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Via email only

27 November 2024

Bruce Sillitoe, Field Manager, Las Vegas Field Office
Whitney Wirthlin, Acting Supervisory Project Manager
Bureau of Land Management
Southern Nevada District Office
ATTN: Larrea, Mosey, and Rock Valley Solar Projects
4701 N. Torrey Pines Drive
Las Vegas, NV 89130
BLM_NV_SND_EnergyProjects@blm.gov

RE: Comments on Variance for Larrea Solar, Mosey Solar, and Rock Valley Solar Projects, Clark County & Nye Counties, NV

Dear Mr. Sillitoe and Mr. Wirthlin,

The Desert Tortoise Council (Council) is a non-profit organization comprised of hundreds of professionals and laypersons who share a common concern for wild desert tortoises and a commitment to advancing the public's understanding of desert tortoise species. Established in 1975 to promote conservation of tortoises in the deserts of the southwestern United States and Mexico, the Council routinely provides information and other forms of assistance to individuals, organizations, and regulatory agencies on matters potentially affecting desert tortoises within their geographic ranges.

Both our physical and email addresses are provided above in our letterhead for your use when providing future correspondence to us. When given a choice, we prefer to receive emails for future correspondence, as mail delivered via the U.S. Postal Service may take several days to be delivered. Email is an "environmentally friendlier way" of receiving correspondence and documents rather than "snail mail."

The Council thanks the Bureau of Land Management (BLM) for notifying us of the opportunity to participate in the public comment period for the variance process for the three proposed projects.

We appreciate this opportunity to provide comments on the above-referenced projects. Given the location of the proposed project in habitats occupied by the Mojave desert tortoise (*Gopherus agassizii*) (synonymous with Agassiz's desert tortoise), our comments include recommendations intended to enhance protection of this species and its habitat during activities authorized by the BLM, which we recommend be added as requirements to the right-of-way (ROW) and other agreements if BLM decides to implement any of the proposed projects. Please accept, carefully review, and include in the relevant project file the Council's following comments and attachment for the proposed projects.

The Mojave desert tortoise is among the top 50 species on the list of the world's most endangered tortoises and freshwater turtles. The International Union for Conservation of Nature's (IUCN) Species Survival Commission, Tortoise and Freshwater Turtle Specialist Group, now considers the Mojave desert tortoise to be Critically Endangered (Berry et al. 2021), "… based on population reduction (decreasing density), habitat loss of over 80% over three generations (90 years), including past reductions and predicted future declines, as well as the effects of disease (upper respiratory tract disease/mycoplasmosis). *Gopherus agassizii* (sensu stricto) comprises tortoises in the most well-studied 30% of the larger range; this portion of the original range has seen the most human impacts and is where the largest past population losses have been documented. A recent rigorous rangewide population reassessment of *G. agassizii* (sensu stricto) has demonstrated continued adult population and density declines of about 90% over three generations (two in the past and one ongoing) in four of the five *G. agassizii* recovery units and inadequate recruitment with decreasing percentages of juveniles in all five recovery units."

This status, in part, prompted the Council to join Defenders of Wildlife and Desert Tortoise Preserve Committee (Defenders of Wildlife et al. 2020) to petition the California Fish and Game Commission in March 2020 to elevate the listing of the Mojave desert tortoise from Threatened to Endangered in California. In its status review, California Department of Fish and Wildlife (CDFW) (2024) stated: "At its public meeting on October 14, 2020, the Commission considered the petition, and based in part on the Department's [CDFW] petition evaluation and recommendation, found sufficient information exists to indicate the petitioned action may be warranted and accepted the petition for consideration. The Commission's decision initiated this status review to inform the Commission's decision on whether the change in status is warranted."

Importantly, in their February 2024 status review, CDFW concluded: **"The Department's recommendation is that uplisting the Mojave Desert Tortoise is warranted."** Receipt of this status review and recommendation was accepted by the Commission in April and the Commission is expected to make a decision on uplisting in December.

Description of Three Proposed Projects

<u>Larrea Solar Project</u>: Naturgy Candela Devco, LLC, (Larrea Applicant) proposes to construct, operate, and eventually decommission the Larrea Solar Project (Larrea Project) on 1,233 acres of BLM-managed land in Clark County, Nevada. If approved, this photovoltaic solar power project would produce up to 205 MW of solar energy, including 820-megawatt hours of onsite battery storage and interconnection (gen-tie line) to the regional transmission system. The Larrea Applicant has applied to the BLM Las Vegas Field Office for a ROW grant for this project.

The Larrea Project would be located in the Pahrump Valley, approximately 7 miles southeast of Pahrump, 38 miles west of Las Vegas, and 5 miles southwest of State Route 160. It would be located on lands designated by BLM as a solar variance area under the Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (BLM and Department of Energy 2012a) and Approved Resource Management Plan Amendments/Record of Decision for Solar Energy Development in Six Southwestern States (BLM and Department of Energy 2012b).

Mosey Solar Project: Renew Development HoldCo, LLC, a subsidiary of Clearway Energy (Mosey Applicant), proposes to construct, operate, and eventually decommission the Mosey Solar Project (Mosey Project) on 3,523 acres of BLM-managed land in Clark and Nye counties, Nevada. If approved, the photovoltaic would produce up to 500 MW of clean energy, including 850 MW of battery storage. The generated electricity would be delivered via a new 230 kV overhead generation gen-tie transmission line to the new Trout Canyon Substation. The Mosey Applicant has applied to the BLM Las Vegas Field Office for a ROW grant for this project.

The Mosey Project would be located in the Pahrump Valley, approximately 10 miles southeast of Pahrump, 30 miles west of Las Vegas, and 2 miles south of State Route 160. Ite would be located on lands designated by BLM as a solar variance area under the Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (BLM and Department of Energy 2012a) and Approved Resource Management Plan Amendments/Record of Decision for Solar Energy Development in Six Southwestern States (BLM and Department of Energy 2012b).

Rock Valley Solar Project: Boulevard Associates, LLC, a subsidiary of NextEra Energy Resources, LLC (Rock Valley Applicant), proposes to construct, operate, and eventually decommission the Rock Valley Solar Project (Rock Valley Project) on 10,105 acres of public lands near Amargosa Valley in Nye County, Nevada. If approved, the project would produce and store up to 1,600 MW of solar energy including 1,600 MW of battery storage. It would include an on-site substation and a dedicated 230- or 500-kilovolt (kV) generation tie-in transmission line (gen-tie) that connects the generation and storage facility from the on-site substation to the transmission grid.

The Rock Valley Project would be located in the Amargosa Valley about half way between Pahrump and Beatty, NV, approximately 0.9 mile southwest of the intersection of US Route 95 and west State Route 373. It would be located on lands designated by BLM as a solar variance area under the Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (BLM and Department of Energy 2012a) and Approved Resource Management Plan Amendments/Record of Decision for Solar Energy Development in Six Southwestern States (BLM and Department of Energy 2012b).

Comments on the Proposed Actions

Notifying the Public

When searching for information about the Larrea Project, Mosey Project, and Rock Valley Project (collectively the Projects) we were unable to find these projects in BLM's National Environmental Policy Act (NEPA) Register. We searched by each project name, then by state, and the results did not include the current public comment period for the variance process for the Projects. In addition, we searched the web sites for BLM's Southern Nevada District Office, Las Vegas Field Office, Pahrump Field Office, Battle Mountain District Office, and Tonopah Field Office and found no information about these projects or the open public comment period.

Many interested persons and organizations (the public) use BLM's National NEPA Register to search for BLM projects with open public comment periods to obtain information about the projects and to know when they can provide comments to BLM on proposed projects. They also look at the BLM district office and field office websites for announcements about public comment opportunities and information on proposed projects Because BLM did not provide information on their National Register regarding the Projects or on their District Office and Field Office websites for the Projects, BLM likely denied the public of their opportunity to participate in and comment on the Projects during the public comment period for the variance process. The only way the Council knew of the Projects and this opportunity for public comment was because BLM contacted the Council directly about this opportunity.

We request that BLM add the Projects and their required public comment period under the variance process to the BLM National NEPA Register. Other BLM offices have used the BLM National Register to announce proposed projects and the availability of a public comment period for solar variance projects (e.g., DOI-BLM-UT-C010-2023-0022-OTHER_NEPA; DOI-BLM-AZ-C000-2023-0001-OTHER_NEPA; DOI-BLM-AZ-P020-2022-0021-OTHER_NEPA, etc.). Announcing the public comment period for the variance process for the Projects on BLM's National NEPA Register would demonstrate that BLM is applying a consistent, non-arbitrary method of informing the public of BLM's consideration of the Projects and the opportunity to comment. IN addition, BLM should announce the Projects and the public comment period on their District Office and Field Office websites. We request that BLM implement a 30-day public comment period using these forms of notification to the public for the Projects.

Factors Considered in the Variance Process

BLM considers several factors, as appropriate, when evaluating ROW applications in variance areas. These include:

- The availability of lands in a solar energy zone (SEZ) that could meet the applicant's needs, including access to transmission.
- Documentation that the proposed project will be in conformance with decisions in current land use plan(s) (e.g., Visual Resource Management class designations and seasonal restrictions) or, if necessary, represents an acceptable proposal for a land use plan amendment.
- Documentation that the proposed project will be consistent with priority conservation, restoration, and/or adaptation objectives in the best available landscape-scale information (e.g., landscape conservation cooperatives, rapid ecological assessments, and State and regional-level crucial habitat assessment tools [CHATs]).
- Documentation that the proposed project can meet applicable programmatic design features adopted in the 2012 Western Solar Plan
- Documentation that the proposed project is in an area with low or comparatively low resource conflicts and where conflicts can be resolved
- If applicable, documentation that the proposed project will be located in, or adjacent to, previously contaminated or disturbed lands such as brownfields identified by the U.S. Environmental Protection Agency's (EPA's) RE-Powering America's Land Initiative or

State, local, and/or tribal authorities; mechanically altered lands such as mine-scarred lands and fallowed agricultural lands; idle or underutilized industrial areas; lands adjacent to urbanized areas and/or load centers; or areas repeatedly burned and invaded by fire-promoting non-native grasses where the probability of restoration is determined to be limited. Preference will be given to proposed projects that are located in, or adjacent to, previously contaminated or disturbed lands under the variance process, assuming all other factors are adequately considered.

- Documentation that the proposed project will minimize adverse impacts on important fish and wildlife habitats and migration/movement corridors (e.g., utilizing the Western Wildlife CHAT, administered by the Western Association of Fish and Wildlife Agencies and coordinating with State fish and wildlife agencies).
- Documentation that any groundwater withdrawal associated with a proposed project will not cause or contribute to withdrawals over the perennial yield of the basin, or cause an adverse effect on Endangered Species Act (ESA)-listed or other special status species or their habitats over the long term. However, where groundwater extraction may affect groundwater-dependent ecosystems, and especially within groundwater basins that have been over appropriated by State water resource agencies, an application may be acceptable if commitments are made to provide mitigation measures that will provide a net benefit to that specific groundwater resource over the duration of the project.
- Documentation that the proposed project will not adversely affect lands donated or acquired for conservation purposes, or mitigation lands identified in previously approved projects such as translocation areas for desert tortoise.
- Documentation that significant cumulative impacts on resources of concern should not occur as a result of the proposed project (i.e., exceedance of an established threshold such as air quality standards).
- If applicable, documentation on evaluation of desert tortoise impacts based on the variance protocol for desert tortoise.

Comments on Variance Factors Process

For the first bulleted factor listed above, BLM should provide information on the availability of space in the designated Solar Energy Zones (SEZs) in the six western states where solar projects have not been approved and could be located. We did not find this information on the Plans of Development for the three Projects or BLM’s Fact Sheets for the Projects – the only documents posted by BLM on the Projects.

Please provide information including maps of locations where BLM has approved solar projects in the SEZs and where BLM has not approved projects under the 2012 Final Programmatic Environmental Impact Statement and Proposed Resource Management Plan Amendments for Utility-Scale Solar Energy Development for Six Western States (FPEIS) and Record of Decision (ROD). We make the same request of BLM when the ROD is approved for the Final Programmatic Environmental Impact Statement and Proposed Resource Management Plan Amendments for Utility-Scale Solar Energy Development (FPEIS) (BLM 2024) (FPEIS) for eleven western states, the locations of these approved SEZs and where solar projects that have not been approved could be located. We anticipate this happening within the next few weeks.

For the second bulleted factor, conformance with current land use plans, the Council reminds BLM that the Las Vegas Resource Management Plan and Final Environmental Impact Statement (RMP) (which is the RMP that includes the area of the Projects) was approved in 1998. This document does not mention solar energy development. Consequently, locating a utility-scale solar energy project anywhere in the RMP area would not violate the RMP.

Additionally, this outdated RMP and BLM's Solar PEIS Record of Decision (ROD) in 2012 predates the release of significant findings regarding substantial tortoise declines in numbers and densities from 2004 with the data and analysis released by the U.S. Fish and Wildlife Service (USFWS) in 2015, with subsequent analysis and data documenting ongoing declines and their severity for the tortoise throughout most of the range of the tortoise and especially in the Eastern Mojave Recovery Unit (Allison and McLuckie 2018, and USFWS 2015, 2020, 2022a, and 2022b; please see Appendix A). The Council views these declines to constitute a significant change affecting the survival and recovery of the tortoise that likely warrants reinitiation of Section 7 consultation with the USFWS along with BLM substantially revising its management of tortoise populations/tortoise habitats to reverse the continuing declines of tortoise numbers and densities with a trajectory of extirpation.

The Solar FPEIS (2012a) and ROD (2012b) predate the identification of the Ivanpah Valley as a highly important area for providing connectivity among desert tortoise populations for maintaining a viable ecological network (Averill-Murray et al. 2021). "Maintaining an ecological network (recovery network) for the Mojave desert tortoise, with a system of core habitats (TCAs [Tortoise Conservation Areas]) connected by linkages (Hilty et al. 2020), is necessary to support demographically viable populations and long-term gene flow within and between TCAs" (Averill-Murray et al. 2021). In addition, "[l]arge, connected landscapes also are necessary to facilitate natural range shifts in response to climate change (Averill-Murray et al. 2021). We remind BLM of the "importance of tortoise habitat outside of TCAs to recovery" of the tortoise because these areas are necessary to provide "gene flow among TCAs and minimizing impacts and edge effects within TCAs") Averill-Murray et al. 2021).

"Ignoring minor or temporary disturbance on the landscape could result in a cumulatively large impact that is not explicitly acknowledged (Goble, 2009); therefore, understanding and quantifying all surface disturbance on a given landscape is prudent." Furthermore, "habitat linkages among TCAs must be wide enough [emphasis added] to sustain multiple home ranges or local clusters of resident tortoises (Beier and others, 2008; Morafka, 1994), while accounting for edge effects, in order to sustain regional tortoise populations." Consequently, effective linkage habitats are not long narrow corridors. Any development within them has an edge effect (i.e., indirect impact) that extends from all sides into the linkage habitat further narrowing or impeding the use of the linkage habitat, depending on the extent of the edge effect.

Averill-Murray et al. (2021) further notes that "To help maintain tortoise inhabitance and permeability across all other non-conservation-designated tortoise habitat, all surface disturbance could be limited to less than 5-percent development per square kilometer because the 5-percent threshold for development is the point at which tortoise occupation drops precipitously (Carter and others, 2020a)." They caution that the upper threshold of 5 percent development per square kilometer may not maintain population sizes needed for demographic or functional connectivity; therefore, development thresholds should be lower than 5 percent.

The lifetime home range for the Mojave desert tortoise is more than 1.5 square miles (3.9 square kilometers) of habitat (Berry 1986) and, as previously mentioned, tortoises may make periodic forays of more than 7 miles (11 kilometers) at a time (Berry 1986).Consequently for linkage habitats for the tortoise to be effective, they must be areas of sufficient size and mostly devoid of development including edge effects (e.g., indirect impacts from nearby development, etc.).

Sinervo et al. (2024) used their eco-physiological model of extinction to predict the distributions of 30 desert-endemic reptile and amphibian species under climate change scenarios. The model predicted the Sonoran desert tortoise (*G. morafkai*) was at a very high risk of extinction as a result of their thermal limits being exceeded by 2070. Although this research did not include the Mojave desert tortoise, it illustrates the importance of providing functioning linkage habitats to connect the current range of the tortoise with the northward movement of tortoise habitats in response to climate change.

Parandhaman (2023) analyzed how the compounded effects of land use and climate change would impact habitat suitability and landscape connectivity for current and future conditions for the tortoise. The habitat-based connectivity models indicated "a significant loss of connectivity in the eastern, central, and southern regions of the tortoise's range" (Parandhaman 2023). In response to climate change, as habitat shifts northward (Parandhaman 2023), but dispersal of the tortoise to follow the habitat is dependent on geography (e.g., topographical and anthropomorphic barriers to movement). Her modelling indicates the loss of connectivity /restricted gene flow that will occur over time as a result of habitat fragmentation. Her analyses revealed the importance of the valleys in southwestern Nevada particularly the Ivanpah and Amargosa valleys in providing tortoise habitat/connectivity as tortoise habitat shifts north in the future (Parandhaman 2023).

Because of the importance of the Ivanpah and Amargosa valleys to the survival of the tortoise now and in the future and the extensive development that has occurred in the northern Ivanpah Valley in Nevada, BLM should not approve more development in the Ivanpah Valley. Further, BLM should use the best available scientific information to determine the needs of the tortoise in the Amargosa Valley especially given the results of the importance of this valley for the future survival of the tortoise, and manage BLM lands to foster the movement of tortoises north as the habitat of the tortoise moves north in response to climate change. This analysis should be periodically revised because the last 20+ years of climate modelling have shown that these change models are conservative and have underestimated the impacts of climate change to flora and fauna.

The Council asserts that if BLM uses the best available science on the status and trend of the tortoise and the impacts of solar development combined with other impacts on BLM managed lands and adjacent lands, and the impacts of climate change, BLM would not approve solar projects in or near TCAs, linkage areas, or areas necessary to facilitate natural range shifts for plants and wildlife, including the tortoise, in response to climate change (e.g., ability for tortoise populations to move north through the Ivanpah and Amargosa valleys to higher latitudes). BLM should conduct and publish this analysis as part of its variance process.

For the third and fourth bulleted factors, consistency with priority conservation and complying with programmatic design features in the PFEIS for 2012, please see our comments above on factor two. In addition, this requirement should be revised to reflect the PFEIS for 2024.

The FPEIS for 2024 includes eliminating solar development from the Ivanpah Valley in Nevada and California. Apparently in BLM"s recent analysis of current data on the tortoise, BLM concluded in the 2024 FPEIS solar development in the Ivanpah Valley is not compatible with the future survival of the tortoise. BLM should use this revised analysis and determination when making its decision on the Larrea and Mosey Solar Projects and not the outdated process BLM adopted 12 years ago in its ROD for the 2012 FPEIS for Solar Projects.

For the fifth bulleted factor, projects located in areas with low resource conflicts, we refer BLM to the information we provided under factor two. For these and other reasons the Council strongly opposes the development of the Projects at the proposed sites because of the high resource conflicts from the siting of the Projects. For example, in their public presentation on the Larrea Project and Mosey Project, BLM provided a map that showed a large grouping of several solar projects that have been constructed, approved, or are in NEPA review (e.g., Purple Sage, Copper Rays, Yellow Pines, Rough Hat, etc.). The Larrea and Mosey Projects would be added to this large grouping of solar projects in addition to the other development projects in the area on federal and non-federal lands. During tortoise surveys for some of these solar projects, pockets of higher densities of tortoises were found. These pockets of higher densities are the exception to the rule of densities of tortoises below the viability threshold in five of the six recovery units.

BLM's approval of several solar projects in an area with fairly high tortoise densities is concerning and does not demonstrate that BLM is using the best available science to locate solar projects ins areas with low resource conflicts. Connectivity of tortoise populations, especially to facilitate movement north in response to climate change would be severely hampered by the development of a large cluster of solar projects in the Ivanpah Valley. The Council is aware that the Desert Tortoise Recovery Office (DTRO) is very concerned about ongoing and future development in the Ivanpah Valley with respect to the tortoise's ability to survive and recover. The Amargosa Valley in Nevada is a continuation of the Ivanpah Valley to the north, thus providing connectivity for the tortoise to move north in response to climate change.

For the sixth bulleted factor, locating projects in, or adjacent to, previously contaminated or disturbed lands, the proposed locations for the Projects do not comply with this factor. These areas are undeveloped land with no previous development. Consequently, the Projects do not meet this factor.

In addition, according to factor 6, BLM should be promoting solar development on impaired habitats that are devoid, or nearly-so, of tortoises. BLM should identify alternative sites that are comprised of degraded habitats, have a very low number of tortoises or no tortoises, and are not important in providing connectivity/linkages between tortoise habitats/populations now or under future climate change conditions.

For factor 7, the project will minimize adverse impacts on important fish and wildlife habitats and migration/movement corridors describe it, please see our comment on factors 2, 3, and 5.

For the eighth factor, impacts of groundwater withdrawal, please see our comments below under "Alteration of Groundwater and Surface Hydrology."

For factor 9, no adverse effects to mitigation lands or conservation lands, please provide maps of where tortoises have been moved in western and southern Clark County (e.g., Yellow Pine Solar, etc.) and southern Nye County to remove them from harm's way for BLM projects, other federal projects, and issued incidental take permits since the tortoise was listed in 1989. A map with this information should be provided in BLM's report on the results of the variance process and analysis of the factors. The Council reiterates language it routinely includes in comment letters to BLM on proposed projects/proposed actions, which is:

> "BLM should add this project and its impacts to a database and geospatial tracking system for special status species, including the Mojave desert tortoise, that track cumulative impacts (e.g., surface disturbance, paved and unpaved routes, linear projects, invasive species occurrence, herbicide /pesticide use, wildfires, etc.), management decisions, and effectiveness of mitigation for each project. Without such a database and tracking system, BLM is unable to analyze cumulative impacts to special status species (e.g., desert tortoises) with any degree of confidence."

For the tenth bulleted factor, that significant cumulative impacts on resources of concern should not occur as a result of the proposed project, The Council believes that the information provided above for factors 2, 3, 5, 6, 7, 8, and 9 clearly show that significant cumulative impacts to the tortoise will occur as a result of additional development of the Larrea and Mosey Projects in the Ivanpah Valley. In addition, please see the information provide below under "Increased Heat Effects," "Alteration of Groundwater and Surface Hydrology," and Cumulative Effects of Existing and Future Projects in the Ivanpah and Amargosa Valleys."

One lesson learned from this information is that BLM should use the best available scientific information in its analysis of cumulative impacts on the survival and recovery of the tortoise in the Eastern Mojave Recovery Unit, and routinely revise this analysis as additional relevant information becomes available, so BLM's decisions are not based on outdated land management documents such as the 1998 RMP and 2012 PFEIS and ROD.

The eleventh bulleted factor is documentation on evaluation of desert tortoise impacts based on the variance protocol for desert tortoise. BLM's variance protocol applies only to TCAs and BLM's map of connectivity habitat. This variance protocol is outdated as it claims BLM's maps of "priority desert tortoise connectivity habitat are available through the Western Solar Plan project Web site." We searched this website and located a map prepared in 2012 for the "PFEIS of Priority Desert Tortoise Connectivity Habitat Identified by the U.S. Fish and Wildlife Service that Overlaps with Variance Lands in the Final Solar PEIS" that was prepared by Argonne National Laboratory, date July 2012 and include in the 2012 FPEIS (https://solareis.anl.gov/documents/fpeis/maps/FWS_Desert_Tortoise_Connectivity.pdf).

Apparently, BLM has not updated its map of areas that are important to the tortoise as connectivity habitat/habitats needed for the future survival of the tortoise. It has not modified the map with the factors that adversely impact the ability of an area to provide connectivity, that is, development and surface disturbance, both temporary and permanent (Averill-Murray et al. 2021). BLM is tasked with using the best available science and continually coordinating with USFWS, especially the DTRO, to use and analyze current data on areas important to the future survival and recovery of the tortoise including tortoise connectivity habitat and the authorized and unauthorized activities occurring there that impact the tortoise. We presume this is what BLM did when it determined in the 2024 FPEIS for Solar Projects that BLM would exclude the Ivanpah Valley from any new solar development.

We remind BLM that relevant data on habitats important for the tortoise data is periodically updated and refined. Hence, data indicating that an area may not be important to the future survival and recovery of the tortoise can become important based on several factors including climate change; revised tortoise demographic data; and types, locations, and impacts of other land uses approved by BLM, other federal agencies, state and local governments, and the private sector .

Please see our comments above for the third and fourth bulleted factors that includes updated information on the importance of the Ivanpah and Amargosa valleys for the future survival of the tortoise. BLM should exclude the Ivanpah Valley from future solar development as BLM states in its FPEIS for Solar Development (2024).

Implementing BLM's 2024 FPEIS for Utility-Scale Solar Energy Development

While the factors listed above may be relevant as presented in the 2012 FPEIS, BLM issued a Final Programmatic Environmental Impact Statement and Proposed Resource Management Plan Amendments for Utility-Scale Solar Energy Development (FPEIS) earlier this year (BLM 2024). We anticipate that the Record of Decision (ROD) for this revised Final PEIS will be issued soon. In addition, we presume that the factors in BLM's 2024 FPEIS will be the applicable factors that BLM must comply with when administering the variance process for the Projects and not the factors in the 2012 FPEIS. BLM should explain how it will adopt and apply the factors listed in the 2024 FPEIS in its variance process for the Projects including the requirement to exclude lands in the Ivanpah Valley. This would include the Larrea and Mosey projects. The Council supports this exclusion. BLM should address and analyze this issue in its consideration of the variance process for the Projects and make this analysis available to the public.

Nomination of an ACEC in the Area of the Projects

How will the nomination of an ACEC in the area affect BLM's determination of whether to grant a variance for the Projects? We strongly recommend that BLM complete the ACEC analysis process before making a decision on whether to grant a variance and move forward with environmental analysis of the Projects. This order of analysis and decision-making is prudent from BLM's economic perspective as well as natural and cultural resources perspective. Once an area has been approved for solar development, its natural and cultural resource values are substantially reduced or eliminated for many decades after decommissioning is completed (Abella 2010), if ever.

Applying Recent Information of Status and Trend of the Tortoise

BLM's ROD for the 2012 PEIS on solar development was issued before the scientific community reported on the substantial declines in adult tortoise densities and numbers and substantial reductions in the occurrence of juvenile tortoise, which means little recruitment of tortoises. The Council has summarized the results of the data and analysis from scientific reports in Appendix A – . Demographic Status and Trend of the Mojave Desert Tortoise (*Gopherus agassizii*) including the Eastern Mojave Recovery Unit (attachment), which is where the Projects are located:

- the Eastern Mojave Recovery Unit had a 67 percent decline in adult tortoise density from 2004 to 2014, the highest rate of decline of the five recovery units.
- all tortoise populations surveyed in this recovery unit have densities that are below the viability level established by the USFWS (1994).
- The Eastern Mojave Recovery Unit provides population and habitat connectivity between the Western Mojave and Colorado Desert recovery units and the Northeastern and Upper Virgin River recovery units. Continued development that fragments tortoise populations and habitats eventually severs the genetic connection between the two recovery units to the west and two to the east.

Because of the precarious demographic condition of the tortoise in the Eastern Mojave Recovery Unit, the remaining pockets of higher density tortoises and their habitats should be conserved. Authority for this conservation comes from section 7(a)(1) of the Endangered Species Act, in which Congress states that all federal agencies "…shall… utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species listed pursuant to Section 4 of this Act." In Section 3 of the FESA, "conserve," "conserving," and "conservation" mean "to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition…" "[A]t which the measures provided pursuant to this Act are no longer necessary" means recovery of the species. In section 2 of the FESA, Congress declared that the "purposes of this Act are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species" and that "all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act."

The Council believes that the data in the attachment ("Attachment A. Demographic Status and Trend of the Mojave Desert Tortoise (*Gopherus agassizii*) including the Eastern Mojave Recovery Unit") demonstrate that BLM's management of the Mojave desert tortoise and its habitat under the 1998 RMP has not been effective in meeting Congress's mandate to BLM to carry out programs for its conservation.

Tortoise Linkage Habitats

How will the recent information the status and trend of the tortoise and the tortoise's needs for linkage habitats and connectivity to new areas in response to climate change be addressed by BLM using the best available science (e.g. (Averill-Murray et al. 2021, etc.)? As stated above, the 2012 FPEIS is outdated with respect to the status and trend of the tortoise in the Eastern Mojave Recovery Unit and the pivotal role this recovery unit plays in connecting the Western Mojave and Colorado Desert Recovery Units with the Northeastern and Upper Virgin River Recovery Units (Parandhaman 2023). We remind BLM that for the tortoise to achieve recovery it must meet recovery criteria in all recovery units (USFWS 2011).

Increased Heat Effects

Utility-scale PV solar projects produce increased heat. A PV "heat island" effect refers to the temperatures in and around PV solar plants increasing from ambient temperature due to replacement of native land cover with solar panels that absorb heat. This is similar to the "urban heat island" effect, where native cover is replaced with pavement and concrete buildings. Solar panels convert solar radiation into heat, which can alter the air flow, energy flux dynamics, and temperatures near the panels (Fthenakis and Yu, 2013; Barron-Gafford et al, 2016). Soils, vegetation, and wildlife may be affected by such changes and increases in temperature in and around the solar farms.

Fthenakis and Yu (2013) found that annual average air temperature in the center of a solar project at heights approximately 2.5 meters (8 feet) above the ground can reach up to 1.9 degrees C (3.5 degrees F) above ambient temperature. This thermal energy dissipates and reaches ambient temperature at 5-18 meters (16-60 feet) above the ground. This same study found a prompt dissipation of thermal energy and decrease to ambient temperatures around the PV panels at 300 meters (984 feet) away from the perimeter of the solar farm and that access roads between solar fields allow for substantial cooling. Over 18 months of data showed that the solar array was cooled to ambient temperatures overnight. This study suggests that increases in temperatures surrounding solar farms are localized during the day.

Similarly, Broadbent (2019) found increased temperatures during the day, with an average 1.3 degrees C increase in air temperature in the solar field at a height of 1.5 meters (5 feet). During the night, their results also showed no significant difference in the air temperatures between the solar facility and a reference site. This study also showed that the average soil temperature at 2 to 6 centimeters (0.75 to 2.4 inches) depth at the solar site was approximately 10 degrees C cooler than at the exposed reference site. By contrast, the nighttime soil temperatures at the solar site were warmer than the reference site. The study demonstrated that shading from solar panels causes cooler soil temperature during the day and slightly warmer soil temperature at night.

Barron-Gafford et al. (2016) monitored three study sites (natural desert ecosystem, traditional built environment (parking lot with commercial buildings), and PV power plant), measuring air temperature at 2.5 meters (8 feet) off the ground. The average annual air temperature was greater at the PV power plant, increasing 2.5 degrees C during the day. Contrary to other studies, a delayed cooling of ambient temperatures was detected in the evenings, with average annual midnight temperatures increasing 3.5 degrees C, compared with the natural desert ecosystem. This study asserted that by removing vegetation, heat-dissipating transpiration from vegetation is decreased, and compared to natural systems, the greater amount of exposed ground surfaces absorbs more solar radiation during the day, which may increase soil temperatures (Barron-Gafford et al, 2016). During the night, stored heat is reradiated, where warming under the panels may be due to the heat trapping of reradiated heat flux (Barron-Gafford et al, 2016). Broadbent (2019) suggests that these considerable nighttime temperature increases detected were partially caused by advection from urban surfaces near the study site.

Devitt (2022) evaluated a large solar facility in the Mojave Desert and the effect it had on adjacent down gradient creosote communities. The study monitored changes in soil and plant water status over a 900-meter transect where a built service road resulted in decoupling of up-gradient washes from down-gradient locations leading to a decline in soil water in storage. Similar to other studies, air temperatures were significantly warmer near the solar facility compared to a reference point. Consistent with Barron-Gafford (2016), night temperatures were found to be higher closest to the solar facility.

Beatty et al. (2017) studied revegetation of a solar facility with varying treatments (varying seed mixes (shade tolerant vs. sun tolerant), varying cultural treatments (protection of seeds), and varying amounts of shade (based on orientation of collector panels). The highest total vegetation cover was associated with seeding warm-season native grasses in the absence of any seed protection. Renewable Energies Agency looked at revegetation under modules for various case studies and recommended using a seed mixture appropriate for local site fauna to promote re-establishment of vegetation (Beatty et al. 2017). Although the study did not address whether successful revegetation fostered reestablishment of wildlife use, incidental observations suggested that it had to some extent.

Notably, these studies were performed on solar sites that were graded and unvegetated. Barron-Gafford concluded, in part, that mitigation of the PV heat island effect would be achieved through targeted revegetation, which could ease ecosystem degradation associated with development of utility scale solar projects (Barron-Gafford et al, 2016). Further, the study performed by Devitt (2022) was located at a solar facility with a fixed panel system. Regarding nighttime temperatures, the study suggested that if the panels are mounted as a tracking system, the panels could be situated in a perpendicular position relative to the ground at night, allowing longwave radiation and trapped heat to escape to the sky, reducing the heat displacement into adjacent plant communities during the early morning hours.

Based on studies to date, impacts to vegetation and wildlife at solar facilities related to the PV heat island effect include increased air temperatures in the vicinity of the solar field (300 to 400 meters from the solar field – Devitt et al. 2022) and changes in soil temperatures. Increased temperatures could impact the species composition of vegetation and wildlife in the vicinity of the solar facility, where temperatures could be too high for certain species to persist. Mobile species may be displaced as they are forced to vacate the area of increased temperatures. Changes in hydrology could reduce water availability for vegetation communities and increases or decreases in soil temperatures could affect persistence of vegetation and habitat suitability for burrowing wildlife.

For tortoises, Slade (2023) found that solar arrays significantly altered the surface-level thermal environment for tortoises and other reptilian species. These altered thermal environments could have unintended physiological and behavioral consequences for ectotherms such as Mojave desert tortoises, given their innate dependence on appropriate environmental temperatures for physiological function and activity. These negative consequences include extended times for eggs at temperatures above thermal maximum for reproduction resulting in reproductive failure, an upward shift in their resting body temperatures that increase metabolic expenditure and water loss, negatively affecting energy balance (Nagy and Medica 1986, Sowell 2001) and therefore survival, among other physiological and behavioral concerns. Tortoises are already living on the upper edge of their thermal limits and could be pushed closer toward extinction by an additional heating effect created by utility-scale solar arrays (Sinervo 2014). Thus, allowing federally protected species such as the tortoise access to certain areas inside solar arrays post-construction in the hopes that they can persist and migrate through their native territories beneath a newly-installed canopy of solar panels appears to be problematic based on the results of Slade's (2023) research. Until demonstrated otherwise, this treatment of solar projects as providing possible value to tortoise for movement and other life history requirements should be considered experimental and not mitigation for the impacts to the tortoise and tortoise habitat.

Alteration of Groundwater and Surface Hydrology

Factor 8 is concerned with ground water hydrology. The Council is concerned that the additional groundwater withdrawals in the area of the three Projects that will be used during their construction, operations and maintenance, and decommissioning will exacerbate the substantial groundwater withdrawals that have already occurred to the groundwater basin in the Pahrump area. In theirs Plans of Development, all three Projects mention drilling a well on site (e.g., "a water well could be drilled on site under separate application" to BLM).

In addition, we are concerned about the long-term impacts of extracting ground water from the groundwater basin(s) that provide habitat for threatened and endangered species at Devil's Hole (Devil's Hole pupfish – *Cyprinodon diabolis*), Ash Meadows National Wildlife Refuge (Amargosa Niterwort - *Nitrophila mohavensis*, Ash Meadows milk-vetch - *Astragalus phoenix*, Ash Meadows sunray - *Enceliopsis nudicaulis corrugata*, Ash Meadows gumplant - *Grindelia fraxinopratensis*, Ash Meadows ivesia - *Ivesia kingii* var. *eremica*, Spring-loving centuary - *Zeltnera nemophila*, Ash Meadows naucorid - *Ambrysus amargosus*, Warm Springs pupfish - *Cyprinodon nevadensis pectoralis*, Ash Meadows Amargosa pupfish - *Cyprinodon nevadensis mionectes*, Ash Meadows speckled dace - *Rhinichthys osculus nevadensis)*, and in the Shoshone and Tecopa areas, the Amargosa vole - *Microtus californicus scirpensis*) as well as other species that depend on this surface water for their survival.

Because of the importance of surface water to these threatened and endangered species and other species of wildlife and the connectedness of the ground water to the Amargosa River and springs in the area, BLM should require the three Applicants to fund a study of the long-term effects to ground water from the ongoing groundwater use, the projected decline in precipitation caused by climate change, the additional withdrawal of the water used for the three Projects, and other relevant effects (e.g., earthquake faults, etc.) that would impact the quantity and quality of ground water in this part of Nevada and nearby California. To ensure that the study is objective and fact-based, BLM should require the Applicants to transfer the funds for the study to a third party with the third party administering the study. We recommend that the U.S. Geological Survey conduct the study of impacts to ground water from the implementation of the three Projects because of their past research in the area (e.g., Stonestrom et al. 2003, Stonestrom et al. 2007, Moreo et al. 2017, Belcher et al. 2019, etc.), their mandate of using science when making finding/recommendations, their knowledge of the requirements for the species listed under the FESA, and because hydrological units/groundwater basins do not follow state boundaries.

The Council believes that BLM should also consider surface hydrology. For example, Devitt et al. (2022) reported that "Construction of roads, transmission lines and utility scale solar photovoltaic facilities can decouple up-gradient washes from down-gradient locations." They reported that the decoupling of the wash system at the solar site "led to a significant decline in soil moisture, canopy level NDVI [normalized difference vegetation index] values and mid-day leaf xylem water potentials." Over time especially combined with climate change, this impact may result in reduced plant reproduction, growth, and survival for plants down-gradient of the decoupling sites including plants not on the project site.

The Plans of Development provide limited topographic information about the project sites, and less information on how and where surface areas would be graded to construct, maintain, and decommission the Projects. Implementation of any grading would likely affect existing surface flows such that they may be decoupled or disrupted and the existing surface flows that convey surface water through the Project sites and farther down gradient would be altered. Disruption of existing surface hydrology would likely impede the already slow growth rate of desert perennial vegetation or may result in plant mortality both on the project site and downgradient.

In addition, when plants die, they release carbon from their roots, stems, and leaves into the atmosphere and contribute to climate change. Given the current climate change conditions, there

is an increasing need for carbon sequestration, not carbon release, therefore, an increasing need to, as a minimum, maintain native plants and not disrupt the surface hydrology of the project site.

BLM should require the three Applicants to fund studies of surface flow during the construction, operations and maintenance, and decommissioning of the Projects to determine the geographic extent of the impacts of surface gradient disruption/decoupling both on-site and off-site and their impacts to the biological components of soils and vegetation and how this would impact wildlife, especially availability of forage and cover from predators and temperature extremes for the tortoise.

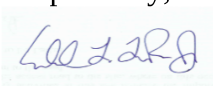
Cumulative Effects of Existing and Future Projects in the Ivanpah and Amargosa Valleys

The Council presumes that BLM will conduct an analysis of the cumulative effects of existing and future projects in the Ivanpah and Amargosa valleys for both federal and non-federal projects and actions. While this analysis is required under NEPA, we believe that conducting it earlier during the variance process would ultimately save BLM and the three Applicants time and money especially of the results of the analysis is that the variance would not be approved.

We appreciate this opportunity to provide the above comments and trust they will help protect tortoises during any resulting authorized activities. Herein, we reiterate that the Council wants to be identified as an Affected Interest for this and all other projects funded, authorized, or carried out by the BLM that may affect desert tortoises, and that any subsequent environmental documentation for this project is provided to us at the contact information listed above. Additionally, we ask that you notify the Desert Tortoise Council at eac@deserttortoise.org of any proposed projects that BLM may authorize, fund, or carry out in the range of any species of desert tortoise in the southwestern United States (i.e., *Gopherus agassizii*, *G. morafkai*, *G. berlandieri*, *G. flavomarginatus*) so we may comment on it to ensure BLM fully considers and implements actions to conserve these tortoises as part of its directive to conserve biodiversity on lands managed by BLM.

Please respond in an email that you have received this comment letter so we can be sure our concerns have been registered with the appropriate personnel and office for this Project.

Respectfully,



Edward L. LaRue, Jr., M.S.
Desert Tortoise Council, Ecosystems Advisory Committee, Chairperson

Attachment - . Demographic Status and Trend of the Mojave Desert Tortoise (*Gopherus agassizii*) including the Eastern Mojave Recovery Unit

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Appendix A. Demographic Status and Trend of the Mojave Desert Tortoise (*Gopherus agassizii*) including the Eastern Mojave Recovery Unit

To assist the Agencies with their analysis of the direct, indirect, and cumulative impacts of the Proposed Project on the Mojave desert tortoise, we provide the following information on its status and trend. In reviewing the data presented below, note that the location of the proposed project is within the Colorado Desert Recovery Unit, which has experienced a decline in tortoise density and abundance of –36%, since 2004.

The Desert Tortoise Council (Council) has serious concerns about direct, indirect, and cumulative sources of human mortality for the Mojave desert tortoise given the status and trend of the species range-wide, within each of the five recovery units, and within the Tortoise Conservation Areas (TCAs) that comprise each recovery unit.

Below are tables with data on changes to Mojave desert tortoise densities and abundance since 2004. Important points from these tables include the following:

Change in Status for the Mojave Desert Tortoise Range-wide
● Ten of 17 populations of the Mojave desert tortoise declined from 2004 to 2014.

● Eleven of 17 populations of the Mojave desert tortoise are below the population viability threshold trough 2021. These 11 populations represent 89.7 percent of the range-wide habitat in CHUs/TCAs.

Change is Status for the Eastern Mojave Recovery Unit – Nevada and California
● This recovery unit had a 67 percent decline in tortoise density from 2004 to 2014, the highest rate of decline of the five recovery units.

● All tortoise populations in this recovery unit have densities that are below the viability level established by the USFWS (1994a).

● The Eastern Mojave Recovery Unit provides population and habitat connectivity between the Western Mojave and Colorado Desert recovery units and the Northeastern and Upper Virgin River recovery units. Continued development that fragments tortoise populations and habitats eventually severs the genetic connection between the two recovery units to the west and two to the east.

Densities of Adult Mojave Desert Tortoises: A few years after listing the Mojave desert tortoise under the Federal Endangered Species Act (FESA), the U.S. Fish and Wildlife Service (USFWS) published a Recovery Plan for the Mojave desert tortoise (USFWS 1994a). It contained a detailed population viability analysis. In this analysis, the minimum viable density of a Mojave desert tortoise population is 10 adult tortoises per mile^2 (3.9 adult tortoises per km^2). This assumed a male-female ratio of 1:1 (USFWS 1994a, page C25) and certain areas of habitat with most of these areas geographically linked by adjacent borders or corridors of suitable tortoise habitat. Populations of Mojave desert tortoises with densities below this density are in danger of extinction (USFWS 1994a, page 32). The revised recovery plan (USFWS 2011) designated five recovery units for the Mojave desert tortoise that are intended to conserve the genetic, behavioral, and morphological diversity necessary for the recovery of the entire listed species (Allison and McLuckie 2018).

Range-wide, densities of adult Mojave desert tortoises declined more than 32% between 2004 and 2014 (Table 1) (USFWS 2015). At the recovery unit level, between 2004 and 2014, densities of adult desert tortoises declined, on average, in every recovery unit except the Northeastern Mojave (Table 1). Adult densities in the Northeastern Mojave Recovery Unit increased 3.1% per year (SE = 4.3%), while the other four recovery units declined at different annual rates: Colorado Desert (–4.5%, SE = 2.8%), Upper Virgin River (–3.2%, SE = 2.0%), Eastern Mojave (–11.2%, SE = 5.0%), and Western Mojave (–7.1%, SE = 3.3%)(Allison and McLuckie 2018). However, the small area and low starting density of the tortoises in the Northeastern Mojave Recovery Unit (lowest density of all Recovery Units) resulted in a small overall increase in the number of adult tortoises by 2014 (Allison and McLuckie 2018). In contrast, the much larger areas of the Eastern Mojave, Western Mojave, and Colorado Desert recovery units, plus the higher estimated initial densities in these areas, explained much of the estimated total loss of adult tortoises since 2004 (Allison and McLuckie 2018).

At the population level, represented by tortoises in the TCAs, densities of 10 of 17 monitored populations of the Mojave desert tortoise declined from 26% to 64% and 11 have densities less than 3.9 adult tortoises per km^2 (USFWS 2015).

Population Data on Mojave Desert Tortoise: The Mojave desert tortoise was listed as threatened under the FESA in 1990. The listing was warranted because of ongoing population declines throughout the range of the tortoise from multiple human-caused activities. Since the listing, the status of the species has changed. Population numbers (abundance) and densities continue to decline substantially (please see Tables 1 and 2).

Table 1. Summary of 10-year trend data for 5 Recovery Units and 17 Critical Habitat Units (CHU)/Tortoise Conservation Areas (TCA) for the Mojave desert tortoise, *Gopherus agassizii* (=Agassiz's desert tortoise). The table includes the area of each Recovery Unit and Critical Habitat Unit (CHU)/Tortoise Conservation Area (TCA), percent of total habitat for each Recovery Unit and Critical Habitat Unit/Tortoise Conservation Areas, density (number of breeding adults/km^2 and standard errors = SE), and the percent change in population density between 2004-2014. Populations below the viable level of 3.9 adults/km^2 (10 adults per mi^2) (assumes a 1:1 sex ratio) and showing a decline from 2004 to 2014 are in red (Allison and McLuckie 2018, USFWS 2015).

Recovery Unit Designated Critical Habitat Unit/Tortoise Conservation Area	Surveyed area (km^2)	% of total habitat area in Recovery Unit & CHU/TCA	2014 density/km^2 (SE)	% 10-year change (2004–2014)
Western Mojave, CA	**6,294**	**24.51**	**2.8 (1.0)**	**–50.7 decline**
Fremont-Kramer	2,347	9.14	2.6 (1.0)	–50.6 decline
Ord-Rodman	852	3.32	3.6 (1.4)	–56.5 decline
Superior-Cronese	3,094	12.05	2.4 (0.9)	–61.5 decline
Colorado Desert, CA	**11,663**	**45.42**	**4.0 (1.4)**	**–36.25 decline**
Chocolate Mtn AGR, CA	713	2.78	7.2 (2.8)	–29.77 decline
Chuckwalla, CA	2,818	10.97	3.3 (1.3)	–37.43 decline

Chemehuevi, CA	3,763	14.65	2.8 (1.1)	–64.70 decline
Fenner, CA	1,782	6.94	4.8 (1.9)	–52.86 decline
Joshua Tree, CA	1,152	4.49	3.7 (1.5)	+178.62 increase
Pinto Mtn, CA	508	1.98	2.4 (1.0)	–60.30 decline
Piute Valley, NV	927	3.61	5.3 (2.1)	+162.36 increase
Northeastern Mojave	**4,160**	**16.2**	**4.5 (1.9)**	**+325.62 increase**
Beaver Dam Slope, NV, UT, AZ	750	2.92	6.2 (2.4)	+370.33 increase
Coyote Spring, NV	960	3.74	4.0 (1.6)	+ 265.06 increase
Gold Butte, NV & AZ	1,607	6.26	2.7 (1.0)	+ 384.37 increase
Mormon Mesa, NV	844	3.29	6.4 (2.5)	+ 217.80 increase
Eastern Mojave, NV & CA	**3,446**	**13.42**	**1.9 (0.7)**	**–67.26 decline**
El Dorado Valley, NV	999	3.89	1.5 (0.6)	–61.14 decline
Ivanpah, CA	2,447	9.53	2.3 (0.9)	–56.05 decline
Upper Virgin River	**115**	**0.45**	**15.3 (6.0)**	**–26.57 decline**
Red Cliffs Desert	115	0.45	15.3 (6.0)	–26.57 decline
Total amount of land	**25,678**	**100.00**		**–32.18 decline**

Density of Juvenile Mojave Desert Tortoises: Survey results indicate that the proportion of juvenile desert tortoises has been decreasing in all five recovery units since 2007 (Allison and McLuckie 2018). The probability of encountering a juvenile tortoise was consistently lowest in the Western Mojave Recovery Unit. Allison and McLuckie (2018) provided reasons for the decline in juvenile desert tortoises in all recovery units. These included decreased food availability for adult female tortoises resulting in reduced clutch size, decreased food availability resulting in increased mortality of juvenile tortoises, prey switching by coyotes from mammals to tortoises, and increased abundance of common ravens that typically prey on smaller desert tortoises.

Declining adult tortoise densities through 2014 have left the Eastern Mojave Desert adult numbers at 64% (Allison and McLuckie 2018, USFWS 2015). Such steep declines in the density of adults are only sustainable if there are suitably large improvements in reproduction and juvenile growth and survival. However, the proportion of juveniles has not increased anywhere in the range of the Mojave desert tortoise since 2007 (Allison and McLuckie 2018).

The USFWS and Utah Division of Wildlife Resources have continued to collect density data on the Mojave desert tortoise since 2014. The results are provided in Table 2 along with the analysis USFWS (2015) conducted for tortoise density data from 2004 through 2014. These data show that adult tortoise densities in most Recovery Units continued to decline in density since the data collection methodology was initiated in 2004. In addition, in the Northeastern Mojave Recovery Unit that had shown an overall increase in tortoise density between 2004 and 2014, subsequent data indicate a decline in density since 2014 (USFWS 2016, 2018, 2019, 2020, 2022a, 2022b).

Abundance of Mojave Desert Tortoises: Allison and McLuckie (2018) noted that because the area available to tortoises (i.e., tortoise habitat and linkage areas between habitats) is decreasing, trends in tortoise density no longer capture the magnitude of decreases in abundance. Hence, they reported on the change in abundance or numbers of the Mojave desert tortoise in each recovery unit (Table 2). They noted that these estimates in abundance are likely higher than actual numbers of tortoises, and the changes in abundance (i.e., decrease in numbers) are likely lower than actual numbers because of their habitat calculation method. They used area estimates that removed only impervious surfaces created by development as cities in the desert expanded. They did not

Table 2. Summary of data for Agassiz's desert tortoise, *Gopherus agassizii* (=Mojave desert tortoise) from 2004 to 2021 for the 5 Recovery Units and 17 Critical Habitat Units (CHUs)/Tortoise Conservation Areas (TCAs). The table includes the area of each Recovery Unit and CHU/TCA, percent of total habitat for each Recovery Unit and CHU/TCA, density (number of breeding adults/km^2 and standard errors = SE), and percent change in population density between 2004-2014 (USFWS 2015). Populations below the viable level of 3.9 breeding individuals/km^2 (10 breeding individuals per mi^2) (assumes a 1:1 sex ratio) (USFWS 1994a, 2015) or showing a decline from 2004 to 2014 are in **red.**

Recovery Unit: Designated CHU/TCA &	% of total habitat area in Recovery Unit & CHU/TCA	2004 density/ km^2	2014 density/ km^2 (SE)	% 10-year change (2004–2014)	2015 density/ km^2	2016 density/ km^2	2017 density/ km^2	2018 density/ km^2	2019 density/ km^2	2020 density/ km^2	2021 density/ km^2
Western Mojave, CA	**24.51**		**2.8 (1.0)**	**–50.7 decline**							
Fremont-Kramer	9.14		2.6 (1.0)	–50.6 decline	4.5	No data	4.1	No data	2.7	1.7	No data
Ord-Rodman	3.32		3.6 (1.4)	–56.5 decline	No data	No data	3.9	2.5/3.4*	2.1/2.5*	No data	1.9/2.5*
Superior-Cronese	12.05		2.4 (0.9)	–61.5 decline	2.6	3.6	1.7	No data	1.9	No data	No data
Colorado Desert, CA	**45.42**		**4.0 (1.4)**	**–36.25 decline**							
Chocolate Mtn AGR, CA	2.78		7.2 (2.8)	–29.77 decline	10.3	8.5	9.4	7.6	7.0	7.1	3.9
Chuckwalla, CA	10.97		3.3 (1.3)	–37.43 decline	No data	No data	4.3	No data	1.8	4.6	2.6
Chemehuevi, CA	14.65		2.8 (1.1)	–64.70 decline	No data	1.7	No data	2.9	No data	4.0	No data
Fenner, CA	6.94		4.8 (1.9)	–52.86 decline	No data	5.5	No data	6.0	2.8	No data	5.3
Joshua Tree, CA	4.49		3.7 (1.5)	+178.62 increase	No data	2.6	3.6	No data	3.1	3.9	No data
Pinto Mtn, CA	1.98		2.4 (1.0)	–60.30 decline	No data	2.1	2.3	No data	1.7	2.9	No data
Piute Valley, NV	3.61		5.3 (2.1)	+162.36 increase	No data	4.0	5.9	No data	No data	No data	3.9

Recovery Unit: Designated CHU/TCA	% of total habitat area in Recovery Unit & CHU/TCA	2004 density/ km^2	2014 density/km^2 (SE)	% 10-year change (2004–2014)	2015	2016	2017	2018	2019	2020	2021
Northeastern Mojave AZ, NV, & UT	**16.2**		**4.5 (1.9)**	**+325.62 increase**							
Beaver Dam Slope, NV, UT, & AZ	2.92		6.2 (2.4)	+370.33 increase	No data	5.6	1.3	5.1	2.0	No data	No data
Coyote Spring, NV	3.74		4.0 (1.6)	+ 265.06 increase	No data	4.2	No data	No data	3.2	No data	No data
Gold Butte, NV & AZ	6.26		2.7 (1.0)	+ 384.37 increase	No data	No data	1.9	2.3	No data	No data	2.4
Mormon Mesa, NV	3.29		6.4 (2.5)	+ 217.80 increase	No data	2.1	No data	3.6	No data	5.2	5.2
Eastern Mojave, NV & CA	**13.42**		**1.9 (0.7)**	**–67.26 decline**							
El Dorado Valley, NV	3.89		1.5 (0.6)	–61.14 decline	No data	2.7	5.6	No data	2.3	No data	No data
Ivanpah Valley, CA	9.53		2.3 (0.9)	–56.05 decline	1.9	No data	No data	3.7	2.6	No data	1.8
Upper Virgin River, UT & AZ	**0.45**		**15.3 (6.0)**	**–26.57 decline**							
Red Cliffs Desert**	0.45	29.1 (21.4-39.6)**	15.3 (6.0)	–26.57 decline	15.0	No data	19.1	No data	17.2	No data	
Range-wide Area of CHUs - TCAs/Range-wide Change in Population Status	**100.00**			**–32.18 decline**							

* This density includes the adult tortoises translocated from the expansion of the MCAGCC, that is resident adult tortoises and translocated adult tortoises.

**Methodology for collecting density data initiated in 1999.

consider degradation and loss of habitat from other sources, such as the recent expansion of military operations (753.4 km2 so far on Fort Irwin and the Marine Corps Air Ground Combat Center), intense or large scale fires (e.g., 576.2 km2 of critical habitat that burned in 2005), development of utility-scale solar facilities (as of 2015, 194 km2 have been permitted) (USFWS 2016), or other sources of degradation or loss of habitat (e.g., recreation, mining, grazing, infrastructure, etc.). Thus, the declines in abundance of Mojave desert tortoise are likely greater than those reported in Table 3.

Habitat Availability: Data on population density or abundance does not indicate population viability. The area of protected habitat or reserves for the subject species is a crucial part of the viability analysis along with data on density, abundance, and other population parameters. In the Desert Tortoise (Mojave Population) Recovery Plan (USFWS 1994a), the analysis of population viability included population density and size of reserves (i.e., areas managed for the desert tortoise) and population numbers (abundance) and size of reserves. The USFWS Recovery Plan reported that as population densities for the Mojave desert tortoise decline, reserve sizes must increase, and as population numbers (abundance) for the Mojave desert tortoise decline, reserve sizes must increase (USFWS 1994a). In 1994, reserve design (USFWS 1994a) and designation of critical habitat (USFWS 1994b) were based on the population viability analysis from numbers (abundance) and densities of populations of the Mojave desert tortoise in the early 1990s. Inherent in this analysis is that the lands be managed with reserve level protection (USFWS 1994a, page 36) or ecosystem protection as described in section 2(b) of the FESA, and that sources of mortality be reduced so recruitment exceeds mortality (that is, lambda > 1)(USFWS 1994a, page C46).

Table 3. Estimated change in abundance of adult Mojave desert tortoises in each recovery unit between 2004 and 2014 (Allison and McLuckie 2018). Decreases in abundance are in red.

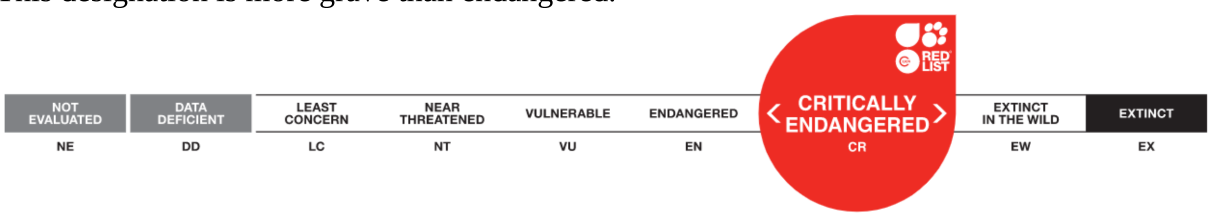
Recovery Unit	Modeled Habitat (km^2)	2004 Abundance	2014 Abundance	Change in Abundance	Percent Change in Abundance
Western Mojave	23,139	131,540	64,871	-66,668	-51%
Colorado Desert	18,024	103,675	66,097	-37,578	-36%
Northeastern Mojave	10,664	12,610	46,701	34,091	270%
Eastern Mojave	16,061	75,342	24,664	-50,679	-67%
Upper Virgin River	613	13,226	10,010	-3,216	-24%
Total	**68,501**	**336,393**	**212,343**	**-124,050**	**-37%**

Habitat loss would also disrupt the prevailing population structure of this widely distributed species with geographically limited dispersal (isolation by resistance Dutcher et al. 2020). Allison and McLuckie (2018) anticipate an additional impact of this habitat loss/degradation is decreasing resilience of local tortoise populations by reducing demographic connections to neighboring populations (Fahrig 2007). Military and commercial operations and infrastructure projects that reduce tortoise habitat in the desert are anticipated to continue (Allison and McLuckie 2018) as are other sources of habitat loss/degradation.

Allison and McLuckie (2018) reported that the life history of the Mojave desert tortoise puts it at greater risk from even slightly elevated adult mortality (Congdon et al. 1993; Doak et al. 1994), and recovery from population declines will require more than enhancing adult survivorship (Spencer et al. 2017). The negative population trends in most of the TCAs for the Mojave desert tortoise indicate that this species is on the path to extinction under current conditions (Allison and McLuckie 2018). They state that their results are a call to action to remove ongoing threats to tortoises from TCAs, and possibly to contemplate the role of human activities outside TCAs and their impact on tortoise populations inside them.

Densities, numbers, and habitat for the Mojave desert tortoise declined between 2004 and 2014 and densities continue to decline in most Recovery Units since 2014. As reported in the population viability analysis, to improve the status of the Mojave desert tortoise, reserves (area of protected habitat) must be established and managed. When densities of tortoises decline, the area of protected habitat must increase. When the abundance of tortoises declines, the area of protected habitat must increase. We note that the Desert Tortoise (Mojave Population) Recovery Plan was released in 1994 and its report on population viability and reserve design was reiterated in the 2011 Revised Recovery Plan as needing to be updated with current population data (USFWS 2011, p. 83). With lower population densities and abundance, a revised population viability analysis would show the need for greater areas of habitat to receive reserve level of management for the Mojave desert tortoise. In addition, we note that none of the recovery actions that are fundamental tenets of conservation biology has been implemented throughout most or all of the range of the Mojave desert tortoise.

IUCN Species Survival Commission: The Mojave desert tortoise is now on the list of the world's most endangered tortoises and freshwater turtles. It is in the top 50 species. The International Union for Conservation of Nature's (IUCN) Species Survival Commission, Tortoise and Freshwater Turtle Specialist Group, now considers Mojave desert tortoise to be Critically Endangered (Berry et al. 2021). As such, it is a "species that possess an extremely high risk of extinction as a result of rapid population declines of 80 to more than 90 percent over the previous 10 years (or three generations), a current population size of fewer than 50 individuals, or other factors." It is one of three turtle and tortoise species in the United States to be critically endangered. This designation is more grave than endangered.



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