD 57625

Brandon Sazue, Sr., Chairman
Crow Creek Sioux Tribal Council
P.O. Box 50
Fort Thompson, SD 57339

Lawrence Bear, Chairman
Skull Valley Band of Goshute Indians
General Council
3359 South Main Street, #808
Salt Lake City, UT 84029

Jeanine Borchardt, Chairperson
Paiute Indian Tribe of Utah Tribal Council
440 N. Paiute Drive
Cedar City, UT 84720-2613

Cyndi Charles, Chairwoman
Paiute Indian Tribe of Utah,
Koosharem Band
223 East 575 North
Cedar City, UT 84720

Phil Pikyavit, Chairman
Paiute Indian Tribe of Utah, Kanosh Band
P.O. Box 101
Kanosh, UT 84637

Alex Shepherd, Chairman
Paiute Indian Tribe of Utah, Cedar Band
440 N. Paiute Drive
Cedar City, UT 87420-2613

Harvey Spoonhunter, Chairman
Northern Arapaho Business Council
P.O. Box 396
Fort Washakie, WY 82514

Donnie Tofpi, Chairman
Kiowa Tribe of Oklahoma
P.O. Box 369
Carnegie, OK 73015

Robert Cournoyer, Chairman
Yankton Sioux Tribe
P.O. Box 248
Marty, SD 57361-0248

Michael Selvage, Chairman
Sisseton-Wahpeton Sioux Tribe
P.O. Box 509
Agency Village, SD 57262

John Billie, President
Navajo Nation, Aneth Chapter
P.O. Box 430
Montezuma Creek, UT 84534

Jeannie Borchardt, Chairwoman
Paiute Indian Tribe of Utah, Indian Peak Band
440 N. Paiute Drive
Cedar City, UT 84720

Herman Farley, President
Navajo Nation, Red Mesa Chapter
P.O. Box 422
Montezuma Creek, UT 84534

Clarence Rockwell, Executive Director
Navajo Utah Commission
P.O. Box 570
Montezuma Creek, UT 84534

Rupert Steele, Chairman
Goshute Business Council
P.O. Box 6104
Ibapah, UT 84034

Rodney Bordeaux, President
Rosebud Sioux Tribal Council
P.O. Box 430
Rosebud, SD 57570

Michael Jandreau, Chairman
Lower Brule Sioux Tribal Council
187 Oyate Circle
Lower Brule, SD 57548

John Yellow Bird Steele, President
Oglala Sioux Tribal Council
P.O. Box 2070
Pine Ridge, SD 57770

James Black, President
Navajo Nation, Oljato Chapter
P.O. Box 360455
Monument Valley, UT 84531

Curtis Cesspooch, Chairperson
Ute Indian Tribe
P.O. Box 190
Ft. Duchesne, UT 84026

Bruce Perry, Chairman
Northwestern Band of Shoshone Nation
707 N. Main St
Brigham City, UT 84302

Glenn Rogers, Chairman
Paiute Indian Tribe of Utah, Shivwits Band
370 North 400 West #2
St. George, UT 84770

Ivan D. Posey, Chairman
Eastern Shoshone Business Council
P.O. Box 217
Fort Washakie, WY 82514

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THE NAVAJO NATION

BLM - UT - 950
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STATE DIRECTORS OFFICE

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JOE SHIRLEY, JR.
PRESIDENT

~~BEN SHELLY~~
~~VICE PRESIDENT~~

July 03, 2008

#910-JM3
due: 7-21-08

Ms. Selma Sierra, State Director
Bureau of Land Management
P.O. Box 45155
Salt Lake City, Utah 84145

Subject: Tribal Consultation Request. Proposing to evaluate solar energy development on BLM lands in Arizona, California, New Mexico, Utah, Nevada and Colorado.

Dear Ms. Sierra:

Our apology for an oversight and missing the deadline date of our response to your request, please note that in reference to your letter of June 23, 2008, the Historic Preservation Department – Traditional Culture Program (HPD-TCP) received a request for consultation regarding the above undertaking and/or project. After reviewing your consultation documents, HPD-TCP has concluded the proposed undertaking/project area **will not impact** any Navajo traditional cultural properties or historical properties.

However, if there are any inadvertent discoveries made during the course of the undertaking, your agency shall cease all operations within the project area. HPD-TCP shall be notified by telephone within 24 hours and a formal letter be sent within 72 hours. All work shall be suspended until mitigation measures/procedures have been developed in consultation with the Navajo Nation.

The HPD-TCP appreciates your agency's consultation efforts, pursuant to 36 CFR Pt. 800.1 (c)(2)(iii). Should you have additional concerns and/or questions, do not hesitate to contact me. My contact information is listed below.

Sincerely,

Judy Martin for

Mr. Tony Joe, Program Manager
Historic Preservation Department – Traditional Culture Program

Tel: 928.871.7688 Fax: 928.871.7886 E-mail: tonyjoe@navajo.org

TCP 08-707
File: Office file/chrono

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2

Janet Eidsness <jeidsness@bluela kerancheria-nsn.gov>

To
"linda_resseguie@blm.gov" <linda_resseguie@blm.gov>,
"Charlotte_Hunter@blm.gov"<Charlotte_Hunter@blm.gov>

07/09/2009 05:34 PM

cc

Subject
PEIS for Solar Energy Development, Six SW States including California - Notice to Blue Lake Rancheria

Hello,

Thank you for providing notice of the BLM and DOE's efforts to develop a PA for Section 106 compliance for the subject undertaking, as described in correspondence to our Chairperson, Claudia Brundin, on July 1, 2009 (signed by Steven J. Borchard).

The California study area is located well outside the Blue Lake Rancheria Tribe's cultural area of geographical concern. We do not wish to participate in consultation at this time.

Best Regards and Good Luck!

Janet P. Eidsness, M.A. RPA
Tribal Heritage Preservation Officer
Blue Lake Rancheria
P.O. Box 428 (428 Chartin Road)
Blue Lake, CA 95525
Voice (707) 668-5101 Extension 329
Fax (707) 668-4272
jeidsness@bluelakerancheria-nsn.gov

1

From: Linda_Resseguie@blm.gov [mailto:Linda_Resseguie@blm.gov]
Sent: Monday, July 13, 2009 3:01 PM
To: Wescott, Konstance L.; Michael_D_Johnson@blm.gov
Subject: Solar PEIS - Klagetoh Chapter, Navajo Nation

Konnie and Michael, I wanted to confirm that Nancy Chee with the Klagetoh Chapter of the Navajo Nation called me last week to discuss our July 1, 2009, outreach letter. She indicated that the solar energy study areas were not close to Chapter lands and while there had previously been interest in locating solar energy projects on Chapter lands, there seemed to be less interest at this point. My understanding was that this Chapter is not interested in further consultation at this time.

Linda J. Resseguie
Realty Specialist WO - 350
202.452.7774; fax 202.452.7708

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AT LARGE
Jesse "Jay" Taken Alive
Margaret M. Gates
Charles W. Murphy
Dave Archambault II
Joseph McNeil Jr.
Jesse McLaughlin

DISTRICTS
Robert Cordova
Cannonball District
Henry Harrison
Long Soldier District
Joe Strongheart Sr.
Wakpala District
Frank White Bull
Kenel District
Joe White Mountain Sr.
Bear Soldier District
Milton Brown Otter
Rock Creek District
Frank Jamerson Jr.
Running Antelope District
Richard D. Bird Jr.
Porcupine District

Ron His Horse Is Thunder
Chairman
Avis Little Eagle
Vice Chairwoman
Geraldine Agard
Secretary

July 21, 2009

Steven, J. Borchard
BLM, California Desert District Manager
22835 Calle San Juan de los Lagos
Riverside, CA 92553

Re: CR CA610-09-01/8100 (CA610.25)

Dear Mr. Borchard,

In regards to the joint Programmatic Environmental Impact Statement for Solar Energy Development (PEIS), we offer the following comments.

We would ask that before any ground disturbance begins, you conduct a Class III archeological survey in order to potentially locate any Native American artifacts and/or items of cultural significance. We also ask that you utilize Native Americans who have been specifically trained to conduct these types of ground surveys.

Should you have any questions, please contact Waste' Win Young, Director of the Standing Rock Sioux Tribal Historic Preservation Office at 701-854-8512.

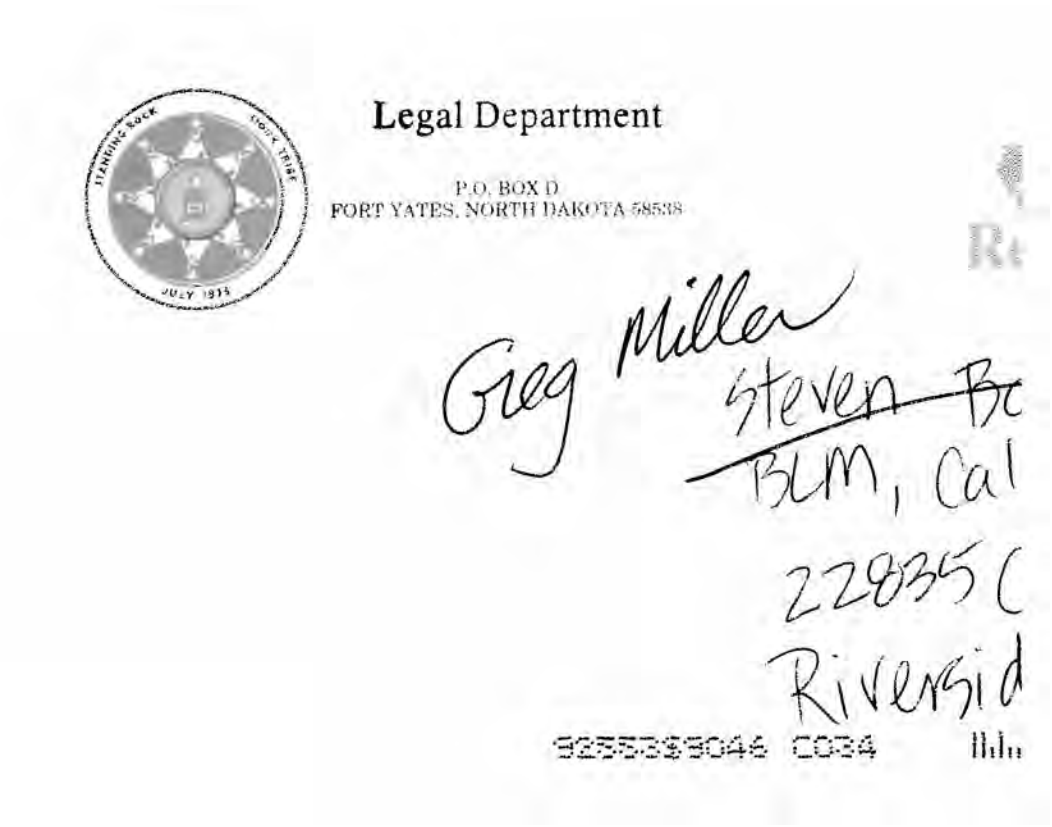
Sincerely,

Geraldine Agard

Ron His Horse Is Thunder, Chairman
STANDING ROCK SIOUX TRIBE

BLDG. 1 NORTH STANDING ROCK AVE. • P.O. BOX D • FORT YATES, NORTH DAKOTA 58538
PHONE: 701-854-7201 or 701-854-8500 • FAX 701-854-7299

1
2


Legal Department
P.O. BOX D
FORT YATES, NORTH DAKOTA 58538
Greg Miller
Steven Bo
BLM, Cal
22835 (
Riversid

1
2

"Darrel Cruz"darrel.cruz@washoetribe.us
To
<Susan_McCabe@blm.gov>
07/28/2009 03:08 PM
cc

Subject
RE: Solar Programmatic Environmental Impact Statement
PEIS)/Washoe Tribe of California and Nevada

Hi Susan,
The areas look like they out of our territory. Based on the map depictions I will not be pursuing this matter. If you have contact with Mr. Kerwin please let him know that it is out of our territory. He has been calling Lynda Shoshone about it.

Thanks Susan,
Darrel

Darrel Cruz CRO/THPO
Tribal Historic Preservation Officer
919 Highway 395 South
Gardnerville, Nevada, 89410
Work (775) 888-0936
Cell (775) 546-3421
FAX (775) 888-0937
darrel.cruz@washoetribe.us

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SolarMap_003

MOAPA BAND OF PAIUTES

MOAPA RIVER INDIAN RESERVATION
P.O. BOX 340
MOAPA, NEVADA 89025
TELEPHONE (702) 865-2787
Fax (702) 865-2875

July 28, 2009

Solar Energy PEIS
Argonne National Laboratory
9700 S. Cass Avenue
EVS/900
Argonne, IL 60439

Re: solar energy study area along the southwest boundary of the Moapa River Indian Reservation near the Arrow Canyon Range

Dear Staff:

The Moapa Band of Paiutes has just learned of the solar energy study area on BLM land along the southwest boundary of the Moapa River Indian Reservation near the Arrow Canyon Range. Because of the close proximity of the proposed site to the reservation I think it is important that the Tribe have an opportunity to study this proposal and provide comments to BLM and DOE.

We request an extension of 60 days for the submission of comments on the solar study area and the potential impact to the Moapa Band of Paiutes. The requested extension will give the Tribe the necessary time to evaluate the proposal and determine its impact, if any, on the reservation.

Sincerely,

Philbert Swain
Tribal Chairman

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THE NAVAJO NATION

JOE SHIRLEY, JR.
PRESIDENT

BEN SHELLY
VICE-PRESIDENT

August 7, 2009

Steven J. Borchard
California Desert District Manager
Bureau of Land Management
22835 Calle San Juan de los Lagos
Riverside, CA 92553

Dear Mr. Borchard:

Our apology for an oversight and missing the deadline date of our response to your request, and that the Navajo Nation Historic Preservation Department – Traditional Culture Program (NNHPD-TCP) is in receipt of the Bureau of Land Management's (BLM) proposed project. BLM and the Department of Energy (DOE) were beginning to work on a joint programmatic Environmental Impact Statement for Solar Energy Development (PEIS) in six southwestern states: Arizona, California, Colorado, Nevada, New Mexico, and Utah.

After reviewing your consultation documents, HPD-TCP has concluded the proposed undertaking/project area **will not impact** any Navajo traditional cultural properties. The HPD-TCP, on behalf of the Navajo Nation has no concerns at this time.

However, the determination made by the HPD-TCP does not necessarily mean that the Navajo Nation has no interest or concerns with the proposed project. If the proposed project inadvertently discovers habitation sites, plant gathering areas, human remains and objects of cultural patrimony the HPD-TCP request that we be notified respectively in accordance with the Native American Graves Protection and Repatriation Act (NAGPRA).

The HPD-TCP appreciates the Bureau of Land Management's consultation efforts, pursuant to 36 CFR Pt. 800.1 (c)(2)(iii). Should you have any additional concerns and/or questions, do not hesitate to contact me electronically at tonyjoe@navajo.org or telephone at 928-871-7750. Mr. Kelly Francis will be taking over all Section 106 Consultations soon within the near future.

Sincerely,

judy Morton for

Tony H. Joe, Jr., Supervisory Anthropologist *(Section 106 Consultations)*
Historic Preservation Department – Traditional Culture Program

TCP 2009-734
CC: Office File/Chrono

HISTORIC PRESERVATION DEPARTMENT P.O. BOX 4950 WINDOW ROCK, ARIZONA 86515 928.871.7198(V) 928.871.7866(FAX)

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PUEBLO OF LAGUNA
P.O. BOX 194
LAGUNA, NEW MEXICO 87026

(505) 552-6598
(505) 552-6654
(505) 552-6655

Office of:
The Governor
The Secretary
The Treasurer

Rolla

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August 14, 2009

Mr. Steve J. Borchard
California Desert District Manager
Bureau of Land Management
California Desert District
22835 Calle San Juan de los Lagos
Riverside, CA 92553

Dear Mr. Borchard:

RE: CR CA610-09-01/8100 (CA610.25)

The Pueblo of Laguna appreciates your consideration to comment on the possible interest your project may have on any traditional or cultural properties.

The Pueblo of Laguna has determined that the undertaking WILL NOT have a significant impact at this time. However, in the event that any new archaeological sites are discovered and any new artifacts are removed, we request to be notified to review items. We also request photographs of items. According to our unpublished migration history, our ancestors journeyed from the north through that area and settled for periods of time before traveling to our present location. Therefore, the possibilities of some findings may exist.

We thank you and your staff for the information provided.

Sincerely,

for John E. Antonio, Sr.
Governor, Pueblo of Laguna

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From: Signa_Larralde@blm.gov [mailto:Signa_Larralde@blm.gov]
Sent: Friday, August 14, 2009 9:44 AM
To: Verhaaren, Bruce T.
Cc: Hartmann, Heidi M.; Wescott, Konstance L.
Subject: RE: Study Area data for NM - Solar PEIS

Bruce,

Thanks very much for all your help with shapefiles and your info about the maps. We had a good meeting with Zuni yesterday. Most of the time was taken up by a Sun Zia Transmission Line presentation, but I did give them a briefing about the Solar PEIS. In short, they advised working directly with their cultural resources people to review any concerns about the study areas, and also said that it may be important for them to visit the study areas.

Thanks again, and I'll be in touch--

Signa

Signa Larralde
State Archaeologist
New Mexico State Office
Bureau of Land Management
1474 Rodeo Road
Santa Fe, NM 87505
phone 505 438-7637
fax 505 438-7426

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SolarMap_20

QUECHAN INDIAN TRIBE
Ft. Yuma Indian Reservation

P.O. Box 1899
Yuma, Arizona 85366-1899
Phone (760) 572-0213
Fax (760) 572-2102

September 3, 2009

Solar Energy PEIS
Argonne National Laboratory
9700 S Cass Avenue – EVS/900
Argonne, IL 60439

Re: Quechan Indian Tribe's Comments on Programmatic Environmental Impact Statement for Solar Energy Development

Dear Solar Energy PEIS Team,

Thank you for notifying us of the preparation of a Programmatic Environmental Impact Statement for the six southwestern states. Portions of BLM lands currently being analyzed for solar development fall within the traditional land area of the Quechan Indian Tribe. In addition, the Tribe has federal reserved rights in the waters of the Colorado River and is concerned about impairment of the quantity and quality of the water resources.

I. Cultural Resource Impacts

The Tribe's concerns regarding cultural resource protection and preservation must be taken into consideration by the United States. This is especially true when projects are proposed within the Tribe's traditional land area. In cases like this, where proposed projects are likely to affect cultural resources, the federal government has an obligation under existing resource protection laws, and pursuant to its trust obligation to the Tribe, to gather accurate information about the location of cultural resources so that it can make a fully informed decision, and then to adequately protect those cultural resources from harm.

The Quechan people and their ancestors have inhabited the area surrounding the confluence of the Colorado and Gila Rivers for centuries. The Indian Claims Commission found that the Quechan Tribe's historic lands extended well beyond the boundaries of the present day Fort Yuma Indian Reservation and includes certain lands to the north and west of the Fort Yuma Indian Reservation that fall within the solar energy study areas. *See* 8 Ind. Cl. Com. 111, 130 (Sept. 30, 1959).

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The Quechan Tribe, who was here prior to the arrival of the Spaniards or Europeans, had several villages scattered throughout what is now Arizona and California. The traditional land area of the Tribe encompasses the lands from Blythe, CA into Mexico and from Gila Bend, AZ to Ocotillo, CA. It is within this geographic area that resources were utilized and the Tribe lived. Plants, animals, landforms, water, and cultural resources must all be considered as they are all used together to tell the history of the Quechan Tribe.

The area is rich in cultural resources that could be impacted by large-scale solar development projects. BLM's 2008 Final Environmental Impact Statement for the Yuma Field Office Resource Management Plan noted that over 4,300 archaeological sites have already been documented within BLM's Yuma Field Office planning area (which overlaps in part with the solar planning area). See page 3-58 of the BLM FEIS. This is especially impressive given that only 16% of that planning area has been surveyed for cultural resources, according to BLM's FEIS. Thus, there could be tens of thousands of additional resources that exist in the area and a portion of these could be impacted or permanently destroyed by new solar development projects. This highlights the importance of comprehensive surveys for resources, and appropriate protection measures, prior to any authorization for new development.

Having participated in numerous discussions for proposed solar projects, the Quechan Tribal Council along with the Quechan Cultural Committee has become aware of some of the problems these projects present.

Long-term loss of vegetation, habitat, and soil are of concern due to the need for a level project area. The potential destruction of traditional plant gathering areas and clay sources located within the project areas is quite concerning to the Tribe. The potential for animals of traditional importance to the Tribe to leave the area due to loss of habitation is also concerning. The projects also could result in a visual blight on the landscape. Moreover, given the size and scope of these projects, a significant amount of land will be disturbed for construction and operation – resulting in significant potential for permanent loss of cultural resources that exist within the Tribe's traditional area.

Due to each solar project having the potential to encompass several thousand acres, we are requesting that the clustering of these projects be prohibited, and that the projects not be located within the Tribe's traditional area that is rich in cultural resources. We are also requesting that any large-scale, centralized solar projects be placed on lands that have already been heavily disturbed, such as abandoned farm land. As mentioned previously, the Tribe has a large traditional land area with an extensive network of cultural resources and Traditional Cultural Properties (TCPs) located within. With each project the Tribe faces the loss of their culture as impacts to cultural resources affiliated with the Tribe, as well as the spiritual landscapes in which they are located, are impacted.

The Tribe is not opposed to solar energy development in general. However, the Tribe would like to recommend that BLM and other federal agencies consider the use of local

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homes and buildings for the placement of solar panels. If each home, business and abandoned building were outfitted with solar panels, the need for large substations would be drastically reduced, thereby reducing the destruction of the Tribes' traditional homeland, the loss of animal habitat, and the need for water that is already at its capacity.

To alleviate the potential for impacts to cultural resources and/or spiritual landscapes we request to be consulted with at the inception of the project, prior to any plans being finalized. Experience has shown us that once the plans for a project are in place people are less open to discussing suggestions from us for mitigation. By contacting and consulting with the Tribe when the project is first proposed, it is our hope that we will be able to work through any potential concerns during the planning process.

II. Traditional Cultural Properties (TCPs) – Indian Pass

The Tribe is aware of numerous applications for solar development within or nearby the area known as Indian Pass, which is a Traditional Cultural Property area that is considered sacred to the Tribe. The Tribe opposes solar development in areas that have been identified as specific TCPs of the Tribe, such as Indian Pass.

The Indian Pass area is rich in cultural resources including a complex trail network, which includes the Xam Kwatcham trail that begins at Avikwame, in southern Nevada, and extends to Avikwalal, on the International Border. This trail is an integral part of the Tribes' creation story and contains both a physical and spiritual component. The surrounding area also includes significant cultural resources such as intaglio sites, desert pavement features, including cleared areas and rock alignments, and artifact scatters.

BLM must not allow the analysis in the programmatic impact statement to focus exclusively on archaeological site impacts, while failing to fully address impacts to resources such as cultural landscapes and TCPs. Cultural landscapes and TCPs, like Indian Pass, can not be piecemealed and need to be considered in their entirety. The focus should be on protection and preservation of the cultural significance of the area, not just its archaeological resources. It is also important to note that the introduction of any new element to this cultural landscape affects the significance of the property, which is why it is equally important to limit effects to the areas and not just to archaeological remains.

III. Water Resource Impacts

The Quechan Tribe's Fort Yuma Reservation was established at its current site in 1884, which gave the Tribe, under federal law, reserved rights to water in the Colorado River with a priority date of 1884. See *Arizona v. California I*, 376 U.S. 344 (1964); *Arizona v. California II*, 460 U.S. 605 (1983); *Arizona vs. California* (consolidated decree), 126 S. Ct. 1543 (2006). Pursuant to the 2006 Supreme Court decree, the Tribe has diversion rights of 71,616 acre-feet per year in California and diversion rights of 6,350 acre-feet per year in Arizona. These rights have a priority date of 1884.

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The federal government must not approve projects that lack adequate water rights or that will result in any impairment to the Tribe's reserved water rights. In addition, the Tribe is also concerned that the proposed large-scale utility solar projects will have negative impacts on the quality of water in the Lower Colorado River Basin. In reviewing the potential impacts to environmental and cultural resources, the cumulative impacts of the solar projects must be considered.

Thank you for your consideration to the Tribe's comments. I look forward to meeting with officials at the local BLM offices to discuss the Tribe's concerns in more detail. If you have any questions, please do not hesitate to call me at (760) 572-2423.

Sincerely,

Mike Jackson, Sr.
President, Quechan Indian Tribe

cc: Senator Dianne Feinstein
Ken Salazar, Secretary of the Interior
Rahm Emanuel, White House Chief of Staff
Valerie Hauser, Advisory Council on Historic Preservation
Nancy Brown, Advisory Council on Historic Preservation
James Peterson, Deputy State Director – Senator Dianne Feinstein
Charlotte Hunter, BLM California State Office
Rolla Queen, BLM California State Office
Michael Taylor, BLM Arizona Deputy State Director
Linda Resseguie, BLM Arizona State Office
Eddie Arreloa, BLM Arizona State Office
Vicki Wood, BLM El Centro Field Office Manager
Carrie Simmons, BLM El Centro Field Office
Chris Dalu, BLM Palm Springs/South Coast Field Office
Bridget Nash-Chrabascz, Quechan Historic Preservation Officer
Dave Singleton, Native American Heritage Commission
Frank Jozwiak, Quechan Indian Tribe Attorney

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Thank you for your comment

The comment tracking number that has been assigned to your comment is SolarM60214.

Comment Date: September 14, 2009 11:26:59AM
Solar Energy Development PEIS
Comment ID: SolarM60214

First Name: [Withheld by requestor]
Middle Initial:
Last Name: [Withheld by requestor]
Organization: Big Pine Paiute Tribe
Address: [Withheld by requestor]
Address 2:
Address 3:
City: [Withheld by requestor]
State: [Withheld by requestor]
Zip: [Withheld by requestor]
Country: [Withheld by requestor]
Email:
Privacy Preference: Withhold name and address from public record
Attachment: bppt_peis_scoping.pdf

Comment Submitted:

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From: Linda_Resseguie@blm.gov [mailto:Linda_Resseguie@blm.gov]
Sent: Tuesday, September 08, 2009 1:59 PM
To: Tom_Burke@blm.gov; Kathleen_Sprowl@blm.gov
Cc: Wescott, Konstance L.; rolla_queen@blm.gov
Subject: Telephone contact with Moapa Band of Paiutes

I received and returned a telephone call from Ian Zabarte, with the Moapa Band of Paiutes' Department of Environmental Protection (telephone number 702-865-2077). Mr. Zabarte had questions concerning the deadline for comments on the solar energy study areas and also about tribal consultation. I offered to put him in touch with someone who could meet with the tribe, but he indicated that the tribe would address the consultation issue in its comments.

Linda J. Resseguie
Realty Specialist WO - 350
202.912.7337; fax 202.452.7708

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September 11, 2009

Solar Energy PEIS
Argonne National Laboratory
9700 S. Cass Avenue--EVS/900
Argonne, IL 60439

Re: Solar Energy Study Area

To Whom It May Concern:

I am writing on behalf of the Native American Land Conservancy (NALC) regarding the designation of solar energy zones in the Mojave and Sonoran Deserts.

The NALC is an intertribal organization, with project affiliations with tribal communities in San Diego, Riverside, San Bernardino, and Imperial counties, as well as with tribal communities in Arizona, Nevada, and Utah. The NALC is a 501c(3) organization established in 1998 to promote the protective management of Native American cultural sites, areas, and resources throughout the traditional aboriginal territories of our member-tribes. The NALC also works to promote understanding and cooperation between our member-tribes and state, federal, and private sector groups, organizations, and agencies. We would like to take this opportunity to offer our comments regarding the potential impact solar development will have on culturally-significant landscapes in the region of interest.

We would first like to commend you both for the diligence and detail represented in the information provided about the solar energy zones. We would also like to make clear our support for the development of appropriate alternative energy resources. At the same time, we have grave concerns about the impacts the development of solar energy will have on culturally significant landscapes. Our concerns, discussed below, include: (1) the nature of the consultation process, (2) the impact of solar development on cultural landscapes, and (3) recommended action steps

The Consultation Process

> If an area is destroyed, marred, or polluted, my people say, the spirits will leave the area. If pollution continues not only animals, birds, and plant life will disappear, but the spirits will also leave. This is one of the greatest concerns of Indian people.[i]

Our first concern with the consultation process is the manner in which tribal communities with a concern for impacts in their aboriginal territories were brought into the process. Native American governments and organizations have long made the point that it is vitally important to engage them in the front-end of the process. In this case it would include, but not be limited to, engaging the tribes in the initial analysis that sets forth the guidelines for identifying solar energy study areas. Unlike other groups or organizations, tribal communities have a conception of the

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landscape that includes a unique evaluative framework based on historically-based understandings of the value and meaning of these sites, areas, and resources. The tribes also enjoy a government-to-government relationship with the United States that underscores the importance of early and frequent engagement of the tribes in a process of this magnitude.

It is crucial that this evaluative framework and these relations be represented in the initial, conceptual stages of development, particularly where a project will have a deleterious impact on the place-based identity of Native American communities. Instead, tribal communities are faced with a situation where they must respond to and select from—and thereby legitimate—alternatives and their embedded evaluative assumptions, principles, and guidelines that marginalize cultural values placed at-risk by the proposed solar projects. Broadly speaking, the effect is to impose a specific definition of reality on the tribal community and to structure the situation so as to limit their cultural and political autonomy. While it can be debated whether engaging the tribes at this level in the initial stages of development is, in the strictest sense, required by state or federal law, failure to do so will, at the very least, compromise the ethical and intellectual integrity and legitimacy of the consultation process.

This process of marginalization leads to our second, and related, concern for the consultation process. Embedded in the consultation is a predisposition to a scientific framework of evaluation grounded in an ontology that relies on a mechanical, push-pull conception of causation. Landscapes understood against this ontic background are conceived as de-totalized, utilitarian, rationalized, and economically useful, and often are characterized in terms of desanctified surface or volume set apart from people, myth, and history; that is, something of instrumental value to be controlled and used.

This hierarchized, formal scientific discourse and its dream of *mathesis universalis* is understandable, and is the typical evaluative framework deployed by land management agencies. However, this has the effect of altogether marginalizing the indigenous conception of the landscape that is sanctified and animistic, ritualized, mythic, totalized, symbolic, and historical, that engages a multilayered, supersensible, as well as serial causation common to indigenous cultures such as the Chemehuevi Indians. The remarks of Dr. Richard Stoffle, working with the Southern Paiute people of the Grand Canyon portion of the Colorado River, are germane this issue in the solar energy study zone. Dr. Stoffle discusses the "great variety of storyscapes that crisscross the landscape of American Indian holy lands," including the Mojave and Sonoran Deserts. Many of these storyscapes involve a "time before today's humans existed, what some would call a mythic time." He emphasizes that the term "mythic" implies only another time before the present time but "it certainly does not imply that either that time or the stories were fictitious."[ii]

While objective in its own terms, the scientific mode of inquiry at best marginalizes, subordinates, or provincializes the indigenous lifeworld and, at worst, altogether excludes the indigenous concept of landscapes and the impacts development on them. Facts—whether we speaking of the physical world of nature or the mental world of belief—are socially constructed. What matters is how the various, relative are truths are understood and treated in relation to each other. Each way of knowledge is relative to how it accords to a theoretical correspondence

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which, in turn, is based on presuppositions that trace to deeply-held cultural beliefs, what the Native American writer posed as the metaphysical backdrop of truth. While this may seem to be an abstruse philosophical argument, it is very real in terms of the potential impact on traditional cultural sites, areas, resources, and landscapes—and the aboriginal lifeworld—in the region of interest. More generally, the consultation process—in its structure, process, and content—ignores any of these concerns as outside the limits of the law and beyond the borders of scientific mode of inquiry. More specifically, the impact on the StoryScape of the Salt Song trail and other cultural properties in the study area, the subject of our second concern with the proposed projects.

Impact of Solar Development on Cultural Landscapes

> This is what makes the Salt Song—gives it its power—because it goes from station to station to station drawing the power of the land and bringing it back. (Larry Eddy, Chemehuevi elder and Salt Song leader)

The significance of storied-landscapes of *Tiwiinyarivipi* includes Salt Song trail sites in the solar study area, anddocumented in tribal oral histories and by historians and anthropologists including Robert Manners, Isabel T. Kelly, and Carobeth Laird. These landscapes and Salt Song trails are associated with the healing agency of power-giving dreams, shamanic animal-familiars, as well as songs that describe the personal and the natural and supernatural landscape in a multi-dimensional reality that Salt Song singers say enable them to fly from place to place.

The Salt Songs remain an important part of the cosmology of these indigenous cultures. Vivienne Jake, a Kaibab Paiute elder, described how the songs talk about the upper world. The Mohave Indian elder Llewellyn Barrackman said these creation songs came from Spirit Mountain and serve as a map of their sacred territory. Matthew Leivas, a Chemehuevi traditionalist and tribal elder and Board Member of the Native American Land Conservancy, stated that the Salt Songs tell about the different sacred sites on the thousand-mile journey and explain the whole history of his people and the connections they have with the elements. Mr. Leivas has also spoken about how the Salt Songs have volition and a life all their own and live in certain caves along the Salt Song trail, as well as traveling throughout Chemehuevi territory.

One of the issues that remains to be addressed is the nature, extent, and consequences of solar energy development on these Salt Song trail sites. This is not only a question of mapping the sites but, as discussed in the previous section, how the sites and the trail are signified by way of scientific versus a discursive field that legitimates, rather than marginalizing, indigenous beliefs. It is difficult to imagine how a public agency, charged with assessing the impacts of development on Salt Song trail sites would respond to the following comments of Chemehuevi elder Larry Eddy:

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> The Indian doctor, he has, as a spirit, he has an animal friend. And nobody sees that animal but him. He calls to that animal through his Songs. He can do this, sing and sing, and when that animal arrives, he knows that he's going to save that person. Until that animal gets there, he doesn't really put on his power. That's hard to express or understand or hard to....He'd sing and sing until the red hawk eagle got there or whatever....They called and they called and that helper wherever he was he heard that Song he could hear it for miles and he heads in direction to that doctor. When he gets there, then the doctor knows, well, I'm going to save this guy....
>
> It was all done in his Songs. He sang his Songs and his Songs were a beckoning to his familiar, whatever it may have been or whatever it was, and [his familiar] could come out from the mountain or from the valley or wherever he was at, he would come down to this doctor singing there and play around there. He'd play around the sick person and do this and do that and that may have been the healing process he's playing around there, playing around, and every now and then he'd jump towards or come towards the doctor and the doctor would sit there and watch him like he's nothing, like he's not paying attention. But as soon as he got close enough the doctor would grab him. And once he had his familiar in his hand or by him and captured him this is when that healing power would be transferred to him, to the doctor, to the patient. That's how they healed. They healed their sick person or ailing person. That's how they did it.

The issue takes another form in the potential impacts on traditional cultural sites such as those associated with Iron Mountain and the Chocolate Mountains. The archaeological importance of these sites has been well-documented by Catherine Fowler, among others. What is less well understood is the marginalizing effect the conventional concept of "mapping" has on the cultural legitimacy and meaning of this information. It is fair to describe the meaning of these locations as found in both the sites, themselves, and in the relationship between different sites in a give cultural ethnoscape. It is certainly important to protect the values inherent in these sites, but it is also important to understand—and to act on the understanding—that there is an important, sacred relationship between the sites that also gives them their sanctified meaning. Once again, the difficulty is in part how the situation is conceived and the pre-assumptions that go into this conception. With this in mind, we would like to recommend a number of steps we believe must be taken to take up and address the issues raised in this letter.

Recommended Action Steps

> It is in the balancing of human values that we make healthy communities, that we find justice. Perhaps if [the United States] can begin making justice here in your nation sitting upon our many nations, you may also begin to envision how to honor others' values, make peace and see unity in the world....You have our earnest prayers.[iii] (Mary Clearing-Sky)

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Given the dimensions and multilayered complexity of the issue of the impacts of solar energy on the Native American sacred sites, areas, resources, and landscapes, we would like to recommend the following steps be taken before the EIS is finalized:

1. The agencies involved in the development of the solar energy study area re-convene a meeting with the affected tribes to assess and review through a series of Listening Sessions, the framework for assessing the impacts on cultural sites, areas, resources, and landscapes.

2. The agencies involved participate in a series of meetings with leaders of the Salt Song tradition to reach a better understanding of the values placed at-risk by the development of solar farms in the Salt Song trail ethnoscape.

We believe these two straightforward action steps would provide a major contribution not only for the this issue, but for other matters that might impact the Native communities in the eastern Mojave Desert. The Native American Land Conservancy is prepared to help in any appropriate way to bring together a better understanding on this matter in the hopes of coming to a solution that is fair to the values and beliefs of all the parties involved.

Respectfully yours,

Kurt W. Russo, Ph.D.
Executive Director
Native American Land Conservancy

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K,Tilley illustrated the "major differences between a 'scientific' or abstract As Thomas Greider and Lorraine Garkovich put it, "meaning is not inherent in the nature of things."[iv] Instead, the meaning of the landscape is produced and reproduced through the process of negotiation and symbolic interactionism in a cultural context.

Conclusion Mary Clearing Sky

Tiwiinyarivipi

Mapping the land

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[i] (Chief) John Snow, *These Mountains Are Our Sacred Places* (Toronto: Samuel-Stevens, 1977), 145.

[ii] Richard W. Stoffle, David B. Halmo, Diane E. Austin, "Cultural landscapes and traditional cultural properties: A Southern Paiute view of the Grand Canyon and Colorado River," *American Indian Quarterly* Vol. 21, Iss.2 (Spring 1997), 232.

[iii] Mary Clearing Sky, "Tallying up for Reparations: Asking for New Promises?" In *Reparations: Repairing the Psychological Harm* (Washington, DC: Office of Ethnic Minority Affairs, 2005), xii-xiv.

[iv] Thomas Greider and Lorraine Garkovich, "Landscapes: The Social Construction of Nature and the Environment," *Rural Sociology* Vol. 59, No. 1 (1994), 2.

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September 14, 2009

NATIONAL TRUST FOR HISTORIC PRESERVATION

VIA ELECTRONIC SUBMISSION
(http://solareis.anl.gov/involve/comments/index.cfm)

Solar Energy PEIS
Argonne National Laboratory
9700 S. Cass Avenue
EVS/900
Argonne, IL 60439

Re: Scoping Comments on the Solar Energy Study Areas and the Solar Energy Programmatic Environmental Impact Statement

To Whom It May Concern:

The National Trust for Historic Preservation (National Trust) commends the efforts of the Bureau of Land Management (BLM) to identify the most appropriate areas for solar energy development while limiting impacts to significant cultural resources. We feel strongly that by incorporating the results of tribal consultation and previous cultural resources inventories into the development of the solar Programmatic Environmental Impact Statement (PEIS) and the specific Solar Energy Study Areas (SESAs), BLM can facilitate efficient and cost-effective renewable energy development while protecting the invaluable, significant cultural resources that are present on America's federal public lands. At the same time, we believe that efficiency and reduction of energy use at private and public scales should be a focus of current and future energy planning. Rather than simply producing and transmitting more energy, we should simultaneously work to reduce our energy needs.

In general, the National Trust supports BLM's development of the PEIS and identification of the specific SESAs. Specifically, we strongly applaud BLM's decision to exclude all units of the National Landscape Conservation System (NLCS) and other areas that contain significant cultural resources. However, we recommend that BLM define two key terms used in the Federal Register notice for the SESAs. We also recommend that BLM evaluate whether several specific resources should be excluded from the SESAs and, if not, whether BLM needs to develop site-specific avoidance or mitigation measures to ensure that solar energy development does not adversely affect those resources.

Interests of the National Trust

The National Trust is a private charitable, educational, non-profit corporation chartered by Congress in 1949 to protect and defend America's historic resources, to further the historic preservation policy of the United States and to facilitate public participation in the preservation of our nation's heritage. *See* 16 U.S.C. §§ 461, 468. With the strong support of 235,000 members nationwide, the National Trust works to bring people together to protect, enhance and enjoy the places that matter to them. By saving the places where great moments from history – and the important moments of everyday life – took place, the National Trust helps revitalize neighborhoods and communities, spark economic development, promote environmental sustainability and protect public lands. The National Trust, which is headquartered in Washington, D.C., has nine regional and field offices, 29 historic sites and partner organizations in all 50 states.

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I. In the PEIS, BLM should define two key terms from the Federal Register notice for the SESAs.

The National Trust commends BLM on identifying "sensitive resource areas" to be excluded from solar energy development, including all units of the National Landscape Conservation System, "Areas of known Tribal concern" and "Areas of known high cultural site density." *See* Notice of Availability of Maps and Additional Public Scoping for Programmatic Environmental Impact Statement To Develop and Implement Agency-Specific Programs for Solar Energy Development; Bureau of Land Management Approach for Processing Existing and Future Solar Applications, 74 Fed. Reg. 31,307, 31,308 (June 30, 2009). However, the National Trust feels that BLM should clearly define the latter two terms in the PEIS to ensure consistent usage and application.

II. BLM should ensure that SESAs do not adversely affect internal or adjacent significant cultural resources.

BLM should clarify whether any "sensitive resource areas" are located within the external boundaries of SESAs or whether SESAs were chosen because they did not intersect with any sensitive resource areas. If SESAs do surround excluded sensitive resource areas, BLM must ensure that those resources are adequately buffered from visual and other indirect impacts from solar energy development. Even if SESAs do not surround sensitive resource areas, SESAs may have the potential to visually and otherwise indirectly impact significant cultural resources that are located outside but adjacent to SESAs. Units of the NLCS contain many of the most stunning and awe-inspiring vistas within the United States. Long views uncluttered by modern human constructions are an essential aspect of the experiences sought by visitors to these federal public lands, and the views and visitors' experiences of them must be protected in order to maintain the integrity of NLCS units.

Therefore, for example, protecting the ruts, swales, buildings, inscriptions and other artifacts directly associated with national historic trails is not enough to preserve the suite of historic and cultural resources that make national historic trails significant. Rather, preserving whole settings and viewsheds of national historic trails—and other units of the NLCS—is vital for enabling visitors to have authentic and high quality experiences of the historic events for which the cultural resources are purportedly preserved. In the National Trails System Act, as amended, "high potential historic sites and high potential route segments" are recognized as the very best sections of national scenic and historic trails that retain the highest historical and cultural integrity. The physical manifestations and viewsheds of these segments, at least, should be completely preserved. Similarly, BLM must thoroughly consider and work to avoid adverse impacts to sacred landscapes that are significant to tribes. As with national historic trails, the significance of these landscapes and of Native American traditional cultural properties goes far beyond their constituent features and artifacts; viewsheds and settings must be uninterrupted by modern constructions in order to maintain the sacred integrity of the landscapes.

BLM also should recognize that many significant cultural sites exist at low densities, and historic trails that are not part of the National Trails System (e.g., the Ehrenberg Road and the Phoenix Stage Road in western Arizona) may cross one or more SESAs. Adverse effects to these regionally important historic resources also should be avoided whenever possible even if the resources do not technically fall within any of the sensitive resource area categories. In addition, BLM should take steps to ensure that sensitive resource areas are not directly or indirectly impacted by construction roads and transmission lines.

III. BLM should compile complete records of all known cultural resources located within the SESAs.

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All data available for cultural resources (e.g., location, temporal affiliation, condition, significance) should be gathered for each of the SESAs and incorporated into a single geographic information system database as part of the evaluation of SESA efficacy. Compiling information into one location will enable BLM to consistently identify which portions of SESAs have already been thoroughly inventoried and which have not. Then the latter locations should be inventoried for cultural resources, at least at a Class II sampling level. Furthermore, thorough tribal consultation should be performed for each of the SESAs as part of their evaluation, even if consultation has been done in nearby areas in the past. Knowing what cultural resources are present in SESAs, at least at a broad landscape level, will help to streamline solar energy development within them while assuring that impacts to significant resources and landscapes are avoided. A similar approach should be taken for areas outside SESAs that are likely to be developed for solar energy production, with developers directed towards locations that have already been inventoried for cultural resources and that contain few or no significant resources.

IV. BLM should evaluate whether to exclude additional cultural resources from SESAs and whether site-specific measures are necessary to avoid or mitigate adverse effects on cultural resources.

Potential impacts to all cultural resources—including prehistoric, historic and traditional sacred and cultural properties—located within SESAs and in proposed solar project areas outside SESAs should be considered in the NEPA and NHPA processes. In addition, we believe that BLM should evaluate whether the cultural resources mentioned below should be excluded from the SESAs in light of their significance and whether BLM should include site-specific measures in the PEIS in order to avoid or mitigate the potential adverse effects of solar energy development on those resources. For example, BLM has not yet defined management boundaries or areas around national scenic and historic trails, except in Wyoming. In that case, during oil and gas development, BLM defined a one-half mile wide special management corridor along the four National Historic Trails that cross the state. BLM severely limited energy development within the trails corridors and required stringent mitigation of visual and other impacts in areas along the trails outside the corridor. We recommend that BLM develop similar protections for trails and other visually sensitive resource areas in the face of solar energy development.

A. Arizona

The three SESAs in Arizona appear to have been well chosen in regard to archaeological sites, as they consist largely of previously disturbed lands. However, some Native American tribes have already expressed concern about impacts of the SESAs on sacred landscapes. Thus, BLM should thoroughly consult with concerned tribes to resolve potential conflicts now. In addition, many nationally and regionally significant historic trails cross the state and could be directly or indirectly impacted by solar energy development both within and outside the SESAs. Of particular concern are trails located in open areas of southwestern Arizona, including the Juan Bautista de Anza National Historic Trail (NHT), El Camino del Diablo, the Ehrenberg Road and the Phoenix Stage Roads. The latter two, in particular, appear to be located close to the Brenda and Gillespie SESAs. While the Federal Register notice states that BLM excluded national trails from the SESAs, BLM must still consider any visual and other types of indirect impacts, such as from increased public access during project construction, that solar energy development may have on the trails. To that end, BLM should develop stipulations for avoiding or mitigating indirect impacts to trails during solar energy development.

Comment [a1]: Which tribes? We should mention them by name.

B. California

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The National Trust is concerned specifically with potential adverse effects to cultural resources within the Riverside East SESA. This area partially overlaps with the boundaries of historic Camp Rice, part of the World War II (WWII) Desert Training Center/ California–Arizona Maneuver Area that has been recommended eligible for the National Register of Historic Places (National Register). Camp Rice is part of an interconnected landscape of similar WWII camp sites in southern California and Arizona and is highly significant both for its association with General Patton and for its contribution to our understanding of how American soldiers were trained during WWII. Still visible at Camp Rice are roads and walkways lined with large pieces of basalt. BLM should modify the boundary of the Riverside East SESA to exclude Camp Rice and other sites within this important WWII cultural landscape.

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C. Colorado

The National Trust is concerned about potential adverse effects to cultural resources located within the De Tilla Gulch and Fourmile East SESAs. Both contain rare Paleoindian archaeological sites whose eligibility for the National Register has generally not yet been determined. Because of Paleoindian sites' potential significance, BLM should develop specific mitigation measures to resolve adverse effects to them. Finally, the National Trust requests that BLM take a close look at the potential of the Fourmile East SESA to directly or indirectly affect the Old Spanish National Historic Trail and adjust the boundaries of the SESA to avoid any negative effects.

D. Nevada

The National Trust is concerned about potential adverse effects to prehistoric cultural resources in the Delamar Valley SESA. Two significant and large rock art sites in this SESA are "The Gathering," located along the Alamo Road off Hwy. 93 and "Rattlesnake Road," located approximately 2.5 miles farther east on the Alamo Road. Because the sites are located adjacent to the road, increased construction traffic could lead to increased visitation and inadvertent or purposeful damage by visitors. In addition, the National Trust requests that BLM take a close look at the potential of the Dry Lake SESA to directly or indirectly affect the Old Spanish National Historic Trail and adjust the boundaries of the SESA to avoid any such effects.

E. New Mexico

The National Trust has no specific concerns about cultural resources located within or near the proposed SESAs in New Mexico.

F. Utah

The National Trust requests that BLM take a close look at the potential of the Escalante Valley, Milford Flats South and Wah Wah Valley SESAs to directly or indirectly impact the Old Spanish NHT and adjust the boundaries of the SESAs to avoid negative impacts to the trail.

IV. Conclusion

While planning for solar energy development on federal public lands, BLM must prioritize the protection of outstanding historic and cultural resources, including significant concentrations of prehistoric and historic archaeological sites, historic trails and Native American traditional cultural properties and sacred sites. Accordingly, BLM should thoroughly evaluate the potential direct and indirect impacts of solar energy development on cultural resources both within and outside SESAs. Definition of the terms "Areas of known Tribal concern" and "Areas of known high cultural site density" will facilitate consistent avoidance of impacts to significant cultural areas, although significant resources are likely found outside those areas. Additionally, compilation of known data into a single GIS system will help BLM to identify and then inventory areas within SESAs whose cultural resources are not yet known. Thorough consultation with tribes, State Historic Preservation Officers, local communities and other interested parties will support this effort. Then, BLM should consult with the above parties to develop measures to avoid or, less ideally, minimize or mitigate adverse effects of solar energy development on significant historic and cultural resources.

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Please include the National Trust on all announcements, as well as all notifications associated with the PEIS process. We appreciate the opportunity to provide these comments and we look forward to participating further in this process.

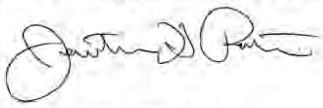
Sincerely,



Anthea Hartig, Director
Western Office, National Trust for Historic Preservation



Barbara Pahl, Director
Public Lands Program and Mountains/Plains Office, National Trust for Historic Preservation



Jonathan Poston, Director
Southwest Office, National Trust for Historic Preservation

Cc: Nancy Brown, Advisory Council on Historic Preservation
Dr. Robin L. Burgess, Federal Preservation Officer
Carol Griffith, Arizona State Historic Preservation Officer
Milford Wayne Donaldson FAIA, California State Historic Preservation Officer
Edward Nichols, Colorado State Historic Preservation Officer
Alice Baldrica, Nevada State Historic Preservation Officer
Jan Biella, Acting New Mexico State Historic Preservation Officer
Wilson Martin, Utah State Historic Preservation Officer

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BIG PINE PAIUTE TRIBE OF THE OWENS VALLEY
Environmental Department
Big Pine Indian Reservation

September 14, 2009

Solar Energy PEIS
Argonne National Laboratory
9700 S. Cass Avenue
EVS/900
Argonne, IL 60439

Dear Preparers,

Subject: Comments on Solar Energy Development Programmatic EIS

The Big Pine Paiute Tribe of the Owens Valley (Tribe) is a federally recognized Tribe located in Owens Valley, California. The Tribe is committed to the preservation of American Indian cultural resources, religious practices, and sacred lands as well as the responsible stewardship of natural resources. Thank you for the opportunity to provide comments during this scoping process for the Solar Energy Programmatic Environmental Impact Statement concerning BLM lands in six southwestern states.

Tribal Consultation Process

A notice was released in the Federal Register on June 30, 2009. The Tribe's first formal notice was via letter received from the BLM California Desert District Manager, dated July 1, 2009. The Tribe requests a copy of the Draft EIS as soon as it is released.

Comments on Scoping Maps

The Tribe encourages the BLM to focus evaluations for possible solar development on lands recently disturbed and to avoid lands showing no evidence of recent disturbance. Although it was difficult to discern (from the documentation provided) the exact criteria used for identifying lands for further study, the level of previous disturbance does not appear to be a criterion, and this is unfortunate. Known restrictions (e.g. designated wilderness or critical habitat for an endangered species) were used to lower the land's suitability or even omit it from further consideration, but it appears an assumption was made along these lines: If the details of a particular resource on a given area of land are unknown, then we assume there may *not* be any noteworthy or valuable resources. In reality, the reverse should be the rationale. If there is no known history of disturbance for an area, then it should be presumed intact and the goal should be to preserve it intact. For BLM lands, therefore, recently disturbed areas not of historic significance, such as mined sites, abandoned farm fields, rail yards, towns, or airfields (etc.) should be given higher priority for development than undisturbed areas. If it is learned that BLM lands are generally minimally disturbed or undisturbed, then BLM lands are probably not the

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priority desert lands for further study for solar development. Certainly, disturbed desert lands do exist, they simply may be on private or other lands (e.g. military).

One BLM Planning Criterion states, "**Environmental protection and energy production** are both desirable and necessary objectives of sound land management practices and are not to be considered mutually exclusive priorities" (quoted from http://solareis.anl.gov/eis/rmps/index.cfm). The statement is problematic, because it can invoke many interpretations, some undesirable and unnecessary. The Tribe and many in the public have trusted the Federal Government with protecting our public lands for the long term and not leasing them to private, for-profit corporations for activities that, while perhaps beneficial to the public in some ways over the relative short term, actually degrade landscapes and resources for hundreds to thousands of years. By protecting the environment, the BLM protects the ability of the natural landscape to provide goods and services to the earth and all living organisms. With global climate change, our reliance on those goods and services is likely to increase. The Tribe feels protection of most all public lands should be a higher priority.

The information provided during the scoping process for this PEIS gives the misleading impression that the lands presented in the maps are the complete extents of lands to be considered for solar development in the six-state area. However, it is known that other areas are currently being studied or have been studied and are further along in the process to construct solar power facilities. For example, a site known as Ivanpah, has been evaluated, but it does not appear on the maps for this PEIS. It is unclear whether new sites, not highlighted in these maps, may be considered for evaluation at a later date. Either everything should be included in this PEIS, or a long, clear description of what is and isn't included, and why, should be presented. This is important for the public to understand the implications of full solar development on BLM desert lands, thus the extent of potential cumulative impacts.

The areas shown on the map for this PEIS are generally located outside the areas considered our Tribal homelands. It is our understanding that all Native Americans throughout the regions presented on the maps will provide specific knowledge on cultural resources to be considered. Even though the maps do not include our region, an important issue in our area has been export of water to fuel distant economies and energy generation. Taking resources from one area to develop resources in another should be avoided. It is imperative that availability of sufficient water resources is evaluated very early in the process. In addition, access to and the availability of any and all other necessary resources beyond insolation and transmission lines should be considered and any impacts associated with use of water and other resources for future solar facilities should be thoroughly evaluated. It is probable that many of the lands identified on the current maps need to be removed due to lack of feasible water supply or for other resource limitations.

The PEIS should make it clear that second tier/ site specific cultural and environmental analyses will still need to be intense once specific areas are identified for further study. The PEIS provides an overview, and not necessarily many details; the details deserve systematic scrutiny and evaluation.

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General Comments

If utility-scale solar is developed on BLM lands throughout the west, there will be impacts. Priorities should be first to avoid as many adverse impacts as possible. Secondly, resource impacts should be minimized if they are deemed necessary and steps should be taken as soon as possible to restore areas and ameliorate impacts. Finally, if sites cannot be fully restored, plans should be in place to compensate for the lost resources, goods, services, and values. The Tribe recommends a fund for mitigation be established for each developed site, and that considerable thought be given to the long-term and currently unquantifiable impacts such development will cause.

The PEIS should perform a thorough evaluation of royalties. Here, a royalty should be defined as the share of the profit paid to the grantor. Because the grantor for public (BLM) lands is the public, decide which public most deserves royalties. It could easily be argued that Native Americans who used resources on these lands long before solar development was anticipated should be the first to be considered for royalty agreements. Many Tribes throughout the desert region are now recognized as sovereign nations.

Sincerely,

Virgil Moose
Tribal Chairperson

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DOCUMENTATION OF TRIBAL CONTACT

Date of Call/Meeting: September 17, 2009

Type of Meeting: Field trip—one topic covered regarded Solar PEIS Study Area in Amargosa Valley

Follow-up:

1. **Call from Tribe:** _____
2. **Call to Tribe:** _____
3. **Face-to-face meeting with tribal representative:** Field visit in Amargosa Valley

Tribe: (include individuals' names and roles)

Barbara Durham, THPO for the Timbisha Shoshone Tribe

BLM: Kathleen Sprowl, BLM Pahrump F.O./RECO archaeologist

Major points raised in discussion:

During a field trip to visit sites within the Pahrump Field Office territory, Ms. Durham was asked if the Timbisha had any formal comments that they would like passed on to the planners of the Solar PEIS regarding tribal concerns. She said the main four concerns for the Amargosa study area are for water use, effects to the vegetation and the animals in the area, and any visual changes to the landscape.

Follow-up needed: None

Copies of this documentation sent to:

Email to: Barbara Durham
Tom Burke (BLM State Office)

Name of recorder: Kathleen Sprowl

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From: Linda_Resseguie@blm.gov [mailto:Linda_Resseguie@blm.gov]
Sent: Thursday, September 17, 2009 11:50 AM
To: Michael_D_Johnson@blm.gov
Cc: rolla_queen@blm.gov; Wescott, Konstance L.
Subject: Telephone Conversation with Albert Tinhorn, Chilchinbeto Chapter, Navajo Nation

I wanted to confirm that Mr. Albert Tinhorn, Community Services Coordinator, for the Chilchinbeto Chapter of the Navajo Nation called today to acknowledge receipt of our August 28, 2009, letter on the solar energy study areas. (I am assuming that this letter went out as part of Rolla's follow-up correspondence to tribes and chapters who did not pick up their certified copies of the original July notification letter.) Mr. Tinhorn's main message was that the solar energy study areas proposed were not located near the Chapter's interests. He did comment that "green friendly"
renewable resource development that preserved the natural environment was culturally relevant to Navajo's and consistent with the Tribe's four sacred elements. The Chapter does not want further information on the Solar PEIS or study areas at this time as they are exceedingly busy with local projects.

Linda J. Resseguie
Realty Specialist WO - 350
202.912.7337; fax 202.452.7708

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Gordon Yellowman<gyellowman@c-a-tribes.org>

To
"'dan_haas@blm.gov'"<dan_haas@blm.gov>
10/07/2009 09:53 AM

cc

Subject
consulting party

Dan, please consider this as a notice to participate as a consulting and cooperating party of interest with the Bureau of Land Management and the Department of Energy (DOE) on the joint Programmatic Environmental Impact Statement for Solar Energy Development (PEIS) in the southwestern states.
Gordon Yellowman

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From: Javier Loera
To: Verhaaren, Bruce T.
Subject: RE: Solar Energy PEIS
Date: Tuesday, February 23, 2010 3:09:11 PM

CR CA610-09-01/8100 (CA610.25)

Steven J. Borchard
California Desert Manager
United States Department of the Interior
Bureau of Land Management
California Desert District
22835 Calle San Juan de los Lagos
Riverside, CA 92553

Dear Mr. Borchard:

This letter is in response to the correspondence received in our office in the summer of 2008. I am sorry that it has taken this long for our response, our previous NAGPRA representative must have misplaced it somewhere. In your letter you provide the Ysleta del Sur Pueblo the opportunity to comment on the proposed solar energy study areas being analyzed as part of the Programmatic Environmental Impact Statement for Solar Development (PEIS), being prepared jointly by the Bureau of Land Management and the U.S. Department of Energy.

While we do not have any comments on this impending proposed study and believe that this project will not adversely affect traditional, religious or culturally significant sites of our Pueblo and have no opposition to it: we would like to request consultation should any human remains or artifacts unearthed during this project be determined to fall under Native American Graves Protection And Repatriation Act guidelines. Copies of our Pueblo's Cultural Affiliation Position Paper and Consultation Policy are available upon request.

Thank you for allowing us the opportunity to comment on the proposed project.

Sincerely,

Javier Loera
War Captain/Tribal Historic and Preservation Officer
Ysleta del Sur Pueblo
119 S. Old Pueblo Rd.
P.O. Box 17579
El Paso, Texas 79917
Phone: (915) 859-8053
Fax: (915) 859-4252
E-mail: jloera@ydsp-nsn.gov

From: Verhaaren, Bruce T. [mailto:brucev@anl.gov]
Sent: Monday, February 22, 2010 4:45 PM
To: Javier Loera
Subject: Solar Energy PEIS

Dear Mr. Loera:

This is to follow up on your recent telephone conversation with Ellen Moret of Argonne National Laboratory, who was calling on behalf of the Bureau of Land Management.

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Last July the Bureau of Land Management's California Desert District Office sent a letter to Governor Paiz seeking his views and comments regarding proposed solar energy study areas being analyzed as part of the Programmatic Environmental Impact Statement for Solar Energy Development (PEIS). The PEIS is being prepared jointly by the Bureau of Land Management and the U.S. Department of Energy.

Since it is possible that he may not have received that letter, dated July 1, 2009, I have attached a facsimile copy.

A draft of the PEIS is currently being prepared and the solar energy study areas are still in the process of being analyzed. Any views or comments the Ysleta del Sur Pueblo may wish to provide continue to be welcome as outlined in the attached letter.

We regret that the letter has not reached you in a timely manner. We value your input and will provide additional information as the project progresses.

Sincerely,

Bruce Verhaaren, Ph.D.
Environmental Science Division
Argonne National Laboratory
bverhaaren@anl.gov
630.252.3240

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From: Borchardt, Jeanine (IHS/PHX)
To: Verhaaren, Bruce T.
Cc: antha007@yahoo.com; SmellyE@q.com; lomeli20034@aol.com; Corrina Bow; cbcletom@q.com; Rollo, Gayle (IHS/PHX); Robb, Gaylord (IHS/PHX)
Subject: RE: Blocked Paiute Website
Date: Tuesday, March 02, 2010 4:39:15 PM

Dear Mr. Verhaaren,

I am requesting more information regarding your project or at the least have the BLM contact me ASAP.

Jeanine Borchardt
Chairwoman

Paiute Indian Tribe of Utah
440 North Paiute Drive
Cedar City, Utah 84721
(435) 586-1112 ext. 102 Fax (435)867-2659
jeanine.borchardt@ihs.gov
www.utahpaiutes.org

From: Verhaaren, Bruce T. [mailto:brucev@anl.gov]
Sent: Tuesday, March 02, 2010 11:39 AM
To: Borchardt, Jeanine (IHS/PHX)
Subject: Blocked Paiute Website

Dear Ms. Borchardt:

I am a researcher at Argonne National Laboratory working with the BLM to produce the Solar Energy Programmatic EIS. The BLM sent a letter to Chairperson Lora Tom introducing the project and providing maps of proposed Solar Energy Study Areas near Cedar City. We would like to ensure that you have that information. If not, we would be glad to provide it, either in hard copy or by e-mail.

Would it be appropriate to provide this information to the leaders of the individual bands that make up the Paiute Indian Tribe of Utah as well? If so, could you provide us with contact information?

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I tried to get that information from your website, http://www.utahpaiutes.org/, but found it was blocked by our cyber security department, because there was evidence of malware having compromised the site. I am attaching their message for your consideration. You may wish to have this checked.

Thank you

Bruce Verhaaren
Environmental Science Division
Argonne National Laboratory
Argonne, IL

630 252-3240

-----Original Message-----
From: rackow@anl.gov [mailto:rackow@anl.gov]
Sent: Tuesday, March 02, 2010 11:54 AM
To: Verhaaren, Bruce T.
Cc: 'cyber@anl.gov'; Huttenga, Andy A.; Wescott, Konstance L.; Rackow, Eugene A.
Subject: Re: Blocked Site

According to multiple info sources that we have, this site has been rather heavily compormised with malware that redirects people to various exploits kits.
This appears to have started in early 2009 and still remains as of Jan 27, 2010.

An example of the report is:
http://www.mywot.com/en/scorecard/utahpaiutes.org

Are you sure this is the site you need to be going to?
Is there someone that can confirm whatever problems they had on the sytem has been cleaned up? I'd rather not expose the lab to a site that multiple services claim to be malicious.

"Verhaaren, Bruce T." made the following keystrokes:
>--_000_53A26D9080464E46A38E98BDF7C99AB00112A19DF50ZZYanlgov_
>Content-Type: text/plain; charset="us-ascii"
>Content-Transfer-Encoding: quoted-printable > >Argonne appears to have blocked http://www.utahpaiutes.org/ > >I would like to gain access to this site if possible. It is needed as part= > of our research for the Solar Energy Programmatic EIS project being conduc= >ted by Argonne's Environmental Science Division.
>
>Thanks
>
>Bruce Verhaaren

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/~\ The ASCII Gene Rackow email: rackow@anl.gov
\ / Ribbon Campaign Cyber Security Office voice: 630-252-7126
X Against HTML Argonne National Lab
/ \ Email! 9700 S. Cass Ave. / Argonne, IL 60439

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From: Sid Morris
To: Verhaaren, Bruce T.
Subject: RE: Solar Energy PEIS info
Date: Thursday, March 04, 2010 1:52:06 PM

Thanks Bruce. Below is my contact information or future mailings.

Regards,

Sid

SID MORRIS
PLANNING AND DEVELOPMENT
SYCUAN BAND OF THE KUMEYAAY NATION
5485 CASINO WAY
EL CAJON, CA 92019

TEL. (619) 445 - 6002 EXT. 1164
FAX (619) 445 - 4396

SMORRIS@SYCUAN-NSN.GOV
WWW.SYCUAN.COM

From: Verhaaren, Bruce T. [mailto:brucev@anl.gov]
Sent: Thursday, March 04, 2010 11:50 AM
To: Sid Morris
Cc: Wescott, Konstance L.; 'Linda_Resseguie@blm.gov'
Subject: Solar Energy PEIS info

Sid

As we discussed over the phone, I am attaching a facsimile copy of the letter that was sent out last July by the BLM informing the tribes of the locations of the proposed solar energy study areas. These SESAs do not include all the lands the BLM considers eligible for solar development. The letter includes the URL for the project website. You will find more information there. As to your specific questions regarding cooperative development of solar facilities you may want to contact Linda Resseguie in BLM's Washington Office. She is leading the Solar PEIS project and would have better information than I would.

I hope this helps.

Bruce Verhaaren
Argonne National Laboratory

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Argonne NATIONAL LABORATORY

TELEPHONE CONVERSATION RECORD

Date: 4 Mar 2010
Time: 11:30 am

Office of the Chief Financial Officer
Procurement Department
Argonne National Laboratory
9700 South Cass Avenue, Bldg. 201
Argonne, IL 60439-4873

CALL FROM: Sid Morris			CALL TO: Bruce Verhaaren		
ORGANIZATION: Sycuan Band of the Kumeyaay Nation			ORGANIZATION: Argonne National Laboratory		
DIV.DEPT.:	LOCATION:	TELEPHONE:	DIV.DEPT.:	LOCATION:	TELEPHONE:
Planning &	El Cajon, CA	619.445.6002 x1164	EVS	Argonne, IL	630.252-3240

SUMMARY - HIGHLIGHTS - KEYPOINTS -AGREEMENTS - COMMITMENTS:

Mr. Morris called in response to our resending information on the SEZs for the Solar Energy PEIS. He is interested in developing solar energy on Sycuan tribal lands and wondered if there was some way to coopate with a developer on BLM lands. I explained our interest in informing the tribes and that the PEIS was concerned with BLM lands only. Once the ROD is issued BLMs policies for solar energy development would be clearer.

GENERAL SUBJECT OF DISCUSSION:

Joint development of solar energy on tribal and BLM lands

ADDITIONAL DISTRIBUTION:

ANL PD-103 (8-06)

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From: Jenny Rothrauff
To: Verhaaren, Bruce T.
Subject: RE: Solar Energy PEIS
Date: Thursday, March 04, 2010 7:58:56 PM

Dear Mr. Verhaaren,

Thank you for sending the attached information for the Viejas Band's review. The area referenced is not something Viejas would typically comment on since the project appears to be outside of the boundaries of San Diego limits.

Your consideration and respect of the Viejas Band's comments on this project is appreciated.

Regards,

Jenny

Jenny Rothrauff
Project Manager
Office of Chairman Bobby Barrett
P. O. Box 908
Alpine, CA 91901
jrothrauff@viejas-nsn.gov
Office (619) 659-2323
Cell (619) 843-9229
Fax (619) 445-5337

From: Verhaaren, Bruce T. [mailto:brucev@anl.gov]
Sent: Thursday, March 04, 2010 10:19 AM
To: Jenny Rothrauff
Subject: Solar Energy PEIS

Dear Ms Rothrauff:

This is to follow up on a recent telephone conversation between you and Lee Northcutt of Argonne National Laboratory, who was calling on behalf of the Bureau of Land Management.

Last July the Bureau of Land Management's California Desert District Office sent a letter to Chairman Barrett seeking his views and comments regarding proposed solar energy study areas being analyzed as part of the Programmatic Environmental Impact Statement for Solar Energy Development (PEIS). The PEIS is being prepared jointly by the Bureau of Land Management and the U.S. Department of Energy.

Since it is possible that Chairman Barrett may not have received that letter, dated July 1, 2009, I have attached a facsimile copy.

A draft of the PEIS is currently being prepared and the solar energy study areas are still in the process of being analyzed. Any views or comments the Viejas Band may wish to provide continue to be welcome as outlined in the attached letter.

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We regret that the letter has not reached you in a timely manner. We value your input and will provide additional information as the project progresses.

Sincerely,

Bruce Verhaaren, Ph.D.
Environmental Science Division
Argonne National Laboratory
bverhaaren@anl.gov
630.252.3240

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From: Lucinda Henry
To: Verhaaren, Bruce T.
Subject: Re: Solar Energy PEIS
Date: Friday, March 05, 2010 8:57:44 AM

Good Morning
After viewing the Solar Energy PEIS, it sounds good and interesting

Thanks for the information

--- On **Thu, 2/18/10, Verhaaren, Bruce T. <*brucev@anl.gov*>** wrote:

> From: Verhaaren, Bruce T. <brucev@anl.gov>
> Subject: Solar Energy PEIS
> To: "'lahenry08@yahoo.com'" <lahenry08@yahoo.com>
> Date: Thursday, February 18, 2010, 12:51 PM
>
> Dear President Henry
>
> This is to follow up on your recent telephone conversation with Lee Northcutt of Argonne National Laboratory, who was calling on behalf of the Bureau of Land Management.
>
> Last July the Bureau of Land Management's California Desert District Office sent a letter to President Begay seeking his views and comments regarding proposed solar energy study areas being analyzed as part of the Programmatic Environmental Impact Statement for Solar Energy Development (PEIS). The PEIS is being prepared jointly by the Bureau of Land Management and the U.S. Department of Energy.
>
> Since it is possible that you may not have received that letter, dated July 1, 2009, I have attached a facsimile copy.
>
> A draft of the PEIS is currently being prepared and the solar energy study areas are still in the process of being analyzed. Any views or comments the White Rock Chapter may wish to provide continue to be welcome as outlined in the attached letter.
>
> We regret that the letter has not reached you in a timely manner. We value your input and will provide additional information as the project progresses.
>
> Sincerely,

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Bruce Verhaaren, Ph.D.

Environmental Science Division

Argonne National Laboratory

bverhaaren@anl.gov

630.252.3240

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March 8, 2010

Attn: Linda J. Resseguie, Realty Specialist
Bureau of Land Management
Washington, D.C. 20240

Re: Solar Energy Study Areas being Used Analyzed as Part of the Programmatic Environmental Impact Statement for Solar Energy Development

The Soboba Band of Luiseño Indians appreciates your observance of Tribal Cultural Resources and their preservation in your project. The information provided to us on said project has been assessed through our Cultural Resource Department, where it was concluded that although it is outside the existing reservation, the project area does fall within the bounds of our Tribal Traditional Use Areas. This project location is in close proximity to known village sites and is a shared use area that was used in ongoing trade between the Luiseno and Cahuilla tribes. Therefore it is regarded as highly sensitive to the people of Soboba.

Soboba Band of Luiseño Indians is requesting the following:

1. **Government to Government** consultation in accordance to Section 106. Including the transfer of information to the Soboba Band of Luiseno Indians regarding the progress of this project should be done as soon as new developments occur.

2. Soboba Band of Luiseño Indians continue to be a lead consulting tribal entity for this project.

3. Working in and around traditional use areas intensifies the possibility of encountering cultural resources during the construction/excavation phase. For this reason the Soboba Band of Luiseño Indians requests that Native American Monitor(s) from the Soboba Band of Luiseño Indians Cultural Resource Department to be present during any ground disturbing proceedings. Including surveys and archaeological testing.

4. Request that proper procedures be taken and requests of the tribe be honored (Please see the attachment)

Sincerely,

Joseph Ontiveros
Soboba Cultural Resource Department
P.O. Box 487
San Jacinto, CA 92581
Phone (951) 654-5544 ext. 4137
Cell (951) 663-5279
jontiveros@soboba-nsn.gov

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Cultural Items (Artifacts). Ceremonial items and items of cultural patrimony reflect traditional religious beliefs and practices of the Soboba Band. The Developer should agree to return all Native American ceremonial items and items of cultural patrimony that may be found on the project site to the Soboba Band for appropriate treatment. In addition, the Soboba Band requests the return of all other cultural items (artifacts) that are recovered during the course of archaeological investigations. Where appropriate and agreed upon in advance, Developer's archeologist may conduct analyses of certain artifact classes if required by CEQA, Section 106 of NHPA, the mitigation measures or conditions of approval for the Project. This may include but is not limited or restricted to include shell, bone, ceramic, stone or other artifacts.

The Developer should waive any and all claims to ownership of Native American ceremonial and cultural artifacts that may be found on the Project site. Upon completion of authorized and mandatory archeological analysis, the Developer should return said artifacts to the Soboba Band within a reasonable time period agreed to by the Parties and not to exceed (30) days from the initial recovery of the items.

Treatment and Disposition of Remains

A. The Soboba Band shall be allowed, under California Public Resources Code § 5097.98 (a), to (1) inspect the site of the discovery and (2) make determinations as to how the human remains and grave goods shall be treated and disposed of with appropriate dignity.

B. The Soboba Band, as MLD, shall complete its inspection within twenty-four (24) hours of receiving notification from either the Developer or the NAHC, as required by California Public Resources Code § 5097.98 (a). The Parties agree to discuss in good faith what constitutes "appropriate dignity" as that term is used in the applicable statutes.

C. Reburial of human remains shall be accomplished in compliance with the California Public Resources Code § 5097.98 (a) and (b). The Soboba Band, as the MLD in consultation with the Developer, shall make the final discretionary determination regarding the appropriate disposition and treatment of human remains.

D. All parties are aware that the Soboba Band may wish to rebury the human remains and associated ceremonial and cultural items (artifacts) on or near, the site of their discovery, in an area that shall not be subject to future subsurface disturbances. The Developer should accommodate on-site reburial in a location mutually agreed upon by the Parties.

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E. The term "human remains" encompasses more than human bones because the Soboba Band's traditions periodically necessitated the ceremonial burning of human remains. Grave goods are those artifacts associated with any human remains. These items, and other funerary remnants and their ashes are to be treated in the same manner as human bone fragments or bones that remain intact

Coordination with County Coroner's Office. The Lead Agencies and the Developer should immediately contact both the Coroner and the Soboba Band in the event that any human remains are discovered during implementation of the Project. If the Coroner recognizes the human remains to be those of a Native American, or has reason to believe that they are those of a Native American, the Coroner shall ensure that notification is provided to the NAHC within twenty-four (24) hours of the determination, as required by California Health and Safety Code § 7050.5 (c).

Non-Disclosure of Location Reburials. It is understood by all parties that unless otherwise required by law, the site of any reburial of Native American human remains or cultural artifacts shall not be disclosed and shall not be governed by public disclosure requirements of the California Public Records Act. The Coroner, parties, and Lead Agencies, will be asked to withhold public disclosure information related to such reburial, pursuant to the specific exemption set forth in California Government Code § 6254 (r).

Ceremonial items and items of cultural patrimony reflect traditional religious beliefs and practices of the Soboba Band. The Developer agrees to return all Native American ceremonial items and items of cultural patrimony that may be found on the project site to the Soboba Band for appropriate treatment. In addition, the Soboba Band requests the return of all other cultural items (artifacts) that are recovered during the course of archaeological investigations. Where appropriate and agreed upon in advance, Developer's archeologist may conduct analyses of certain artifact classes if required by CEQA, Section 106 of NHPA, the mitigation measures or conditions of approval for the Project. This may include but is not limited or restricted to include shell, bone, ceramic, stone or other artifacts.

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Sent by:
"shanan M." <martineau@shivwits.org>
To
<linda_resseguie@blm.gov>
cc
<shayjaym@hotmail.com>
Subject
PEIS for Solar Energy
03/18/2010 12:08 PM

In Refference to: 1610 (300)

Linda

I am writing on behalf of Shivwits Band Council about the PEIS for Solar Energy Development. We are very much interested in this study, in fact we have had a company that had come to us wanting us to put solar energy here on the Shivwits reservation.

We would like some more information on what the government-to-government consultaion on the Solar PEIS is all about or any information that we may need to know about these issues.

You can contact me, Shanan Martineau at; 435-773-1821 or throught this e-mail. Also our Chairwoman Charlotte Lomeli at: 435-668-8997 or email: lomeli20034@aol.com

I am on Shivwits Council and also do the secretary duties for our Band.

Thanks

Shanan Martineau
Cultural Resources Manager
6060 W 3650 N
Ivins, UT 84738
phone: 435-773-1821
Fax: 435-656-8002

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From: Linda_Resseguie@blm.gov
To: Verhaaren, Bruce T.
Cc: Michael_D_Johnson@blm.gov
Subject: confirmation on call with Gerald Ahasteen, Low Mountain Chapter, Navajo Nation
Date: Tuesday, March 30, 2010 11:57:28 AM

Bruce, I wanted to confirm that Gerald Ahasteen called today because he had received our Solar PEIS mailing. (The Chapter Web site identifies Mr. Ahasteen as the Chapter President.) He noted that the nearest BLM land was about 150 miles away from the Chapter location, and so they have no real interest in or concern with the BLM Solar PEIS effort.

Linda J. Resseguie
Realty Specialist WO - 350
202.912.7337; fax 912.7199

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