Thank you for your comment, Michael Connor.

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Western Watersheds Project is submitting this research paper with its comemts. Thank you.

Wildlife Conservation and Solar Energy Development in the Desert Southwest, United States

JEFFREY E. LOVICH AND JOSHUA R. ENNEN

Large areas of public land are currently being permitted or evaluated for utility-scale solar energy development (USSED) in the southwestern United States, including areas with high biodiversity and protected species. However, peer-reviewed studies of the effects of USSED on wildlife are lacking. The potential effects of the construction and the eventual decommissioning of solar energy facilities include the direct mortality of wildlife; environmental impacts of fugitive dust and dust suppressants; destruction and modification of habitat, including the impacts of roads; and off-site impacts related to construction material acquisition, processing, and transportation. The potential effects of the operation and maintenance of the facilities include habitat fragmentation and barriers to gene flow, increased noise, electromagnetic field generation, microclimate alteration, pollution, water consumption, and fire. Facility design effects, the efficacy of site-selection criteria, and the cumulative effects of USSED on regional wildlife populations are unknown. Currently available peer-reviewed data are insufficient to allow a rigorous assessment of the impact of USSED on wildlife.

Keywords: solar energy development, Mojave Desert, Sonoran Desert, wildlife, desert tortoises

The United States is poised to develop new renewable energy facilities at an unprecedented rate, including in potentially large areas of public land in the Southwest. This quantum leap is driven by escalating costs and demand for traditional energy sources from fossil fuels and by concerns over global climate change. Attention is focused largely on renewable forms of energy, especially solar energy. The potential for utility-scale solar energy development (USSED) and operation (USSEDO) is particularly high in the southwestern United States, where solar energy potential is high (USDOI and USDOE 2011a) and is already being harnessed in some areas. However, the potential for USSEDO conflicts with natural resources, especially wildlife, is also high, given the exceptional biodiversity (Mittermeier et al. 2002) and sensitivity (Lovich and Bainbridge 1999) of arid Southwest ecosystems, especially the Mojave (Randall et al. 2010) and Sonoran Deserts, which are already stressed by climate and human changes (CBI 2010). In addition, the desert Southwest is identified as a "hotspot" for threatened and endangered species in the United States (Flather et al. 1998). For these reasons, planning efforts should consider ways to minimize USSEDO impacts on wildlife (CBI 2010). Paradoxically, the implementation of large-scale solar energy development as an "environmentally friendly" alternative to conventional energy sources may actually increase environmental degradation on a local and on a regional scale (Bezdek 1993, Abbasi and Abbasi 2000) with concomitant negative effects on wildlife.

A logical first step in evaluating the effects of USSEDO on wildlife is to assess the existing scientific knowledge. As renewable energy development proceeds rapidly worldwide, information is slowly accumulating on the effects of USSEDO on the environment (for reviews, see Harte and Jassby 1978, Pimentel et al. 1994, Abbasi and Abbasi 2000). Gill (2005) noted that although the number of peer-reviewed publications on renewable energy has increased dramatically since 1991, only 7.6% of all publications on the topic covered environmental impacts, only 4.0% included discussions of ecological implications, and less than 1.0% contained information on environmental risks. A great deal of information on USSEDO exists in environmental compliance documents and other unpublished, non-peer-reviewed "gray" literature sources. Published scientific information on the effects on wildlife of any form of renewable energy development, including that of wind energy, is scant (Kuvlesky et al. 2007). The vast majority of the published research on wildlife and renewable energy development has been focused on the effects of wind energy development on birds (Drewitt and Langston 2006) and bats (Kunz et al. 2007) because of their sensitivity to aerial impacts. In contrast, almost no information is available on the effects of solar energy development on wildlife.

From a conservation standpoint, one of the most important species in the desert Southwest is Agassiz's desert

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tortoise (*Gopherus agassizii*; figure 1). Distributed north and west of the Colorado River, the species was listed as *threatened* under the US Endangered Species Act in 1990. Because of its protected status, Agassiz's desert tortoise acts as an "umbrella species," extending protection to other plants and animals within its range (Tracy and Brussard, 1994). The newly described Morafka's desert tortoise (*Gopherus morafkai*; Murphy et al. 2011) is another species of significant conservation concern in the desert Southwest, found east of the Colorado River. Both tortoises are important as ecological engineers who construct burrows that provide shelter to many other animal species, which allows them to escape the temperature extremes of the desert (Ernst and Lovich 2009). The importance of these tortoises is thus greatly disproportionate to their intrinsic value as species. By virtue of their protected status, Agassiz's desert tortoises have a significant impact on regulatory issues in the listed portion of their range, yet little is known about the effects of USSEDO on the species, even a quarter century after the recognition of that deficiency (Pearson 1986). Large areas of habitat occupied by Agassiz's desert tortoise in particular have potential for development of USSED (figure 2).

*Figure 1. Agassiz's desert tortoise (*Gopherus agassizii*). Large areas of desert tortoise habitat are developed or being evaluated for renewable energy development, including for wind and solar energy. Photograph: Jeffrey E. Lovich.*

In this article, we review the state of knowledge about the known and potential effects, both direct and indirect, of USSEDO on wildlife (table 1). Our review is based on information published primarily in peer-reviewed scientific journals for both energy and wildlife professionals. Agassiz's desert tortoise is periodically highlighted in our review because of its protected status, wide distribution in areas considered for USSEDO in the desert Southwest, and well-studied status (Ernst and Lovich 2009). In addition, we identify gaps in our understanding of the effects of USSEDO on wildlife and suggest questions that will guide future research toward a goal of mitigating or minimizing the negative effects on wildlife.

Background on proposed energy-development potential in the southwestern United States

The blueprint for evaluating and permitting the development of solar energy on public land in the region, as is required under the US National Environmental Policy Act (USEPA 2010), began in a draft environmental impact statement (EIS) prepared by two federal agencies (USDOI and USDOE 2011a). The purpose of the EIS is to "develop a new Solar Energy Program to further support utility-scale solar energy development on BLM [US Bureau of Land

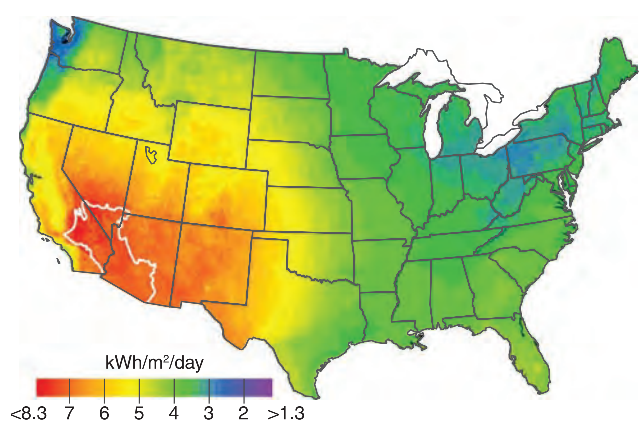

Figure 2. Concentrating solar energy potential (in kilowatt-hours per square meter per day [kWh/m^2/day]) of the United States. The map shows the annual average direct normal solar resource data based on a 10-kilometer satellite-modeled data set for the period from 1998 to 2005. Refer to NREL (2011) for additional details and data sources. The white outline defines the approximate composite ranges of Agassiz's (west of the Colorado River) and Morafka's (east of the Colorado River) desert tortoises (Murphy et al. 2011) in the United States, both species of significant conservation concern. This figure was prepared by the National Renewable Energy Laboratory for the US Department of Energy (NREL 2011). The image was authored by an employee of the Alliance for Sustainable Energy, LLC, under Contract no. DE-AC36-08GO28308 with the US Department of Energy. Reprinted with permission from NREL 2011.

Table 1. List of known and potential impacts of utility-scale solar energy development on wildlife in the desert Southwest.

Impacts due to facility construction and decommissioning	Impacts due to facility presence, operation, and maintenance
Destruction and modification of wildlife habitat	Habitat fragmentation and barriers to movement and gene flow
Direct mortality of wildlife	Noise effects
Dust and dust-suppression effects	Electromagnetic field effects
Road effects	Microclimate effects
Off-site impacts	Pollution effects from spills
Destruction and modification of wildlife habitat	Water consumption effects
	Fire effects
	Light pollution effects, including polarized light
	Habitat fragmentation and barriers to movement and gene flow
	Noise effects

Management] -administered lands… and to ensure consistent application of measures to avoid, minimize, or mitigate the adverse impacts of such development" (p. ES-2). As of February 2010, the BLM had 127 active applications for solar facilities on lands that the BLM administers. According to USDOI and USDOE (2011a), all of the BLM-administered land in six states (California, Arizona, Utah, Nevada, New Mexico, and Colorado) was considered initially, for a total of 178 million hectares (ha). Not all of that land is compatible with solar energy development, so three alternative configurations are listed by USDOI and USDOI (2011a) for consideration, ranging from 274,244 to 39,972,558 ha. The larger figure is listed under the *no action alternative* where BLM would continue to use existing policy and guidance to evaluate applications. Of the area being considered under the two action alternatives, approximately 9 million ha meet the criteria established under the BLM's preferred action alternative to support solar development. Twenty-five criteria were used to exclude certain areas of public land from solar development and include environmental, social, and economic factors. The preferred alternative also included the identification of proposed *solar energy zones* (SEZs), defined as "area[s] with few impediments to utility-scale production of solar energy" (USDOI and USDOE 2011a, p. ES-7). By themselves, these SEZs constitute the nonpreferred action alternative of 274,244 ha listed above. Maps of SEZs are available at *http://solareis.anl.gov/documents/dpeis/index.cfm.*

Several sensitive, threatened, or endangered species are being considered within the EIS, but Agassiz's desert tortoise is one of only four species noted whose very presence at a site may be sufficient to exclude USSED in special cases (see table ES.2-2 in USDOI and USDOE 2011a). The potential effects of USSEDO are not trivial for tortoises or other wildlife species. Within the area covered in the draft EIS by USDOI and USDOE (2011a), it is estimated that approximately 161,943 ha of Agassiz's desert tortoise habitat will be directly affected. However, when including direct and indirect impacts on habitat (excluding transmission lines and roads that would add additional impacts; see Lovich and Bainbridge 1999, Kristan and Boarman 2007), it is estimated that approximately 769,230 ha will be affected. Some SEZs are adjacent to critical habitat designated for the recovery of Agassiz's desert tortoise, and this proximity is considered part of the indirect impacts.

On 28 October 2011, while this paper was in press, the BLM and US Department of Energy released a supplement to the EIS (USDOI and USDOE 2011b, 2011c) after receiving more than 80,500 comments. The no action alternative remains the same as in the EIS. The new preferred alternative (slightly reduced to 8,225,179 ha as the modified program alternative) eliminates or adjusts SEZs (now reduced to 115,335 ha in 17 zones as the modified SEZ alternative) to ensure that they are not in high-conflict areas and provides incentives for their use. The new plan also proposes a process to accommodate additional solar energy development outside of SEZs and to revisit ongoing state-based planning efforts to allow consideration of additional SEZs in the future.

The impacts of USSED on wildlife: Effects due to construction and decommissioning

The construction and eventual decommissioning of solar energy facilities will have impacts on wildlife, including rare and endangered species, and on their habitats in the desert (Harte and Jassby 1978). These activities involve significant ground disturbance and direct (e.g., mortality) and indirect (e.g., habitat loss, degradation, modification) impacts on wildlife and their habitat (Kuvlesky et al. 2007). Solar energy facilities require large land areas to harness sunlight and convert it to electrical energy. According to Wilshire and colleagues (2008), photovoltaic panels with a 10% conversion efficiency would need to cover an area of about 32,000 square kilometers, or an area a little smaller than the state of Maryland, to meet the current electricity demands of the United States. Many of the areas being considered for the development of solar energy in the Mojave and Sonoran Deserts are, at present, relatively undisturbed (USDOI and USDOE 2011a).

The extent of surface disturbance of USSED is related to the cooling technology used. Because of the scarcity of water in the desert Southwest region, dry-cooling systems, which consume 90%–95% less water than wet-cooling systems (EPRI 2002), are becoming a more viable option for concentrating solar facilities. Although wet-cooling systems are more economical and efficient, they consume larger amounts of water per kilowatt-hour (Torcellini et al. 2003). Unlike wet-cooling systems, dry-cooling systems use ambient air, instead of water, to cool the exhaust steam from the turbines. However, to achieve a heat-rejection efficiency similar to that in a wet-cooling system, Khalil and colleagues (2006) estimated that a direct dry-cooling system will require a larger footprint and would thus affect more wildlife habitat.

Although we found no information in the scientific literature about the direct effects of USSED on wildlife, the ground-disturbance impacts are expected to be similar to those caused by other human activities in the desert (Lovich and Bainbridge 1999).

Dust and dust suppressants. USSED transforms the landscape substantially through site preparation, including the construction of roads and other infrastructure. In addition, many solar facilities require vegetation removal and grading. These construction activities produce dust emissions, especially in arid environments (Munson et al. 2011), which already have the potential for natural dust emission. Dust can have dramatic effects on ecological processes at all scales (reviewed by Field et al. 2010). At the smallest scale, wind erosion, which powers dust emission, can alter the fertility and water-retention capabilities of the soil. Physiologically, dust can adversely influence the gas exchange, photosynthesis, and water usage of Mojave Desert shrubs (Sharifi et al. 1997). Depending on particle size, wind speed, and other factors, dust emission can physically damage plant species through root exposure, burial, and abrasions to their leaves and stems. The physiological and physical damage to plant species inflicted by dust emissions could ultimately reduce the plants' primary production and could indirectly affect wildlife food plants and habitat quality.

From an operational perspective, dust particles reduce mirror and panel efficiency in converting solar energy into heat or electricity. To combat dust, solar energy facilities apply various dust suppressants to surfaces with exposed soil (e.g., graded areas, areas with vegetation removed, roads). There are eight categories of common dust suppressants used for industrial applications: water, salts and brines, organic nonpetroleum products, synthetic polymers, organic petroleum, electrochemical substances, clay additives, and mulch and fiber mixtures (reviewed in Piechota et al. 2004). In a study conducted in the Mojave Desert in which the hydrological impacts of dust suppressants were compared, Singh and colleagues (2003) reported that changes did occur in the volume, rate, and timing of runoff when dust suppressants were used. In particular, petroleum-based and acrylic-polymer dust suppressants drastically influenced the hydrology of disturbed areas by increasing runoff volume and changing its timing. When it is applied to disturbed desert soils, magnesium chloride ($MgCl_2$), a commonly used salt-based dust depressant, does not increase runoff volume but does, however, increase the total suspended solids loads in runoff (Singh et al. 2003).

Others have highlighted the fact that there is a dearth of scientific research and literature on the effects of dust suppressants on wildlife, including the most commonly used category of dust depressant: brines and salts (Piechota et al. 2004, Goodrich et al. 2008). However, the application of $MgCl_2$ to roads was correlated with a higher frequency of plant damage (Goodrich et al. 2008). Because chloride salts, including $MgCl_2$, are not confined to the point of application but have the ability to be transported in runoff (White and Broadly 2001), the potential exists for a loss of primary production associated with plant damage in the habitats surrounding a solar facility, which could directly affect wildlife habitat.

Mortality of wildlife. We are not aware of any published studies documenting the direct effects of USSED on the survival of wildlife. However, subterranean animals can be affected by USSED, including species that hibernate underground. In the Sonoran Desert portion of California, Cowles (1941) observed that most reptiles in the Coachella Valley hibernated at depths of less than 33 centimeters (cm), with many at considerably shallower depths. Included in his observations were flat-tailed horned lizards (*Phrynosoma mcallii*)—a species of special concern in the region because of solar energy development (USDOI and USDOE 2011a)—and the federally protected Coachella Valley fringe-toed lizard (*Uma inornata*). Even lightweight vehicles like motorcycles are capable of causing greatly increased soil density (soil compaction) at a depth of 30–60 cm as their tires pass over the surface (Webb 1983). These observations suggest that vehicular activities in the desert have the potential to kill or entrap large numbers of subterranean animals (Stebbins 1995) through compressive forces or burrow collapse. Similar or greater impacts would be expected from the heavy equipment associated with the construction activities at an energy facility.

Destruction and modification of wildlife habitat. Despite the absence of published, peer-reviewed information on the effects of USSED on wildlife and their habitats, a considerable body of literature exists on the effects of other ground-disturbing activities on both ecological patterns and processes that are broadly comparable. Ground-disturbing activities affect a variety of processes in the desert, including soil density, water infiltration rate, vulnerability to erosion, secondary plant succession, invasion by exotic plant species, and stability of cryptobiotic soil crusts (for reviews, see Lovich and Bainbridge 1999, Webb et al. 2009). All of these processes have the ability—individually and together—to alter habitat quality, often to the detriment of wildlife. Any disturbance and alteration to the desert landscape, including the construction and decommissioning of utility-scale solar energy facilities, has the potential to increase soil erosion. Erosion can physically and physiologically affect plant species and can thus adversely influence primary production (Sharifi et al. 1997, Field et al. 2010) and food availability for wildlife.

Solar energy facilities require substantial site preparation (including the removal of vegetation) that alters topography and, thus, drainage patterns to divert the surface flow associated with rainfall away from facility infrastructure (Abbasi and Abbasi 2000). Channeling runoff away from plant communities can have dramatic negative effects on water availability and habitat quality in the desert, as was shown by Schlesinger and colleagues (1989). Areas deprived of runoff from sheet flow support less biomass of perennial and annual plants relative to adjacent areas with uninterrupted water-flow patterns.

The impacts of roads. Roads are required in order to provide access to solar energy infrastructure. Both paved and unpaved roads have well-documented negative effects on wildlife (Forman and Alexander 1998), and similar effects are expected in utility-scale solar energy facilities. Although road mortality is most easily detected on the actual roadway, the effects of roads extend far beyond their physical surface. In a study of the effects of roads on Agassiz's desert tortoise populations in southern Nevada, von Seckendorff Hoff and Marlow (2002) examined transects along roads with traffic volumes varying from 25 to 5000 vehicles per day. Tortoises and tortoise sign (e.g., burrows, shells, scat) decreased with their proximity to a road. On roads with high traffic volumes, tortoises and tortoise sign were reduced as far as 4000 meters from the roadside. Roads with lower traffic volumes had fewer far-reaching effects.

Another effect of roads in the desert is the edge enhancement of plants and arthropod herbivores (Lightfoot and Whitford 1991). Perennial plants along the roadside are often larger than those farther away, and annual plant germination is often greatest along the shoulders of roads. It is possible that increased runoff due to impervious pavement or compacted soil contributes to this heterogeneity of vegetation in relationship to a road. Agassiz's desert tortoises may select locations for burrow construction that are close to roads, perhaps because of this increased productivity of food plants (Lovich and Daniels 2000). Although this situation suggests potentially beneficial impacts for herbivorous species of wildlife, such as tortoises, it increases their chance of being killed by vehicle strikes, as was shown by von Seckendorff Hoff and Marlow (2002).

Off-site impacts. Direct impacts on wildlife and habitat can occur well outside the actual footprint of the energy facility. Extraction of large amounts of raw materials for the construction of solar energy facilities (e.g., aggregate, cement, steel, glass); transportation and processing of those materials; the need for large amounts of water for cooling some installations; and the potential for the production of toxic wastes, including coolants, antifreeze, rust inhibitors, and heavy metals, can affect wildlife adjacent to or far from the location of the facility (Abbasi and Abbasi 2000). Abbasi and Abbasi (2000) summarized data suggesting that the material requirements for large-scale solar facilities exceed those for conventional fossil-fuel plants on a cost-per-unit-of-energy basis. In addition, water used for steam production at one solar energy facility in the Mojave Desert of California contained selenium, and the wastewater was pumped into evaporation ponds that attracted birds that fed on invertebrates. Although selenium toxicity was not considered a threat on the basis of the results of one study, the possibility exists for harmful bioaccumulation of this toxic micronutrient (Herbst 2006). In recognition of the hazard, Pimentel and colleagues (1994) suggested that fencing should be used to keep wildlife away from these toxic ponds.

The impacts of USSED on wildlife: Effects due to operation and maintenance

This category includes the effects related to the presence and operation of the solar facility, not the physical construction and decommissioning of the same. Some of the effects (e.g., mortality of wildlife and impacts caused by roads) are similar to those discussed previously for construction and decommissioning and are not discussed further.

Habitat fragmentation. Until relatively recently, the desert Southwest was characterized by large blocks of continuous and interconnected habitat. Roads and urban development continue to contribute to habitat fragmentation in this landscape. Large-scale energy development has the potential to add to and exacerbate the situation, presenting potential barriers to movement and genetic exchange in wildlife populations, including those of bighorn sheep (*Ovis canadensis*), deer (*Odocoileus* spp.), tortoises, and other species of concern and social significance. Research conducted on the effects of oil and gas exploration and development (OGED) on wildlife in the Intermountain West provides a possible analog to USSEDO, since comparable data are not available for the desert Southwest. The potential effects on mule deer (*Odocoileus hemionus*) and other wildlife species include impediments to free movement, the creation of migration bottlenecks, and a reduction in effective winter range size. Mule deer responded immediately to OGED by moving away from disturbances, with no sign of acclimation during the three years of study by Sawyer and colleagues (2009). Some deer avoidance resulted in their use of less-preferred and presumably less-suitable habitats.

Despite a lack of data on the direct contributions of USSEDO to habitat fragmentation, USSEDO has the potential to be an impediment to gene flow for some species. Although the extent of this impact is, as yet, largely unquantified in the desert, compelling evidence for the effects of human-caused habitat fragmentation on diverse wildlife species has already been demonstrated in the adjacent coastal region of southern California (Delaney et al. 2010).

Noise effects. Industrial noise can have impacts on wildlife, including changes to their habitat use and activity patterns, increases in stress, weakened immune systems, reduced reproductive success, altered foraging behavior, increased predation risk, degraded communication with conspecifics, and damaged hearing (Barber et al. 2009, Pater et al. 2009). Changes in sound level of only a few decibels can elicit substantial animal responses. Most noise associated with USSEDO is likely to be generated during the construction phase (Suter 2002), but noise can also be produced during operation and maintenance activities. Brattstrom and Bondello (1983) documented the effects of noise on Mojave

Desert wildlife on the basis of experiments involving off-highway vehicles. Noise from some of these vehicles can reach 110 decibels—near the threshold of human pain and certainly within the range expected for various construction, operation, and maintenance activities (Suter 2002) associated with USSEDO. This level of noise caused hearing loss in animals, such as kangaroo rats (*Dipodomys* spp.), desert iguanas (*Dipsosaurus dorsalis*), and fringe-toed lizards (*Uma* spp.). In addition, it interfered with the ability of kangaroo rats to detect predators, such as rattlesnakes (*Crotalus* spp.), and caused an unnatural emergence of aestivating spadefoot toads (*Scaphiopus* spp.), which would most likely result in their deaths. Because of impacts on wildlife, Brattstrom and Bondello (1983) recommended that "all undisturbed desert habitats, critical habitats, and all ranges of threatened, endangered, or otherwise protected desert species" (p. 204) should be protected from loud noise.

Although many consider solar energy production a "quiet" endeavor, noise is associated with their operation. For example, facilities at which wet-cooling systems are used will have noises generated by fans and pumps. As for facilities with dry-cooling systems, only noise from fans will be produced during operation (EPRI 2002). Because of the larger size requirements of dry-cooling systems, there will be more noise production associated with an increase in the number of fans.

Electromagnetic field generation. When electricity is passed through cables, it generates electric and magnetic fields. USSEDO requires a large distribution system of buried and overhead cables to transmit energy from the point of production to the end user. Electromagnetic fields (EMFs) produced as energy flows through system cables are a concern from the standpoint of both human and wildlife health, yet little information is available to assess the potential impact of the EMFs associated with USSEDO on wildlife. Concerns about EMFs have persisted for a long time, in part because of controversy over whether they're the actual cause of problems and disagreement about the underlying mechanisms for possible effects. For example, there is presently a lack of widely accepted agreement about the biological mechanisms that can explain the consistent associations between extremely low-frequency EMF exposure from overhead power lines and childhood leukemia, although there is no shortage of theories (Gee 2009).

Some conclude that the effects of EMFs on wildlife will be minor because of reviews of the often conflicting and inconclusive literature on the topic (Petersen and Malm 2006). Others suggest that EMFs are a possible source of harm for diverse species of wildlife and contribute to the decline of some mammal populations. Balmori (2010) listed possible impacts of chronic exposure to athermal electromagnetic radiation, which included damage to the nervous system, disruption of circadian rhythm, changes in heart function, impairment of immunity and fertility, and genetic and developmental problems. He concluded that enough evidence exists to confirm harm to wildlife but suggested that further study is urgently needed. Other authors suggest that the generally inconsistent epidemiological evidence in support of the effects of EMFs should not be cause for inaction. Instead, they argue that the precautionary principle should be applied in order to prevent a recurrence of the "late lessons from early warnings" scenario that has been repeated throughout history (Gee 2009).

Magnetic information is used for orientation by diverse species, from insects (Sharma and Kumar 2010) to reptiles (Perry A et al. 1985). Despite recognition of this phenomenon, the direct effects of USSEDO-produced EMFs on wildlife orientation remains unknown.

Microclimate effects. The alteration of a landscape through the removal of vegetation and the construction of structures by humans not only has the potential of increasing animal mortality but also changes the characteristics of the environment in a way that affects wildlife. The potential for microclimate effects unique to solar facilities was discussed by Pimentel and colleagues (1994) and by Harte and Jassby (1978). It has been estimated that a concentrating solar facility can increase the albedo of a desert environment by 30%–56%, which could influence local temperature and precipitation patterns through changes in wind speed and evapotranspiration. Depending on their design, large concentrating solar facilities may also have the ability to produce significant amounts of unused heat that could be carried downwind into adjacent wildlife habitat with the potential to create localized drought conditions. The heat produced by central-tower solar facilities can burn or incinerate birds and flying insects as they pass through the concentrated beams of reflected light (McCrary et al. 1986, Pimentel et al. 1994, Tsoutsos et al. 2005, Wilshire et al. 2008).

A dry-cooled solar facility—in particular, one with a concentrating-trough system—could reject heated air from the cooling process with temperatures 25–35 degrees Fahrenheit higher than the ambient temperature (EPRI 2002). This could affect the microclimate on site or those in adjacent habitats. To our knowledge, no research is available to assess the effects of USSEDO on temperature or that of any other climatic variable on wildlife. However, organisms whose sex is determined by incubation temperatures, such as both species of desert tortoises, may be especially sensitive to temperature changes, because small temperature changes have the potential to alter hatchling sex ratios (Hulin et al. 2009).

Pollutants from spills. USSEDO, especially at wet-cooled solar facilities, has a potential risk for hazardous chemical spills on site, associated with the toxicants used in cooling systems, antifreeze agents, rust inhibitors, herbicides, and heavy metals (Abbasi and Abbasi 2000, Tsoutsos et al. 2005). Wet-cooling solar systems must use treatment chemicals (e.g., chlorine, bromine, selenium) and acids and bases (e.g., sulfuric acid, sodium hydroxide, hydrated lime) for the prevention of fouling and scaling and for pH control of the water used in their recirculating systems (EPRI 2002).

Solar facilities at which a recirculating system is used also have treatment and disposal issues associated with water discharge, known as *blowdown*, which is water with a high concentration of dissolved and suspended materials created by the numerous evaporation cycles in the closed system (EPRI 2002). These discharges may contain chemicals used to prevent fouling and scaling. The potentially tainted water is usually stored in evaporative ponds, which further concentrates the toxicants (Herbst 2006). Because water is an attraction for desert wildlife, numerous species could be adversely affected. The adverse effects of the aforementioned substances and similar ones on wildlife are well documented in the literature, and a full review is outside the scope of this article. However, with the decreased likelihood of wet-cooling systems for solar facilities in the desert, the risk of hazardous spills and discharges on site will be less in the future, because dry-cooling systems eliminate most of the associated water-treatment processes (EPRI 2002). However, there are still risks of spills associated with a dry-cooling system. More research is needed on the adverse effects of chemical spills and tainted-water discharges specifically related to USSEDO on wildlife.

Water consumption (wet-cooled solar). The southwestern United States is a water-poor region, and water use is highly regulated throughout the area. Because of this water limitation, the type of cooling systems installed at solar facilities is limited as well. For example, a once-through cooling system—a form of wet cooling—is generally not feasible in arid environments, because there are few permanent bodies of water (i.e., rivers, oceans, and lakes) from which to draw cool water and then into which to release hot water. Likewise, other wet-cooling options, such as recirculating systems and hybrid systems, are becoming less popular because of water shortage issues in the arid region. Therefore, the popularity of the less-efficient and less-economical dry-cooling systems is increasing on public lands. Water will also be needed at solar facilities to periodically wash dust from the mirrors or panels. Although there are numerous reports in which the costs and benefits were compared both environmentally and economically (EPRI 2002, Khalil et al. 2006) between wet- and dry-cooled solar facilities, to our knowledge no one has actually quantified the effects of water use and consumption on desert wildlife in relation to the operation of these facilities.

Fire risks. Any system that produces electricity and heat has a potential risk of fire, and renewable energy facilities are no exception. Concentrating solar energy facilities harness the sun's energy to heat oils, gases, or liquid sodium, depending on the system design (e.g., heliostat power, trough, dish). With temperatures reaching more than 300 degrees Celsius in most concentrated solar systems, spills and leaks from the coolant system increase the risk of fires (Tsoutsos et al. 2005). Even though all vegetation is usually removed from the site during construction, which reduces the risk of a fire propagating on and off site, the increase of human activity in a desert region increases the potential for fire, especially along major highways and in the densely populated western Mojave Desert (Brooks and Matchett 2006).

The Southwest deserts are not fire-adapted ecosystems: fire was historically uncommon in these regions (Brooks and Esque 2002). However, with the establishment of numerous flammable invasive annual plants in the desert Southwest (Brown and Minnich 1986), coupled with an increase in anthropogenic ignitions, fire has become more common in the deserts, which adversely affects wildlife (Esque et al. 2003). For Agassiz's desert tortoise, fire can translate into direct mortality at renewable energy facilities (Lovich and Daniels 2000) and can cause reductions in food and habitat quality. To our knowledge, however, there is no scientific literature related to the effects of USSEDO-caused fire on wildlife.

Light pollution. Two types of light pollution could be produced by solar energy facilities: ecological light pollution (ELP; Longcore and Rich 2004) and polarized light pollution (PLP; Horváth et al. 2009). The latter, PLP, could be produced at high levels at facilities using photovoltaic solar panels, because dark surfaces polarize light. ELP can also be produced at solar facilities in the form of reflected light. The reflected light from USSEDO has been suggested as a possible hazard to eyesight (Abbasi and Abbasi 2000). ELP could adversely affect the physiology, behavior, and population ecology of wildlife, which could include the alteration of predation, competition, and reproduction (for reviews, see Longcore and Rich 2004, Perry G et al. 2008). For example, the foraging behavior of some species can be adversely affected by light pollution (for a review, see Longcore and Rich 2004). The literature is limited regarding the impact of artificial lighting on amphibians and reptiles (Perry G et al. 2008), and, to our knowledge, there are no published studies in which the impacts on wildlife of light pollution produced by USSEDO have been assessed. However, light pollution is considered by G. Perry and colleagues (2008) to be a serious threat to reptiles, amphibians, and entire ecological communities that requires consideration during project planning. G. Perry and colleagues (2008) further recommended the removal of unnecessary lighting so that the lighting conditions of nearby habitats would be as close as possible to their natural state.

Numerous anthropogenic products—usually those that are dark in color (e.g., oil spills, glass panes, automobiles, plastics, paints, asphalt roads)—can unnaturally polarize light, which can have adverse effects on wildlife (for a review, see Horváth et al. 2009). For example, numerous animal species use polarized light for orientation and navigation purposes (Horváth and Varjú 2004). Therefore, the potential exists for PLP to disrupt the orientation and migration abilities of desert wildlife, including those of sensitive species. In the review by Horváth and colleagues (2009), which was focused mostly on insects but included a few avian references, they highlighted the fact that anthropogenic products that produce PLP can appear to be water bodies to wildlife and can become ecological traps for insects and, to a lesser degree, avian species. Therefore, utility-scale solar energy facilities at which photovoltaic technology is used in the desert Southwest could create a direct effect on insects (i.e., ecological trap), which could have profound but unquantified effects on the ecological community surrounding the solar facility. In addition, there may be indirect effects on wildlife through the limitation of plant food resources, especially if pollinators are negatively affected. As was stated by Horváth and colleagues (2009), the population- and community-level effects of PLP can only be speculated on because of the paucity of data.

Unanswered questions and research needs

In our review of the peer-reviewed scientific literature, we found only one peer-reviewed publication on the specific effects of utility-scale solar energy facility operation on wildlife (McCrary et al. 1986) and none on utility-scale solar energy facility construction or decommissioning. Although it is possible that we missed other peer-reviewed publications, our preliminary assessment demonstrates that very little critically reviewed information is available on this topic. The dearth of published, peer-reviewed scientific information provides an opportunity to identify the fundamental research questions for which resource managers need answers. Without those answers, resource managers will be unable to effectively minimize the negative effects of USSEDO on wildlife, especially before permitting widespread development of this technology on relatively undisturbed public land.

Before-and-after studies. Carefully controlled studies are required in order to tease out the direct and indirect effects of USSEDO on wildlife. Pre- and postconstruction evaluations are necessary to identify the effects of renewable energy facilities and to compare results across studies (Kunz et al. 2007). In their review of wind energy development and wildlife, with an emphasis on birds, Kuvlesky and colleagues (2007) noted that experimental designs and data-collection standards were typically inconsistent among studies. This fact alone contributes measurably to the reported variability among studies or renders comparisons difficult, if not impossible. Additional studies should emphasize the need for carefully controlled before-after-control-impact (BACI) studies (Kuvlesky et al. 2007) with replication (if possible) and a detailed description of site conditions. The potential payoff for supporting BACI studies now could be significant: They could provide answers for how to mitigate the negative impacts on wildlife in a cost-effective and timely manner.

What are the cumulative effects of large numbers of dispersed or concentrated energy facilities? Large portions of the desert Southwest have the potential for solar energy development. Although certain areas are targeted for large facilities because of resource availability and engineering requirements (e.g., their proximity to existing transmission corridors), other areas may receive smaller, more widely scattered facilities. A major unanswered question is what the cumulative impacts of these facilities on wildlife are. Would it be better for wildlife if development is concentrated or if it is scattered in smaller, dispersed facilities? Modeling based on existing data would be highly suspect because of the deficiency of detailed site-level published information identified in our analysis. Except for those on habitat destruction and alteration related to other human endeavors, there are no published articles on the population genetic consequences of habitat fragmentation related to USSED, which makes this a high priority for future research.

What density or design of development maximizes energy benefits while minimizing negative effects on wildlife? We are not aware of any published peer-reviewed studies in which the impacts on wildlife of different USSED densities or designs have been assessed. For example, would it benefit wildlife to leave strips of undisturbed habitat between rows of concentrating solar arrays? Research projects in which various densities, arrays, or designs of energy-development infrastructure are considered would be extremely valuable. BACI studies would be very useful for addressing this deficiency.

What are the best sites for energy farms with respect to the needs of wildlife? The large areas of public land available for renewable energy development in the desert Southwest encompass a wide variety of habitats. Although this provides a large number of choices for USSED, not all areas have the same energy potential because of resource availability and the limitations associated with engineering requirements, as was noted above. Detailed information on wildlife distribution and habitat requirements are crucially needed for proper site location and for the design of renewable energy developments (Tsoutsos et al. 2005). Public-resource-management agencies have access to rich geospatial data sets based on many years of inventories and resource-management planning. These data could be used to identify areas of high value for both energy development and wildlife. Areas with overlapping high values could be carefully studied through risk assessment when it appears that conflicts are likely. Previously degraded wildlife habitats, such as old mine sites, overgrazed pastures, and abandoned crop fields, may be good places to concentrate USSED to minimize its impacts on wildlife (CBI 2010).

Can the impacts of solar energy development on wildlife be mitigated? The construction of solar energy facilities can cause direct mortality of wildlife. In addition, building these facilities results in the destruction and fragmentation of wildlife habitat and may increase the possibility of fire, as was discussed above. Beyond these effects, essentially nothing is known about the operational effects of solar energy facilities on wildlife. Current mitigation strategies for desert tortoises and other protected species include few alternatives other than translocation of the animals from the footprint of the development into other areas. Although this strategy may be appealing at first glance, animal translocation has a checkered history of success, especially for reptiles and amphibians (Germano and Bishop 2008, CBI 2010). Translocation has yet to be demonstrated as a viable long-term solution that would mitigate the destruction of Agassiz's desert tortoise habitat (Ernst and Lovich 2009, CBI 2010).

Conclusions

All energy production has associated social and environmental costs (Budnitz and Holdren 1976, Bezdek 1993). In their review of the adverse environmental effects of renewable energy development, Abbasi and Abbasi (2000) stated that "renewable energy sources are not the panacea they are popularly perceived to be; indeed, in some cases, their adverse environmental impacts can be as strongly negative as the impacts of conventional energy sources" (p. 121). Therefore, responsible, efficient energy production requires both the minimization of environmental costs and the maximization of benefits to society—factors that are not mutually exclusive. Stevens and colleagues (1991) and Martín-López and colleagues (2008) suggested that the analyses of costs and benefits should include both wildlife use and existence values. On the basis of our review of the existing peer-reviewed scientific literature, it appears that insufficient evidence is available to determine whether solar energy development, as it is envisioned for the desert Southwest, is compatible with wildlife conservation. This is especially true for threatened species such as Agassiz's desert tortoise. The many other unanswered questions that remain after reviewing the available evidence provide opportunities for future research, as was outlined above.

The shift toward renewable energy is widely perceived by the public as a "green movement" intended to reduce greenhouse-gas emissions and acid rain and to curb global climate change (Abbasi and Abbasi 2000). However, as was noted by Harte and Jassby (1978), just because an energy technology is simple, thermodynamically optimal, renewable, or inexpensive does not mean that it will be benign from an ecological perspective. The issue of wildlife impacts is much more complex than is widely appreciated, especially when the various scales of impact (e.g., local, regional, global) are considered. Our analysis shows that, on a local scale, so little is known about the effects USSEDO on wildlife that extrapolation to larger scales with any degree of confidence is currently limited by an inadequate amount of scientific data. Therefore, without additional research to fill the significant information void, accurate assessment of the potential impacts of solar energy development on wildlife is largely theoretical but needs to be empirical and well-founded on supporting science.

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Thank you for your comment, Michael Connor.

The comment tracking number that has been assigned to your comment is SEDDsupp20101.

Comment Date: January 26, 2012 23:57:05PM
Supplement to the Draft Solar PEIS
Comment ID: SEDDsupp20101

First Name: Michael
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Attachment: WWP-Hagertyetal2011.pdf

Comment Submitted:

Western Watersheds Project is submitting this research paper with its comment letter. Thank you.

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RESEARCH ARTICLE

Making molehills out of mountains: landscape genetics of the Mojave desert tortoise

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Abstract Heterogeneity in habitat often influences how organisms traverse the landscape matrix that connects populations. Understanding landscape connectivity is important to determine the ecological processes that influence those movements, which lead to evolutionary change due to gene flow. Here, we used landscape genetics and statistical models to evaluate hypotheses that could explain isolation among locations of the threatened Mojave desert tortoise (*Gopherus agassizii*). Within a causal modeling framework, we investigated three factors that can influence landscape connectivity: geographic distance, barriers to dispersal, and landscape friction. A statistical model of habitat suitability for the Mojave desert tortoise, based on topography, vegetation, and climate variables, was used as a proxy for landscape friction and barriers to dispersal. We quantified landscape friction with least-cost distances and with resistance distances among sampling locations. A set of diagnostic partial Mantel tests statistically separated the hypotheses of potential causes of genetic isolation. The best-supported model varied depending upon how landscape friction was quantified. Patterns of genetic structure were related to a combination of geographic distance and barriers as defined by least-cost distances, suggesting that mountain ranges and extremely low-elevation valleys influence connectivity at the regional scale beyond the tortoises' ability to disperse. However, geographic distance was the only influence detected using resistance distances, which we attributed to fundamental differences between the two ways of quantifying friction. Landscape friction, as we measured it, did not influence the observed patterns of genetic distances using either quantification. Barriers and distance may be more valuable predictors of observed population structure for species like the desert tortoise, which has high dispersal capability and a long generation time.

Keywords Landscape genetics · Desert tortoise · *Gopherus agassizii* · Mojave desert · Least-cost-path · Isolation-by-resistance · Habitat suitability model

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Introduction

Habitat fragmentation can increase isolation among populations, and isolation can increase extinction risk for many species (Crooks and Sanjayan 2006; Fischer and Lindenmayer 2007) due to demographic stochasticity, increased numbers of deterministic threats, and loss of genetic variation (Lande 1988; Saunders et al. 2001; Fahrig 2003; Henle et al. 2004; Reed 2004; Fischer and Lindenmayer 2007). Although landscape connectivity alone is usually not sufficient to ensure population persistence (Taylor et al. 2006), it does provide several clearly important means of reducing some extinction risks (Crooks and Sanjayan 2006). Among other benefits, connectivity in the landscape allows dispersal from the natal range, aids in rescue effects to prevent local extinctions, facilitates gene flow that prevents inbreeding, and fosters adequate responses to environmental change through the potential for long-term adaptation, the ability to adjust the natural distribution, and potential for recolonization after disturbance (Crooks and Sanjayan 2006).

The degree to which a landscape facilitates or impedes an organism's movement within a population depends both upon structural and functional components (Taylor et al. 1993; Brooks 2003; Taylor et al. 2006). The structural components include landscape heterogeneity that influences the habitat available to the organism, and the functional component describes the organism's response to the available habitat (Brooks 2003; Taylor et al. 2006). Quantifying both components helps us to understand how organisms move through the landscape and to identify where important habitat connections exist within the landscape. Dispersal (or some measure of movement) is one common metric to evaluate the factors that facilitate connectivity and the consequences of the amount of connectivity (Wiens 2001; Uezu et al. 2005). Inferences from genetic data have been recognized as a viable alternative to direct measurements of dispersal (Koenig et al. 1996; Waples 1998; Bohonak 1999; Brooks 2003), and a means to quantify functional connectivity (Brooks 2003; Stevens et al. 2006; Holderegger and Wagner 2008). However, gene flow only represents a subset of dispersal movements because it requires effective reproduction (Brooks 2003; Cushman et al. 2006).

Spatially explicit models and genetic data analyzed using a landscape genetics approach can be used to test specific hypotheses regarding natural levels of habitat connectivity, the influence of particular landscape features on individual movement, and the effects of habitat fragmentation (Manel et al. 2003; Keyghobadi 2007; Storfer et al. 2007). The questions addressed are species-specific, and they are constrained to the temporal and spatial scale at which individuals of a species experience their surroundings (Wiens 2001; Brooks 2003; Holderegger and Wagner 2008). Natural populations often depart from strict isolation-by-distance (Wright 1943), which occurs when the only barrier to gene flow is geographic distance and results in an average increase in genetic differentiation as geographic distance increases (Wright 1943; Slatkin 1993; Epperson 2003). Departures from isolation-by-distance suggest that additional features govern the movement of individuals, and hence the spatial genetic structure (e.g., Coulon et al. 2004; Broquet et al. 2006; Cushman et al. 2006; Epps et al. 2007). Modifying a model of straight-line distance among habitat patches to include features representing the heterogeneity of the landscape that an organism experiences could improve our understanding of landscape connectivity (Adriaensen et al. 2003; Theobald 2006).

Here, we evaluated multiple hypotheses of isolation and quantified landscape connectivity for the Mojave population of the desert tortoise (*Gopherus agassizii*). The Mojave desert tortoise is listed as threatened under the U.S. Endangered Species Act of 1973 (USFWS 1994), and tortoise habitat in this region has become fragmented by transportation corridors, utility infrastructure, and urban development over the past century (Tracy et al. 2004). Although few data exist on dispersal of desert tortoises (Morafka 1994), a recent assessment of spatial genetic structure in this long-lived species suggests that historic movement among adjacent populations has been extensive (Hagerty and Tracy 2010). Genetic differentiation among populations is small, although spatial structure is present (Hagerty and Tracy 2010). Geographic distance explains approximately 68% of the variation in genetic distance (Murphy et al. 2007; Hagerty and Tracy 2010). Nevertheless, there are natural features of the landscape occupied by desert tortoises that likely facilitate or impede movement of individuals in the landscape, and identifying these key components is important for recovery of this threatened species.

We tested hypotheses about putative causes of isolation in a causal modeling framework (Legendre 1993; Cushman et al. 2006) to assess which potential drivers of genetic structure best correlate with patterns of gene flow. Our a priori models were chosen to test specific hypotheses regarding factors that seem to be the most relevant in determining connectivity among tortoise habitat. We assessed three possible causes of isolation: (1) geographic distance, (2) dispersal barriers, and (3) landscape friction or a measure of the habitat's resistance to flow of individuals through it. Seven potential models incorporated all combinations of isolation by barriers, isolation by landscape friction, and isolation by geographic distance. The causal modeling framework allowed us to identify a single supported model among this set of competing hypotheses. Additionally, we tested each of these models with two quantifications of landscape friction that require different algorithms and assumptions: least-cost path (Adriaensen et al. 2003; Theobald 2006) and isolation-by-resistance (McRae 2006; McRae and Beier 2007; McRae et al. 2008).

Materials and methods

Study system

The Mojave desert tortoise inhabits portions of the Mojave and Colorado Deserts, spanning four states in the southwestern United States (Utah, Arizona, Nevada, and California; Germano et al. 1994). The Mojave and Colorado deserts (>160,000 km^2) are heterogeneous in climate, geology, and topography (Rowlands et al. 1982); however, habitat is relatively continuous at low-elevations (300–900 m) where the vegetation is dominated by creosote scrub (*Larrea tridentata*; Luckenbach 1982). Mojave desert tortoises most commonly occur in areas with gentle slopes, sufficient shade resources, and friable soils to allow burrow construction (Bury et al. 1994; USFWS 1994; Andersen et al. 2000).

Sampling and genotyping

Between 2004 and 2006, blood was collected from 744 desert tortoises throughout the range where the species is federally listed, which includes areas north and west of the Colorado River (Hagerty and Tracy 2010). Sampling sites included areas sampled during annual population monitoring (USFWS 2006) along randomly placed transects within critical habitat, which are the areas that are actively managed for recovery by the U.S. Fish and Wildlife Service, and systematically-placed transects outside of critical habitat areas (Hagerty and Tracy 2010). Universal Transverse Mercator (UTM) coordinates of individual locations were recorded when DNA samples were collected. Individuals were pooled into 25 sampling locations (N = 12–80), which were identified based upon geographic features such as large valleys or combinations of small, connected valleys (Fig. 1). Each of these locations can be assigned to one of seven genotype groups that were identified previously using Bayesian assignment tests (Hagerty and Tracy 2010). The geographic centroid of each sampling location was calculated by finding the central point in polygons defined for the 25 defined sampling regions in ArcGIS (ver. 9.2, ESRI, Redlands, CA, USA) and used to represent populations for further analyses (Fig. 1). The average area of the polygons was 1000 km^2 with a 50 km diameter. We determined that this size polygon was reasonable for this study because desert tortoises have been observed moving greater than 30 km in a single foray (Edwards et al. 2004).

The 20 microsatellites used in this study were loci originally developed for *G. polyphemus* (GP15, GP30, GP61; Schwartz et al. 2003), the Sonoran population of *G. agassizii* (GOAG3, GOAG4, GOAG7; Edwards et al. 2003), and the Mojave population of *G. agassizii* (14 markers; Hagerty et al. 2008). Specific conditions for amplification and fragment analysis are described in detail elsewhere (Hagerty et al. 2008; Hagerty and Tracy 2010). We amplified the microsatellites and completed fragment analysis in collaboration with the Nevada Genomics Center (http://www.ag.unr.edu/Genomics/). All alleles were scored with GeneMapper 5.0 (Applied Biosystems, Inc., Foster City, CA, USA).

The microsatellite loci did not deviate from Hardy–Weinberg proportions and did not exhibit significant linkage disequilibrium (Hagerty and Tracy 2010). Loci exhibited high gene diversity and allelic richness (Hagerty and Tracy 2010). We calculated pair-wise genetic distance measures for the 25 sampling locations: $F_{ST}/(1 - F_{ST})$ (as recommended by Rousset (1997)) using pair-wise F_{ST} values from FSTAT (Goudet 1996), the genotype likelihood ratio (D_{LR}; Paetkau et al. 1997) in DOH (Paetkau et al. 1997), and Nei's standard genetic distance D_S (Nei

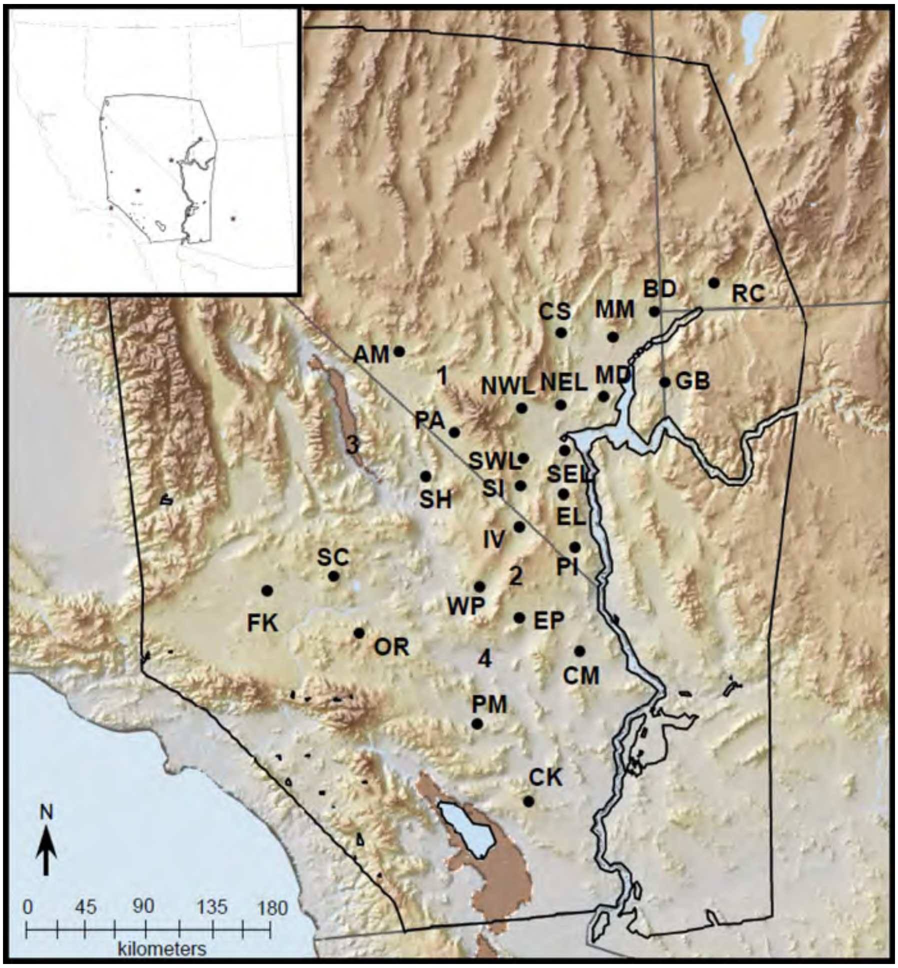

Fig. 1 Map of the sampled locations for landscape genetics of the Mojave desert tortoise. The *thick black line* designates the outline of the coverage of the habitat model. State outlines are designated as *grey lines*. The center for each of the 25 sampling locations are shown as *black dots* and are identified as follows: RC (Red Cliffs Desert Reserve, UT), Beaver Dam Slope (NV, UT), MM (Mormon Mesa, NV), GB (Gold Butte, NV), MD (Muddy Mountains, NV), CS (Coyote Springs, NV), NEL (Northeast Las Vegas, NV), NWL (Northwest Las Vegas, NV), AM (Amargosa Desert, NV), PA (Pahrump, NV), SH (Shadow Valley, CA), IV (Ivanpah, CA), WP (West Providence Mountains, CA), SI (South I-15 corridor—Sloan, Jean, Roach, NV), SWL (Southwest Las Vegas Valley, NV), SEL (Southeast Las Vegas, NV), EL (Eldorado Valley, NV), PI (Piute Valley, NV), CM (Chemehuevi Valley, NV), EP (East Providence Mountains, CA), CK (Chuckwalla Bench, CA), PM (Pinto Mountains, CA), OR (Ord-Rodman Valleys, CA), SC (Superior-Cronese Valleys, CA), FK (Fremont-Kramer Valleys, CA). Major topographic features include: (1) Spring Mountains, (2) New York and Providence Mountains, (3) Death Valley, and (4) Cadiz Valley. The Baker Sink begins near “3” and ends near “4”

1972) in Tools for Population Genetic Analysis (TFPGA; Miller 1997). Results were similar among all genetic distance measures, so we only report analyses using D_{LR} (Supplementary material). We also calculated pair-wise Euclidean distances (m) as a measure of straight-line geographic distance between pairs of the centroids of our sampling locations in ArcGIS (ver. 9.2, ESRI, Redlands, CA, USA).

Statistical model of suitable habitat

We identified levels of landscape friction with a model of the distribution of potential habitat in space (Wang et al. 2008) instead of the approach that uses expert opinion or ad hoc measures using environmental variables (Adriaensen et al. 2003; Verbeylen et al. 2003; Broquet et al. 2006; Theobald 2006; McRae and

Beier 2007). The implicit assumption is that a model of habitat suitability is a valid approximation for landscape permeability to dispersal (Broquet et al. 2006; Epps et al. 2007; Wang et al. 2008). We developed a model of habitat suitability using the presence data (15,311 observations) and environmental layers described in Nussear et al. (2009). We used 12 environmental variables to predict the presence of the Mojave desert tortoise throughout their geographic range. The environmental data consisted of various GIS layers of vegetation, topography, soils and precipitation (Table 1). Tortoise presence points were aggregated into a 1 km^2 grid where one or multiple locations per km^2 indicated presence of tortoises. The total number of number of presence points was reduced to 6,350 grid cells containing tortoises. Environmental layers were calculated at a 1 km^2 scale either directly (e.g., precipitation) or using an area-weighted average for each 1 km^2 cell (e.g., elevation). The number of environmental layers was reduced from an initial set of 16 GIS layers (Nussear et al. 2009) using AIC ranking (Burnham and Anderson 2002) in a bi-directional, stepwise model-ranking process (Lehmann et al. 2002). A Generalized Regression Analysis and Spatial Prediction (GRASP) modeling algorithm (Lehmann et al. 2002) was used to build the model using 80% of the points (5,080), and the remaining 20% of the points (1,270) were used for model evaluation. Model performance was evaluated using receiver-operating characteristics (ROC) that were calculated using the ROCR package (Sing et al. 2005) in R (R Development Core Team 2009). The 12-variable model had a high AUC (area under the ROC curve) test score (0.92) and had a significant Pearson's correlation coefficient of 0.75 ($P < 0.001$), indicating a substantial agreement between the predicted habitat and the observed presence of desert tortoises in the testing set. The resulting predictive model of Mojave desert tortoise occurrence was represented by a floating-point value ranging from 0 to 1, which we defined as suitability of tortoise habitat in each cell. We used this model of tortoise occurrence to create a cost surface for the isolation by landscape friction model. Thus, cells of lower potential habitat would reduce the ability to traverse the landscape. The cost surface was calculated by subtracting each cell value from 1.

We also created a binary representation of habitat suitability by classifying habitat suitability as a binary distribution where 1 equaled habitat and 0 equaled non-habitat by using a threshold that included 99% of all known presence cells (using a model value >0.125). Cells that were non-habitat were coded as "no data" in the binary cost surface, which caused those cells to be complete barriers to movement. This binary model was used as our isolation by barriers model because it designated places that would not be considered tortoise habitat, but explicitly allowed tortoises to move across all other cells without friction.

Table 1 Variables used to model potential habitat for the Mojave desert tortoise (Nussear et al. 2009)

Category	Variable	Data layer description	Source
Topography	Elevation	30 m DEM	Wallace and Gass (2008)
	Slope	Derived from 30 m DEM	Wallace and Gass (2008)
	Northness (aspect)	Derived from 30 m DEM	Wallace and Gass (2008)
	Average surface roughness	Derived from 30 m DEM	Wallace and Gass (2008)
	Percent smoothness	Derived from 30 m DEM	Wallace and Gass (2008)
Soils	Average bulk density		STATSGO database; Bliss (1998)
	Depth to bedrock		STATSGO database; Bliss (1998)
	Average percentage of rocks	>254 mm B-axis diameter	STATSGO database; Bliss (1998)
Vegetation	Perennial plant cover		Wallace et al. (2008)
	Annual plant proxy		Wallace and Thomas (2008)
Climate	Mean dry season precipitation	30 year normal period (1961–1990) May–October	Blainey et al. (2007)
	Mean wet season precipitation	30 year normal period (1961–1990) November–April	Blainey et al. (2007)

We analyzed the resulting cost surfaces with the centroids of the 25 tortoise sampling locations using least-cost-path and isolation-by-resistance as quantifications of landscape friction. The area covered by the GRASP model included the entire area sampled for population genetics, and the Colorado River was included as an absolute barrier in all models (Fig. 1; Nussear et al. 2009).

Quantifying landscape friction: least-cost path

Least-cost-path analyses are used to estimate a least-cost distance between habitat patches (Adriaensen et al. 2003; Theobald 2006). The least-cost distance is a modified Euclidean distance that uses landscape friction to determine a more ecologically-relevant path between patches (Verbeylen et al. 2003; Theobald 2006). Typically, least-cost distance is calculated using a cost-weighted function (cost associated with moving across a cell). The least-cost path for each pair of locations was quantified with the cumulative cost across all cells while moving from location A to B in GRASS GIS (ver. 6.3; GRASS Development Team 2008). We plotted the least-cost path between each of the 25 sampling locations in ArcGIS (ver. 9.2, ESRI, Redlands, CA, USA).

Quantifying landscape friction: isolation-by-resistance

Isolation-by-resistance is based in circuit theory, and uses a graph theoretic approach to predict movement patterns and quantify the effects of certain landscape features (McRae 2006; McRae et al. 2008). The edges between nodes (or locations) in the graph network are represented as analogs to resistors in an electrical circuit and the same basic concepts apply (i.e., Ohm's Law; McRae et al. 2008). Resistance distance is a measure of isolation that is similar to the least-cost distance; however, the resistance distance decreases as the number of available pathways between locations increases (McRae et al. 2008). In addition to integrating connectivity across all possible paths, the resistance distance assumes that the disperser does a random walk between points, basing each movement on the relative quality of the habitat in all directions. When the movement corresponds to gene flow, which operates on a different spatio-temporal scale, the surrogate is migration rate per generation (McRae 2006).

We calculated resistance distance between all pairs of desert tortoise locations in Circuitscape (ver. 3.4; McRae and Shah 2009). For our models, the habitat suitability in each grid cell was treated as a conductance value (the inverse is resistance). Circuitscape provided a pair-wise resistance distance matrix as well as a cumulative (additive among pairs) current map, representing the expected probability of movement for random walkers, which we viewed in ArcGIS (ver. 9.2, ESRI, Redlands, CA, USA).

Causal modeling framework and Mantel tests

To evaluate geographic distance, barriers, and landscape friction in a causal modeling framework (Legendre 1993; Cushman et al. 2006), we identified the diagnostic expectations for each of the seven possible hypotheses of causal relationships (Table 2). Diagnostic expectations for each model included a specific set of partial correlations to be statistically significant or not (Table 2). For example, under the distance only model, geographic distance would have a significant positive correlation with genetic distance after parsing out the barrier or landscape-friction matrix (Table 2). Under the same model, the barrier and landscape-friction matrices would not be significantly correlated to genetic distance after parsing out geographic distance (Table 2). Then, we compared the statistical relationship between genetic distance and each model (Legendre 1993; Cushman et al. 2006). We determined a single supported model by testing each factor against the competing factors and then evaluating the combined results. The hypothesis with the most support should meet all of the diagnostic expectations associated with that hypothesis, providing a rigorous evaluation of the potential factors that impede gene flow (Table 2).

We completed Mantel tests (Mantel 1967) and partial Mantel tests (Smouse et al. 1986) in Program R using the "vegan package" (Oksanen et al. 2007). A Pearson product-moment correlation was calculated, and we determined significant correlations by using a permutation test with 10,000 replicates. We used the Monte Carlo *P*-value to determine significant simple and partial Mantel correlations, but only used them to determine which diagnostic expectations were met for each model. These actions reduced the chance of bias in our interpretations, and they address some of the criticisms of partial Mantel tests

Table 2 Evaluation of the isolation hypotheses using two quantifications of landscape friction: least-cost path (LCP) and isolation-by-resistance (IBR)

Partial Mantel	Diagnostic expectations and model support													
	Distance only		Barrier only		Landscape only		Distance and barrier		Distance and landscape		Landscape and barrier		Distance, landscape, barrier	
	LCP	IBR*	LCP	IBR	LCP	IBR	LCP*	IBR	LCP	IBR	LCP	IBR	LCP	IBR
DG.B	**>0**	**>0**	NS	NS	NA	NA	**>0**	**>0**	**>0**	**>0**	NS	NS	**>0**	**>0**
DG.L	**>0**	**>0**	NA	NA	NS	NS	**>0**	**>0**	**>0**	**>0**	NS	NS	**>0**	**>0**
BG.D	NS	**NS**	**>0**	>0	NA	NA	**>0**	>0	NS	**NS**	**>0**	>0	**>0**	>0
BG.L	NA	NA	**>0**	**>0**	NS	NS	**>0**	**>0**	NS	NS	**>0**	**>0**	**>0**	**>0**
LG.B	NA	NA	**NS**	**NS**	>0	>0	**NS**	**NS**	>0	>0	>0	>0	>0	>0
LG.D	**NS**	**NS**	NA	NA	>0	>0	**NS**	**NS**	>0	>0	>0	>0	>0	>0

The diagnostic expectations (partial Mantel test and the expected significance value) for each hypothesis are listed. *D* distance, *B* barrier (binary habitat model), *L* landscape (continuous habitat model), *G* genetic distance (D_{LR}), *NS* not significant, >0 = *P*-value below 0.05, *NA* not applicable. A period separates the main matrices on the left from the covariate matrix on the right that is partialed out in the partial Mantel test. For example, DG.B is a partial Mantel test between the distance, and the genetic distance matrices with the barrier matrix partialed out. Model support is indicated with bold type based upon the *P*-value for each partial Mantel test compared to the diagnostic expectations. Refer to Table 3 for the exact *P*-values for each partial Mantel test

* The hypothesis with the most support

(Raufaste and Rousset 2001; Rousset 2002, but see Castellano and Balletto 2002; Balkenhol et al. 2009).

Results

Mantel correlations

Euclidean distance correlated significantly with pairwise genetic distance, as evidenced by a significant Mantel correlation (Table 3). Additionally, least-cost distances and resistance distances for the landscape-friction and barrier models were correlated significantly with genetic distances between pairs of sampling locations (Table 3). However, the simple Mantel correlations were lower for the resistance-distance matrices (Table 3).

Causal modeling and partial Mantel tests

The hypothesis of isolation with the most support varied depending on the quantification of landscape friction (Table 2). Using least-cost distances, the barrier and distance model was fully supported by all the statistical expectations. Using resistance

Table 3 Mantel and partial Mantel correlations (*r*) between spatial and genetic pairwise distances among 25 sampling locations

Mantel or partial Mantel test	Least-cost distance		Resistance distance	
	r	*P*-value	*r*	*P*-value
DG	0.821	**0.0001**		
BG	0.820	**0.0001**	0.467	**0.0001**
LG	0.738	**0.0001**	0.351	**0.0001**
DG.B	0.194	**0.0300**	0.766	**0.0001**
DG.L	0.537	**0.0001**	0.806	**0.0001**
BG.D	0.188	**0.0250**	−0.094	0.7900
BG.L	0.339	**0.0004**	0.580	**0.0001**
LG.B	−0.256	0.9930	−0.507	0.9900
LG.D	−0.077	0.7740	−0.241	0.1940

Spatial distances are resistance distance or least-cost distance using the cost surface from the habitat model. The Mantel test statistic *r* is based on a one-sided Pearson's product-moment correlation and significance values are based on 10,000 permutations. *D* distance, *B* barrier (binary habitat model), *L* landscape (continuous habitat model), *G* genetic distance (D_{LR}). A period separates the main matrices on the left from the covariate matrix on the right that is partialed out in the partial Mantel test. For example, DG.B is a partial Mantel test between the Euclidean distance and the genetic distance matrices with the barrier distance matrix partialed out. Bold values indicate *P*-values < 0.05

distances, the distance model was fully supported (Table 2). The outcome of the BG.D partial Mantel test was the main difference between the two landscape friction quantifications, causing the barrier and distance model to not be fully supported using resistance distances (Tables 2, 3). The landscape-friction component of all hypotheses had no support based on the diagnostic expectations (Tables 2, 3).

The cumulative, least-cost paths across the 25 locations were similar in the landscape-friction and barrier models (Fig. 2). The paths for both models did not include large areas of unsuitable habitat such as the northwest corner of the range and major mountain ranges such as the Spring Mountains (Fig. 2). The barriers were apparent in both models, however, the lack of a gradient across other habitat in the barrier model made individual paths between locations more direct, making them more similar to the Euclidean distance (not shown). Similar barriers and habitat corridors were visible in the isolation-by-resistance maps (Fig. 3) when compared to the least-cost-path maps (Fig. 2). Mountain ranges (e.g., Spring, New York, Providence, and Sheep Ranges) and low elevation areas (Death and Cadiz Valley) had no current flow (Fig. 3). The northeastern portion of the desert tortoise's range in Nevada and into California,

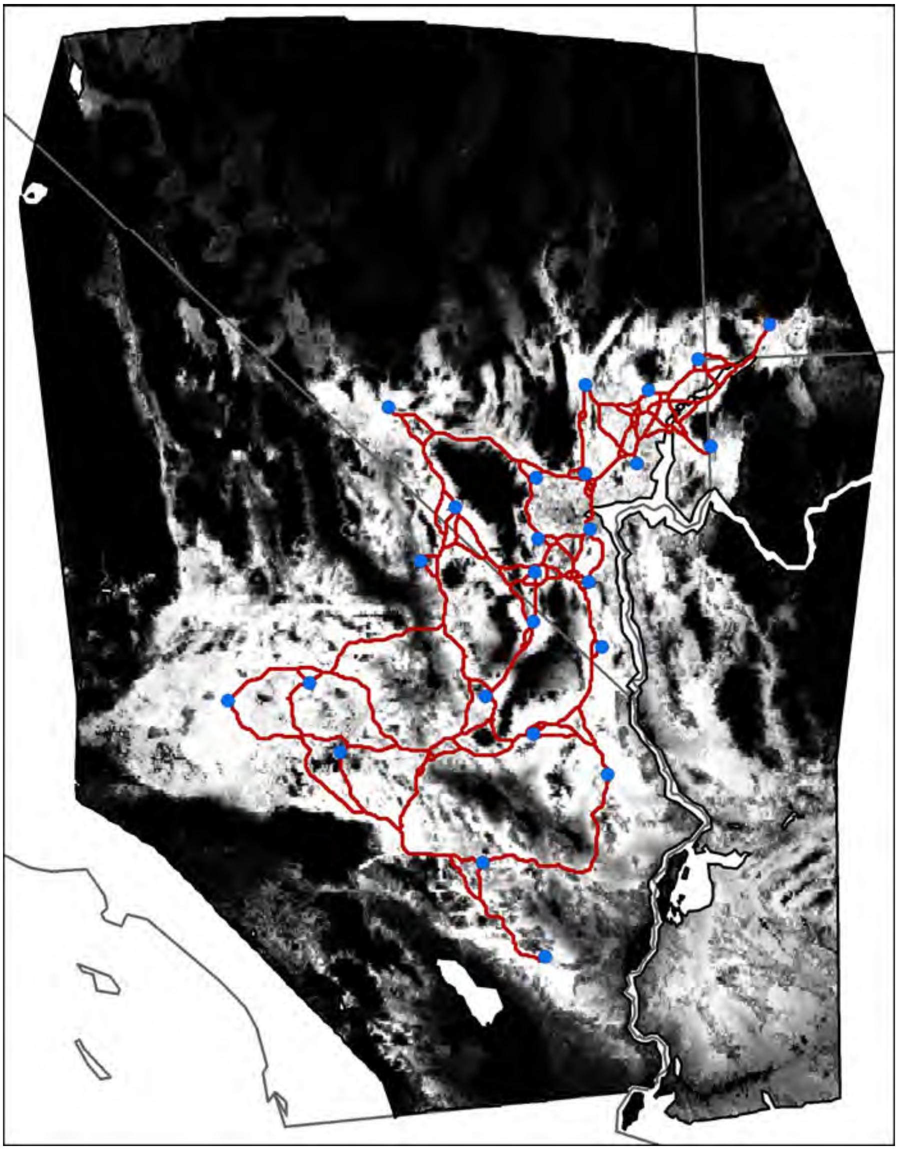

Fig. 2 Distribution of desert tortoise habitat in the Mojave Desert predicted using the 12-variable GRASP model in Program R and the cumulative least-cost path using the 25 pair-wise population comparisons. Gradient of *grey* (floating values) indicate probability of desert tortoise occurrence. *Black* indicates lowest probability (0) while *white* indicates highest probability (1). *Red lines* indicate least-cost paths between pairs of sampling locations. *Blue dots* represent the 25 population centroids

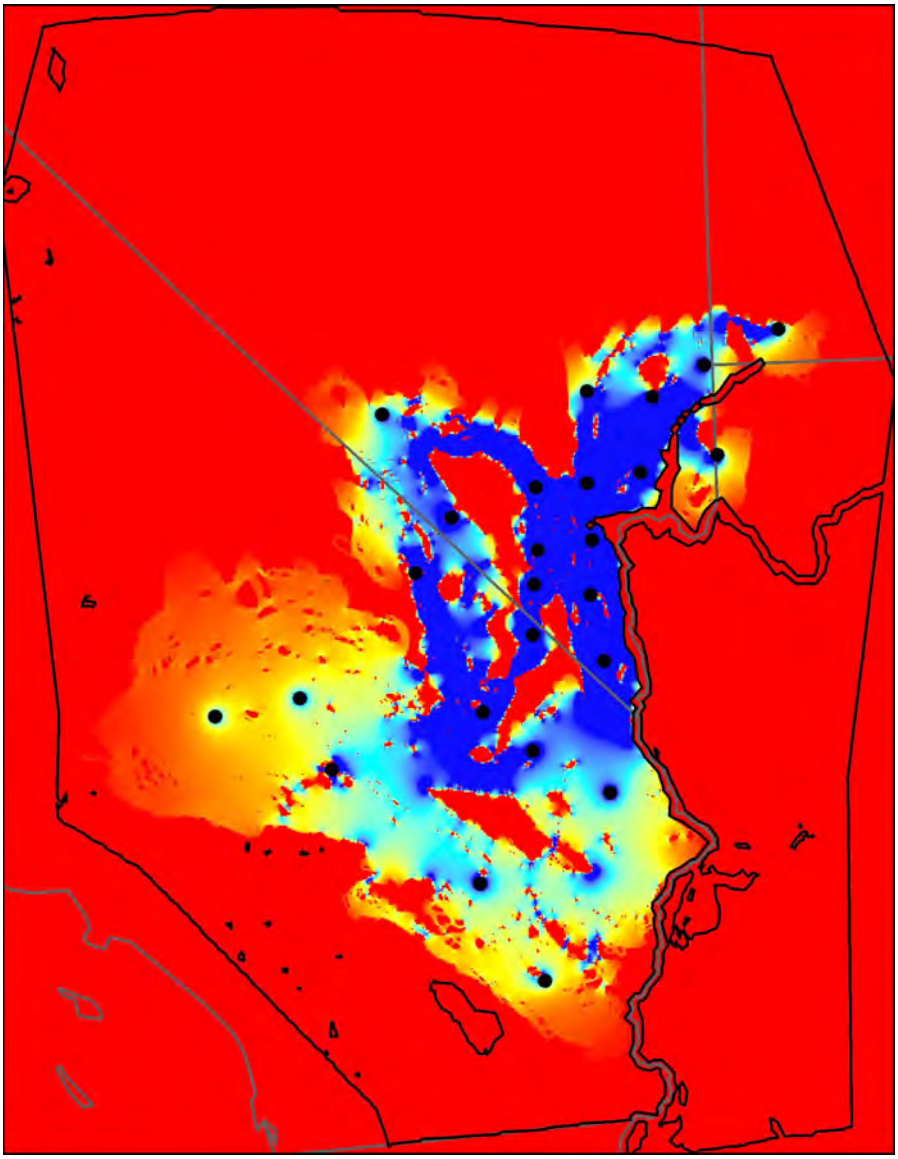

Fig. 3 Cumulative current maps between pairs of populations from the isolation-by-resistance models using the binary 12-variable habitat model (barrier). The gradients of colors indicate the probability of desert tortoise movement, with *red regions* indicating no current, *yellow* and *orange regions* representing low current, and *blue regions* representing high current. *Black dots* represent the 25 population centroids

mainly through Las Vegas valley, along the Colorado River, and regions between mountain ranges, contained areas of very high current density (Fig. 3). In contrast, natural barriers did not fragment habitat within California and had more diffuse current flow between sampling locations (Fig. 3).

Discussion

We evaluated hypotheses about isolation among populations of the Mojave desert tortoise in a causal modeling framework to determine which factors most likely limit gene flow. Hypotheses included combinations of three factors: geographic distance, dispersal barriers, and landscape friction. We identified geographic distance and dispersal barriers as dominant factors associated with genetic structure, while landscape friction, as we defined it, had little to no little influence.

Previously, the desert tortoise was identified as a model organism for studying isolation-by-distance (Edwards et al. 2004). Straight-line distances among locations of desert tortoises strongly correlates with genetic distances, suggesting that dispersal distance is a major factor shaping genetic structure among, and within, populations (Edwards et al. 2004; Murphy et al. 2007; Hagerty and Tracy 2010). Our data supported these previous assertions, which is an unusual circumstance for natural populations. For a majority of terrestrial species, straight-line distances are correlated only weakly with genetic distance (e.g., Vos et al. 2001; Coulon et al. 2004; Broquet et al. 2006; McRae and Beier 2007). However, genetic distance correlates well with geographic distance at a landscape scale for some terrestrial turtles and tortoises (e.g., Howeth et al. 2008).

Dispersal barriers also were correlated with genetic distance, and the distance and barriers hypothesis was the best-supported model with the least-cost distance quantification. Therefore, dispersal distance may not be the only factor impeding gene flow. Gene flow among desert tortoise populations is at least partially restricted by large topographic features such as high-elevation mountain ranges (e.g., Spring Mountains, New York Mountains, Providence Mountains) and very low elevation regions (e.g., Death Valley, Cadiz Valley; Fig. 1). These apparent elevation barriers are visible in the maps of landscape friction (Figs. 2, 3) and elevation explained a high proportion of the variance in tortoise presence in the habitat model (Nussear et al. 2009). Elevation appears to be an important determinant of these partial barriers, but it is an indirect measure of several variables, including thermal environment, soil type, and vegetation assemblages (e.g., Nagy and Medica 1986; Germano et al. 1994; Zimmerman et al. 1994; Andersen et al. 2000; Nussear 2004). Thus, areas with extremely high or low elevations likely impose thermal constraints that we were unable to model directly, provide suboptimal vegetative cover, and physically impair movements.

Due to one diagnostic expectation, barriers appeared not to affect genetic structure with the resistance-distance quantification. Differences between the quantifications of landscape friction could explain this result. Most importantly, when more than one pathway is available to traverse the landscape or the size of the path increases, the resistance distance effectively decreases, but the least-cost distance does not (McRae et al. 2008). The redundancy in habitat corridors may have reduced resistance (friction) enough that the barriers were no longer correlated with genetic distance between sampling locations of desert tortoises. The underlying assumptions of the algorithm are also different. The least-cost-path algorithm, which is an overall measure of landscape friction, assumes that a disperser has complete knowledge of the landscape as it chooses the "preferred" route (McRae et al. 2008), though the feasibility of the route is not considered (Adriaensen et al. 2003). The isolation-by-resistance algorithm assumes that the disperser is equivalent to a random walker that chooses a direction for each step based only on the relative quality of the habitat in the adjacent directions, allowing the potential for wandering (McRae et al. 2008). However, it is important to recall that we investigated how the landscape influences migration rates per generation across a large geographic area, not individual dispersers among habitat patches. In this case, we can interpret the optimal path (s) as proportionally increasing the amount of gene flow.

The differences between the two quantifications can be compared by regression of the residuals from linear regressions of the friction measures against Euclidean distance. Individual comparisons with higher least-cost distances compared to the Euclidean distance (higher residuals) are locations that are separated by large mountain ranges. For example, the South I-15 corridor (SI) and Pahrump (PA) are separated by approximately 66 km straight-line distance, but are also separated by the Spring Mountains. These locations have a pair-wise F_{ST} of 0.023 (Hagerty and Tracy 2010). In contrast, two locations with an equivalent straight-line distance that are not separated by a mountain range (Amargosa Desert and Pahrump) have a pair-wise F_{ST} value of 0.009 (Hagerty and Tracy 2010). This example illustrates why the barriers and distance hypothesis was supported by the diagnostic expectations with the least-cost distance. However, individual comparisons with higher resistance distances compared to the Euclidean distance (higher residuals) are locations that are separated by "pinch points," or areas with very narrow habitat corridors that increase the resistance distance. For example, high resistance distances are connected to locations such as Red Cliffs Desert Reserve (RC), which has a very narrow area of habitat that connects it to the rest of the range (Fig. 3). These narrow habitat corridors appear to drive the results for isolation-by-resistance. Multiple habitat corridors that circumvent the mountain barriers reduce the resistance, and could explain the reduction in support for the barriers and distance hypothesis.

We did not find any support for the hypothesis that landscape friction per se causes isolation for Mojave desert tortoises and there are several potential reasons for this. First, friction accumulates with distance, so isolation-by-distance may dominate the explained variance, thus masking additional resistance. Second, our landscape variables may be insufficient to capture the factors influencing the movement of tortoises through the landscape, although they are good predictors of tortoise presence. Quantifying landscape friction relies on relevant landscape variables, which accurately reflect the cost of dispersal for the individual at the appropriate temporal and spatial scale (Balkenhol et al. 2009). Therefore, the effectiveness of the approach depends upon success in modeling landscape friction (Holderegger and Wagner 2008). Our chosen landscape variables, which describe desert tortoise habitat in the present, also may not capture the appropriate temporal scale to explain the genetic population structure (Balkenhol et al. 2009). Further, we used statistical habitat models (Austin 2002; Lehmann et al. 2002), where the chosen variables were predictors of tortoise habitat suitability, and used as a proxy for landscape friction. Thus, the cost surfaces from the habitat suitability model may only reflect habitat use and not the cost of dispersal (Epps et al. 2007).

Another potential explanation for the lack of support for landscape resistance is that the processes that influence movement at finer spatial and temporal scales may not impact observed, broad scale patterns of population structure (Lee-Yaw et al. 2009). Although heterogeneity in variables such as annual and perennial vegetation and precipitation likely influence daily, seasonal, and annual movements of tortoises, these variables provided little explanation for the patterns of genetic structure that we observed at the regional level. The effects of landscape variables may be limited at these broader spatial scales, especially for species with strong dispersal capabilities that have multiple avenues for gene flow (Lee-Yaw et al. 2009). At the regional scale, desert tortoise habitat had considerable redundancy in habitat corridors, which may reduce the impact of any high resistance areas at a local scale (Fig. 3). The most influential features in this system are likely absolute barriers to dispersal such as the Colorado River, which separates the Mojave and Sonoran populations of the desert tortoise (Murphy et al. 2007).

Our study reinforces the hypothesis that habitat within the Mojave population of the desert tortoise was well connected. We can deduce from the *F*-statistics and assignment tests that gene flow among adjacent populations within the Mojave and Colorado Deserts was relatively high, at least historically (Hagerty and Tracy 2010). Las Vegas Valley was hypothesized previously to be a transitional corridor between the northern and southern reaches of the geographic range (Britten et al. 1997; Hagerty and Tracy 2010). We detected habitat corridors in Las Vegas Valley, and along the foothills of the New York and Providence Mountains (Fig. 3). In comparison to the northeastern Mojave Desert, habitat in the southwestern portion of the range is more continuous and has few "pinch points" that indicate important, restricted habitat corridors (i.e., low habitat redundancy). The Baker Sink is a low-elevation barrier that begins in Death Valley and separates these topographically different areas (Fig. 1).

Despite inferring the existence of partial barriers, gene flow was most likely possible through local interactions over many generations. Therefore, most, if not all, dispersal barriers were permeable over the long temporal scale at which tortoise population dynamics likely occur. Genetic exchange and dispersal are population-level processes, which occur over long temporal scales from decades to centuries, especially for species with long generation times (Brooks 2003; Keyghobadi 2007). Thus, our models are best used for addressing large-scale patterns of gene flow that were present for generations, not the nuances of dispersal over short time scales (McRae 2006; Epps et al. 2007; Lee-Yaw et al. 2009).

Our modeling cannot address any present day barriers to gene flow for the Mojave desert tortoise. For species with long generations times (such as the desert tortoise), detecting the effects of recent habitat fragmentation may be difficult, even when using variable molecular markers (Keyghobadi 2007, though see Murphy et al. 2008). Indeed, any changes in gene flow that have occurred over the past century, such as the construction of major highways, are likely not yet visible with microsatellite markers because the generation time for a desert tortoise is estimated to be 25 years (USFWS 1994; Hagerty and Tracy 2010). However, evidence exists that roads can cause changes in genetic structure with sufficient time (e.g., Vos et al. 2001; Epps et al. 2005), and in some cases as few as five generations (Murphy et al. 2008). We can hypothesize that fragmentation of the Mojave Desert has altered the natural patterns of dispersal and gene flow for this species, which we began to uncover in this study. Future work should include tests of the effects of fragmentation and modeling to predict any resulting genetic effects.

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Thank you for your comment, Ann Congdon.

The comment tracking number that has been assigned to your comment is SEDDsupp20102.

Comment Date: January 26, 2012 23:57:14PM
Supplement to the Draft Solar PEIS
Comment ID: SEDDsupp20102

First Name: Ann
Middle Initial: M
Last Name: Congdon
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Address 3:
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State: CA
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Country: USA
Privacy Preference: Don't withhold name or address from public record
Attachment:

Comment Submitted:

There was insufficient publication and many people have not read the report. I am requesting an extension of the public comment period for the following reasons:
The Solar PEIS Supplement (a 582-page document) with its extensive scientific data and regulatory information requires time for stakeholders to make informed comments.
An extension of the public comment period (3 months) is necessary to have sufficient time to adequately analyze the effects of 20 million additional acres of public lands and to ensure a meaningful democratic process.

The size of these variance lands east of the City of Twentynine Palms and east of the Air/Ground Combat Center will affect wildlife corridors and other environmental, cultural, and economic resources. Solar development on these lands and their proximity to the Joshua Tree National Park which attracts visitors from all over the world will have a significant effect on the local and regional tourism economy of the gate-way communities in the Morongo Basin.

Thank you for your comment, Alan Carlton.

The comment tracking number that has been assigned to your comment is SEDDsupp20103.

Comment Date: January 27, 2012 00:05:27AM
Supplement to the Draft Solar PEIS
Comment ID: SEDDsupp20103

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Comment Submitted:

Dear Secretary Salazar,

I appreciate the opportunity to submit comments to the Bureau of Land Management ("BLM") on the Supplement to the Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States ("Supplement to the Draft PEIS"). I am submitting these comments as someone who cares deeply about preserving our precious Western ecosystems and wild lands. However, I also have a strong commitment to halting climate change and ending our dependence on fossil fuels.

I support developing rules to guide solar projects to the most appropriate areas to minimize impacts to wildlife and ecosystems. I strongly support limiting development on public lands to low-impact solar energy zones.
Your proposal to allow additional projects outside zones (the "Variance Process") could undermine the entire solar energy program if developers can site solar projects in areas with high environmental resource value. If the variance process is included in the final program, please make sure that variance applications are the exception not the rule by processing such applications only in areas with low resource conflicts and only when solar energy zones contain insufficient land. Variance applications should be processed in accordance with IM No. 2011-061.

I commend the BLM for excluding fragile and ecologically important areas from solar development in response to environmental concerns (the "Exclusion Areas"). I would like to see this list of Exclusion Areas expanded to include additional environmentally sensitive areas and those areas important to the survival of wildlife species such as: wildlife habitat management areas, golden eagle foraging and nesting habitat, the entire Ivanpah Valley in both Nevada and California, Citizens Wilderness Proposals, lands acquired by the BLM for conservation purposes and the entire Pisgah Valley.

Sincerely,

Thank you for your comment, Marilyn Jasper.

The comment tracking number that has been assigned to your comment is SEDDsupp20104.

Comment Date: January 27, 2012 01:25:18AM
Supplement to the Draft Solar PEIS
Comment ID: SEDDsupp20104

First Name: Marilyn
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Comment Submitted:

We care deeply about preserving our ecosystems and wildlife habitat as well as halting climate change/dependency on fossil fuels. Rules to establish solar projects in appropriate areas that minimize impacts and to limit such projects to low-impact solar energy zones must be established and fully followed. Allowing projects outside such zones ("Variance Process") should not be allowed, especially if any high-value environmental resources would be impacted. If/when rarely allowed, Variance applications should be processed in accordance with IM No. 2011-061.
Any/All efforts to exclude fragile and important areas as well as any areas which are important for wildlife survival must given highest priority in locating solar development.

Thank you for your comment, Brian King.

The comment tracking number that has been assigned to your comment is SEDDsupp20105.

Comment Date: January 27, 2012 10:34:05AM
Supplement to the Draft Solar PEIS
Comment ID: SEDDsupp20105

First Name: Brian
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Attachment: Rocky Mountain Power - Comments on Solar Draft PEIS - 27January2012.pdf

Comment Submitted:

ROCKY MOUNTAIN POWER
A DIVISION OF PACIFICORP

1407 West North Temple
Salt Lake City, UT 84116

January 27, 2012

Supplemental and Draft Solar Programmatic Environmental Impact Statement (PEIS)

Rocky Mountain Power Comment Letter

To Whom It May Concern,

Rocky Mountain Power (the Company), a division of PacifiCorp, appreciates the U.S. Department of Energy, Energy Efficiency and Renewable Energy Program and the U.S. Department of the Interior, Bureau of Land Management's efforts to facilitate future siting of utility-scale solar /renewable energy development and efforts to ensure consistent application of conservation and mitigation measures applicable to such development. The Company serves over 1 million customers in three states, Idaho, Utah and Wyoming.

The Company maintains and operates transmission lines within the vicinity of SEZs identified in the PEIS in Utah and is currently planning additional lines, notably the Sigurd to Red Butte 345 kV Transmission Line Project (DEIS released in summer of 2011). As such the Company takes vested interest in energy resource development within its service territory.

The Company provides the following comments for consideration as follows:

Criteria to Identify SEZs

Criteria to identify SEZs include proximity to transmission lines, as stated specifically for the Milford Flats South SEZ on page 13.2-1, Section 13.2.1.1 General Information, lines 3-39 and is further evident in the description of the Milford Flats South SEZ which includes the following statement on page 13.2-1, lines 23-24 that "The nearest alternating current transmission line is a 345-kV line that runs north to south about 19 mi (31 km) southeast of the eastern boundary of the proposed SEZ.". The Company recognizes that proximity to transmission is one of several criteria, albeit a fairly important criterion, used to identify SEZs.

The Company concurs with the assumption made on page 13.2-3, Section 13.2.1.2 Development Assumptions for the Impacts Analysis, lines 24-29 stating "It is possible that this existing line could be used to provide access from the SEZ to the transmission grid, but the 345-kV capacity of that line may be inadequate for 576 to 1,037 MW of new capacity (note: a 500-kV line can approximately accommodate the load of one 700-MW facility). At full build-out capacity, it is likely that new transmission and/or

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upgrades of existing transmission lines would be required to bring electricity from the proposed Milford Flats South SEZ to load centers; however, at this time, the location and size of such new transmission facilities is unknown."

Similar conclusions are made for the Escalante Valley SEZ (3 miles from the termination of an existing 138 kV line).

The Company would like to emphasize that the existence of a transmission line does not necessarily mean that adjacent generation sources can be accommodated by that line. Therefore, this section of the document appears to make a conclusion that may be premature and inaccurate without much further detailed study of the transmission capacity on the existing system in the vicinity of an SEZ.

Safety and Setback from Existing Facilities

The Company requests that safety issues, such as setback distances from existing and currently proposed transmission lines be incorporated and clearly articulated within the PEIS and identification of SEZs. Based on review of maps of the proposed Milford Flats South and Escalante Valley SEZs, it is difficult to determine their location in relation to the Companies currently proposed Sigurd to Red Butte 345 kV transmission line study corridor and any potential siting conflicts that may exist.

Regulatory Mechanisms

The Company encourages the BLM to consider potential Applicants' responsibilities under other federal processes and/or regulatory obligations as part of its assessment for future generation potential; especially those related to transmission system reliability and governed by the Western Electricity Coordinating Council (WECC) and/or the Federal Energy Regulatory Commission (FERC).

The Company appreciates consideration of its comments. Please contact Aaron Gibson (801-756-1201), aaron.gibson@rockymountainpower.net, with any questions.

Sincerely,

Aaron Gibson
Customer and Community Manager

Thank you for your comment, Sally Miller.

The comment tracking number that has been assigned to your comment is SEDDsupp20106.

Comment Date: January 27, 2012 10:54:38AM
Supplement to the Draft Solar PEIS
Comment ID: SEDDsupp20106

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Attachment: 1-27-2012 SPEIS comments FINAL+Appendix.pdf

Comment Submitted:

Please accept these comments on behalf of Audubon California, California Wilderness Coalition, Defenders of Wildlife, Natural Resources Defense Council, Sierra Club and The Wilderness Society.

Thank you.

AUDUBON CALIFORNIA
CALIFORNIA WILDERNESS COALITION
DEFENDERS OF WILDLIFE
NATURAL RESOURCES DEFENSE COUNCIL
SIERRA CLUB
THE WILDERNESS SOCIETY

January 27, 2012

Delivered via electronic submission to the BLM Solar PEIS website and U.S. mail

Ms. Shannon Stewart
Solar Energy PEIS
Argonne National Laboratory
9700 S. Cass Avenue – EVS/240
Argonne, IL 60439
Submitted via U.S. Mail and Email

RE: Comments on Supplement to the Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (California portion)

Dear Ms. Stewart:

Following are comments on the Bureau of Land Management's (BLM's) and the Department of Energy's (DOE's) jointly prepared Supplemental Programmatic Environmental Impact Statement (SPEIS) for Solar Energy Development in Six Southwestern States, submitted by Audubon California, California Wilderness Coalition, Defenders of Wildlife, Natural Resources Defense Council, Sierra Club and The Wilderness Society. Our organizations have been deeply involved in protecting California's public lands for decades and, more recently, in renewable energy development throughout the state, especially in the desert region. These comments are specific to California, and we hope you will give them serious consideration.

I. Introduction.

We appreciate that the Department of the Interior (DOI) has recognized via the issuance of the SPEIS the wisdom of adopting a "directed development" approach to large-scale solar energy development on the west's public lands, as reflected in the modified solar energy development program alternative. We applaud this modified approach and believe it will lead to the best large scale solar development projects located in the most suitable places on our public lands.[1]

[1] We believe that large scale solar development on appropriate private lands within the California desert is not only feasible but essential, and are pleased to see BLM acknowledge the importance of public-private land use planning for solar energy development in the SPEIS. See, e.g., SPEIS at p. 2-29. There may also be potential for development of some large-scale solar on Department of Defense (DOD) lands; see, e.g., http://www.serdp-estcp.org/News-and-Events/News-Announcements/Program-News/DoD-study-finds-7-000-megawatts-of-solar-energy-potential-on-DoD-installations-in-Mojave-Desert ("The study concludes that 25,000 acres are 'suitable" for solar development' on DOD lands in the Mojave Desert.")

We strongly believe that, ultimately, the success of the DOI's and the BLM's solar energy program depends on developing policy and guidelines that will guide projects to the most appropriate locations, thus limiting environmental impacts and facilitating the timely construction of the most appropriate projects. We appreciate the DOI's commitment to zone-based development, as expressed not just in this supplemental document but also in the remarks of officials at the time the supplement was released. See, e.g., Department of Interior news release, October 27, 2011; http://www.blm.gov/wo/st/en/info/newsroom/2011/october/NR_10_27_2011.html.

We look forward to working further with the DOI and the BLM to ensure that: 1) appropriate Solar Energy Zones (SEZs) are identified and designated; 2) solar projects are guided to those zones via appropriate development incentives in the zones; 3) additional information needed to ensure "smart from the start" development is incorporated into regional mitigation plans and SEZ-specific project design features; 4) additional policy and/or plans needed to support a comprehensive and environmentally responsible solar energy development program on our public lands are adopted; and 5) the decisions made in the Final PEIS are integrated into and coordinated with the Desert Renewable Energy Conservation Plan (DRECP) planning effort for the Mojave and Colorado deserts of California, and the BLM remains committed to managing its lands in the California desert in conjunction with the DRECP.

The proposal to make some BLM lands open to "variance" applications is new, and, if included in the final program, must be accompanied by measures to ensure that such applications and any resulting projects are the exception, not the rule.[2] The additional lands we believe should be excluded from variance applications are detailed below and in our comments on the Draft PEIS,[3] which we fully incorporate by reference herein. We recommend that DOI acknowledge that any variance applications considered after adoption of the Final PEIS and before adoption of the DRECP must be consistent with the developing DRECP conservation strategy pursuant to the "consistency" requirements of the California's Natural Communities Conservation Planning Act of 2003. See California Department of Fish and Game sections 2800, et seq.[4]

The deserts of California are particularly vulnerable to climate change; in fact the California Desert has been determined to be a "hot spot" for climate change. See, e.g., http://www.stanford.edu/~omramom/Diffenbaugh_GRL_08.pdf. While large-scale solar facilities may help to alleviate the effects of climate change and we therefore believe they need to be developed promptly, they have very direct impacts on the fragile desert landscape and its inhabitants, which could be exacerbated by climate change. The DOI and the BLM thus have a careful "balancing act" to do to ensure that solar development occurs in the most appropriate locations for such development while not irreversibly harming the ability of desert inhabitants to adapt to climate change.

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[2] Some of our organizations previously supported a well-defined and limited "variance" process. See letter of May 2, 2011 from California Desert Renewable Energy Working Group to Robert Abbey, Director, BLM.

[3] See NRDC, et al, April 29, 2011.

[4] Similarly, the consideration of new SEZs within the California Desert Conservation Area should also be consistent with the DRECP.

Our comments are organized as follows: We first discuss the California Desert Conservation Area (CDCA) and the DRECP; both the California-specific designation and the California-specific planning initiative have important relevance to the SPEIS. Next we discuss our recommendations for fine-tuning the California SEZs, followed by comments on recommended exclusion areas that we raised in our comments on the Draft PEIS and which we feel are not sufficiently addressed in the SPEIS. We call your attention to section six, in which we make recommendations for improving protection for the desert tortoise, a bellwether species for the California desert. Finally, we discuss issues raised by the supplement, including pending applications, and provide our recommendations for improving the maps and data that are presented in the SPEIS.

II. The California Desert Conservation Area.

Congress established the CDCA in 1976. See Section 601 of the Federal Land Policy and Management Act (FLPMA), 43 U.S.C. §§ 1701 *et seq*. In enacting this statute, Congress found that "the California desert environment is a total ecosystem that is extremely fragile, easily scarred, and slowly healed" and stated that its "purpose" in designating the CDCA was "to provide for the immediate and future protection and administration of the public lands in the California desert …, and the maintenance of environmental quality." Id., §§ 1781 (a)(2), (b). Congress further directed the preparation of "a comprehensive, long-range plan" for the CDCA with public participation. Id., §§ 1781 (a) (6), (d).

While we recognize that times have changed and additional demands for uses of public lands within the CDCA for renewable energy development have arisen, we nonetheless underscore the importance of FLPMA's provisions for the CDCA, and the importance of the CDCA to our organizations and the millions of Americans who annually utilize and enjoy these lands. Public lands within the CDCA are important for their historical, scenic, archaeological, environmental, biological, cultural, scientific, educational, recreational and economic resources, and there is strong public support for preserving these lands and their multiple resource values. We believe BLM's directed development approach will best help to meet state and federal renewable energy goals while preserving public lands and resources of key importance within the CDCA.

In addition to the provisions of FLPMA for the CDCA, the preferred alternative in the SPEIS and each of the alternatives needs to be consistent with the overall goals and objectives for management of public land resources, including but not limited to wildlife and vegetation, as contained in the CDCA plan, as amended. We emphasize the importance of this requirement by citing the following language from the BLM:

> "[T]he intent of the CDCA Plan is to ensure as nearly as humanly possible that the recognition brought by Congress and the people into law—that the California Desert is not a wasteland but a precious public resource—is effectively guaranteed in its management, that the uses of today do not preclude the users of tomorrow, and that we preserve and develop these assets wisely with full regard for their social and environmental as well as economic values.

CDCA Plan, as amended, p. 7 (1980).

III. The Desert Renewable Energy Conservation Plan and the SPEIS.

We thank the BLM for acknowledging the importance of the DRECP and affirming its commitment to the DRECP process, an issue we raised in our comments on the Draft PEIS. We believe it is critically important that the decisions made in the Final PEIS and the accompanying Record of Decision (ROD) are integrated into the DRECP process and that the BLM commits in the Final PEIS to managing its lands in the California desert consistent with the DRECP as provided in FLPMA.

We especially appreciate BLM's commitment to: "rely on the California DRECP planning effort…to identify new or expanded SEZs" (SPEIS at p. 2-28); "use the DRECP as the foundation for possible amendments to the CDCA Plan and three RMPs" (id. at p. 2-29); and "identify priority areas for renewable energy development (potentially through the identification of additional SEZs) and associated conservation on BLM lands within the DRECP planning area" (id. at p. 2-29). That being said, we recognize and appreciate that the Solar PEIS is a stand-alone document, and that it contains a mechanism to identify new SEZs in the future independent of other planning processes. See, e.g., SPEIS at p. 2-29, Appendix D.

Additional coordination is needed between the BLM and other agencies involved in the DRECP process. Specifically, we believe BLM should take the following actions to ensure improved coordination and consistency between the Solar PEIS and the DRECP:

1. The BLM and the DOI should take steps to ensure that the Final PEIS, ROD and the solar program that is established afford sufficient flexibility to permit compliance with FLPMA's "consistency language," which requires that BLM land use plans "be consistent with State … plans to the maximum extent [the Secretary] finds consistent with the Federal law and the purposes of this Act." 43 U.S.C. § 1712 (c)(9). The ROD signed for the Final PEIS should not pre-empt the DRECP nor preclude conservation on BLM lands that may be identified for such purposes via the DRECP. In other words, DOI and the BLM need to ensure that the PEIS, accompanying ROD and the new solar program are consistent with the mandates of FLPMA, but also that the Bureau retains sufficient flexibility to ensure consistency with recommendations for BLM lands that may be developed via the DRECP.
2. The BLM should specifically list or describe (e.g., via an appendix to the Final PEIS) potential public or combined public-private (i.e., "conjunctive") lands that have been suggested by stakeholders during the PEIS process as having the potential to be designated as additional solar development zones and that could be subject to intensive review and analysis in the DRECP planning process. Examples include the specific areas that have been suggested by our organizations in the Daggett Triangle and Western Mojave areas of California.[5]

   We appreciate that the BLM has already issued a Draft EIS for potential renewable energy development within the West Chocolate Mountains Renewable Energy Evaluation Area (July 1, 2011), an area which was suggested by several of our organizations and others.
3. The BLM indicates that SEZ-specific regional mitigation plans will be developed, and that initial regional mitigation plans will be presented in the Final PEIS. SPEIS at p. 2-24. Development of plans that fall within the DRECP planning area should be coordinated with the other agencies in the Renewable Energy Action Team (REAT), so that the range

[5] See Appendix C to Draft PEIS comments of NRDC, et al.

of feasible mitigation measures across both public and private lands can be identified and analyzed. BLM should clarify in the Final PEIS that it will coordinate with the DRECP planning effort in the development of those plans that affect the DRECP planning area, and that it will manage the public lands within the CDCA consistent with the DRECP to the maximum extent possible under FLPMA.

IV. Proposed Solar Energy Zones.

We appreciate that some of our comments and recommendations on the four proposed SEZs that were presented in the Draft PEIS were incorporated into the SPEIS. In particular, we very much appreciate that both the proposed Pisgah and Iron Mountain SEZs were dropped, although, as discussed below, we believe that the Pisgah SEZ should be completely excluded from solar development, as was Iron Mountain. For each of the remaining two SEZs, Riverside East and Imperial East, we recommend that the BLM include in the Final PEIS a chart that identifies not only the additional land and resource data that are needed to perform necessary analyses but also who is responsible for compiling the data and completing each item listed, and a timetable for completion of the individual tasks. We also request that BLM commit to accepting and responding to comments on the SEZ-specific regional mitigation plans and design guidelines that are presented in the Final PEIS.[6]

Within specific SEZs, we recommend that a tiered mitigation strategy be adopted entailing, in priority order, 1) impact avoidance, 2) impact minimization and 3) compensation for unmitigated impacts through off-site habitat acquisition and enhancement for key species and their habitats. The feasibility of compensatory habitat acquisition and enhancement must be verified so that needed actions can be implemented in a timely and effective manner.

A. Iron Mountain.

We thank the BLM for deleting the proposed Iron Mountain SEZ, and for recognizing concerns about this SEZ that were raised by numerous stakeholders including conservation organizations, solar industry developers, utilities and others. We also thank the BLM for identifying the proposed Iron Mountain SEZ as an "exclusion area" in Table 2.2-1 (SPEIS at p. 2-17). The area's extremely high value wilderness and other resources coupled with the lack of nearby or planned transmission amply justifies this decision. We remain concerned, however, that substantial acreage within the Citizens'-proposed Iron Mountain Wilderness, which partially overlaps the former SEZ, remains open to variance applications; we request that this area be added to the list of exclusion areas. Please see our comments and a map showing the overlap in Appendix A.

B. Pisgah.

We thank the BLM for deleting the proposed Pisgah SEZ. However, we oppose these lands remaining open to variance applications. See SPEIS at B-14. The area contains superlative resources, including:

- Twelve special status species;
- Habitat that provides essential connectivity between the western Mojave, eastern Mojave and northern Colorado deserts;

[6] As well as other sections the BLM says will be presented in the Final PEIS.

- A significant drainage from the Cady Mountains that has not been mapped by the National Wetlands Inventory;
- Lands acquired with private conservation funds and Land and Water Conservation Fund monies (775-1700 acres);
- Desert tortoise habitat and connecting corridors;
- Desert bighorn sheep habitat and potential to disrupt metapopulations and intermountain movements;
- Golden eagle habitat;
- Mojave fringe toed-lizard habitat;
- Rare plants, including white-margined beard tongue (*Penstemon albomarginatus)*, *Androstephium breviflorum* and *Castela emory*.
- Significant cultural sites.

See comments of NRDC at al. on Draft PEIS. The same reasons we advanced in opposition to the designation of these lands as a SEZ support their designation as an exclusion area that is not subject to variance applications.

As previously noted, in our comments on the Draft PEIS we suggested that BLM assess the "Daggett Triangle," three combined public-private land areas totaling more than 16,000 acres located west of the proposed Pisgah SEZ. We request that these areas be specifically identified in the Final PEIS as public and/or combined public-private lands that may be appropriate for further analysis as part of the DRECP as a public/private solar zone.

C. Riverside East.

We thank the BLM for addressing a number of our site-specific concerns within the proposed Riverside East SEZ. BLM has designated "no development" areas for 11,547 acres within the SEZ, including a portion of McCoy Wash, Ford Dry Lake and Palen Dry Lake, and areas previously identified for non-development through site-specific project level NEPA analysis.[7] Additionally, BLM has reduced the size of the SEZ by 43,439 acres, eliminating other areas of concern to our organizations (e.g., Pinto Wash, Upper Chuckwalla Valley). We appreciate these modifications.

Nonetheless, we believe this SEZ will benefit from further fine-tuning, and we have the following recommendations. Some of these issues were raised in our comments on the Draft PEIS; we also bring to your attention several issues that have surfaced since issuance of the Draft PEIS.

Issues Raised in Previous Comments on Draft PEIS, Riverside East SEZ.

1. Connectivity areas for habitat, wildlife and climate change adaptation.

[7] While we welcome these decisions, we believe the public needs more clarity about them. The BLM should provide readily accessible maps that will enable stakeholders to clearly understand which areas have been eliminated from potential development within the Riverside East SEZ. For example, we are confused as to what part of McCoy Wash is proposed for non-development. See detailed comments under Microphyll Woodlands and in section IX.

In our comments on the Draft PEIS, we requested that the BLM identify key connectivity areas to preserve habitat integrity for a variety of wildlife and plant species now and into the future as our planet's climate changes.[8]

Due to the linear nature of the Riverside East SEZ and the potential of solar development in this SEZ to sever connections between the Sonoran and Mojave ecosystems, the BLM must provide landscape level habitat linkages within and across this SEZ (e.g., for desert tortoise, Mojave fringe-toed lizard, desert bighorn sheep, etc). We recommend that such movement corridors be roughly delineated via the process of developing the SEZ-specific design features and the initial regional mitigation plan for the Riverside East SEZ, and that they be further refined at the project-specific level.

The BLM should coordinate the mapping of wildlife and habitat linkages with other agencies via the REAT and the DRECP planning process. In fact, the BLM now has good access to data, the Western Wildlife Crucial Habitat Assessment Tool (CHAT). This initiative should assist the agency and its partners in identifying critical habitat and wildlife linkages, or corridors, which should be protected by the SPEIS and the DRECP. See Instruction Memorandum (IM) No. 2012-039; see also http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2012/IM_2012-039.html.

We also are concerned that the SPEIS fails to acknowledge the importance of preserving migratory bird pathways and stopovers on the Pacific Flyway. Migratory birds can be affected by solar development, particularly power towers. The BLM should also work with the REAT to ensure that the appropriate data are collected and migratory bird pathways and stopovers are mapped as promptly as possible and preserved in the future. If sufficient data are not now available, we request that BLM require the gathering of data for migratory bird pathways and stopovers for all site-specific power-tower projects that are proposed within the vicinity of the Riverside East SEZ (including any projects that are proposed outside the SEZ within variance areas nearby). We also request that BLM require strict monitoring and utilize "adaptive management" in its processing and management of power tower proposals throughout the California desert, so that these projects can be adjusted over time as needed to minimize impacts on resident and migratory birds.

The preservation of habitat connectivity is not only important in the Riverside East SEZ, but throughout the California desert. We request that BLM commit to working with other agencies with jurisdiction in the desert to develop a plan for protecting these areas, especially in light of climate change.

2. Sand Transport, sand transport corridors and sand source areas.

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[8] A recent scientific paper indicates the importance of maintaining plant species richness in the face of climate change: "Our results suggest that the preservation of plant biodiversity is crucial to buffer negative effects of climate change and desertification in drylands." See Maestre et al, http://in.bgu.ac.il/SiteAssets/Pages/news/Plant_Species_Richness/Science%20Plant%20Species%20Richness%20and%20biodiversity.

The SPEIS has improved the proposed Riverside East SEZ by incorporating "non-development" areas within the SEZ, presumably in part to avoid the critically important sand transport corridors and sand source areas. However, as proposed, the "non-development" areas do not include all areas of the sand transport corridor as identified by several sources. Muhs et al. (2003) specifies a much larger area of Aeolian sand in the SEZ. In 2011, the California Public Utilities Commission undertook additional investigation and identification of the sand transport corridor in this area.[9] In their review, the sand transport corridor is much more extensive, originating in the Pinto Basin of Joshua Tree National Park, the Palen Valley and the Palen/McCoy Valley and extending eastwards to the edge of the agricultural development in the Palo Verde Valley south of Interstate 10.

The BLM should exclude additional contiguous areas of the sand transport corridor and sand source areas, via the SEZ-specific regional mitigation plan and/or in the SEZ-specific design features, for a number of reasons. First, disruption of sand transport corridor functionality near corridor sources affects all downwind resources. Secondly, sand dune habitat is a rare resource on the landscape and because the geological and geographical features that transport sand and form dunes are extremely limited, the species that have evolved to rely on this unique habitat are also quite rare and typically endemic only to dune systems. Because of the uniqueness of the Aeolian habitat, impacts to sand transport systems are therefore comparatively greater than to other habitat types. Impacts are also much more challenging to mitigate because of the limited habitat type and complex Aeolian requirements that form and maintain the sand transport and dune habitat. Lastly, any facility put in or even adjacent to a sand transport corridor will suffer significant impacts from sand abrasion and require regular clearing of sand from the structures, increasing maintenance and operational costs.[10]

The final program needs to ensure the consistent conservation of sand transport corridors and sand dune areas across the region, and not just in the Riverside East SEZ. Several additional corridors and dune systems have been identified within the CDCA.[11] As previously stated in our comments on the Draft PEIS, models have also been developed to identify conservation areas that are essential to maintain sand transport corridors.[12] These data and models should be incorporated into the analysis and key areas that maintain the Aeolian function of the sand transport corridors should be included as BLM-administered lands not available for solar development.

3. Microphyll woodlands.

We appreciate that the BLM appears to have identified a portion of McCoy Wash, containing important microphyll woodland habitat, as a "non-development area" within the Riverside East SEZ. However, the BLM also appears to have left a substantial amount of acreage of this important habitat type potentially open to development, an action that could place this key ecosystem at risk.[13] In numerous conversations our organizations have had with BLM staff, they

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[9] See ESA-PSW 2011 www.cpuc.**ca**.gov/environment/info/aspen/dpv2/sfeir/apps/ap3.pdf
[10] The lifespan of these projects also will likely be decreased.
[11] See Muhs 2003
[12] See, e.g., Barrows 1996
[13] For example, the red line on the map on p. C-59 that we presume indicates McCoy Wash does not appear to adequately protect the microphyll woodlands in McCoy Wash. See section IX below.

have expressed the belief that, given the extensive acreage of this habitat type included in the Right of Way issued for the Blythe solar energy project, no additional loss of microphyll woodland habitat should be permitted. We request that additional microphyll woodland habitat within the Riverside East SEZ be identified for non-development via SEZ-specific design features and/or the SEZ-specific regional mitigation plan for Riverside East. BLM carefully mapped this habitat type ("Desert Dry Wash Woodland") as part of the Northern and Eastern Colorado Desert (NECO) Management Plan (2002). See NECO Plan, Map 3-3. These mapping data should be used as the foundation for identifying additional microphyll woodlands for non-development within the SEZ, through SEZ-specific design features and/or the regional mitigation plan for the Riverside East SEZ.

Issues Raised Since Release of Draft PEIS, Riverside East SEZ.

Since the Draft PEIS was released, several issues have arisen that the supplement has not analyzed. These issues should be addressed in the Final PEIS, subsequent management plan amendments, the regional mitigation plan, through SEZ-specific design features and/or at the project-specific level.

1. Lands with wilderness characteristics.

Since the Draft PEIS was issued, BLM conducted an inventory of "Lands with Wilderness Characteristics" (LWC) pursuant to Section 201 of FLPMA and IM 2011-154. The results of this inventory in the Riverside East SEZ are presented in the SPEIS at p. C-60. The inventory identified 11,925 acres of LWC, approximately 7,175 acres (60%) within the Riverside East SEZ (approximately 40% of the LWC lie just outside and west of the Riverside East SEZ). Large-scale solar energy development and the preservation of LWC are inherently incompatible, and we request that the LWC identified within this SEZ be removed from the SEZ or identified as a "non-development" zone within the SEZ.[14]

The LWC identified by the BLM that are within the Riverside East SEZ overlap with other areas of importance that we have previously argued should not be developed. These include dissected (alluvial) fan habitat important to desert tortoise,[15] and microphyll woodland habitat which has not been adequately protected by the delineation of McCoy Wash. It should also be noted that the LWC identified on the map on page C-60 of the SPEIS appear to overlap closely with the microphyll woodland habitat that is located in the western portion of the proposed McCoy Solar project.

The LWC outside the SEZ are also adjacent to the Palen-McCoy wilderness, and are proposed as a variance area. We request that the LWC identified outside the Riverside East SEZ be added to the list of exclusion areas. The BLM should recommend these lands as an addition to the designated wilderness and manage them in the interim to protect their wilderness characteristics. The fact that these lands are located in a major wash makes them a poor potential site for solar development. The area is also home to several sensitive species, including California leaf-nosed bat, desert tortoise, California McCoy snail, Harwood's milk-vetch and Las Animas colubrina.

[14] If this does not happen, then the BLM should devise mitigation at the project-specific level to mitigate for the loss of wilderness characteristics.
[15] See discussion below.

2. Dissected fans.

Since the Draft PEIS was issued, three projects have been approved within the proposed Riverside East SEZ.[16] During the processing of each of these project applications, the U.S. Fish and Wildlife Service identified "dissected fans" as important habitat for the Threatened desert tortoise. The following language is from the Fish and Wildlife Service's Biological Opinion on the Desert Sunlight project:

> We recommend that the BLM amend the CDCA Plan to prohibit additional renewable energy development (i.e., utility-scale solar and wind energy facilities) within the upper bajadas (mapped as "dissected fans" on the Landforms Map 3-4 in BLM 2002) adjacent to the mountains of northeastern Riverside County. This recommendation is intended to protect the higher quality desert tortoise habitats in the recovery unit.

Desert Sunlight Biological Opinion; 7/6/2011. See http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/palmsprings/desert_sunlight.Par.83759.File.dat/Desert%20Sunlight%20BO.pdf. There is similar language in the Biological Opinions for the other projects.

Due to the importance of preserving dissected fans for desert tortoise, we recommend that the BLM identify and map the dissected fans and include measures to avoid development in these habitats in the forthcoming design features, regional mitigation plans and site-specific project level analyses.

3. Visual Resource Management Class II & III height limits.

The BLM has proposed ten foot height limits on solar infrastructure within the Riverside East SEZ, consistent with criteria for Visual Resource Management (VRM) Class II & III lands; these are proposed as "visual resource mitigation requirements." SPEIS at p. C-58-59. While we appreciate the BLM's acknowledgement of the visual impacts of large scale solar development, we are concerned about the fact that the proposed limitations on development within the SEZ for visual reasons will effectively limit the technology that can be utilized in these areas. Of greater concern, these limits also put increased pressure on the BLM to allow development in areas outside the SEZ, e.g., in variance areas. Most importantly, the proposed limits significantly reduce the acreage of the proposed SEZ. If further reductions in the size of the Riverside East SEZ are going to occur, we strongly prefer they be for biological or cultural reasons, e.g., designated wildlife movement corridors, desert tortoise habitat connectivity areas, etc., rather than to minimize visual impacts. Large scale solar developments inherently have significant visual impacts, and such impacts need to be accepted as part and parcel of such development.[17]

D. Imperial East

The BLM should adopt SEZ-specific design features for the proposed Imperial East SEZ to help mitigate for impacts to the flat-tailed horned lizard consistent with the rangewide management

[16] I.e., Desert Sunlight, Blythe and Genesis solar projects.

[17] We do believe that visual impacts can and should be mitigated via the development of site-specific design features and mitigation measures identified in the initial regional mitigation plan for the Riverside East SEZ; both the design features and the regional mitigation measures should be included in the Final PEIS. Site-specific visual impacts should also be mitigated on a project-level basis.

strategy for the Flat-tailed horned lizard, and with the management goals and objectives for the East Mesa Wildlife Habitat Management Area. Protections for the flat-tailed horned lizard should also be incorporated into the initial regional mitigation plan for this SEZ.

We appreciate that the BLM has designated five acres of wetlands within this SEZ as a non-development area.

V. Exclusion Areas.

We appreciate that the BLM has made modifications to the list of exclusion areas originally proposed, i.e., those areas that will not be subject to variance applications. See Table 2.2-1 (SPEIS at p. 2-16). We are particularly pleased that the following areas were added to the list of exclusion zones:

- Lands within Mojave Trails National Monument, including proposed wilderness areas;
- Lands encompassed by the (withdrawn) Iron Mountain SEZ;
- Non-development lands identified in EISs for already approved solar energy projects (e.g., Genesis, Blythe and Desert Sunlight);
- Lands proposed for transfer to the National Park Service.

We believe that the following lands and land use categories identified immediately below should also be added to the list of exclusion areas. These areas were identified as candidates for exclusion in our previous comments.[18] We also recommend desert tortoise proposed connectivity areas for exclusion; see section VI.

1. Citizens Wilderness Proposals.

While we appreciate that citizens' proposed wilderness within the proposed Mojave Trails National Monument and proposed additions to Death Valley National Park wilderness were excluded, parts of four citizens'-inventoried proposed wilderness areas[19] remain open to variance applications: Bighorn Mountain, Iron Mountain, Palen-McCoy and Volcanic Tablelands. Additionally, lands proposed for variance applications overlap with 20,600 acres of the Vinagre Wash Special Management Area in Senator Feinstein's California Desert Protection Act legislation (2011) and with acreage in the McCoy Wash area that contains LWC as identified by the BLM, which we discuss above. Please see Appendix A to these comments for a detailed description of these areas provided by the California Wilderness Coalition and our reasons why they should be excluded from development.

2. Wildlife Habitat Management Areas.

Wildlife Habitat Management Areas (WHMAs) were established by the BLM in its management plan for the CDCA, and subsequent amendments to the plan, each of which was subject to extensive public participation. See, e.g., Northern and Eastern Colorado Plan Amendment, 2002; West Mojave Plan Amendments, 2006; CDCA Plan Amendments, 1981-1990. According to the wildlife element of the CDCA Plan, WHMAs and their associated site-specific plans are one of

[18] For more detail on these and other proposed exclusion areas see our comments on the Draft PEIS.
[19] The inventory of these public lands as potential wilderness areas was coordinated by the California Wilderness Coalition. Bighorn, Iron Mountain and Volcanic Tablelands were inventoried between 1998-2001; Palen-McCoy in 2006.

two primary management tools designed to achieve the objective of the CDCA to protect wildlife habitat important to a suite of species. As we have previously requested, the BLM should include WHMAs as a new category of exclusion areas or under criteria #8. See SPEIS at p. 2-16.[20]

Because proposed development in WHMAs is bound to be controversial,[21] designating the WHMAs as exclusion areas will save BLM and developers time and money, and avoid costly delays.

3. Golden Eagle habitat.

In our comments on the Draft PEIS, we asked that the BLM take special care to protect Golden Eagle, a fully protected species under the Bald and Golden Eagle Protection Act of 1940. The SPEIS, however, does not acknowledge the importance of Golden Eagle.

Specific lands important to Golden Eagle as nesting territories and associated foraging habitats should be excluded from variance applications. These lands include the WHMAs, as mentioned above (some are of particular importance to Golden Eagle), and additional lands as appropriate that have been designated by the BLM as "Key Raptor Areas" and which are within proposed variance areas.

4. Ivanpah Valley Public Lands.

The Ivanpah Valley is a unique valley spanning the state line between California and Nevada. Because of this political boundary, impacts to biological resources from renewable energy developments in different parts of the same valley are evaluated by different states. The Ivanpah Valley is important because it is home to a dense population of the federally threatened desert tortoise as well as rare plant communities. A small portion of the valley in California is designated as a desert tortoise Area of Critical Environmental Concern (ACEC) under the Northern and Eastern Mojave Plan. A portion of federally designated critical habitat is also identified in the southeastern part of the valley.

Surveys on both sides of the state line indicate an extant, robust population of desert tortoise. In fact, the U.S. Fish and Wildlife Service's (FWS) October 10, 2010 Biological Opinion on the Ivanpah Solar Electric Generating Station (ISEGS), which is located in the southwestern part of the valley, states at p. 63: "We recommend that the Bureau amend the California Desert Conservation Area Plan to prohibit large-scale development (e.g., solar energy facilities, wind

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[20] In Table 2.2-1, BLM has already identified as exclusion areas

> "All areas where…*BLM has made a commitment to take certain actions* with respect to sensitive species habitat..."

(Emphasis ours.) The BLM should clarify in the Final PEIS specifically which "certain actions" are meant to be included in this category of exclusion areas.

[21] As our experience with the Desert Sunlight Project attests: the fact that a WHMA was located within the proposed project area required additional time to resolve this project with the company. Other projects proposed or permitted that overlapped to varying degrees with WHMAs include the Palen Solar Power Project and Genesis Solar Energy Project.

development, etc.) within the area bounded by Interstate 15, the State line, and Clark Mountains." This recommendation was limited to the land on the California side of the border, because the local office of the consulting agencies' jurisdiction was in California.

As the BLM is well aware, the ISEGS project quickly reached its "take" limit of desert tortoises and had to re-initiate consultation with the Service, which resulted in a new Biological Opinion on June 10, 2011. In the new Biological Opinion, the FWS expanded its recommendation to include the whole of the Ivanpah Valley, stating "We recommend that the Bureau amend the necessary land use plans to prohibit large-scale development (e.g., solar energy facilities, wind development, etc.) within all remaining portions of the Ivanpah Valley to reduce fragmentation within the critical linkage between the Ivanpah Critical Habitat Unit and the Eldorado Critical Habitat Unit." (at pg. 92-93). This new recommendation recognizes that the whole valley is important to the survival of this population of desert tortoise, and that the linkage between the Ivanpah Critical Habitat Unit, which is in California, and the Eldorado Critical Habitat Unit, which is in Nevada, must be kept intact.[22] In line with the direction already identified by the FWS, BLM-administered lands within the Ivanpah Valley should be included as an exclusion area not available for further solar development.

Although BLM is undertaking a new cumulative effects analysis for a portion of the Ivanpah Valley (and which does not include much of the valley in Nevada), it has not finished the analysis. Nor has the BLM developed either a comprehensive bi-state assessment or a long-term management plan for this important valley. Meanwhile, the entire Ivanpah Valley has been nominated as an ACEC, in order to provide further safeguards for the desert tortoise in this important valley as well as a suite of very rare plants and significant cultural values present there. To avoid further degradation of the valley, we urge that it be excluded from solar development.

5. Lands Acquired for Conservation.

As previously noted in our comments on the Draft PEIS, the BLM should exclude lands that were purchased with Land and Water Conservation Funds and donated to BLM for conservation purposes from being subject to variance applications.

VI. Desert Tortoise.

The desert tortoise is a bellwether species for the Mojave and Sonoran desert ecosystems. Listed as a federal threatened species by the FWS in 1990, desert tortoise numbers remain low in spite of ongoing recovery efforts, and this animal remains in an imperiled state. Since renewable energy development has the potential to significantly and irreversibly affect desert tortoise populations and the ability of this iconic species to recover, it is essential that the DOI adopt standards for solar energy development in the Final PEIS that will provide for the recovery of desert tortoise populations and the species as a whole. These standards should include: 1) the protection of key habitat for the desert tortoise, including occupied and unoccupied but

[22] See also Hagerty, B.E., K.E. Nussear, T.C. Esque, and C.R. Tracy. 2010. Making molehills out of mountains: landscape genetics of the Mojave desert tortoise. Landscape Ecology. DOI 10.1007/s10980-010-9550-6.

suitable habitat, and 2) the protection of key connectivity habitats and linkages for the desert tortoise.

We recommend that the United States Geological Survey (USGS) desert tortoise habitat suitability model[23] and desert tortoise density be used to provide interim criteria for areas where variance applications will be accepted but also recognize that development of a more detailed model is needed to guide conservation of the species at the appropriate scale required for solar project siting. The USGS desert tortoise habitat suitability model was intended to provide guidance for conservation planning at the range-wide scale, and represents the most comprehensive effort to define suitable habitat for the species to date. The one kilometer cell size used for this analysis and the emphasis on topographical, soil, and meteorological data as predictors make the model useful for predicting at the landscape-scale, but they do not provide the needed precision for analyses at the sub-regional scale or at the solar project sitting level. Until additional refinement of a habitat model is completed by FWS, the following criteria should be met:

For applications in variance areas that are within the range of desert tortoise but outside of proposed connectivity areas, (as modified by our recommendations in these comments), the applicant must provide documentation of the following:

- Project area has less than or equal to 2 tortoises (>160 mm Midline Carapace Length) per square mile; and
- Where Habitat Potential Index Value is 0.7 or greater, verification that the habitat condition is "highly converted."[24] This verification should be provided through application of science-based models of land conditions through field inspection.

Our recommended criterion of two adult desert tortoises per square mile is based on current range-wide density estimates within recovery units that range from three to 36 per square mile.[25]

The predicted habitat suitability rating of 0.7 and above (on a scale of 0 to 1.0) is significant because 95% of the lands with a rating of greater than 0.7 in the USGS habitat suitability model also had confirmed presence of desert tortoises based on field survey data. This habitat model, based on 10 environmental factors that included soils, vegetation, precipitation, elevation, and topography, is a sufficiently robust, science-based model, for interim land use planning and conservation planning for the Desert tortoise and its habitat, but further refinements are needed to make habitat suitability predictions more accurate and precise, both to protect important habitat as well as to ensure that areas not important for the species are not mis-identified.

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[23] Nussear, K.E., T.C. Esque, R.D. Inman, L. Gass, K.A. Thomas, C.S.A. Wallace, J.B. Blainey, D.M. Miller, and R.H. Webb. 2009. Modeling habitat of the desert tortoise (*Gopherus agassizii*) in the Mojave and parts of the Sonoran Deserts of California, Nevada, Utah, and Arizona: U.S. Geological Survey Open-File Report 2009-1102, 18 p.

[24] "Highly converted" refers to urban, suburban and agricultural lands that are heavily altered. While some can support conservation targets, their ecological context is highly compromised.

[25] U.S. Fish and Wildlife Service. 2010. DRAFT Range-wide Monitoring of the Mojave Population of the Desert Tortoise: 2010 Annual Report. Report by the Desert Tortoise Recovery Office, U.S. Fish and Wildlife Service, Reno, Nevada. 49 pp.

Pursuing a model at finer scales would require the use of variables that directly or indirectly assess the resources used by tortoises when selecting habitat, such as the presence of plants used for forage, vegetation diversity, density of annuals vs. perennials, and so on. In addition, habitat connectivity analyses must be integrated with habitat suitability analyses in order to ensure that the focus is on preserving suitable and occupied habitat that is connected with other population areas as well as to ensure these connectivity areas themselves are preserved to provide meta-population persistence.

The USGS desert tortoise habitat suitability model does not account for urban development, habitat destruction/fragmentation, or natural disturbances that have lowered habitat quality in recent years. Thus, we recommend using The Nature Conservancy's (TNC's) Mojave Desert Ecoregional Assessment[26] and the Conservation Biology Institute's Framework for Effective Conservation Management of the Sonoran Desert in California[27] to exclude these lands as having little or no habitat or conservation value. We recognize that it may be necessary to verify the habitat condition through field inspection and to accurately assess the adult desert tortoise density. We also recognize that modeling of suitable desert tortoise habitat needs to be refined through further field study and analysis, and that updated models should be developed soon and applied to our recommended criteria in variance areas as they become available.

Successful recovery of the desert tortoise requires that existing populations and their higher rated habitats are protected from deleterious human impacts. If recovery actions are successful to the point of promoting population increases, lands included in our recommended Modified Option 2 where solar energy development would be inappropriate could be the very areas into which newly recruited tortoises would need to move in response to climate change or simply expand their population in response to successful recovery efforts.

Preserving connectivity between desert tortoise conservation areas is vital to promoting gene flow and maintaining and enhancing desert tortoise populations. Connectivity can only be preserved by maintaining intact landscape-level habitat, so it is critical that connectivity areas be conserved and protected.

We therefore strongly recommend that connectivity areas be excluded from development. We also recommend that the BLM's proposed connectivity habitats shown on Figure 2.2-2 (SPEIS at p. 2-36) be replaced with the connectivity (or "linkage") habitats recommended by the FWS in its comments on the Draft PEIS. See comments of U.S. Fish and Wildlife Service, Draft PEIS, May 6, 2011, Figure B-2. It is important to understand that agency's recommendations identified lands to be included in a "…*minimum linkage design necessary for the conservation and recovery*

[26] Randall, J. M., S.S. Parker, J. Moore, B. Cohen, L. Crane, B. Christian, D. Cameron, J. MacKenzie, K. Klausmeyer and S. Morrison. 2010. Mojave Desert Ecoregional Assessment. Unpublished Report. The Nature Conservancy, San Francisco, California. 106 pages + appendices. Available at: http://conserveonline.org/workspaces/mojave/documents/mojave-desert-ecoregional-2010/@@view.html.

[27] Conservation Biology Institute. 2009. A Framework for Effective Conservation Management of the Sonoran Desert in California. Prepared for The Nature Conservancy. 78 pp. + appendices.

of the Mojave population of the desert tortoise…" (FWS DPEIS comments, Figure B-2. Emphasis ours.

VII. Issues Raised by the Supplement.

A. **Prioritization of Areas for additional data/analysis collection (via Action Plans).**

The BLM notes at p. 2-41 of the SPEIS that it will "prioritize the collection of additional data and analysis (listed in the Action Plans in Appendix C of the SPEIS) in those SEZs that are most likely to be developed in the near future." We request that the BLM prioritize the Riverside East SEZ for such action. As the agency is well aware, there are additional projects presently being considered in this SEZ (see Appendix A of the SPEIS). The timely completion of additional analysis for this SEZ will facilitate development in the locations that are best suited for such intensive use in the fragile desert.

We also believe that an initial regional mitigation plan should be developed for the Riverside East SEZ and presented in the Final PEIS. Due to the number of SEZ-specific issues that need to be mitigated, early development of a regional mitigation plan for the Riverside East SEZ will ensure that projects are processed in a timely manner.

B. **Pending Applications – CA projects.**

Our organizations have reviewed the so-called "first in line" projects for California that are listed in Appendix A of the SPEIS. We believe the list for California needs to be revised.

Certain developers have gone through the permit review process, have ended up with rights of way and have proceeded not to develop approved projects (e.g., Blythe Solar Project, Imperial Valley Solar Project). This is an unconscionable waste of the BLM's time and taxpayer dollars. In order to prevent this situation from occurring in the future, the BLM needs to do two things: First, the BLM needs to tighten up its diligence requirements and weed out the companies that are not serious or capable of developing projects. Second, since the BLM is going to rely on IM 2011-060 and IM 2011-061 issued in February 2011 to process applications on this list, we would like to help the BLM prioritize the pending projects, using the criteria in the IM and our deep and widespread knowledge of the environment, to ensure that the projects BLM processes first are truly those that are the least problematic. For the projects that are problematic, sufficient time should be allotted for other development options to be found (e.g., suitable locations within SEZs or on degraded private lands) so that these projects are not processed or permitted in the original locations proposed.

As an example of what we consider a "problematic" project, we question why Broadwell Lake is still on BLM's list of first in line projects. The proposed project is within the proposed Mojave Trails National Monument, which is a proposed exclusion area. We believe this project should be rejected by BLM and removed from the list.

We also believe that the BLM should not approve projects in the California desert that are inconsistent with the developing conservation strategy within the DRECP planning area.

VIII. Cumulative Impacts.

Our organizations were disappointed not to see any further analysis of cumulative impacts in the SPEIS, either for the revised solar development program (including the variance areas), or for past, present and reasonably foreseeable development within the Riverside East and Imperial East SEZs. The BLM intends to defer these analyses to the Final PEIS. See, e.g., SPEIS at 2-80. We hope and expect to see a complete analysis of cumulative impacts in the Final PEIS, and look forward to providing comment on it.

IX. Mapping and Biological Information.

We appreciate the effort to provide spatial data via the SPEIS website to the public for further review and analysis of the information contained in the Draft PEIS and the Supplement. Where there is additional spatial data desired that is not included in the downloadable zip files, we request that the BLM develop a system to provide that information to the public. For those who do not have GIS capabilities, we request that the BLM publish more clearly defined maps of both the proposed SEZs and proposed variance areas in the Final PEIS.

The maps provided in the Supplement are inadequate as illustrated by the following three examples. First, there is no map provided of the proposed variance areas listed in Table 2.2-1. While the website contains a map of proposed variance areas,[28] it is at a coarse scale and it is difficult to tell exactly where the variance areas are located. Secondly, in the Riverside East SEZ, what we believe to be McCoy Wash is indicated by a red line but it is not listed as such nor is the width of the exclusion area for that particular area specified anywhere in the document or on the maps. See SPEIS at p. C-59. A further reconnaissance of this non-developable area near the McCoy Wash revealed that it was a less than one quarter mile-wide corridor running through the McCoy wash and microphyll woodland system that is actually greater than one mile wide. Lastly, the desert tortoise connectivity corridors map on p. 2-36 contains no citations or explanation of the data used to generate the map.

These and other problems with the presentation of maps and data[29] need to be remedied as soon as possible so that stakeholders understand what is being proposed and the potential impacts of the proposed action on the environment. We recommend that revised maps and relevant data be made available for public review as soon as possible via the website, and that they be included in the Final PEIS.

X. Conclusion.

We thank the DOI and the BLM for proposing an approach to solar energy development on public lands in California that will direct appropriate large-scale solar energy development needed to help alleviate the effects of climate change to specific locations that can best accommodate such development, ensure the timely development of projects and help ensure that the natural and cultural resources of the California desert are protected for future generations. We respectfully request that you incorporate our proposed modifications to

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[28] http://solareis.anl.gov/documents/supp/maps/alternatives/Solar_Supplement_CA_Statewide_Poster.pdf

[29] E.g., we recommend that the data used to develop the desert tortoise variance recommendations on pp. 2-36 – 2-37 be made available as soon as possible and be included as an appendix to the Final PEIS.

ensure that projects are limited to the most appropriate locations in order to avoid permanent damage to the very fragile web of life in the California deserts.

Sincerely,

Garry George
Renewable Energy Project Director
Audubon California
4700 North Griffin Avenue
Los Angeles, CA 90031

Ryan Henson
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Senior Regional Conservation Representative
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Lee Vining, CA 93541

Attachments:

Appendix A: Proposed wilderness areas and Special Management Area that should not be included in variance zones.

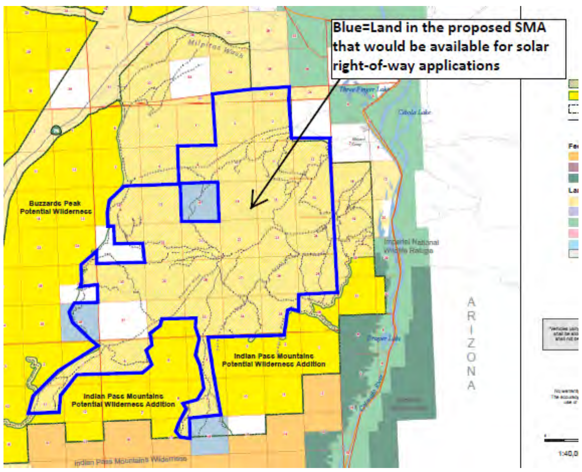
APPENDIX A

Proposed wilderness areas and other lands that should not be included in variance zones

Prepared by California Wilderness Coalition

The Proposed Vinagre Wash Special Management Area

Approximately 20,600 acres of the Vinagre Wash Special Management Area (SMA) that is proposed in Senator Dianne Feinstein's California Desert Protection Act of 2011 (S. 138) is zoned as a proposed variance area under the Modified Program Alternative in the SPEIS.

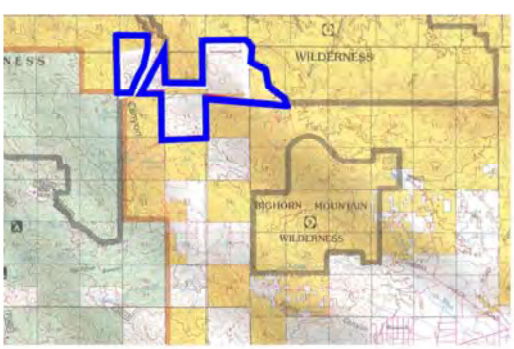


The proposed SMA should be excluded from the variance area because it is composed of extremely rugged, rolling terrain that is inappropriate for solar development and the portions that are relatively flat are in large washes that experience violent flash floods. In addition, the area is used by the US Navy for training purposes, it is popular for family recreation, it is adjacent to the Indian Pass Wilderness and lands that are proposed as potential wilderness in S. 138, it contains many important Native American cultural sites and it is known for its great ecological diversity and importance (for example, it includes one of the few Gila woodpecker populations to be found in California and the largest Sonoran desert woodland in North America). Lastly, many former private lands in the area were once owned by the Catellus Corporation and they were donated to the BLM with the specific understanding that they would be managed for conservation purposes.

Bighorn Mountain Proposed Wilderness Addition

There are several small parcels of proposed variance areas scattered across approximately 1,620 acres of this proposed wilderness addition.

We request that the proposed wilderness addition be excluded from the variance zone because this rugged, boulder-strewn landscape dotted with yucca, pinyon pines, Joshua trees and occassional Jeffrey pines is quite mountainous and is therefore completely inappropriate for solar development. The area is also too ecologically sensitive for it to be developed, since it is an important transition zone and wildlife migration corridor between the Mojave Desert and the San Bernardino Mountains. Mule deer, mountain lion, bobcat, golden eagles, Nelson's bighorn sheep and the southern rubber boa all call the area home.

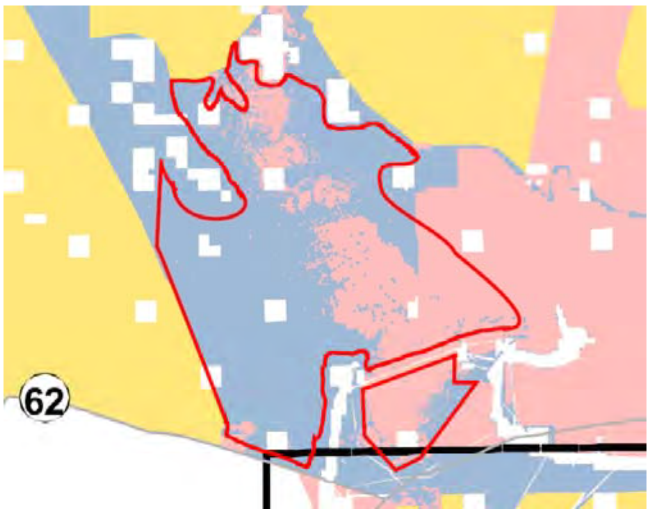


Bighorn Mountain Additions

The proposed addition was included in Senator Barbara Boxer's, Representative Hilda Solis' and Representative Mike Thompson's California Wild Heritage Act in the 107th-110th Congresses and it is possible that it could be included in future legislation as well.

Iron Mountain Proposed Wilderness

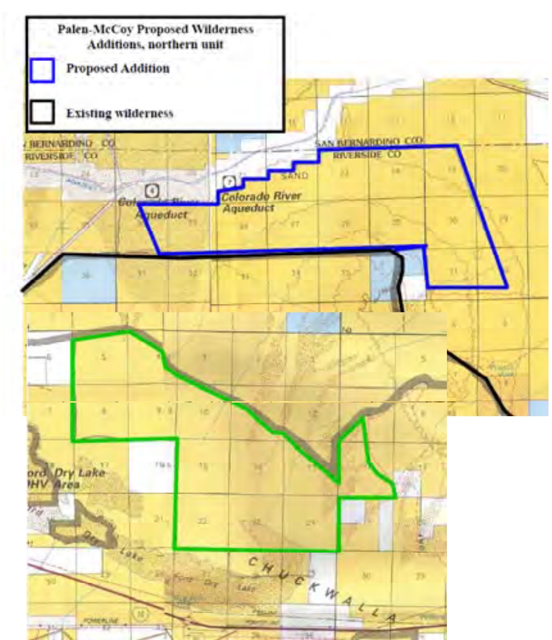
At roughly 120,000 acres, Iron Mountain is the largest remaining unprotected roadless area in California. The region is composed of the extremely rugged Iron Mountains, the Kilbeck Hills, sweeping bajadas, "perched" sand dunes (unusual dunes that are located atop cliffs) and playas. As is shown on the map at left, there is substantial acreage of proposed variance areas scattered across the majority of this proposed wilderness.



We request that the proposed wilderness addition be excluded from the from the variance zone because the region is a critical habitat corridor between the Old Woman Mountains Wilderness and the Sheephole Wilderness for Nelson's bighorn sheep. Other sensitive species known to live in the area include desert tortoise, Alverson's foxtail cactus, Harwood's eriastrum, small-flowered androstephium, Mojave fringe-toed lizard, prairie falcon and hepatic tanager. In the years ahead the importance of the proposed wilderness as both a corridor and as core habitat will continue to grow as lands to the south and east of Iron Mountain may be developed. Much of the proposed variance area between the Kilbeck Hills and the Iron Mountains currently consists of vast sand dunes that are also inappropriate sites for development because of the ecological importance shifting sands play in the Mojave Desert's ecosystem.

Palen-McCoy Proposed Wilderness Additions

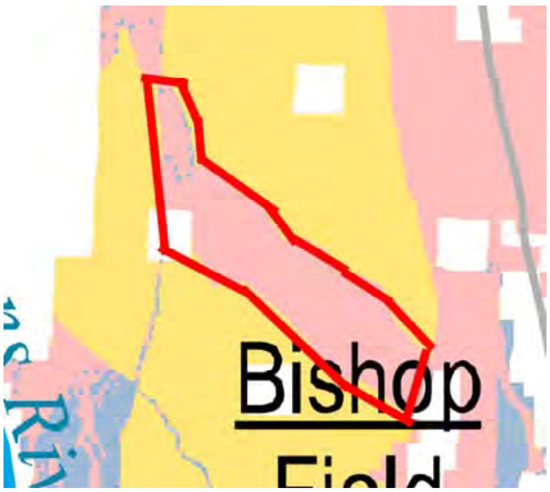
The Palen-McCoy Wilderness contains immense valleys and four steep mountain ranges. It also includes bajadas, salt flats, washes, dunes and in some ways it is a microcosm of the Mojave Desert. While working on what became the Omnibus Public Land Management Act of 2009, staff of the CWC identified four wilderness-quality areas that could be added to the adjacent existing wilderness, two of which were added by Congress and two that were not.



One of the remaining areas that has not yet been protected as wilderness is on the north (approximately 7,000 acres) and the other is on the south (approximately 11,000 acres). These areas are home to Bendire's thrasher, California leaf-nosed bat, California McCoy snail, desert tortoise, hepatic tanager, Le Conte's thrasher, Mojave fringe-toed lizard, Nelson's bighorn sheep, pallid bat, and prairie falcon. The region's midland ironwood forest is the largest such ecosystem in the California desert.

The existing wilderness and the adjacent roadless land together comprise one of the largest remaining wild areas in southeastern California. Four mountain ranges, dunes, gigantic washes, large bajadas and other landforms come together in the region and help explain its diverse wildlife and plant habitat. These two areas should be excluded from the possibility of development.

Volcanic Tablelands Proposed Wilderness. The Volcanic Tablelands rise several hundred feet above the floor of the Owens Valley. The landscape is rugged and is comprised of hard volcanic tuff, which is



highly uneven in its topography. The Volcanic Tablelands also contain extensive cultural resources including village sites, renowned petroglyphs and other archaeological resources. There are four BLM wilderness study areas (WSAs) on the Volcanic Tablelands (Fish Slough, Volcanic Tableland, Chidago Canyon and Casa Diablo), and the Citizens' Wilderness Proposal acreage for this area abuts all but Volcanic Tablelands as is shown at left. Not only does the region contain superlative resources, the variance lands identified are unfit for siting of large-scale solar development projects due to their topography and also their small size (77 acres). For these reasons, the lands should be excluded from consideration for variance applications. Remaining non-citizens' wilderness inventory lands in the vicinity of the Volcanic Tablelands should also be excluded for the same reasons.

Thank you for your comment, Leslie Barrett.

The comment tracking number that has been assigned to your comment is SEDDsupp20107.

Comment Date: January 27, 2012 10:55:56AM
Supplement to the Draft Solar PEIS
Comment ID: SEDDsupp20107

First Name: Leslie
Middle Initial: J
Last Name: Barrett
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Address 3:
City: Santa Monica
State: CA
Zip: 90401
Country: USA
Privacy Preference: Don't withhold name or address from public record
Attachment: PEIS Variance Request.pdf

Comment Submitted:

Celtic Energy Corporation

1507 Seventh Street, Suite 540
Santa Monica, CA 90401

January 26, 2012

Solar Energy Draft PEIS
Argonne National Laboratory
9700 South Cass Avenue
EVS/240
Argonne, IL 60439

<u>Comments on the Supplement to the Draft Solar PEIS</u>

Dear Agencies:

Celtic Energy Corporation ("CEC") is a developer of renewable solar and wind energy projects. CEC and its partners currently have over 12 utility-scale renewable energy projects in three four western states with over 2,000 MW under development. In California, this development includes four major wind energy projects on Bureau of Land Management ("BLM") managed lands. California represents a strategic and important focus for CEC's development portfolio.

CEC also supports the efforts of the Department of Energy ("DOE"), the BLM and all the co-operating agencies in supporting the goal for the responsible development of renewable energy in the western United States. CEC shares this objective through sensible siting and conscientious development.

When reviewing any development proposal, CEC takes great care in identifying and analyzing prospective site characteristics. CEC evaluates its compatibility with surrounding land uses and whether residual impacts to the environment are minimized. After much detailed analysis, CEC believes that it has found such a potential solar development site. This site is unique in that it retains excellent solar resources, has likely mitigatible environmental impacts, is on land largely previous disturbed, is adjacent to transmission rights-of-way, substations and other solar developments, and has little other apparent public use.

We have reviewed the proposed Solar Development Area Maps and find that this excellent potential solar development site has not yet been specifically identified. The site is; however, partially within areas identified as a proposed Variance area. The characteristics of the proposed solar development site are as follows:

- Project Name – Mojave Diamonds
- Land Owner – United States Department of the Interior, managed by the BLM
- Acreage – 6000 acres approx.
- Location – County of Kern, California (10 miles north of the community of Mojave)
- Address – West of State Route 14 between Randsburg Cutoff and Pine Tree Canyon
- Sections – T31S R36E, Sec. 24, 26 and 34; T31S R361/2E, Sec. 12, 13, 24, 25 and 36; T32S R35E, Sec. 24 and 26n2; and T32S R36E, Sec. 4, 8, 10e2, 12sw, 14ne, 18 and 22w2nw,swnw,news,nese
- APN's – Various
- Map – See enclosed

CEC appreciates that given the project acreage, this site may not be suitable as an independent Solar Energy Zone; however, we believe that portion of the proposed site currently designated as a variance area should be extended to the whole site.

Additional supporting factors include:

- The surrounding area is a hub for existing and permitted solar and wind electricity generation
    - Los Angeles Department of Water & Power ("LADWP") Barren Ridge Substation is at the northern boundary
    - Southern California Edison ("SCE") recently constructed Windhub Substation and proposed Highwind Substation are within seven miles of the project boundary
    - LADWP's proposed 230kV Transmission Line crosses the Mojave Diamonds Project site boundary (anticipated construction date of 2014)
    - LADWP's existing 230kV Transmission Line is proposed to be upgraded through the Mojave Diamonds project site
    - BLM Classification – Limited with Type II Application accepted

- There are numerous other major solar projects planned on adjacent lands
    - 100MW Cal City Solar, east of Mojave Diamonds Project site
    - 96MW Barren Ridge Solar, northeast of Mojave Diamonds Project site
    - 18MW Nautilus Solar Energy, Cantil Site, northeast of Mojave Diamonds Project
    - 100MW RE Distributed Project, adjacent easterly.
    - 38MW Ridge Rider Solar, northeast of Mojave Diamonds Project site

- In order to accommodate the flexibility described in the program objectives, the modified program alternative allows for utility-scale development in variance areas outside of the Solar Energy Zones and exclusion areas in accordance with a proposed variance ordinance. As the draft Solar PEIS document indicates, there are twenty-nine categories of lands that would be excluded from solar development. None of these categories are found at the proposed Mojave Diamonds Solar Project site. Moreover, the site is:
    - Project to accommodate a PV Array system of approximately 200MW total.
    - Site is not within the BLM-administered lands considered off-limits to development. Rather the site has been serialized by BLM as CACA052842
    - Lands have a slight southeast slope of approximately 3%
    - Solar isolation levels are greater than 7.0 kWh/m2/day
    - The Mojave Diamonds site is not in or adjacent to designated critical habitat, special management areas, wilderness study areas or ACECs
    - Preliminary biological assessments indicates that the site has no apparent critical habitat for any threatened or endangered species
    - The site is not a right-of-way exclusion areas or avoidance area
    - The site is not a special recreational management area or other special use area

According to the map published by the Argonne National Laboratory, dated October 2011, titled "BLM-Administered Lands in California Available for Application for Solar Energy ROW Authorizations under the Modified BLM Alternatives Considered in the Supplement", the Mojave Diamonds Project site appears only partially to have been included in Lands Available for Application – Modified Program Alternative (Variance Areas). For all the reasons stated above, including that the project application has already been accepted by the BLM, CEC believes the proposed PEIS can be enhanced with the inclusion of this Mojave Diamonds Project site.

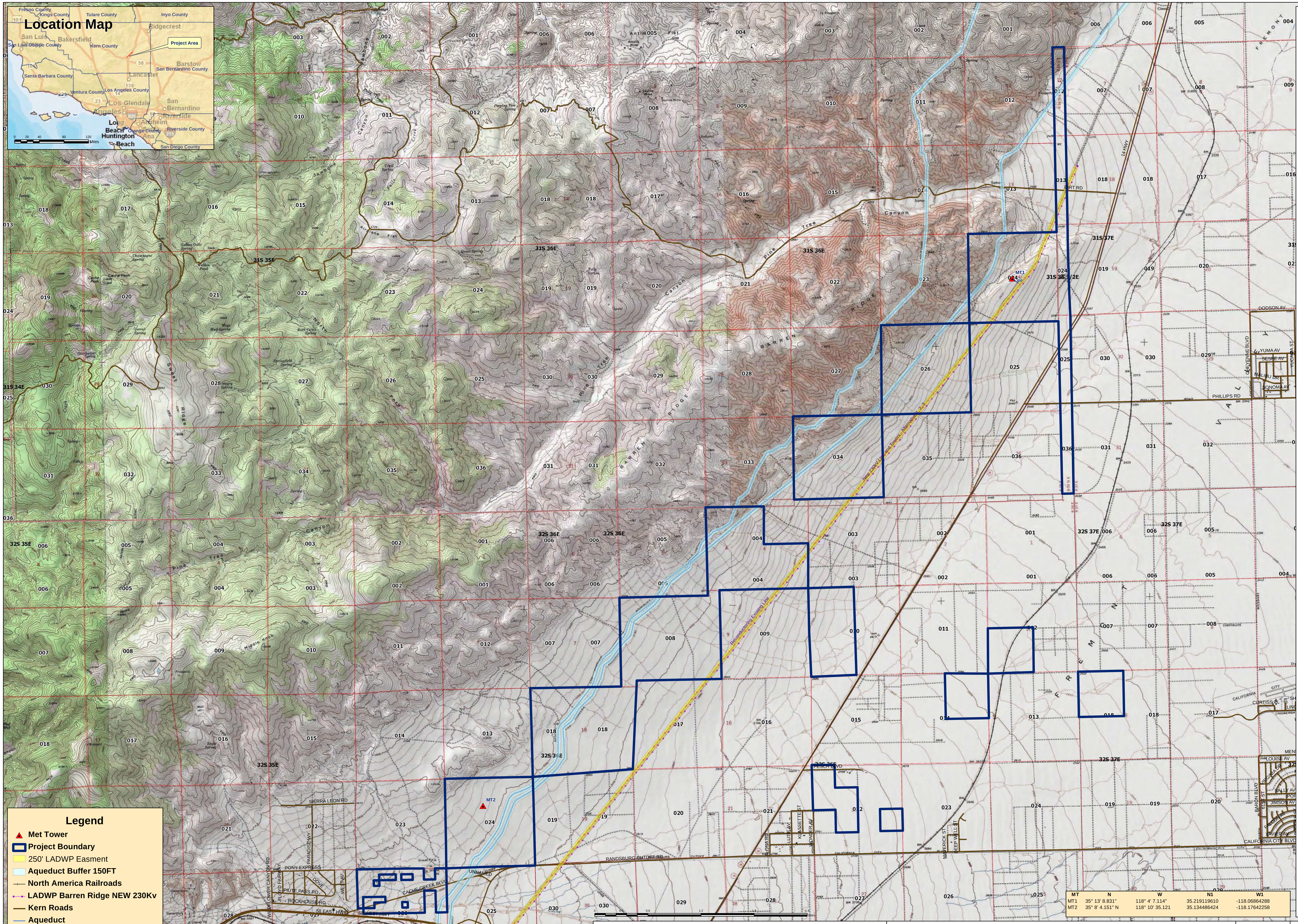
We appreciate the opportunity to comment of the proposed Solar PEIS and are available at any time to discuss further the recommendations included in this transmittal. Should you have any questions or require further information, please do not hesitate to contact me.

Sincerely,

Leslie J. Barrett

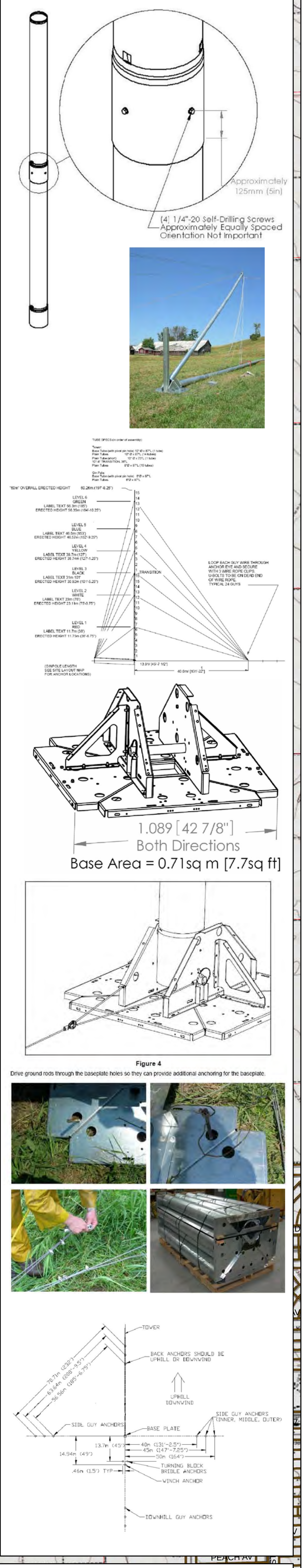
Leslie John Barrett, PE, MBA, Esq.
President

Celtic Energy Corporation
1507 Seventh Street, #540
Santa Monica, CA 90401



NOTES:

1. Wind forces and allowable member loads are calculated according to TIA/EIA standards.
2. Wind speeds are fastest mile wind velocity per EIA-222-F.
3. MES is non linear material mode in Algor FEA software and elastic analysis in SAP Software have been used to determine member forces an all the other loads.
4. Foundation has been analysed in Algor FEA software and any necessary anchor bolts, ground anchors and stakes.



MT	N	W	N1	W1
MT1	35° 13' 8.831"	118° 4' 7.114"	35.219119610	-118.06864288
MT2	35° 8' 4.151" N	118° 10' 35.121	35.134486424	-118.17642258

Mojave Diamonds Project

Project Site Plan

CELTIC ENERGY CORPORATION

Celtic Energy Corporation
1507 7th Street, #540
Santa Monica, CA 90401

Tel. 800-590-8839
relations@windnrginc.com
windnrginc.com

Date: 10/11/2011

Serial Number CACA 052842

BLM Ridgecrest Field Office

Project #12349

Drawn By: NRG Consulting Engineers

Thank you for your comment, Nada Culver.

The comment tracking number that has been assigned to your comment is SEDDsupp20108.

Comment Date: January 27, 2012 11:00:55AM
Supplement to the Draft Solar PEIS
Comment ID: SEDDsupp20108

First Name: Nada
Middle Initial:
Last Name: Culver
Organization: The Wilderness Society
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Address 2:
Address 3:
City: Denver
State: CO
Zip: 80202
Country: USA
Privacy Preference: Don't withhold name or address from public record
Attachment: TWS Comments on Supplement to Solar PEIS - 2nd letter.pdf

Comment Submitted:

One of 2 letters TWS will be submitting today is attached.

January 27, 2012

Solar Energy Draft PEIS
Argonne National Laboratory
9700 S. Cass Avenue
EVS/240
Argonne, IL 60439

Re: Comments on Supplement to Draft Solar PEIS

To Whom It May Concern:

Please accept these comments on the Supplement to the Draft Solar Programmatic Environmental Impact Statement (PEIS). We appreciate the Bureau of Land Management providing further information and an opportunity for public comment. This letter is submitted in addition to the letter that The Wilderness Society is submitting with other organizations, in order to highlight a number of important issues that merited further discussion.

BLM should refine the proposed process for designating new SEZs in the Final PEIS.

We generally support the new SEZ identification process proposed in the Appendix D to the Supplement and recommend that it be strengthened in a few key areas to ensure that new SEZs are truly needed and are suitable for designation.

Key recommended changes:

- The Final PEIS should specify that petitions for new SEZs solely based on supporting single solar ROW applications will be denied – individual applications outside of zones should be handled through the variance process, and a developer proposing a single project should not justify designating a new SEZ.
- The Final PEIS should include, as part of the technical and economic feasibility criteria, consideration of planned or potential power plant retirements and subsequent changes to transmission access.
- The BLM should add the screening criteria recommended in [section XX of the group comment letter] and in the state-specific comments submitted separately to the list of screening criteria for new SEZs that will be incorporated into the Final PEIS.
- Among additional factors to be considered for new SEZs identified in the Supplement, the BLM should include opportunities for co-location of energy

development, such as co-location of solar development with wind or oil and gas projects, in the Final PEIS.

- While the appearance of exclusion areas within new SEZs can make sense in some situations (such as a few isolated wetlands within a very large SEZ), the BLM should take into consideration the fact that while these areas will be excluded from development, their productivity and health may be severely compromised if they are surrounded by solar development. For this reason, every effort should be made to minimize the designation of SEZs with significant numbers and/or acreage of exclusion areas within them.

The Final PEIS should set out additional specific incentives for development in SEZs.

The Modified Solar Energy Development Program Alternative will not limit development to zones, so it is important that BLM provide incentives and reduce disincentives for locating projects in SEZs. We support the incentives set out in Section 2.2.2.2.3 of the Supplement, including faster permitting with appropriate tiering of NEPA analysis, regional mitigation plans, transmission analysis, economic benefits, maintaining BLM's Renewable Energy Coordination Offices and teams, and incentives to transmission developers. We recommend that the Final PEIS detail the following **additional incentives**:

- Applications in SEZs will be given priority for agency resources including for processing;
- Applications for development outside of SEZs will be subject to a surcharge (of up to 50% for pending applications) on the per acre rental fee; and
- Applications in SEZs will be processed as Category 5 rights-of-way (master agreements), which allows more flexibility on cost-sharing between the application and BLM, while applications outside of SEZs will be processed as Category 6 right-of-way grants.

In addition, the Supplement now sets out a detailed approach to processing pending applications, which pertains to applications submitted before the date of publication for the Supplement for applications outside SEZs, but only pertains to applications submitted before June 30, 2009, for applications within SEZs. This differential treatment could be seen as a disincentive to applicants in zones and should be changed.

DOE should strengthen the preferred alternative.

We support DOE's preferred alternative, especially with the addition of more detailed information on the proposed programmatic guidance, which identifies general mitigation measures (for specific resources and for prioritizing disturbed lands and avoiding sensitive lands) and areas to avoid impacts. Supplement, pp. 3-1 – 3-7. We recommend specific improvements below.

Key recommended changes:

- DOE's programmatic environmental guidance in the Final PEIS should identify *excluded* categories of lands and explicitly incorporate the exclusion areas set out by BLM.
- DOE's guidance continues to reference streamlining environmental review but does not define what this means. In our comments on the Draft PEIS, we noted that DOE had not explained this term. We reiterate the importance of the Final PEIS stating that DOE will conduct all necessary environmental reviews associated with individual projects, which is not addressed in the Draft PEIS or the Supplement.
- The Final PEIS should set out programmatic mitigation measures to ensure that they are more than just "considerations." DOE's program can adopt the measures developed by the BLM and could also include additional incentives for siting in best locations, such as already-disturbed lands.

<u>Specific guidance is needed on solar energy development – set out in TWS letter of August 26, 2011.</u>

On August 26, 2011, The Wilderness Society provided specific recommendations for additional interim guidance to be issued prior to release of the Supplement to the solar energy review, which would ultimately form an integral part of the BLM's solar energy program. We noted that this guidance should also be incorporated into the Final PEIS and, as recommended in the BLM's response, we are resubmitting and incorporating by reference our detailed recommendations on specific guidance that should be set out in the Final EIS. Areas of guidance that are not currently addressed in the Supplement are:

- Targeted guidance on use of off-site mitigation and compensation;
- More specific NEPA requirements, such as release of a preliminary range of alternatives, defining a reasonable range of alternatives, and describing the scope of cumulative impacts analysis; and
- Onsite use of natural gas to support solar energy development.[1]

<u>Criteria for addressing pending applications should be strengthened to better support the BLM's stated goal to facilitate environmentally responsible solar development, primarily in zones.</u>

Section 1.7.2 of the Supplement states that the BLM will continue to process pending applications and defines "pending applications" as those on file prior to issuance of the Supplement, except for those in SEZs, which are only considered "pending" if submitted prior to June 30, 2009. We support BLM's acknowledgment that it has broad authority under FLPMA to reject pending solar applications prior to completing the NEPA process

[1] Our original recommendations also included direction on a pilot program for competitive leasing; however, in light of the recently-issued Advance Notice of Proposed Rulemaking Regarding a Competitive Process for Leasing Public Lands for Solar and Wind Energy Development, we will provide our comments and recommendations directly through that formal process.

and prior to issuance of the Solar PEIS ROD. However, in order to better support the agency's goals, we recommend the following specific improvements.

Key recommended changes:

- BLM should focus on eliminating unacceptable project applications from its processing queue without delay. With few exceptions, areas identified as exclusion or high conflict areas, as defined by IM 2011-061, represent lands with important environmental, cultural, or recreational values. BLM should quickly identify which project applications are within areas that would be excluded under the Final EIS or in high conflict areas and reject those with documented conflicts. The agency should also apply diligence requirements set out in IM 2011-060 to these applications.
- Pending applications within SEZs should be given the opportunity to choose to be analyzed under the program set out in the Solar PEIS ROD.
- Pending applications outside SEZs that are not on excluded or high conflict lands should also be given the opportunity to choose to submit a new application within a SEZ.
- Pending applications should only include those submitted prior to June 30, 2009.

Thank you for your consideration of our comments.

Very truly yours,

Nada Culver
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Denver, CO 80202
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ATTACHMENT

THE
WILDERNESS
SOCIETY

August 26, 2011

Via electronic mail and U.S. Mail

Director Robert Abbey
Bureau of Land Management
U.S. Department of the Interior
1849 C St NW
Washington, DC 20240

Re: Needed guidance for development of solar energy on BLM lands

Director Abbey:

We are writing to commend you for the continued evolution of your agency's program to administer solar energy resources on the public lands and to ask for additional action in advance of a final programmatic environmental impact statement and record of decision. We recognize you inherited an agency facing a significant backlog of renewable energy applications as the result of a decade of inattention and inactivity. The substantial progress made toward rationalizing development of these critical clean energy resources is due principally to your "smart from the start" vision, your leadership, and your strong commitment to building upon lessons learned.

Nowhere is this more evident than in the ongoing effort to finalize the programmatic environmental impact statement for solar energy. The Bureau has made a strong commitment to compile additional information on the proposed Solar Energy Zones originally identified by the agency as priority areas for solar development, as well as key policy issues such as criteria for identifying new Solar Energy Zones and additional details regarding how the zone-based program will operate going forward. By striking the right balance between protecting wildlife and wild lands and facilitating faster and cheaper development, this program is the way forward to create green jobs and clean power for years into the future.

However, while this additional effort is underway there is a continuing need to provide guidance for the benefit of field staff, applicants, and other stakeholders. We offer the following recommendations for additional interim guidance to be issued prior to release of the supplement to the solar energy review. As a key part of the BLM's solar energy program, we also expect this guidance to be incorporated into the final programmatic environmental impact statement.

1. <u>Targeted guidance on use of off-site mitigation and compensation.</u>

The BLM is in need of tailored guidance on the use of off-site mitigation in the context of solar energy development, which would acknowledge the range of resources and uses to be addressed, as well as guide the agency in developing and requiring use of this important tool.

Industrial-scale solar energy development is currently occurring on the public lands using multi-decade rights of way and is likely to prevent all or most other uses of sites for at least the term of those ROWs, if not beyond, due to modifications sites during construction and operations. Instruction Memorandum (IM) 2011-003 prescribes 30-year terms. Off-site mitigation can – and should – provide a way to compensate for the loss of use of the affected public lands. In fact, off-site mitigation is already being used to address impacts from solar energy projects to habitat for both plants and wildlife in California. The Draft Solar PEIS only specifically contemplates use of off-site mitigation for visual resources, cultural resources and wetlands. The application to wetlands is based on existing "no net loss" policy. Draft PEIS, p. 5-65. With respect to loss of visual resources, the Draft states:

> In addition to mitigation measures that directly reduce the visual resource impacts of solar energy and associated facilities, the off-site mitigation of visual impacts may be an option in some situations. Off-site mitigation should 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 (e.g., 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 Instruction Memorandum No. 2008-204, Offsite Mitigation (BLM 2008f).

Draft PEIS, Section 5.12.3.7 Use of Off-Site Mitigation Measures for Visual Resources, pp. 5-203 – 5-204 (emphasis added).

The Draft PEIS also references the use of offsite mitigation for impacts to cultural resources, without detailed discussion. Draft PEIS, p. 5-220. However, despite the obvious and ongoing need for use of off-site mitigation to address the impacts of large-scale solar energy development, the Draft PEIS does not address the issue in detail. There is no discussion of the many other resources that will be affected or lost, and should be subject to off-site, compensatory mitigation; and there is no detailed direction as to how needed off-site mitigation should be developed and applied.

Further, the agency's current guidance on offsite mitigation (IM 2008-204 "Offsite Mitigation ") does not specifically address solar development or distinguish among the types of "large development projects" where offsite mitigation might be appropriate, which are identified as:

- Oil, gas, or geothermal fields, or individual wells that will make up a large field and associated rights-of-way;
- Major road, electrical, or pipeline rights-of-way projects;
- Wind farms or solar arrays;
- Municipal water reservoirs;
- Mining operations; and
- Recreation and Public Purposes Act leases or patents in important habitat.

In light of the long-term and virtually exclusive use of large blocks of the public lands required for solar energy development, clearer direction is needed regarding the use of off-site mitigation.

The BLM could meet this need for additional direction on the use of off-site mitigation for solar energy development by supplementing IM 2005-069 with additional guidance focused on the use of offsite mitigation for solar energy projects that includes the following elements and statements:

- Recognition that solar development is likely to prevent all or most other uses of sites for decades at a time and, therefore, it is expected that offsite mitigation will be needed to address impacts to a variety of resources and uses.
- Clarification of the agency's authority to require offsite mitigation (even if the applicant does not propose its use).
- Direction that resources and uses that should be considered for off-site mitigation (including compensatory mitigation) include, but are not limited to habitat for wildlife or plants, water, recreation, scenic values, cultural resources, and ecosystem function[1].
- Off-site mitigation requirements will be developed for each project with input from the applicant and state wildlife agencies, as well as other experts.
- NEPA analyses for projects will incorporate off-site mitigation, including a range of alternatives.
- In order to rely upon off-site mitigation to reduce impacts, the agency must[2]:
    - Have authority to implement the measures,
    - Have a reasonable expectation that it will have the resources needed to implement and monitor the mitigation measures, and
    - Have a reasonably, scientifically-based expectation that the mitigation measures will effectively avoid or reduce impacts.

[1] In California, offsite mitigation is being used to address habitat loss. While the California Fish and Game Department has required some of this mitigation, the BLM's California Desert Conservation Area Plan also specifies mitigation ratios for loss of certain categories of lands, including critical habitat.
[2] Consistent with Council on Environmental Quality Memorandum of January 14, 2011.

2. Baseline terms and conditions for ROWs that address solar energy and set out the BLM's authority to change and supplement terms.

As indicated, solar energy development is currently permitted and managed through a right-of-way grant that sets out terms and conditions, using the agency's standard form (SF299). The SF299 is used for a wide variety of uses, but historically has not been used to permit actions that become an exclusive use for decades, such as industrial-scale energy development. While the BLM can adapt the ROW form for individual projects, there are specific terms that should apply to all solar energy projects. A standard set of terms and conditions that applies to the construction, operation and reclamation of solar energy projects would ensure that the information gathered and lessons learned from the BLM's recent processing of numerous applications is used to improve all projects. These terms and conditions should include some of the innovative and carefully tailored terms developed as part of protest resolution discussions in California, such as:

- Provision for designating "unavailable" areas within rights-of-way to better manage a contiguous area and protect important resources;
- Requirement that any compensatory lands acquired as part of mitigation will be subject to permanent protection via fee acquisition and transfer for permanent management and conservation;
- Commitment not to assert or otherwise claim any water rights, surface or groundwater, beyond the use permitted under the specific ROW terms;
- Provision for the BLM to require modified or new monitoring as new information is developed or concerns identified and to incorporate such results into site management activities;
- Requirement to make monitoring results available to the public;
- Notice and commitment that substantial changes in the proposed and approved technology will require additional NEPA review before construction and operation can proceed.

These terms should also address and discourage speculative permit applications. The BLM should include in its standard terms a clear statement that assignment or transfer will not permitted in the first three years after authorization is given without a demonstration of need and technical and economic viability of the party interested in acquiring the approved ROW grant before approving reassignment or transfer. Additionally, BLM should provide for review and application of the same criteria in the event of a change in ownership of the company holding the grant and assert its authority to cancel a grant if viability is in question. Finally, BLM should require construction activity to commence within 12 months of a grant except under extraordinary circumstances with BLM's explicit approval.

The BLM should either create a new right-of-way grant application form for solar energy development or create a supplement to the SF299 specific to solar energy development. In addition to setting out specific terms for management of projects, each ROW should include terms to protect the BLM's ability to reassess and impose additional protective measures based on new information or policies, including but not limited to newly-discovered listed species or monitoring data. The BLM should specifically preserve its prerogative to apply new policies and new program requirements, such as diligence requirements, zoning/prioritization decisions, best management practices and bonding requirements, many of which should be developed in detail through the Solar PEIS and will likely continue to be refined[3].

The agency already makes use of similar terms in other documents providing for development on public lands. For example, oil and gas leases include stipulations to advise lessees that they will be subject to new terms in similar situations. IM 2010-117 (Oil and Gas Leasing Reform) sets forth in Appendix I a comparable approach requiring all leases to contain stipulations preserving the Bureau's right to impose new restrictions upon discovery of special status species or cultural and historic resources.

3. <u>More detailed guidance on inventory of cultural and historic resources and consultation.</u>

Preserving our shared cultural history is an important part of the BLM's mission, cited in both the Federal Land Policy and Management Act (FLPMA) and the National Historic Preservation Act. BLM is legally obligated to consult with Tribal entities and other consulting parties, including State Historic Preservation Officers, local governments, and other interested individuals and organizations, at the earliest feasible opportunity. In addition, BLM is required to identify sites that are eligible for listing or are listed on the National Register of Historic Places, and take develop measures to avoid or mitigate damage to cultural resources and historic properties. Unsuccessful efforts to engage and respond to the concerns of Tribal entities and other interested, consulting parties have led to not only publicized resentment but also legal actions and even an injunction against construction of an approved solar energy project. While the agency is working on a programmatic agreement (PA) for solar energy, a structured approach to not only compliance but also proactive outreach will better position proposed projects for success and can build on the provisions of the PA.

The BLM can issue new guidance for early, timely, personalized, and in-person consultation and outreach to Tribes and other consulting parties. This guidance can apply as part of finalizing Solar Energy Zones, as part of prioritizing areas for development within zones, throughout the processing of applications, and during construction and operation of projects. Key elements of the guidance would be:

- At each step, consultation and outreach should incorporate:
  - Sufficient time for response from Tribal representatives,
  - In-person conference to discuss concerns and try to reach resolution as early as
  - possible,
  - Formal response from agency staff demonstrating efforts to accommodate
  - Tribal concerns, and
  - Identification and evaluation of historic properties.
- Identification and evaluation may be conducted in progressive stages of detail, but should be completed prior to the application stage and be conducted at each stage as soon as there is enough information to make it feasible to do so.
- All parties to PAs should be given opportunities to provide input at all stages identified above.

[3] The agency already uses lease stipulations with similar language for new information, determinations and policy in oil and gas leases, which can provide a reference.

- PAs for the Solar Energy PEIS and for other zones, priority areas or individual projects should follow the steps outlined above for consultation, identification and evaluation, as well as addressing Tribal concerns and potential impacts to cultural and historical resources.

4. More specific NEPA requirements –

The National Environmental Policy Act (NEPA) dictates that BLM take a "hard look" at the environmental consequences of a proposed action and the requisite environmental analysis "must be appropriate to the action in question."[4] In order to take the "hard look" required by NEPA, BLM is required to assess impacts and effects that include: "ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative." 40 C.F.R. § 1508.8. NEPA regulations define "cumulative impact" as:

> the impact on the environment which results from the incremental impact of the action when **added to other past, present, and reasonably foreseeable future actions** regardless of what agency (Federal or non-Federal) or person undertakes such other actions. **Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.**

40 C.F.R. § 1508.7 (emphasis added). In the context of industrial-scale solar energy development, these impacts are wide-ranging and significant. Specific guidance for thorough analysis of projects will ensure impacts are identified early on and can be addressed through improvements or even rejection of projects. There are a number of key aspects of NEPA analysis of solar energy projects that should be addressed in new or amended policy guidance:

a. Preliminary range of alternatives is issued for public comment.

NEPA requires BLM to "[e]ncourage and facilitate public involvement in decisions which affect the quality of the human environment"; and notes that "public scrutiny" is "essential to implementing NEPA." 40 C.F.R. § 1500.1(b); § 1500.2(d). Releasing a range of preliminary alternatives for public comment, prior to finalizing and issuing a formal Draft EIS (or EA), would advance NEPA's twin goals of providing meaningful public participation in government decisions and ensuring government decisions affecting the quality of the environment are fully informed by all relevant information.

The BLM and other federal agencies already make use of this tool. Numerous BLM offices have used preliminary alternatives as a way to expand opportunities for public comment on resource management plans (RMPs). For instance, the Arizona Strip BLM Office provided preliminary management alternatives, giving the public a chance to submit comments and giving the BLM valuable insight into their management approaches (available on-line at: http://governor.utah.gov/rdcc/Y2003/03-2902.pdf). The Las Cruces Field Office (New Mexico)

[4] *Metcalf v. Daley*, 214 F.3d 1135, 1151 (9th Cir. 2000); *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 348 (1989).

also held workshops and solicited public comments on preliminary alternatives for the Tri-County RMP (see RMP Newsletter 3, available at http://www.blm.gov/nm/st/en/fo/Las_Cruces_District_Office/tricounty_rmp.html) and the Trackways National Monument (see press release, available at http://www.blm.gov/pgdata/etc/medialib/blm/nm/field_offices/las_cruces/las_cruces_planning/trackways_rmp.Par.97147.File.dat/NewsRelease_ptnm_workshop9_2010.pdf, and preliminary alternatives highlights, available at http://www.blm.gov/pgdata/etc/medialib/blm/nm/field_offices/las_cruces/las_cruces_planning/trackways_rmp.Par.4873.File.dat/Issue_summaryV2_rgedit.pdf).

Requiring BLM field offices to provide a preliminary range of alternatives for comment as part of NEPA analysis for solar energy projects would allow the agency to identify key issues or places or approaches to a project that are not being considered but could lead to serious opposition, or improvements in a project, or even substantial legal flaws in the analysis.

b. Reasonable range of alternatives is analyzed.

NEPA requires the BLM to consider alternatives to the proposed action.[5] This requirement has been described as the "heart" and "linchpin" of the environmental review by the courts and the Council on Environmental Quality ("CEQ"), respectively.[6] Agencies must "rigorously explore" all reasonable alternatives to the proposed action and "[d]evote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits." 40 C.F.R. § 1502.14(a). Further, in defining what is a "reasonable" range of alternatives, NEPA requires consideration of alternatives "that are practical or feasible" and not just "whether the proponent or applicant likes or is itself capable of carrying out a particular alternative"; in fact, "[a]n alternative that is outside the legal jurisdiction of the lead agency must still be analyzed in the EIS if it is reasonable."[7] The foregoing principles are equally applicable to an EA.

IM 2011-059 provides initial guidance on the range of alternatives, but should contain more specificity regarding reasonableness and should also be revised to acknowledge the important information that can be gained from analyzing alternatives in different locations. Consequently, in the context of a solar energy project, BLM guidance should clarify that a reasonable range of alternatives includes the proposed alternative, a no action alternative, and at least two additional alternatives that consider:

- ,
- alternate locations beyond the specific boundaries of proposed rights-of way, including private land alternatives,
- smaller "footprint" or size than the proposed action, which could reduce environmental impacts,

[5] 42 U.S.C. § 4332(2)(C)(iii); *Bob Marshall Alliance v. Hodel*, 852 F.2d 1223, 1228-1229 (9th Cir. 1988).

[6] *See Monroe County Conservation Council v. Volpe*, 472 F.2d 693, 697-698 (2nd Cir. 1972); 40 C.F.R. § 1502.14.

[7] Council on Environmental Quality, Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations, Questions 2A and 2B, available at http://ceq.hss.doe.gov/nepa/regs/40/40p3.htm; 40 C.F.R. §§ 1502.14, 1506.2(d).

- different technology from that in the proposed action, which may be more efficient or reduce environmental impacts (such as using less water), if feasible, and
- a range of reasonable foreseeable development for the proposal and adjacent lands, including consideration of non-project alternative.

c. Cumulative impact analysis should take into account connected actions and additional projects affecting resources in the area.

To satisfy NEPA's hard look requirement, the cumulative impacts assessment must do two things: First, BLM must catalogue the past, present, and reasonably foreseeable projects in the area that might impact the environment. [8] Second, BLM must analyze these impacts in light of the proposed action.[9] If BLM determines that certain actions are not relevant to the cumulative impacts analysis, it must "demonstrat[e] the scientific basis for this assertion."[10] A failure to include a cumulative impact analysis of actions within a larger region will render NEPA analysis insufficient.[11] While the treatment of this issue has improved with recent EISs, more work is needed.

For solar energy projects, guidance should define the needed cumulative impact analysis to ensure sufficient review of all likely connected actions (such as transmission associated with a proposed project) and additional projects planned for the area, all of which can have compounding effects and significant effects on natural resources. In particular, it is clear that other proposed solar projects and their associated transmission in the California Desert are likely to cause significant impacts on habitat for the desert tortoise , which should affect the size, design, technology, and mitigation measures that would be required to responsibly permit additional development of a new project in tortoise habitat. To date, BLM EISs have conceded these effects but have not analyzed the impacts of such development on potential tortoise recovery or whether the cumulative impacts can in fact be mitigated. Completing a more thorough analysis of cumulative impacts would enable the agency to determine mitigation that is needed on a landscape level, such as protecting migration corridors, as well as more site-specific adjustments to project boundaries or technology to provide added protection for wildlife, plants or water that are being stressed from a variety of uses.

5. Dealing with pending applications

In advance of a final PEIS and ROD, BLM has the opportunity to resolve confusion surrounding which applications will be treated under which set of rules with a clear policy statement is how the Bureau will address pending applications. Specific recommendations were offered by a coalition of developers and conservationists, and should form the basis for new guidance to be issued immediately.

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[8] *Muckleshoot Indian Tribe v. U.S. Forest Service*, 177 F.3d 800, 809–10 (9th Cir. 1999).
[9] *Id.*
[10] *Sierra Club v. Bosworth*, 199 F.Supp.2d 971, 983 (N.D. Ca. 2002).
[11] *See, e.g., Kern v. U.S. Bureau of Land Management*, 284 F.3d 1062, 1078 (9th Cir. 2002) (analysis of root fungus on cedar timber sales was necessary for an entire area).

New guidance should spell out which applications will be subject to the land use and other requirements to be finalized in the ROD. In February 2011, the Bureau issued significant new policy guidance sending a clear indication to new applicants that, in combination with the Draft PEIS, development will be confined to areas of low resource conflict. Accordingly, any new applications filed on or after March 1, 2011, should be governed by the terms of the Solar PEIS ROD when finalized. This rule should not apply to boundary adjustments to move an existing project application to a nearby area in order to avoid environmental or cultural conflicts, even if this relocation would technically require a "new" application.

To improve the processing of other pending applications submitted before March 1, 2011, the existing guidance for the administration of solar energy development on public lands must be improved and revised as follows:

- The BLM should establish a new processing fee structure for the costs of "holding" a location, set at a level sufficient to dampen speculation and to acknowledge the acreage that may be subject to restriction while BLM processes complicated applications for utility-scale solar projects. Neither BLM's current ROW regulations and guidance nor BLM's guidance on processing solar energy applications adequately addresses this risk. All applicants would be required to pay these processing fees in full into escrow before application processing begins.
- The BLM should clearly define all POD requirements and enforcement mechanisms.
- The Bureau should revise the screening criteria laid out in IM 2011-061 with the screens proposed by industry and conservation community partners in December 2010,[12] respecting the additional accommodations provided to the National Park Service. The Bureau should coordinate with the Department of Energy, Treasury, and other federal agencies to apply screens within their expertise to ensure that limited public resources are focused on only the most viable applications. The Secretary of the Interior is not the only person who is concerned about the "flipping" of ROW authorizations that has occurred to date.
- Pending applications should then be subject to environmental screening as follows:
    - Early outreach prior to NOI (as provided under IM 2011-061).
    - Project Rating according to environmental criteria, based on available data, to group pending applications by likelihood of conflict as described in screens (high, medium and low) and applicants notified.
    - All pending applications, regardless of when filed, that are determined by the BLM to be in high conflict areas following consultation with the applicant and stakeholders, should be rejected.

6. <u>Leasing pilot program</u>

Solar development is administered using a right-of-way application under FLPMA. This legal instrument is a poor fit for commercial energy development. ROW relates to the *use of lands* not the *development of a resource* on or emanating from lands. The placement of facilities *on*, or other physical use *of*, federal lands is very different from the commercial development of a resource. ROW authorizations under FLPMA are intended for and better suited to limited uses of

[12] *See California Desert Renewable Energy Working Group letter to Director Abbey*, December 22, 2010.

lands under a multiple-use framework, than to long-term, exclusive commercial resource development operations.

For other energy resources, leases have proven more appropriate than ROW authorizations for resource development in collecting a fair return to taxpayers and ensuring the long-term certainty required by developers and the public alike.

The Bureau should take immediate steps to prepare for a transition to leasing solar energy resources on public lands. It is clear that the management of these fuel sources benefits from leasing systems designed to deal with long-term, commercial operations. But the Bureau should carefully evaluate the elements of a leasing system most appropriate for a young industry like solar. To do so, the Bureau should initiate a pilot demonstration effort evaluating methods of competitive offering in the case of overlapping applications in solar energy zones, with the purpose of experimenting with ways to resolve competitive interest to the maximum benefit of government and taxpayers.

7. Standardized and mandatory policies and design features

The Draft Solar PEIS includes a set of "Current and Proposed Bureau of Land Management Solar Energy Development Policies and Design Features" as Appendix A, which may be incorporated into the agency's Solar Energy Program. A key aspect of incorporating these practices into the program and into all future projects will be creating a version of the list that can be issued as soon as possible and made mandatory (where applicable) to all projects.

BLM and other federal agencies have developed an effective way to make a "menu" of terms and mitigation measures required to all projects as they are applicable. The Record of Decision on the PEIS for the West-wide Energy Corridors includes Appendix B – Interagency Operating Procedures (available at http://corridoreis.anl.gov/documents/docs/Energy_Corridors_final_signed_ROD_1_14_2009.pdf), which applies as follows:

> These Interagency Operating Procedures (IOPs) are adopted as part of the plan amendments and are mandatory, as appropriate, for projects proposed within the Section 368 corridors. Not all IOPs will be appropriate for all projects; those that apply to pipelines, for instance, are not appropriate to transmission lines. These IOPs are practicable means to avoid or minimize environmental harm from future project development that may occur within the designated corridors. The IOPs set forth below are not intended and should not be construed to alter applicable provisions of law or regulation or to reduce the protections afforded thereby to the resources addressed in the IOPs.

These IOPs address all aspects of project, including design, transportation, specific affected resources, construction, decommissioning, and consultation. In addition, the IOPs clarify where they may apply differently to different ecosystems.

A similar list of practices and procedures can be finalized and issued *immediately* to apply to all projects, and then updated and incorporated as part of finalizing the PEIS, as well. The BLM can and should make this list available immediately, without waiting for the Solar PEIS to be finalized.

As part of issuing a list of mandatory policies and design features, the BLM should also include an analysis of their effectiveness –in terms of evaluating the broader categories and their application in specified situation. In the Draft Solar PEIS, the BLM asserts that its "comprehensive set of mitigation requirements would ensure that impacts from solar energy development on BLM-administered lands would be mitigated to the fullest extent possible." Draft Solar PEIS, p. 6-104. However, in order to rely on these measures, the agency must provide data and analysis that demonstrate why the proposed policies and design features will "constitute an adequate buffer against the negative impacts that may result from the [proposed alternatives]."[13] Simply identifying mitigation measures, without analyzing the effectiveness of the measures, violates NEPA. Agencies must "analyze the mitigation measures in detail [and] explain how effective the measures would be . . . A mere listing of mitigation measures is insufficient to qualify as the reasoned discussion required by NEPA."[14] Thus, in addition to providing the scientific basis for adopting these policies and practices, the BLM must discuss why the selected mitigation measures are likely to be successful in the context of NEPA analysis for individual projects.

As part of our comments on the Draft Solar PEIS, we provided a compilation of best management practices for renewable energy siting and development drawn from scientific, peer-reviewed research prepared by Utah Clean Energy and several other conservation groups in the West (attached as Appendix VIII to those comments). We once again urge the BLM to carefully examine this document as part of producing a compendium of design features that are scientifically supported. IM 2011-003 references certain best management practices and applicable documents that are made available in different locations, but does not provide an easily accessible, comprehensive listing that is needed to make inclusion of these provisions in permits for individual projects practical, realistic, and likely.. Guidance providing such a listing and making it mandatory for all solar energy projects in applicable contexts should not be delayed.

8. <u>On-site use of natural gas especially with regard to hybrid plants</u>

Increasingly, developers are turning to hybrid generation options on private lands projects to bolster the variability of the solar resource. Pairing natural gas-fired generation with solar energy development can be a logical match, but the economic and environmental advantages of renewable energy generation (like solar) can be eclipsed if a distinction is not clearly drawn between solar development technologies that may require a minimal amount of natural gas and those that depend on a non-renewable fossil fuel as a chief generation resource.

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[13] *Nat'l Parks & Conservation Ass'n v. Babbitt*, 241 F.3d 722, 734 (9th Cir. 2001).
[14] *Nw. Indian Cemetery Protective Ass'n v. Peterson*, 764 F.2d 581, 588 (9th Cir. 1985), *rev'd on other grounds*, 485 U.S. 439 (1988).

Co-locating a solar facility with a large natural gas facility to gain an advantage for developing natural gas-fired electricity on public lands should be clearly addressed and discouraged. Guidance should be issued to address on-site use of natural gas or other non-renewable fuels used in the generation of electricity to firm solar and wind generation, and define what constitutes a renewable energy project.

We sincerely hope the BLM will not delay in issuing this critical guidance and appreciate your attention to these recommendations. As always, we are available and interesting in meeting with you to discuss these important matters further.

Very truly yours,

Nada Culver, Senior Counsel and Director
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Chase Huntley
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Thank you for your comment, Claire Sears-Barker.

The comment tracking number that has been assigned to your comment is SEDDsupp20109.

Comment Date: January 27, 2012 11:11:18AM
Supplement to the Draft Solar PEIS
Comment ID: SEDDsupp20109

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Comment Submitted:

Thank you for taking the effort to compile and go through all the comments and bring public meetings to us through-out this process.

I want to emphasize that at this point in our technological advances-and our increased dedication to conservation-the Government should be supporting the "Distributed Generation Modeling" to address our nations energy issues in a way that is compliant and complimentary to the word moniker "green". Please see "Solar Done Right" for more information, or google "Bill Powers". Every community has distinct renewable resources, but the sun shines almost everywhere.

Corporate use of public lands should be the LAST option to follow before utilizing already denigrated (preferably private) lands. Communities-within these developments-should have clear and dependable economic benefit.

In particular-developing SEZ's within the San Luis Valley-not only is planning on export that is not supported by transmission at this time-but is also not going to make substantial economic benefits to the tax structure of any of the communities.

With the proposed decrease in irrigation pumping of lands within the SLV, we have in our midst-already denigrated lands of higher acreages than those proposed in the SEZ studies, which would bring economic benefit under tax distributions-if not in long term employment....distributive modeling near point of use is a much "greener" option all the way around. Leave undeveloped land-undeveloped-please.

Thank you for listening.
Claire