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Desert Bighorn Sheep Study

Soda Mountain Solar Project

JUNE 2024

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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
ACE	Areas of Conservation Emphasis
BLM	U.S. Bureau of Land Management
BTR	biological technical report
Caltrans	California Department of Transportation
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
County	San Bernardino County
EIR	environmental impact report
GIS	geographic information system
I	Interstate
WEAP	Worker Environmental Awareness Program

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1 Introduction

Soda Mountain Solar LLC is proposing to construct a large-scale, photovoltaic solar facility near the western base of the South Soda Mountains, in the Mojave Desert (Figure 1, Project Location; all figures for this study are located in Appendix A). The Soda Mountain Solar Project (project) was originally proposed in 2007; however, the San Bernardino County (County) Board of Supervisors did not approve the Final Environmental Impact Report (EIR). Since that time, the project has been revised and the applicant is working to obtain permits/approval for the project to move forward.

During the review of the original EIR, the public and partner agencies raised concerns about the project's potential impacts to desert bighorn sheep (*Ovis canadensis nelsoni*) movement. The revised project encompasses a smaller footprint, intended to decrease potential interference with future efforts to re-establish bighorn sheep movement across Interstate (I) 15 (SWCA 2023).

This Desert Bighorn Sheep Study (study) was prepared to accomplish the following:

- Conduct a thorough literature review of studies regarding desert bighorn sheep as they pertain to development in the desert, particularly in relation to renewable energy development and the impacts this type of development may have on desert bighorn sheep
- Discuss any implications the project may have on current and future wildlife linkages, corridors, and migration pathways, specifically as they pertain to desert bighorn sheep within the vicinity of the Soda Mountains
- Provide a summary of previous studies of desert bighorn sheep collar/movement data collected within the vicinity of the Soda Mountains
- Conduct and summarize a geographic information system (GIS) analysis of collar/movement data provided by the California Department of Fish and Wildlife (CDFW)
- Discuss applicable mitigation measures previously discussed and proposed for the project
- Provide recommendations to reduce any potential impacts to desert bighorn sheep from the project

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2 Project Information

2.1 Project Location and Study Area

The 2,670-acre study area (i.e., project components and project easements) is located approximately 7 miles southwest of the unincorporated community of Baker in San Bernardino County, California, and approximately 50 miles northeast of Barstow. It is situated within the alluvial fan along the western slopes of the South Soda Mountains. The study area is bordered by I-15 to the west, the Mojave Preserve to the northeast, Rasor Off-Highway Vehicle Recreation Area (administered by the U.S. Bureau of Land Management [BLM]) to the southeast, and the Cave Mountains to the south. The entire study area occurs on the eastern side of I-15, except the gen-tie area located on the west side of I-15 (Figure 1) (SWCA 2023).

Elevation within the study area generally increases west to east, toward the South Soda Mountains; however, in the southern portion of the study area, south of Rasor Road, the elevation gradually increases north to south (Figure 1). Elevation within the study area ranges from approximately 1,275 feet above mean sea level to 1,475 feet above mean sea level, and the area is composed of undeveloped, vacant lands that are bisected by dirt roads, including Rasor Road.

The habitat within the site can be generally described as Mojavean desert scrub and desert wash scrub. Many ephemeral washes flow east to west through the project site, flowing out of the South Soda Mountains. These washes are generally dominated by creosote bush–white bursage (*Larrea tridentata–Ambrosia dumosa*) scrub, cheesebush–sweetbush (*Ambrosia salsola–Bebbia juncea*) scrub, and California joint fir–longleaf joint fir (*Ephedra californica–Ephedra trifurca*) scrub, while the rest of the project site is dominated by creosote bush–white bursage scrub (Appendix B, Site Photographs; SWCA 2023).

2.2 Project History

On December 14, 2007, Soda Mountain Sola, LL, filed a right-of-way grant application with BLM to construct, operate, maintain, and decommission the project, which triggered the need for a land use plan amendment to identify the project site as suitable for a large-scale solar project in the California Desert Conservation Area. The California Desert Conservation Area Plan Amendment required analysis of potential impacts of the project under the National Environmental Policy Act.

In August 2012, the project applied for groundwater well permits with the County, triggering the need for an environmental analysis under the California Environmental Quality Act (CEQA). BLM and the County jointly prepared a proposed amendment to the California Desert Conservation Area Plan and an Environmental Impact Statement/EIR under the National Environmental Policy Act and CEQA. These documents were published in June 2015.

In March 2016, BLM issued a Record of Decision to approve Alternative B, which revised the original project by removing a solar array on the west side of I-15 (i.e., the North Array), and which included future efforts to restore desert bighorn sheep connectivity. In August 2016, the County held a hearing to adopt the EIR and approval of the revised groundwater well permits; however, the County Board of Supervisors declined to certify the EIR. As such, no decision was made regarding the groundwater well permits.

Soda Mountain Solar LLC revised the project by removing the groundwater wells, thus removing the need for the project to apply for a discretionary permit from the County. On June 6, 2022, CDFW received an Incidental Take Permit application from Soda Mountain Solar LLC to incidentally take Agassiz's desert tortoise (*Gopherus agassizii*). In accordance with the California Code of Regulations, Title 14, Section 783.5, CDFW cannot finalize the Incidental Take Permit until CDFW has received a certified CEQA document. At this time, CDFW is the state agency with the greatest responsibility for approving the project as a whole. Therefore, CDFW is currently the CEQA lead agency for the project. In addition to the Incidental Take Permit, the project will also require a Lake and Streambed Alteration Agreement from CDFW, along with a Title 27 Discharge Permit and a federal Clean Water Act Section 401 Permit from the Lahontan Regional Water Quality Control Board (SWCA 2023).

2.3 Project Description

The current project proposes to construct, operate, maintain, and decommission a 300 megawatt photovoltaic solar facility. The project includes four solar power arrays, as well as operation and maintenance buildings, stormwater infrastructure, and a battery energy storage system. In addition, the project proposes to construct a substation and switchyard on the west side of I-15, within the gen-tie area. Fencing will be installed around the perimeter of the project; however, the drainage canal areas located between the arrays will not be fenced (Figure 2, Project Design).

3 Species Information

3.1 Desert Bighorn Sheep Natural History

California is home to two subspecies of bighorn sheep: Sierra Nevada bighorn sheep (*Ovis canadensis sierrae*) and desert bighorn sheep (*Ovis canadensis nelsoni*). Desert bighorn sheep inhabit the mountain ranges within the Mojave Desert where they are well adapted to survive. These animals have short legs and a stocky build, which provide them the necessary low center of gravity for life on steep, rocky slopes. They also possess extremely keen eyesight, allowing them to detect and avoid predators in the open habitat of the Mojave Desert (CDFW 2012). There are a number of factors that influence habitat selection for desert bighorn sheep. The following provides a brief discussion of some of these factors.

Terrain

Terrain is one of the major factors that influence desert bighorn sheep habitat selection. In general, bighorn habitat can be broken into two categories: mountain habitat and intermountain habitat (Figure 3, Bighorn Sheep Terrain). Mountain habitat includes historic habitat of desert bighorn sheep within California with a slope of 15% or greater, while intermountain habitat includes low lying, relatively flat areas (i.e., slope less than 15%). Desert bighorn sheep spend most of their time in mountain habitat, as it is visually open, allowing for early predator detection, and it provides escape terrain in the form of steep, generally rocky, slopes. Ewes (female sheep) often select steeper slopes than rams (males), particularly during lambing season (CDFW 2012). Intermountain habitat is less visually open; therefore, desert bighorn spend less time in these areas. However, intermountain habitat is critical as it provides the ability to travel between mountain ranges/populations. These movements allow for genetic exchange between populations, as well as the re-colonization of suitable habitat (Bleich et al. 1990; Epps et al. 2007, 2010, 2018; Creech et al. 2014). In addition, intermountain habitat can provide access to resources such as early forage/food in the spring (CEC 2012; CDFW 2012).

Forage

The availability of forage also plays a key role in habitat use and selection by desert bighorn sheep. These animals select the most nutritious forage available, which varies by season and region (Krausman et al. 1989). In general, they obtain a great deal of nutrients during the winter and spring months, after cool season rainfall, when forage is plentiful (Wehausen 2005). A recent study found that desert bighorn sheep prefer south-facing slopes in the winter months and north-facing slopes in the fall. South-facing slopes experience slightly warmer temperatures in the winter months, thus new forage becomes available on these slopes earlier than in other areas (Aiello et al. 2023).

Previous studies on desert bighorn sheep have shown that while the species is typically associated with mountainous terrain, they will and have been observed using canyon bottoms, washes, alluvial fans, plateaus, and valley floors, not only for movement between mountain habitat areas, but also as important foraging areas (Schwartz et al. 1986; Bleich et al. 1997). Desert bighorn ewes have been observed to select low elevation, south-facing slopes following the first cool season rains. This is likely attributed to ewes that are close to giving birth. During drought years, or in the absence of early rainfall, females that are nearing the end of gestation may also seek forage in low lying washes. The importance of these low elevation areas was documented in a study conducted in the Whipple Mountains of California that documented “particularly high mortality” of both lambs and ewes among translocated desert bighorn sheep into a fenced enclosure. The study concluded this was likely due to the fenced

area precluding these animals access to low-elevation slopes and washes that are often selected by ewes during late gestation and early lactation (Berbach 1987). It is clear that while the lower elevation intermountain areas (canyon bottoms, washes, alluvial fans, etc.) do not experience frequent and heavy use by desert bighorn sheep, they play an important role in providing movement opportunities and critical forage opportunities.

Water

Access to a reliable water source is another key factor that influences desert bighorn sheep habitat selection. During the cooler months of the year, particularly during years with good rainfall, desert bighorn sheep obtain the majority of their water needs from the forage they consume; however, during the hot, dry summers in the Mojave Desert, these animals regularly visit water sources (Turner 1973). Studies have shown that desert bighorn are highly influenced by the location of, and distance to, reliable water sources, particularly during the hot, summer months (Bleich et al. 1997; Aiello et al. 2023). Ewes will typically come to drink water approximately once every 3 days during the summer (Miller et al. 1984) and will shift their locations to be nearer to a reliable water source beginning in April or May. Most lamb mortalities occur in the spring when temperatures rise but available forage and water decline (Wehausen 2005). In fact, a study in 2004 by Epps found that the lack of reliable water sources was a statistically significant factor associated with a higher extinction probability for desert bighorn sheep populations within California. The presence of a reliable water source enhances the physiological health of desert bighorn sheep (Bleich et al. 2010).

3.2 Challenges Faced by Desert Bighorn Sheep

All desert bighorn sheep in California once existed as a single metapopulation until Southern California was divided by interstate highways that created movement barriers for these animals, dividing the metapopulation into metapopulation fragments (Figure 4, Desert Bighorn Sheep Metapopulation Fragments in California) (Epps et al. 2005, 2007; CDFW 2012). Each metapopulation fragment is comprised of multiple herds, which occupy one or more mountain ranges. These herds are small and relatively isolated, and as such, they are vulnerable to the loss of genetic diversity and the availability of resources (Epps et al. 2005, 2013). The following section provides a brief discussion of challenges faced by desert bighorn sheep.

Habitat Fragmentation/Loss/Degradation

While mountainous habitat in the Mojave Desert has largely remained intact, the surrounding intermountain habitat has been fragmented by development (roadways, canals, urbanization, renewable energy developments, etc.). This loss of intermountain habitat is problematic for the species, as desert bighorn readily move across these intermountain habitats to reach and migrate between nearby populations (Bleich et al. 1990; Epps et al. 2007; Creech et al. 2014). As previously discussed, desert bighorn sheep occur in small, isolated populations (often less than 100 individuals) (Epps et al. 2003; Dolan 2006), which are vulnerable to genetic drift. This can quickly reduce a population's genetic diversity, leaving them vulnerable and less likely to persist. Gene flow between populations is crucial to the long-term conservation of desert bighorn sheep. Additionally, movements between mountain ranges allow for re-colonization of vacant habitats where extirpations occur (Epps et al. 2013). Intact, intermountain habitat allows for gene flow and re-colonization to occur; thus, it is important to ensure intermountain habitats remain intact at a level that continues to allow desert bighorn sheep to migrate between populations (CDFW 2012).

As previously discussed, intermountain habitat not only provides critical movement opportunities between mountain ranges/populations, but it also provides seasonal resources sought out by desert bighorn sheep, such as higher nutritional forage during the cooler months, which appears to play an important role for pregnant and/or lactating ewes. Development within these areas can displace desert bighorn sheep from this habitat where they would otherwise obtain access to resources such as forage, thus resulting in a reduced carrying capacity of the habitat overall (CDFW 2012).

Limited Water Resources

Desert bighorn sheep rely heavily on surface water sources, particularly during the hot, summer months. Studies have shown that desert bighorn sheep summer home ranges are much smaller than winter home ranges and typically only include habitat that is within a short distance from a reliable water source (Blong and Pollard 1968; Leslie and Douglas 1979; Cunningham and Ohmart 1986; Krausman et al. 1999; Longshore et al. 2009). Once the hot temperatures subside, desert bighorn have been observed to quickly expand their home ranges (CDFW 2012). In addition, it has been shown that drinking water allows these animals to convert their food more efficiently, which leads to an increase and a more stable population density (CDFW 2012).

As climate change continues to progress, California and the Mojave Desert have experienced longer and hotter summers, as well as longer and more intense droughts. These factors, in combination with human development and agriculture, which have drawn down the water table for many years, mean that there are fewer reliable surface water sources for desert bighorn sheep to rely upon. The long-term stability of desert bighorn sheep populations is directly affected by the availability of water sources. As development in and around desert bighorn sheep habitat continues, it is important to consider current and possible future water sources that desert bighorn sheep can access (CDFW 2012).

Disease

Desert bighorn sheep are susceptible to introduced diseases that originated in domestic sheep, goats, and cattle. Domestic sheep and goats are thought to pose the greatest risk to desert bighorn, as they have been observed to socialize with them, providing opportunities for disease transmission, particularly respiratory tract diseases like pneumonia. Pneumonia has been found to be the cause of many desert bighorn sheep die-offs and is thought to explain the historical pattern of widespread extirpation of desert bighorn sheep populations within areas where domestic sheep have been grazed (Wehausen et al. 2011).

In May 2013, Mojave Preserve biologists encountered dead and sick desert bighorn sheep while inspecting wildlife guzzles within the Preserve. Samples were collected from one of the deceased individuals and laboratory analysis indicated the animal had been positive for pneumonia. It was hypothesized the disease outbreak originated from domestic sheep or goats (NPS 2013). Desert bighorn sheep die-offs have been documented since the second half of the 19th century and were attributed to one of the factors in extensive losses of desert bighorn sheep populations (Beuchner 1960).

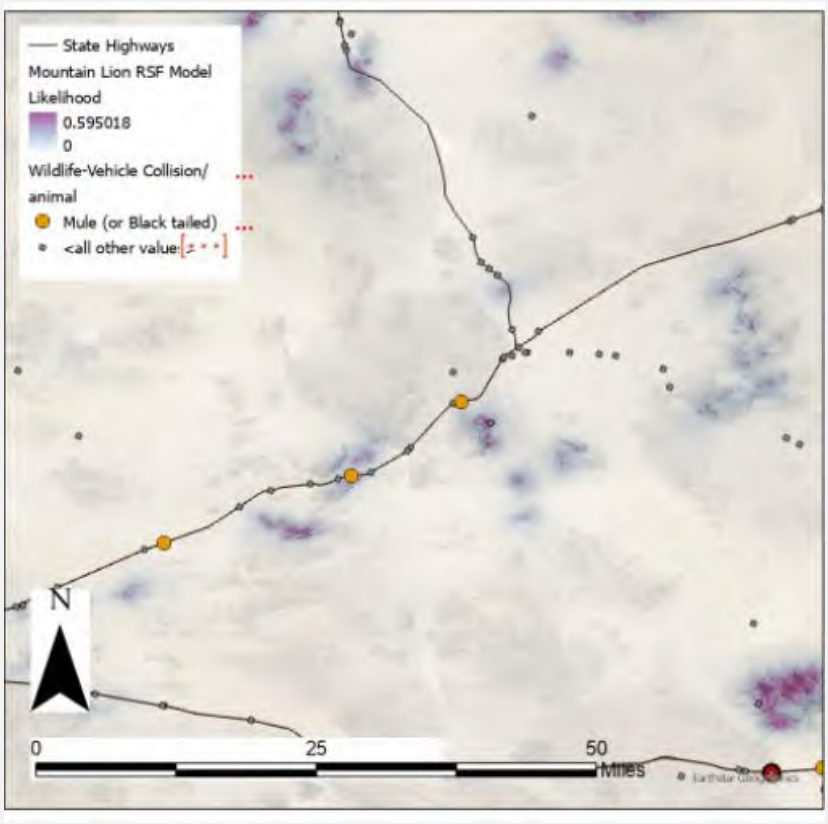
Disease is an important factor to consider and monitor, particularly respiratory diseases, for desert bighorn sheep. Their small population sizes and limited genetic diversity make them particularly vulnerable to disease outbreaks, which can cause widespread mortality and result in localized extirpation (CDFW 2012).

Mountain Lion Predation

A variety of species prey on desert bighorn sheep, including coyotes (*Canis latrans*), bobcats (*Lynx rufus*), golden eagles (*Aquila chrysaetos*), and mountain lions (*Puma concolor*) (Ober 1931; Kelly 1980; Berger 1991; Nichols and Bunnell 1999; Bleich 1999). In areas where desert bighorn range overlaps that of mule deer, mountain lions have been documented to be the primary predator of desert bighorn sheep (Wehausen 1996; Hayes et al. 2000; Rominger et al. 2004). In many of these cases, the significant loss of desert bighorn sheep has been attributed to just a few mountain lion individuals that may have displayed a shift in their prey selection from cervids (i.e., deer) to focus more on desert bighorn sheep (Ross et al. 1997; Ernest et al. 2002; Festa-Bianchet et al. 2006). Given desert bighorn sheep live in small, isolated populations, it takes very few mountain lions to significantly impact a population, even if desert bighorn sheep make up a small proportion of the prey base of those lions (Ernest et al. 2002).

While the CDFW predicted habitat modeling for both mule deer (CWHR M181[ds2625]) and mountain lion (CWHR M165[2616]) show the closest predicted habitat is approximately 28 miles to the east of the study area in the Old Dad/Granite/Providence Mountains and 35 miles to the northeast in the Ivanpah/Clark Mountains, Dellinger et al.'s (2020) mountain lion model shows modeled habitat within the Soda Mountains. Additionally, there is a cervid roadkill location (UC Davis 2024) at I-15 and the Soda Mountains as well. The closest mountain lion wildlife–vehicle collision is along I-40 approximately 40 miles to the southeast of the study area (Exhibit 1). These are likely extreme movements for both species as the region is generally less suitable for these species. Mountain lions are capable of moving such distances and do occasionally find their way to these areas and hunt, but they are transient. It is unlikely that either species would find or stay near this desert bighorn population very often or for very long. Therefore, it is unlikely that supplementary water would draw in deer or subsequently mountain lions.

Exhibit 1: Dellinger et al. (2020) mountain lion habitat suitability modeling and wildlife-vehicle collision data (UC Davis 2024) for region.



3.3 Solar Energy and Desert Bighorn Sheep

Dudek conducted a literature search regarding variables related to solar energy development that may influence desert bighorn sheep. Because of the variability in biology and responses to stimuli between ungulate species, leads for other surrogate species (e.g., deer, antelope) were not pursued. The following section provides a summary of the findings of this research.

3.3.1 Effects of Solar Glare and Polarized Light

The impact of solar glare and polarized light created by solar facilities on desert bighorn sheep is not well documented; however, understanding the general behavior and environmental challenges faced by desert bighorn sheep can provide insight into the potential impacts of solar glare and polarized light on this species. As previously discussed, desert bighorn sheep are highly adapted to arid climates and are typically found in steep, rocky terrain, where they rely on their agility and keen eyesight to detect and escape from predators. They are social animals that form herds and require access to water sources, which are crucial for their survival, particularly in the summer and for pregnant ewes. Desert bighorn sheep residing in arid environments where solar facilities are prevalent are

already existing at their physiological limits, making any additional movement potentially costly and detrimental to their survival (Vale and Brito 2015).

While specific studies on the effects of solar glare and polarized light on desert bighorn sheep behavior or physiology were not found, it has been well established that wildlife can be sensitive to changes in their environment. The highly reflective surfaces of solar panels could potentially affect the animals' visibility and alter their natural behavior patterns (Chock et al. 2021). A significant concern is the hypothesized "lake effect," in which solar panels are mistaken for water bodies, potentially luring desert bighorn sheep to the facilities, similar to how waterfowl are attracted to solar installations (Kagan et al. 2014). The movement to these false oases could result in unnecessary energy expenditure, leading to fatigue, dehydration, and an increased risk of predation. This false lure to water could be particularly harmful, leading to injury, stranding, or even death, especially for more vulnerable individuals like young and elderly desert bighorn sheep. The sensory systems of large mammals such as the desert bighorn sheep might be affected by the reflection and polarization of light from solar panels (Chock et al. 2021), potentially leading to disorientation or confusion, further exacerbating the risks associated with the lake effect.

3.3.2 Solar Facility Construction and Operational Noise

Wildlife can be sensitive to introduced noise within their environment, which can affect their behavior, communication, foraging habits, and reproductive success. Noise can also cause stress and lead to habitat avoidance, potentially disrupting wildlife movement and migration patterns. However, the specific impacts of noise from solar facilities on different wildlife species are not well-studied, and the evidence is still emerging. During construction there is a lot of activity and potential for numerous sources of noise. In general, after construction, there is little noise at these facilities, with few employees performing mostly random maintenance activities. During certain times of the year, increases in activity and noise would come from trimming back vegetation.

The expansive infrastructure required and noise from increased human presence for solar facilities may disrupt established migration corridors and restrict gene flow (Chock et al. 2021). Similar barriers like roadways and mining operations have been shown to cause rapid declines in genetic diversity among desert bighorn sheep populations (Epps et al. 2005). Desert bighorn sheep show a strong aversion to human disturbances, with 61% fleeing from hikers and 17% from vehicles (Papouchis et al. 2001), indicating that the presence of people and vehicles at solar facilities could lead to a significant majority, potentially 78%, of these animals fleeing. In addition, the construction and operation of these facilities may change the landscape in ways that could affect the desert bighorn sheep's natural behavior. The development could usurp or add barriers to bighorn sheep movement. For example, the presence of fences and other infrastructure might restrict access to water sources or foraging areas, posing indirect risks (Kagan et al. 2014).

Reimer and Snodgrass (2009) suggest negative impacts from solar facility land use may be similar to those of wind farms. Additional effects may also be present, such as "habitat fragmentation; interference with migration corridors; reduced access to watering holes; increased edge effects (e.g., introducing nonnative, invasive or predatory species); changes in water flow patterns; interference with eolian processes 17 (i.e., sand movement and dune formation); glare (for CSP systems); vehicular traffic; hazardous material release; and increased risk of fire" (Reimer and Snodgrass 2009).

3.3.3 Desert Bighorn Sheep Ability to Learn and Adapt

Desert bighorn sheep demonstrate a robust propensity for learning and retaining critical information about their environment, which is vital for their survival and reproduction. Studies show that Sierra Nevada Bighorn Sheep exhibit a high rate of switching between resident and migratory behavior, a trait hypothesized to be underpinned by social learning and cultural transmission (Spitz et al. 2018; Jesmer et al. 2018; Lowrey et al. 2020). This learning extends to remembering birth sites, foraging locations, and water sources, with evidence suggesting that translocated individuals, lacking the collective memory of native populations, initially show less migratory behavior (Jesmer et al. 2018). However, over time, as they accumulate and share information within their social groups, their migratory propensity increases (Jesmer et al. 2018). This collective knowledge, passed down through generations, is crucial for maintaining population abundance, with the loss of migration potentially leading to a significant decline in knowledge about high-quality forage locations (Jesmer et al. 2018; Merkle et al. 2019). Fidelity to birthing sites has been shown in some studies (Etchberger and Krausman 1999) but not in others (Bangs et al. 2005; Karsch et al. 2016). A study in domestic sheep, which are closely related to desert bighorn sheep, displayed spatial memory in a pasture where they learned the location of food-containing bowls over multiple trials (Edwards et al. 1996). Desert bighorn sheep also demonstrate strong site fidelity, particularly in homogenous landscapes where travel costs between suitable sites are high (Morrison et al. 2021). Overall, site fidelity was strongest during the late summer and weakest during the late winter for desert bighorn sheep (Morrison et al. 2021). In short, desert bighorn sheep are adaptable.

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4 Conservation Considerations for the Soda Mountain Area

4.1 Terrestrial Connectivity

The Soda Mountains are considered to be a relatively poor habitat with a high extinction probability for desert bighorn sheep due to the low rainfall that the area experiences combined with the low elevations compared to other Mojave Desert mountain ranges (CDFW 2012), despite supporting apparent robust populations for many years. This mountain range is unique, as it is split by I-15; therefore, it provides an important opportunity to enhance gene flow between the northern and north-central metapopulation fragments. In addition, there is a reliable water source near Zzyzzx, which is located on the southeastern side of the South Soda Mountains. Previous studies have documented the importance of a reliable water source, particularly during the hot, summer months, for desert bighorn sheep when selecting habitat (Bleich et al. 1997; Miller et al. 1984).

The Terrestrial Connectivity dataset is one of four key components that is included in CDFW's Areas of Conservation Emphasis (ACE) dataset. The Terrestrial Connectivity dataset builds upon the California Essential Habitat Connectivity dataset and is intended to provide an overview of landscape connectivity across the State of California based on the most up-to-date information, assess the connectivity importance of the landscape, and serve as a spatial library that compiles existing connectivity studies across the state. The data are presented as a map of hexagons that encompass 2.5 square miles; each hexagon is assigned a connectivity rank from 1 to 5 based on the conservation and connectivity importance of an area.

As is depicted in Figure 5, Terrestrial Connectivity Map, the study area is mapped as rank 3 and rank 4. Rank 3 hexagons are defined as having "connections with implementation flexibility." Rank 3 areas have been identified as having connectivity importance but have not been identified as channelized areas, species corridors, or habitat linkages at this time; however, this may change with future changes to the surrounding lands. Rank 4 hexagons are areas with "conservation planning linkages." Rank 4 areas include habitat connectivity linkages mapped in the California Essential Habitat Connectivity dataset and fine-scale regional connectivity studies analyzed for the ACE dataset. Habitat connectivity linkages represent the best connections between core natural areas in order to maintain habitat connectivity. This ranking is from a multi-species perspective. When considering a metapopulation structure species like desert bighorn sheep that primarily relies on "islands" within the landscape, rank 3 and 4 areas have greater importance.

It is clear, based on the ACE 3 and 4 rankings of the study area, that this area plays an important role in maintaining landscape connectivity; however, the study area is not mapped as an ACE Rank 5, which would indicate the land was "irreplaceable" and an "essential corridor." Figure 5 shows that the lands in the surrounding vicinity of the study area are also mapped as ACE Rank 3 and 4, thus indicating that this area in general is important to maintaining terrestrial connectivity; however, there is some flexibility with where these linkages and corridors can be located (CDFW 2024).

4.2 California Desert Linkage Network

In 2012, the California Desert Linkage Network study was published. The goal of this study was to "identify lands essential to maintain or restore functional connectivity among wildlands for all species or ecological processes of interest in the California desert and as a vital adaptation strategy to conserve biodiversity during climate change" (Penrod et al. 2012). One of the focal species of this study was the desert bighorn sheep. Penrod et al. (2012) explained that this species was selected as a focal species for this study as they are "extremely sensitive to habitat loss and fragmentation" (Bleich et al. 1996; Rubin et al. 1998; Singer et al. 2000; USFWS 2000). As part of this study, suitable desert bighorn sheep habitat was delineated and categorized as a core area, patch area, or less than a patch area. The study delineated habitat with a slope of 20–85 degrees and designated this as escape terrain. All escape terrain was considered suitable habitat for desert bighorn sheep. In addition, adjacent flat areas that were less than 300 meters from this escape terrain were also considered suitable habitat for desert bighorn sheep. Habitat that met these criteria was removed and considered unsuitable if it contained one of the following criteria: (1) dense vegetation that would restrict visibility, (2) too far from a water source, and (3) within 150 meters of development. Finally, the suitable habitat was categorized as a core, patch, or less than a patch as follows:

- Core = area of suitable habitat ≥ 300 km^2 (74,132 acres)
- Patch = area of suitable habitat ≥ 13 km^2 (3,212 acres) but ≤ 300 km^2 (74,132 acres)
- Less than a Patch = area of suitable habitat < 13km^2 (3,212 acres)

As depicted in Figure 6, Wildlife Linkage and Connectivity Modeling, the South Soda Mountains, including some small areas within the study area, are mapped as a patch of suitable desert bighorn sheep habitat. One of the proposed I-15 Mojave wildlife crossing locations occurs at the northern portion of this mapped patch area and would provide a connection between this patch area and the less than a patch area across I-15. This study did not model the North Soda Mountains as suitable desert bighorn habitat due to the lack of water resources; however, these mountains would be considered suitable habitat with the addition of a reliable water source and provide connectivity to the Avawatz Mountains, which were mapped as a core habitat for desert bighorn sheep (Penrod et al. 2012). The I-15 Mojave wildlife overcrossing project (see Section 4.3 below), which is underway directly adjacent to the study area, would provide connections between the south and north Soda Mountains. Desert bighorn sheep within the South Soda Mountains (mapped as patch habitat) move between it and the Cady Mountains (mapped as core habitat) as shown by telemetry data from several individuals; thus, both mountain ranges appear to be connected and important to that population of animals.

In addition to modeling desert bighorn sheep, Figure 6 shows a linkage located just south of the South Soda Mountains patch. This linkage follows the Mojave River, which the California Desert Linkage Network study included in order to provide connectivity among many of the targeted landscape blocks that occur along the river (Penrod et al. 2012). While this linkage is unlikely to be used by desert bighorn sheep as a movement linkage, it will be important in conserving the Mojave River, which is the primary water source accessible to desert bighorn sheep in the Cady Mountain core area.

4.3 I-15 Mojave Wildlife Crossing Restoration Project

As previously discussed, and visible in Figure 4, I-15 currently acts as a barrier between the north and north-central desert bighorn sheep metapopulation fragments. Recently, the California Department of Transportation (Caltrans), CDFW, and Brightline West agreed to design and construct three wildlife overcrossings across I-15 and the future

Brightline West high-speed rail system that will be constructed within the median of I-15. The goal of these overcrossings is to provide a sustainable and safe pathway for wildlife to cross I-15, especially desert bighorn sheep, as well as to contribute to bolstering habitat connectivity within the Mojave Desert.

One of the proposed wildlife crossings would be located at the northern portion of the South Soda Mountains, which is northeast of the study area. This crossing, along with the other two proposed crossing structures, would not only allow for safe movement across I-15, but also allow for critical genetic exchange between the metapopulation fragments and provide access to additional habitat and resources. While there are four existing underpasses and bridges near the Soda Mountain Solar study area, there have been few documented observations of desert bighorn sheep using these structures. A wildlife crossing that provides for the need of desert bighorn sheep to maintain open visibility of their surroundings is much more likely to be successful. Furthermore, wildlife crossings over highways have proven successful for desert bighorn sheep in Arizona, Nevada, Canada, and elsewhere. The Union Pass wildlife crossing in Arizona has shown significant utilization by desert bighorn sheep, which has been attributed to the crossing's location within high-quality desert bighorn sheep habitat (Bristow and Crabb 2008).

4.3.1 Wildlife Corridor Width to Support Desert Bighorn Sheep

In Arizona, the initial use of wildlife corridors after construction indicated desert bighorn sheep showed a preference for wider passages (30 meters wide) (Gagnon et al. 2022). However, over time, the difference in preference disappeared and the actual width of these structures became less significant than the quality of the habitat they were constructed in (Gagnon et al. 2022). McKinney and Smith (2007) documented the consistent use of the 275-meter-wide Sugarloaf Mesa Bridge by desert bighorn sheep. Additionally, Gagnon et al. (2022) report that preliminary data from both Nevada and Arizona indicate desert bighorn sheep prefer 100-meter-wide underpasses but attributed this to the area beneath the large underpasses maintaining larger expanses of natural habitat. There was significant utilization of Union Pass wildlife crossing in Arizona, despite it not being the largest or widest structure (51 meters wide × 25 meters high × 17 meters long) (Bristow and Crabb 2008). Similarly, this study concludes that the Union Pass was likely used due to its location in high-quality desert bighorn sheep habitat. These studies all emphasize that desert bighorn sheep prioritize corridors that maintain larger expanses of natural habitat. Dodd et al. (2007) also highlight that structural design fostering high openness ratios (height × width divided by length) encourages animal movement, suggesting that the quality and ease of passage may outweigh simple width measurements. Thus, habitat quality and structural design facilitating minimal travel distance within the corridor appear to be more critical than corridor width alone. All studies reported above do indicate that desert bighorn sheep likely utilize corridors wider than 50 meters at a higher rate than narrower corridors.

The following summarizes the raw data obtained from the papers cited above. The correlation analysis of the structural dimensions of wildlife corridors and their usage by desert bighorn sheep reveals no statistically significant relationships. Specifically, the width of the corridors shows a slight negative correlation with crossings per year (r = −0.265, p = 0.431), while height has a negligible negative correlation (r = −0.038, p = 0.912), and length displays a weak positive correlation (r = 0.285, p = 0.396). A linear regression analysis revealed that the openness ratio was negatively correlated with crossings per year (r = 0.12, p = 0.290), indicating that the model is not statistically significant. The absence of statistical significance in these results suggests that the number of annual crossings is not strongly dependent on the corridors' width, height, length, or openness. This indicates that other factors not measured in this analysis may be influencing wildlife movement through these corridors or that the sample size may be too limited to discern a clear pattern of significance. Possible reasons for width selection include good sightlines, presence of suitable habitat, stressors forcing movement, the promise of necessary life history items (e.g., water, forage, mates), and other factors.

Aiello et al. (2024), performed a before-after-control-impact study using GPS collars and trail cameras to determine desert bighorn sheep use of underpasses in this region (underpasses along I-15 and I-40 near Mojave National Preserve, California). Underpasses mostly included bridge structures with openness ratios varying between 0.46 to 4.99. Two culverts were much smaller with openness ratios of 0.08 and 0.19. Ultimately, target underpasses were supplemented with water guzzlers to entice crossing by desert bighorn sheep. Similar to other Murphy-Mariscal et al. (2015), no desert bighorn sheep were found to pass through the structures.

The internal fenced corridors vary between 45 meters to over 144 meters wide, but generally less than 100 meters wide. Despite this, these fenced corridors are likely not sufficient for desert bighorn sheep use due to a lack of visual openness beyond the fencing. The solar arrays and angular fenced viewshed through the corridor will not allow desert bighorn sheep to see very far and are likely to either place them at greater risk of predation by mountain lions, cause them to avoid the corridor altogether, or force them to rush through the area.

4.4 Human Activities in Vicinity of Soda Mountain

Desert bighorn sheep exhibit varied behavioral responses to human recreational activities such as hiking, mountain biking, and vehicular traffic. These responses include fleeing encounters, particularly with hikers, and displaying avoidance behaviors toward areas with high human activity levels. While some individuals may habituate to regular disturbances like road traffic, overall, they tend to maintain distance from heavily frequented human areas, potentially leading to habitat avoidance (Papouchis et al. 2001; Sproat et al. 2019). For example, Sproat et al. (2019) observed that desert bighorn sheep adjust their behavior in the presence of humans, showing reduced grazing and increased vigilance in high human activity areas, suggesting human recreation may adversely influence their foraging habits. Likewise, Lowrey and Longshore (2017) found that increased human recreation activity, particularly mountain biking, in natural habitats led to desert bighorn sheep abandoning previously inhabited areas, effectively shrinking their available territory due to recreational disturbances. This avoidance behavior can decrease suitable habitat use and disrupt critical movement and migration patterns essential for their survival (Papouchis et al. 2001; Wiedmann and Bleich 2014).

Camping also negatively impacts desert bighorn sheep, leading to decreased foraging time, altered activity budgets, and habitat abandonment (Sproat et al. 2019). For instance, desert bighorn sheep tended to avoid areas near water or trails where campsites were concentrated in the popular Rae Lakes area of Kings Canyon National Park (Hicks and Elder 1979). In July and August, Hicks and Elder (1979) documented 2,675 overnight stays, with visitor surveys revealing that rams were rarely spotted, reported by only 2% of groups. Additionally, desert sheep exhibited a preference for human non-use meadows over human-use meadows in the same study (Hicks and Elder 1979). Similarly, increased human presence associated with camping and other outdoor activities disrupts the natural behaviors and habitat use of desert bighorn sheep, potentially leading to long-term consequences for their survival (Papouchis et al. 2001; Switalski 2018) and has been linked to local population declines (Schoenecker 1997).

Studies indicate that desert bighorn sheep show significant responses to different types of human activity, with hikers eliciting the most severe reactions, followed by vehicles and mountain bikers (Papouchis et al. 2001. Research on mammalian responses to off-road vehicle activity suggests mixed findings at the community level, with some species showing resilience while others, like elk and mountain goats, alter their movement and habitat selection in response to off-highway vehicle presence (Luckenbach and Bury 1983; Zielinski et al. 2008; Preisler et al. 2006; Shanley and Pyare 2011). Avoidance of areas with high human activity, such as road corridors, led to a reduction in desert bighorn sheep suitable habitat use by as much as 15% (Papouchis et al. 2001).

As depicted in Figure 7, Recreational Access in Project Vicinity, Rasor Off-Highway Vehicle Recreation Area is located within a portion of the South Soda Mountains. As noted in the Soda Mountain Draft Biological Technical Report (BTR), this off-highway vehicle area experiences heavy use, which has resulted in a high level of disturbance in the form of trash and numerous non-native and invasive plant species throughout the study area and surrounding landscape. Given a portion of the South Soda Mountains is already impacted by human recreational activities, it is important to ensure any additional human activities within the area (i.e., construction and operation of the proposed project) will not result in displacement of desert bighorn sheep from their habitat and required resources, as well as from areas that provide for movement opportunities between populations, allowing for essential gene flow.

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5 Data Analysis of South Soda Mountains and Vicinity

As discussed above, the project proposes to construct a large-scale, photovoltaic solar facility near the western base of the South Soda Mountains directly adjacent to key occupied habitat and connectivity restoration activities. The South Soda Mountains are located within the north-central metapopulation fragment and are inhabited by a herd of desert bighorn sheep estimated to be 51–100 individuals during a ground count in May 2012 (CDFW 2012). A brief site visit by Dudek wildlife biologists Sarah Greely and Brock Ortega verified the presence of easily detectable individuals by scat, track, and visual observation (December 20, 2023; 7:15 a.m. to 12:00 p.m.; 52 °F–66°F; 0% cloud cover; 0–1 mph winds). The South Soda Mountain herd is 1 of 10 desert bighorn sheep herds that make up the north-central metapopulation fragment. The Cady Mountains are located just southeast of the South Soda Mountains and are also inhabited by a herd of desert bighorn sheep. According to the Conservation Plan for Desert Bighorn Sheep in California (CDFW 2012), these two herd units have a high priority level for conservation as they are located at a potential desert bighorn sheep migration pathway across I-15 between the Cady and South Soda Mountains and the Soda Mountains north of I-15 (i.e., north Soda Mountains). Recent studies, one unpublished and one published, have focused and analyzed the potential impacts and movements of the South Soda Mountain herd. The following presents a summary of the findings of these studies.

5.1 Methods

Before initiating the GIS analysis of the desert bighorn sheep collar/movement data, Dudek reviewed previous studies analyzing and discussing desert bighorn sheep habitat utilization and movement patterns of the South Soda Mountain herd and surrounding herd units. The results and conclusions of these previous studies helped to guide our GIS analysis of the collar and movement data provided by CDFW. The following sections discuss the above-mentioned previous studies and discuss the results of the GIS analysis conducted by Dudek.

5.2 Previous South Soda Mountain Desert Bighorn Sheep Studies

5.2.1 Potential Impacts of Proposed Solar Energy Development Near the South Soda Mountains on Desert Bighorn Sheep Connectivity (Epps et al. 2013)

In February 2013, Epps et al. released an unpublished study entitled “Potential Impacts of Proposed Solar Energy Development Near the South Soda Mountains on Desert Bighorn Sheep Connectivity.” The report assessed the area between the South Soda Mountains (south of I-15) and the Soda Mountains (north of I-15) for restoration of desert bighorn sheep connectivity across I-15. The study indicated that the connection between the Soda Mountains and South Soda Mountains is “the most important restorable corridor for the long-term demographic potential (i.e., population recolonization by ewes) across the entire southeastern Mojave Desert” (Epps et al. 2013). The report further states that this area could be especially important to efforts to restore connectivity between the bighorn populations north of I-15 and those south of I-15.

Epps et al. (2013) explained that the genetic connectivity between Mojave Desert bighorn populations is a function of both the geographic distance between populations and the slope of the habitat. The study identified the corridor linking the Avawatz Mountains (located north of the Soda Mountains) and the South Soda Mountains as having the "highest-ranking restorable corridor" in their analysis with respect to long-term demographic connectivity, as well as being the only restorable corridor that is a short enough distance to effectively connect bighorn populations across I-15 as it pertains to the maximum dispersal range of a ewe (Epps et al. 2007, 2013).

5.2.2 Movement Models and Simulation Reveal Highway Impacts and Mitigation Opportunities for Metapopulation-distributed Species (Aiello et al. 2023)

In January 2023, Christina Aiello, along with several other authors, including Epps, published a study that took a more in-depth look at the potential for restoring connectivity between desert bighorn metapopulation fragments. Aiello et al. (2023) analyzed GPS collar data from desert bighorn within the study area to better understand the movement patterns of desert bighorn sheep as they pertain to barriers, such as I-15, as well as to identify ideal locations for desert bighorn sheep movement across valleys where highways currently exist. Ultimately, the study aimed to help locate and prioritize mitigation efforts to reconnect metapopulations by predicting habitat use without highway barriers based on desert bighorn movement data.

When predicting habitat use without highway barriers, the area between the South Soda Mountains and the northern Soda Mountains showed the largest increase in accessible habitat, which included high elevations that are currently inaccessible, thus supporting the conclusions reached by Epps et al. in 2013. Aiello et al. (2023) found that without barriers, the potential increase in accessible and suitable habitat for desert bighorn sheep could be substantial and would include high-elevation areas considered crucial for populations currently inhabiting low-elevation ranges, such as the southern Soda Mountains, as they face the risk of climate-related extinction. Simulations within the southern Soda Mountains predicted that if desert bighorn sheep were able to move across I-15, they could access 138% more habitat than is currently accessible.

Overall, these two studies emphasize the importance of the southern Soda Mountains as a potential "stepping stone" in reconnecting the northern and north-central metapopulation fragments and the need to ensure that any development within this area not preclude desert bighorn sheep from accessing any future wildlife crossings between the southern Soda Mountains and the northern Soda Mountains.

5.3 GIS Analysis Findings

Dudek was provided a subset of GPS collar data from desert bighorn sheep within the southern Soda Mountains and surrounding area. The dataset included 50 individuals (specifically, 36 females and 14 males) and was collected between November 2013 and May 2023; however, the majority of data (specifically 24 individuals) within this dataset was collected between 2020 and 2022. The average length of time data were collected on an individual within this dataset was 17.6 months. All data provided were checked for accuracy by CDFW using a screening algorithm; therefore, the data presented are accurate. Figure 8, Bighorn Sheep Collar Data Overview Map, depicts the geographical extent of the data that were analyzed by Dudek.

The data collected and analyzed represents only a partial picture of the whole. The GPS collars collect a single GPS point per time interval, which is typically set to 4 or 6 hours. Desert bighorn sheep are highly mobile animals and can move vast distances in a short period of time. As such, one can ascertain that areas that include occurrence points are used by desert bighorn sheep; however, areas lacking occurrence points cannot be presumed to be unused by or unimportant for the desert bighorn sheep, as the dataset only represents a portion of the overall habitat use and movement patterns of any one individual animal and is not representative of the whole picture. Additionally, the data provided were limited to a specific geographic area; therefore, data points for individuals that moved outside this geographic area are not included in this analysis. For example, one female shows data that ranged across 21 months; however, the dataset provided only included 8 data points. This may indicate this individual moved outside of the geographic area of interest; thus, additional data points were not included within the data provided by CDFW.

The following sections summarize the findings of the GIS analyses of the dataset.

5.3.1 Habitat Use by Slope

As previously discussed, desert bighorn sheep spend a majority of their time in mountainous habitat (i.e., areas with a slope of 15% or more) as it provides for visual openness and escape terrain. The recent study by Aiello et al. (2023) confirms this information, stating their study found that desert bighorn sheep remained close to ridges . The GIS analysis conducted by Dudek confirms these findings. Figures 9 and 9A, Seasonal Use of Habitat by Males, show the data points for all 14 males within the dataset, while Figures 10 and 10A, Seasonal Use of Habitat by Females, show the data points for all 36 females within the dataset. In all figures, the vast majority of the data points are located within the mountain habitat areas; however, it is also evident that the desert bighorn sheep are utilizing the intermountain habitat/lower elevation flat areas as well. This includes the intermountain habitat located between the South Soda Mountains and the project site, particularly along the northeastern portion of the project site. Incursions onto the study area for both males and females appear to primarily occur during the winter period.

5.3.2 Seasonal Habitat Use

Aiello et al. (2023) found that the desert bighorn sheep included within their study showed a preference for north-facing slopes in the fall, which was defined as October through November, and a preference for south-facing slopes in the winter, defined as December through March. Of the 50 individuals within dataset provided to Dudek, 40 individuals (28 females and 12 males) show data points collected for at least one year, or across all four seasons. Figures 9A and 10A show a breakdown of habitat use across the seasons for males and females. Seasons were defined using the same parameters used by Aiello et al. and are as follows:

- Winter = December through March
- Spring = April through June
- Summer = July through September
- Fall = October through November

Both the males and females show an increase in the amount of data points within the south-facing slopes and within the lower elevation portions of these south-facing slopes during the winter months (Figures 9A and 10A). Given the smaller dataset of male desert bighorn sheep as compared to females, this shift is more apparent in the

figures showing male seasonal use as compared to the figures depicting female seasonal use. The males also show an increase in the use of north-facing slopes during the fall months; however, due to the large dataset of females, it is difficult to see any patterns in female slope use. Figures 11A through 11J show relevant study area–adjacent individual desert bighorn sheep GPS locations by season.

Figures 11A through 11F depict individual female desert bighorn sheep locations by season. In general, during the warmer summer months, the locations are more clustered around the water source on the northeastern side of the South Soda Mountains. Locations collected during the winter months tend to be more spread out and do not appear to center around the water sources located within the South Soda Mountains. Additionally, the females show more occurrences within the intermountain habitat between the northeastern portion of the study area and the South Soda Mountains, with some individuals showing occurrences within the study area itself. Figures 11G through 11J depict individual male desert bighorn sheep locations by season. Three of these individuals show points clustered around the water source near Zzyzzx during the warmer months in spring and summer. Figure 11I depicts Male 1862, showing summer habitat use clustered around a small mountain south of the study area where a water source was added in 2020. Cooler season habitat use (i.e., winter months) is more spread out and does appear to favor south-facing slopes. In addition, the winter points indicate males spend more time in the area between the northeastern portion of the study area and the South Soda Mountains in the winter than during other seasons, and particularly in the lower elevation, intermountain habitat (i.e., alluvial fan).

5.3.3 Desert Bighorn Sheep Use of the Study Area

The dataset provided by CDFW included a total of 261,868 points. As previously discussed, the data include only a small subset of the actual desert bighorn sheep population in this area and only represent a narrow snapshot of weather and temperatures that desert bighorn sheep experience. Some desert bighorn sheep may use the resources differently than are depicted, and impending climate change will likely negatively affect these lower elevation sites, making all local forage resources more important. Of these data, 30 points (0.01%) are within the study area and these occurrences were collected from 11 individuals (7 females and 4 males). These occurrences did not appear to be influenced by the sex of the animals, as approximately 57% were collected from females while approximately 43% were collected from males. The occurrences within the study area have a strong seasonal component, as approximately 80% of the occurrences occur during the winter months (i.e., December through March), with the remaining few occurrences scattered evenly across spring, summer, and fall (i.e., two occurrences in each season).

6 Impact Analysis

This section addresses direct and indirect impacts to desert bighorn sheep that would result from implementation of the project and provides the significance determinations for proposed or potential impacts. Mitigation recommendations are provided in Section 7 below.

6.1 Explanation of Findings of Significance

Impacts to sensitive vegetation communities, special-status plant and wildlife species, and jurisdictional aquatic resources, including wetlands, must be quantified and analyzed to determine whether such impacts are significant under CEQA. CEQA Guidelines Section 15064(b) states that an ironclad definition of a "significant" effect is not possible because the significance of an activity may vary with the setting. Appendix G of the CEQA Guidelines, however, does provide "examples of consequences which may be deemed to be a significant effect on the environment" (14 CCR 15064[e]). These effects include substantial effects on rare or endangered species of animal or plant or the habitat of the species. CEQA Guidelines Section 15065(a) is also helpful in defining whether a project may have a significant effect on the environment. Under that section, a proposed project may have a significant effect on the environment if the project has the potential to (1) substantially degrade the quality of the environment, (2) substantially reduce the habitat of a fish or wildlife species, (3) cause a fish or wildlife population to drop below self-sustaining levels, (4) threaten to eliminate a plant or animal community, (5) reduce the number or restrict the range of a rare or endangered plant or animal, or (6) eliminate important examples of a major period of California history or prehistory.

The following are the significance thresholds for biological resources provided in the CEQA Guidelines Appendix G Environmental Checklist, which states that a project would potentially have a significant effect if it does any of the following:

- Impact BIO-1. Has a substantial adverse effect, either directly or through habitat modifications, on any species identified as being a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFW or USFWS.
- Impact BIO-2. Has a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations, or by CDFW or USFWS.
- Impact BIO-3. Has a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means.
- Impact BIO-4. Interferes substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors or impedes the use of native wildlife nursery sites.
- Impact BIO-5. Conflicts with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.
- Impact BIO-6. Conflicts with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or state habitat conservation plan.

The evaluation of whether an impact to a particular biological resource is significant must consider both the resource itself and the role of that resource in a regional context. Substantial impacts are those that contribute to, or result in, permanent loss of an important resource, such as a population of a rare plant or wildlife species. Impacts may be important locally because they result in an adverse alteration of existing site conditions but considered not significant because they do not contribute substantially to the permanent loss of that resource regionally. The severity of an impact is the primary determinant of whether that impact can be mitigated to a level below significance.

For the purposes of this report and the project's possible effects on desert bighorn sheep (while a managed and hunted subspecies, it is considered sensitive—CDFW Fully Protected, BLM Sensitive species, and U.S. Forest Service Sensitive; CDFW Special Animals List - April 2024) only findings of significance related to Impact Bio-1 have been evaluated.

6.2 Definition of Impacts

Direct impacts refer to complete loss of a biological resource. For the purposes of this report, direct impacts refer to the area where vegetation clearing, grubbing, or grading replaces biological resources. Direct impacts were quantified by overlaying the proposed impact limits on the biological resources map of the study area. Direct impacts would occur from construction of the solar facility and associated infrastructure. All impacts are considered permanent direct impacts.

Indirect impacts are reasonably foreseeable effects caused by a project's implementation on remaining or adjacent biological resources outside the direct disturbance zone. For purposes of this report, indirect impacts may affect areas associated with biological resources present within the Cady Mountains. Indirect impacts may be short-term and construction-related or long-term and associated with development in proximity to biological resources.

The evaluation of project impacts is organized by the resource potentially affected: riparian and sensitive vegetation communities (special-status vegetation communities), special-status species, jurisdictional waters and wetlands, and wildlife movement.

6.2.1 Impact BIO-1: Special-Status Species

Direct Impacts to Desert Bighorn Sheep

There is some potential for desert bighorn sheep to be directly impacted by the project, primarily by collision with work vehicles. This is likely a minor risk. The larger direct impact is related to the permanent removal of forage within the project footprint. While most of their time is spent in the adjacent hills, there are some occurrences of desert bighorn sheep moving down into the flatter adjacent lands onto the project site. There is not enough known about the seasonal foraging use of certain plant species by desert bighorn sheep, and the importance of these plant species during drought years is not known. Further, only a fraction of the South Soda Mountain herd was collared; therefore, while the collar data provide good insights into how the herd selects and uses the habitat, there may be important segments of the South Soda Mountain population that utilize the surrounding habitat differently that are not identified with this dataset. The project would result in a direct loss of possible foraging habitat. These impacts would be significant without mitigation. With the implementation of recommended **Mitigation Measure (MM) BIO-2**, WEAP; **MM-BIO-4**, Biological Monitoring; applicant proposed measure (**APM) BIO-37**, Restriction of Pets; **MM-BIO-6**, Fence Design and Site Permeability; **MM-BIO-23**, Project Footprint Setback; **MM-BIO-25**, Mitigation and

Monitoring Plan; **MM-BIO-26**, Limited Operating Period; and **MM-BIO-27**, Work Boot Decontamination, these impacts would be less than significant.

Indirect Impacts

Project implementation could result in indirect impacts to desert bighorn sheep related to short-term construction-related activities, and long-term activities.

Short-Term Indirect Impacts

Short-term indirect impacts could occur to desert bighorn sheep due to construction noise and a general increase in human activity directly adjacent to occupied islands of habitat that support the full range of biological needs for the Soda Mountain population including foraging and breeding. Night work is not expected to occur; therefore, lighting is not a concern. Human activity is currently present in the form of off-highway vehicle use and camping; however, during construction, the entire northwestern face of the occupied habitat would be exposed to constant activity throughout the day. Construction would include a combination of extended lower-level noise, but there would also be periods of loud and/or abrupt noise, which can have particularly negative effects on desert bighorn sheep. Startling may cause ewes to briefly abandon lambs or may cause lambs to be knocked off or stumble off of ledges and steep slopes, among other effects, resulting in injury and mortality. This effect might also be considered a possible direct impact. Repeated startling noise events may cause desert bighorn sheep to artificially adjust their use of the habitat island to other locations within the South Soda Mountains that may not support the key resources needed or preferred by the desert bighorn sheep. These impacts would be considered significant without mitigation. With the implementation of recommended measures **MM-BIO-2**, WEAP; **MM-BIO-4**, Biological Monitoring; **APM-BIO-37**, Restriction of Pets; **MM-BIO-6**, Fence Design and Site Permeability; **MM-BIO-23**, Project Footprint Setback; **MM-BIO-26**, Limited Operating Period; and **MM-BIO-27**, Work Boot Decontamination, these impacts would be considered to be less than significant.

Helicopters will not be used for construction; therefore, no short-term indirect impacts from helicopter use are anticipated. Likewise, blasting will not be required during this project's construction.

Long-Term Indirect Impacts

Long-term indirect impacts could occur to desert bighorn sheep, primarily due to project fencing and proximity to occupied habitat. As currently planned, the project will fence the project site and leave relatively narrow corridors between the East Array and South Arrays 1, 2, and 3 (Figure 12, Project Distance to 10% Slope). These corridors are generally too narrow to be useful for desert bighorn sheep; however, individuals do move down to the flat alluvial fan areas and there is potential for individuals to find their way into these corridors, get disoriented, and find themselves stuck between the solar facility and I-15, which could then lead to a wildlife–vehicle collision. Similarly, the northern fence boundary and the fencing proposed for the new I-15 wildlife overcrossing structure just to the north will leave a large gap that could encourage desert bighorn sheep to pass through these two fenced areas and then lead to the narrow area between the western project fencing and I-15, leading to a wildlife–vehicle collision.

Minimal project lighting is anticipated and is confined to project buildings situated in the western portion of the site, away from montane desert bighorn sheep habitat and close to existing lighting from I-15. The 2023 BTR includes **MM-BIO-16**, Lighting Specifications to Minimize Bird and Bat Impacts, which calls for minimizing night lighting during construction by using shielded directional lighting that is pointed downward, thereby avoiding illumination of

adjacent natural areas (SWCA 2023). Lighting will be directed internally and away from external habitat; therefore, no long-term indirect impacts due to lighting are anticipated.

Helicopters will not be used for post-construction work or monitoring; therefore, no long-term indirect impacts from helicopter use are anticipated.

The project as proposed is situated closer to occupied habitat than historically recommended by species experts and CDFW. Previous guidance provided by CDFW, beginning in April 2013, recommended a 0.25-mile buffer between the project and the slope hinge point (defined as where the 10% slope angle changes) to minimize indirect effects, mountain habitat avoidance, and possible reduction in gene flow. Appendix C includes a table detailing the history of guidance by CDFW for the project as it pertains to desert bighorn sheep.

Combined fencing and project proximity to key mountain habitat would result in long-term indirect impacts. These impacts would be considered significant without mitigation. With the implementation of recommended measures **APM-BIO-37**, Restriction of Pets; **MM-BIO-6**, Fence Design and Site Permeability, **MM-BIO-22**, Artificial Water Sources; **MM-BIO-23**, Project Footprint Setback; **MM-BIO-24**, Compensatory Mitigation; and **MM-BIO-25**, Mitigation and Monitoring Plan, these impacts would be considered to be less than significant.

7 Recommendations

In addition to a review of relevant literature and location-specific desert bighorn sheep studies, Dudek also reviewed the historical record of proposed project designs, analysis, and feedback regarding this project as it relates to desert bighorn sheep, which is provided in Appendix C. Based on the information provided in this report and the impacts analysis, recommended mitigation and minimization measures are provided in Table 1.

Table 1 provides a summary of recommendations for the proposed project to minimize and mitigate significant impacts to desert bighorn sheep. Several of the recommendations within Table 1 have been previously discussed and recommended by CDFW; however, Table 1 also includes additional recommendations, each of which are discussed in further detail below.

Table 1. Recommended Mitigation and Minimization Measures

Recommendation	Current Mitigation Measure within 2023 BTR	Purpose of Recommendation
Worker Environmental Awareness Program (WEAP) Training	MM-BIO-2	In addition to nine areas currently included within **MM-BIO-2** of the BTR, it is recommended that an additional chapter/section be added to the WEAP training with specific details on desert bighorn sheep.
Biological Monitoring	MM-BIO-4	Biological monitoring should include desert bighorn sheep
Restriction of Pets	APM-BIO-37	It is recommended that a new mitigation measure be added to the BTR using the language found with the CDFW Incidental Take Permit for the project.
Wildlife fencing	MM-BIO-6: Fence Design and Site Permeability	It is recommended that **MM-BIO-6** be revised to include a commitment that project fencing will be tied into the fencing for the proposed wildlife crossing. It is also recommended that the project fencing not be permeable to desert bighorn sheep. Finally, it is recommended that the final project fencing plans be reviewed and approved by CDFW prior to the project breaking ground.
Installation of Water Sources	None	It is recommended that a new mitigation measure be added to the BTR stating the project will commit to the installation of at least five new water sources, with the locations, type, and method of installations to be determined in cooperation with CDFW and BLM. Locations of the new water sources may be installed on public or private lands; however, locations should be within 5 miles of the project boundary.

Table 1. Recommended Mitigation and Minimization Measures

Recommendation	Current Mitigation Measure within 2023 BTR	Purpose of Recommendation
Project Footprint Revision	None	It is recommended that the project footprint be revised to avoid the 0.25-mile buffer from the 10% slope of the surrounding landscape, specifically in the northern array area.
Compensatory Mitigation	None	It is recommended that the desert tortoise compensatory mitigation lands also include forage mitigation lands for desert bighorn sheep. In order to meet this recommendation, the habitat would need to occur within 1 kilometer of occupied habitat or CDFW identified desert bighorn sheep habitat.
Mitigation and Monitoring Plan	None	It is recommended that a mitigation measure be added to the BTR stating the project will create a Mitigation and Monitoring Plan. This plan should commit to monitoring the wildlife crossings, water sources, and all other implemented mitigation measures for a minimum of 8 years with an annual monitoring report provided to CDFW by January 31, with a final report covering the entire monitoring period (i.e., at least 8 years).
Limited Operating Period	None	It is recommended that the project avoid construction activities within 500 meters of occupied habitat during lambing season (i.e., December 1 through June 30) and that no loud, sudden noises (such as pile driving) occur during that period in order to avoid startling sheep.
Wash station/foot bath	None	It is recommended that a wash station and/or footbath be used for all staff entering the project site to ensure no disease transmission from domestic livestock be inadvertently introduced to the project site and surrounding area. For those staff who have/interact with/live near goats, sheep, and other livestock, it is recommended those individuals use separate footwear that remains at the project site.

7.1 Worker Environmental Awareness Program (WEAP) Training (2023 BTR MM-BIO-2)

The Bighorn Sheep Survey Results and Analysis Report, hereafter referred to as the 2013 Bighorn Sheep Report (Panorama 2013), included a Worker Environmental Awareness Program (WEAP) measure as a potential mitigation measure. In response to this report, CDFW provided a letter of comment which included a request for further clarification regarding what was to be included in the WEAP and how the measure would mitigate impacts to desert bighorn sheep. The most recent BTR includes a much more detailed mitigation measure for a WEAP; however, it does not reference desert bighorn sheep. This measure is applicable and should be incorporated with the following underlined modifications to address desert bighorn sheep.

Revised MM-BIO-2: Worker Environmental Awareness Program (WEAP). Prior to project initiation, the Designated Biologist shall develop and implement the WEAP (APM 44), which will be available in English and Spanish. Wallet-sized cards summarizing the information shall be provided to all construction and operation and maintenance personnel. The WEAP shall include the following:

1. An explanation of the sensitivity of the vegetation communities and special-status plant and wildlife species within and adjacent to work areas, and proper identification of these resources.
2. Biology and status of the desert tortoise, golden eagle, burrowing owl, other nesting birds, desert bighorn sheep, kit fox, and American badger and measures to reduce potential effects on these species.
3. Actions and reporting procedures to be used if desert tortoise, burrowing owl, other nesting birds, desert bighorn sheep, kit fox, or American badger are encountered.
4. An explanation of the function of flagging that designates authorized work areas.
5. Driving procedures and techniques to reduce mortality of wildlife on roads.
6. Discussion of the federal ESA and CESA, BGEPA, and MBTA and the consequences of non-compliance with these acts.
7. The importance of avoiding the introduction of invasive weeds onto the project site and surrounding areas.
8. A discussion of general safety protocols such as hazardous substance spill prevention and containment measures and fire prevention and protection measures.
9. A review of mitigation requirements that are applicable to their work.

7.2 Biological Monitoring (2023 BTR MM-BIO-4)

The 2013 Bighorn Sheep Report included a biological monitor measure as a potential mitigation measure (Panorama 2013). In a comment letter, CDFW requested further clarification as to how the measure would mitigate impacts to desert bighorn sheep. The 2023 BTR includes a detailed mitigation measure for biological monitoring; however, it does not reference desert bighorn sheep. This measure is applicable and should be incorporated with the following underlined modifications to address desert bighorn sheep.

Revised MM BIO-4: Biological Monitoring. Biological Monitor(s) shall be employed to assist the Designated Biologist in conducting preconstruction surveys and monitoring ground disturbance, grading, construction, decommissioning, and restoration activities. Additionally, biological monitoring shall be performed during any ground disturbance or grading activities that occur during operation and maintenance. The Biological Monitor(s) shall have sufficient

education and field experience to understand resident wildlife species biology; have experience conducting desert tortoise, burrowing owl, desert bighorn sheep, kit fox, and badger field monitoring; and be able to identify these species and their sign (including active burrows and scat). The Designated Biologist shall submit a resume, at least three references, and contact information for each prospective Biological Monitor to CDFW and USFWS for approval. To avoid and minimize effects on biological resources, the Biological Monitor(s) shall assist the Designated Biologist with the following:

1. Be present during construction activities that take place in suitable habitat for desert tortoise, burrowing owl, kit fox, badger, or other protected species to prevent or minimize harm or injury to these species. This also includes unfenced construction activities for desert bighorn sheep.
2. 2Activities of the Biological Monitor(s) include, but are not limited to, ensuring compliance with all avoidance and minimization measures; monitoring for desert tortoise, burrowing owl, desert bighorn sheep, kit fox, badger, and other protected species; halting construction activity in the area if an individual is found; and checking the staking/flagging of all disturbance areas to be sure that they are intact and that all construction activities are being kept within the staked/flagged limits. If a desert tortoise, burrowing owl, desert bighorn sheep, kit fox, badger, or other protected species is found within a work area, the Biological Monitor(s) shall immediately notify the Designated Biologist, who shall determine measures to be taken to ensure that the individual is not harmed.
3. Inspect the study area for any special-status wildlife species.
4. 4Ensure that potential habitats within the construction zone are not occupied by special-status species (e.g., potential burrows or nests are inspected).
5. 5In the event of the discovery of a non-listed, special-status ground-dwelling animal, recover and relocate the animal to adjacent suitable habitat at least 200 feet from the limits of construction activities.
6. 6At the end of each workday, inspect all potential wildlife pitfalls (e.g., trenches, bores, other excavations) for wildlife and remove wildlife as necessary. If the potential pitfalls will not be immediately backfilled following inspection, the Biological Monitor(s) will ensure that the construction crew slopes the ends of the excavation (3:1 slope), provides wildlife escape ramps, or completely and securely covers the excavation to prevent wildlife entry.
7. Inspect the site to ensure trash and food-related waste is placed in closed-lid containers and that workers do not feed wildlife. Also inspect the work area each day to ensure that no microtrash (e.g., bolts, screws, etc.) is left behind.

7.3 Restriction of Pets (2023 BTR APM-BIO-37)

The 2013 Bighorn Sheep Report included a pet restriction measure as a potential mitigation measure (Panorama 2013); however, in a comment letter, CDFW requested further clarification on the measure as it was written. Per the comment letter from CDFW, “in the current form it suggests pets will be restricted to the project site only – CDFW recommends that pets not be allowed on the project site.” This measure is important, but we recommend the measure be modified significantly to fully protect desert bighorn sheep. Modifications are provided in underline below.

Revised APM BIO-37: *Pets and Domestic Animals:* No pets or domestic animals shall be allowed on-site prior to or during construction, except kit fox scat detection dogs (with CDFW approval) used for preconstruction surveys or postconstruction kit fox mortality monitoring. The project will not authorize the housing or grazing of domestic animals on the project site.

Feeding Animals: Feeding of animals will be prohibited to discourage the spread of non-native birds, to discourage the spread of disease and pathogens, etc.

7.4 Fence Design and Site Permeability (2023 BTR MM BIO-6)

The 2013 Bighorn Sheep Report included a wildlife fencing potential mitigation measure that required the project to "use wildlife fencing to direct [desert] bighorn sheep towards underpasses for safe crossing of I-15." The comment letter from CDFW stated that opportunities for desert bighorn sheep to access and move through existing underpasses must not be hindered by the project. CDFW also commented that the design of the wildlife fencing being proposed by the project was not clear and requested the Applicant provide additional details with respect to the wildlife fence design. Recently, Brightline West, Caltrans, and CDFW entered into an agreement to construct the I-15 Mojave Wildlife Crossings.

As identified above, fencing plan modifications should occur to prevent desert bighorn sheep from possible wildlife-vehicle collisions. Studies performed by Arizona Department of Transportation and others determined that fencing should be 2 meters–2.5 meters to effectively prevent 91%–100% of desert bighorn sheep from crossing over them (for review see Figure 19 and 20 in Huijser et al. 2015).

This measure is applicable to the project and should be incorporated with the following underlined modifications to address desert bighorn sheep.

Revised MM BIO-6: Fence Design and Site Permeability. Fences installed around the proposed project should be designed to allow for the passage of wildlife. Depending on the fencing material, the bottom of the fence line should have gaps of approximately 4 to 6 inches and knuckled back to create a smooth edge. Alternate designs may also be constructed with prior written approval from CDFW and USFWS. Regardless, the project shall ensure that any such fence meets existing specifications that have been developed to preclude accidental entanglement of desert bighorn sheep, deer, and other animals.

Fencing – sufficient to prevent desert bighorn sheep passage (e.g., 2m-2.5m tall chain-link) – should be installed at the corridor entrances between (a) the East Array and South Array 1, (b) South Array 1 and South Array 2, and (c) South Array 2 and South Array 3 on the east side (Figure 2, Project Design). Gaps of approximately 4 to 6 inches should occur at the bottom of the fence to allow small wildlife, mesocarnivores, coyote and American badger to pass under. Additionally, the project shall extend a line of project fencing to the north to connect with the wildlife exclusion fencing associated with the I-15 overcrossing structure (Figure 13, Fencing Plans of the Desert Bighorn Sheep Study). Approximately 1,640 linear feet of this can be accomplished within the existing project boundary, but the additional approximately 300 linear feet will need to be coordinated with BLM and possibly Caltrans. The project will secure the necessary encroachment permits or other mechanism to continue fencing between the project boundary and the wildlife exclusion fencing associated with the I-15 overcrossing structure. Care should be taken when connecting the fences to make sure that they are physically connected or directly abut one another such that

wildlife can't pass through or get stuck between them. The ultimate fencing plans should be reviewed by CDFW for final approval prior to site disturbance activities.

7.5 Installation of Artificial Water Sources

In the comment letter from CDFW regarding the 2013 Bighorn Sheep Report, CDFW wrote that the proposed single water source, one on each side of I-15, was inadequate and that multiple water sources were necessary to encourage use by desert bighorn sheep on a year-round basis in the south end of the north Soda Mountains, as well as to encourage the desert bighorn sheep to use existing culverts and potential future wildlife overpasses. Specifically, CDFW recommended the development of six water sources. The BLM's Record of Decision included MM 3.4-3a, which stated the Applicant/Owner of the project was to provide funding to install three to five artificial water sources in north Soda/Avawatz Mtns and provide funding to refill them through the life of the project.

The need to add artificial water structures in and around the project site has been recommended throughout the project proposal period and for previous project iterations. As such, it is recommended that a new mitigation measure be included that requires the installation of five new artificial water structures.

Recommended New MM-BIO-22. Artificial Water Sources: The project will design and install at least five new artificial water sources for desert bighorn sheep to use. The location, design, and method of installations will be determined in cooperation with CDFW and BLM and the ultimate plan will be approved by CDFW and BLM. The locations may be on private or public lands but must be located within 5 miles of the project boundary to mitigate this metapopulation. Because the I-15 wildlife overcrossing will be installed adjacent to the site, water structure installations should occur on both sides on I-15 with a possible preference for one proximate to the overcrossing structure. The project shall establish a non-wasting endowment to monitor and maintain the water features in perpetuity.

7.6 Project Footprint Revision

In the comment letter from CDFW regarding the 2013 Bighorn Sheep Report, CDFW stated that a wildlife bridge location had been identified and that the project footprint would preclude the desert bighorn sheep access to this future wildlife bridge. In addition, CDFW commented that the project reduces the desert bighorn sheep access to foraging habitat and escape terrain. CDFW recommended placing the project perimeter fencing 0.25 miles from the 10% slope. In August 2016, CDFW met with the project team. The current project includes several areas where the project encroaches within this 0.25-mile buffer from the 10% slope hinge point (Figure 12), but primarily within the East Array which is most proximate to the new I-15 wildlife overcrossing. This recommended mitigation measure would require reconfiguring project components to adhere to that setback.

Recommended New MM-BIO-23. Project Footprint Setback: Prior to project approval, the project will reconfigure the East Array alignment to stay outside of the 0.25-mile setback. This includes fencing and permanent infrastructure (e.g., roads). Smaller currently proposed (Figure 12) encroachments may remain with the exception of the fencing intrusion between South Array 1 and South Array 2. Solar arrays lost during the reconfiguration of East Array may be added elsewhere so long as they do not additionally encroach upon the setback. This only applies to setbacks originating east of I-15.

7.7 Compensatory Mitigation

The project creates potentially significant impacts to desert bighorn sheep foraging habitat. Currently, **MM-BIO-12** requires 1:1 compensatory mitigation for desert tortoise habitat. Due to the overlap in value between desert tortoise habitat and desert bighorn sheep foraging habitat in certain locations, this measure will ensure that this compensatory mitigation is also meaningful to foraging desert bighorn sheep.

Recommended New MM-BIO-24. Compensatory Mitigation: If **MM-BIO-12** (Desert Tortoise Compensatory Mitigation) is adhered to and occurs within approximately 1 kilometer of desert bighorn sheep-occupied or CDFW-identified/modeled desert bighorn sheep habitat, then no additional compensatory habitat mitigation would be required as the acquired habitat would also satisfy the foraging needs of desert bighorn sheep. However, if the mitigation lands acquired for **MM-BIO-12** do not satisfy this requirement, then separate compensatory mitigation for loss of desert bighorn sheep foraging habitat (i.e., all lands east of I-15 that are fenced in) at a 1:1 ratio meeting all of the other requirements (i.e., requirements for acquisition, initial improvement, and long-term management of compensation lands) and protections afforded under **MM-BIO-12** will be required.

7.8 Desert Bighorn Sheep Mitigation and Monitoring Plan

In response to the 2013 Bighorn Sheep Report, CDFW commented that in addition to the proposed mitigation measures, future wildlife bridges, water sources, and all other implemented mitigation measures should be monitored for a minimum of 8 years. It is important to monitor the effectiveness of the desert bighorn sheep mitigation measures. Previous analysis and attached mitigation measures required the project to assist with the planning of a wildlife crossing structure in this vicinity. Since this has been accomplished by the Brightline project in coordination with Caltrans and CDFW, it is appropriate that this project still contribute to the overall effectiveness monitoring as it relates to this project's effects on desert bighorn sheep. Particularly because this project may have an effect on the actual effectiveness of the overcrossing structure due to the project's proximity. Therefore, the addition of a Mitigation Monitoring Plan is necessary.

Recommended New MM-BIO-25. Mitigation and Monitoring Plan: Prior to site disturbance, the project will prepare a desert bighorn sheep mitigation and monitoring plan. The plan will be approved by CDFW and BLM. This plan will require monitoring of wildlife crossings, fencing effectiveness, water sources, and all other implemented mitigation measures for a minimum of 8 years with an annual monitoring report provided to CDFW by January 31, and a final report covering the entire monitoring period (i.e., at least 8 years) by January 31st of the final year. Components of this requirement may be modified if already covered by other monitoring efforts (e.g., Brightline, Caltrans). The plan will include the methods for monitoring, identify what is being monitored, identify the goals of the measures, methods for determining the effectiveness of the measures, and remedial triggers and measures if the mitigation does not meet the goals.

7.9 Limited Operating Period

As discussed above, loud noises—particularly brief and unexpected noises—may cause harm to desert bighorn sheep and particularly lambs. The following mitigation measure is intended to minimize that potential.

Recommended New MM-BIO-26. Limited Operating Period: Noises greater than 85 A-weighted decibels (dBA) maximum sound level (L_{max}) will not be allowed within 500 meters of the hinge point (10% slope line) between December 1 and June 30. If loud work must occur, even briefly, then the project must get CDFW concurrence that

the desert bighorn sheep lambing period is done or verify, in coordination with CDFW, that there are no desert bighorn sheep on the facing slope within a distance that would be expected to be subject to an 85 dBA L_{max} sound level. If the project believes that they may need to ultimately perform loud work during the lambing period, then they shall coordinate with CDFW early (i.e., ideally as soon as possible, but minimally before the lambing period) to determine how much additional desert bighorn sheep-specific monitoring will be needed for CDFW to evaluate whether the request is feasible. Simply monitoring a week or two in advance will not provide enough data to perform the evaluation.

7.10 Wash Station/Foot Bath

As discussed above, there are concerns regarding the potential for disease to infect the resident desert bighorn sheep population. The following measure is intended to minimize that potential.

Recommended New MM-BIO-27. Work Boot Decontamination: All construction personnel will be trained on the importance of and procedures for decontaminating boots to prevent transmission of disease from domesticated sheep and goats to desert bighorn sheep. In addition, all quarry workers who have potential contact with domesticated sheep and/or goats (for example at farms, fairs, etc.) will be identified and shall decontaminate work boots prior to entering the project area. Decontamination shall involve scrubbing the soles of work boots with a 10% bleach solution to remove all organic matter and kill pathogens. Alternatively, footwear may be changed to ensure that potentially contaminated footwear does not enter any quarry area.

8 Conclusion

The project applicant revised the footprint to avoid impacts to mountainous portions of the site by constructing within the flat areas between the South Soda Mountains and I-15. However, the current project design still directly abuts occupied areas and incurs into the recommended 0.25-mile buffer from the 10% slope hinge point. This is near a critical location where work is already underway to construct an overcrossing structure to connect the population south of I-15 with habitat and populations north of I-15. This overcrossing structure is designed to re-establish key and critical genetic connections. These flatter areas also provide foraging habitat to desert bighorn sheep during the winter periods and may be very important for certain segments of the population or during drought years. Telemetry data were collected for a subset of the population and may not adequately indicate landscape usage for the entire population or during drought conditions.

While human activity does currently occur within the vicinity of this population of desert bighorn sheep, and telemetered desert bighorn sheep primarily use the steeper sloped areas, the project will place a novel facility next to well-occupied desert bighorn sheep habitat, introduce new containing fencing, and introduce potential direct and indirect stressors to the population. These changes might exacerbate the desert bighorn sheep's susceptibility to disease, cause distraction that may cause harm to lambs or make them more likely to be predated upon, cause habitat use shifts that may affect vigor or population numbers, and other effects.

However, through the implementation of several revised and new mitigation measures as outlined in Section 7, it is anticipated that impacts to desert bighorn sheep will be reduced to less than significant.

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9 Acknowledgments

Contributors to this document include Sarah Greely, biologist; Meghan Martin, PhD, biologist; Mark McGinnis, GIS lead; and Brock Ortega, senior wildlife biologist.

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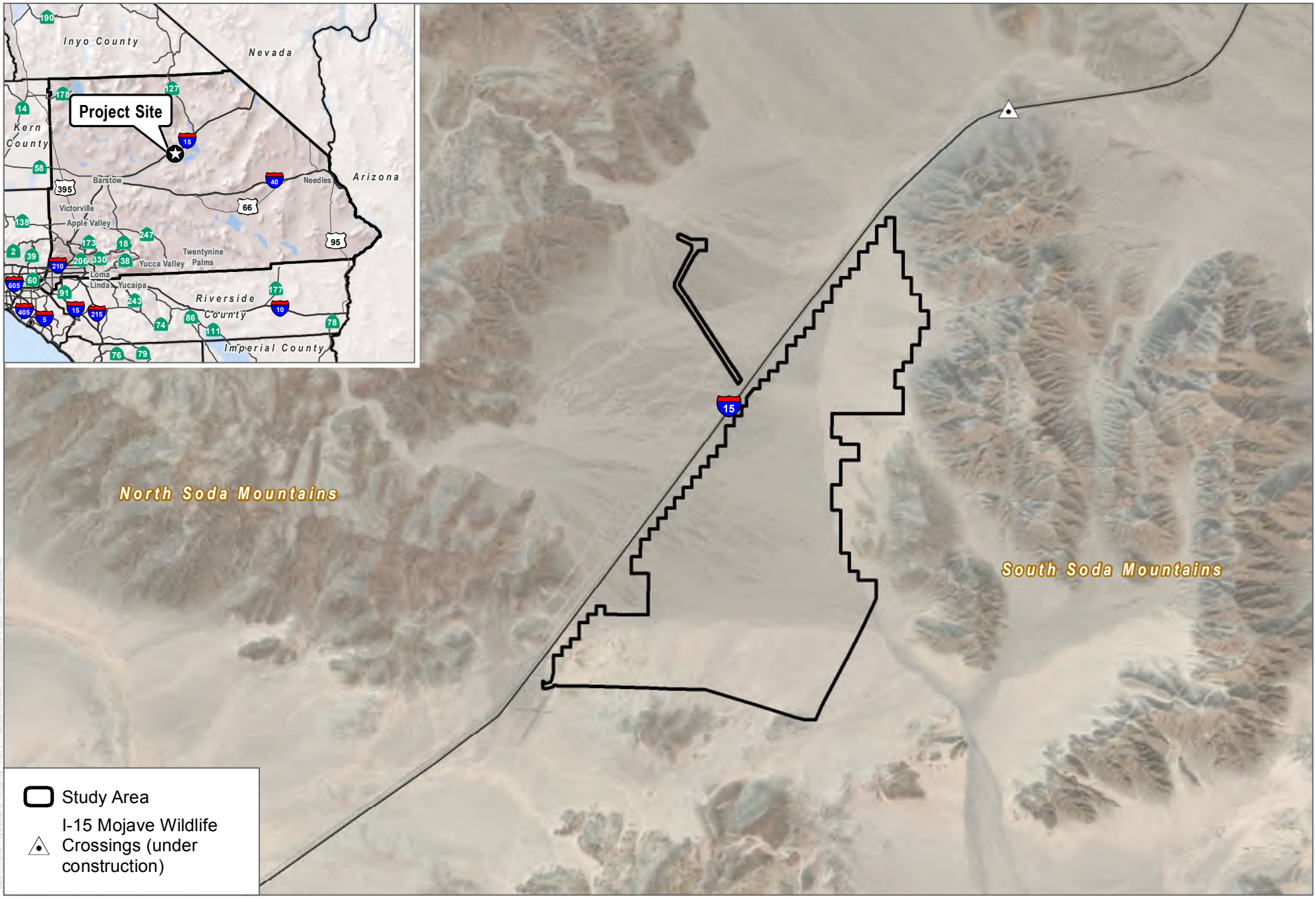
Appendix A
Figures



SOURCE: ESRI 2023

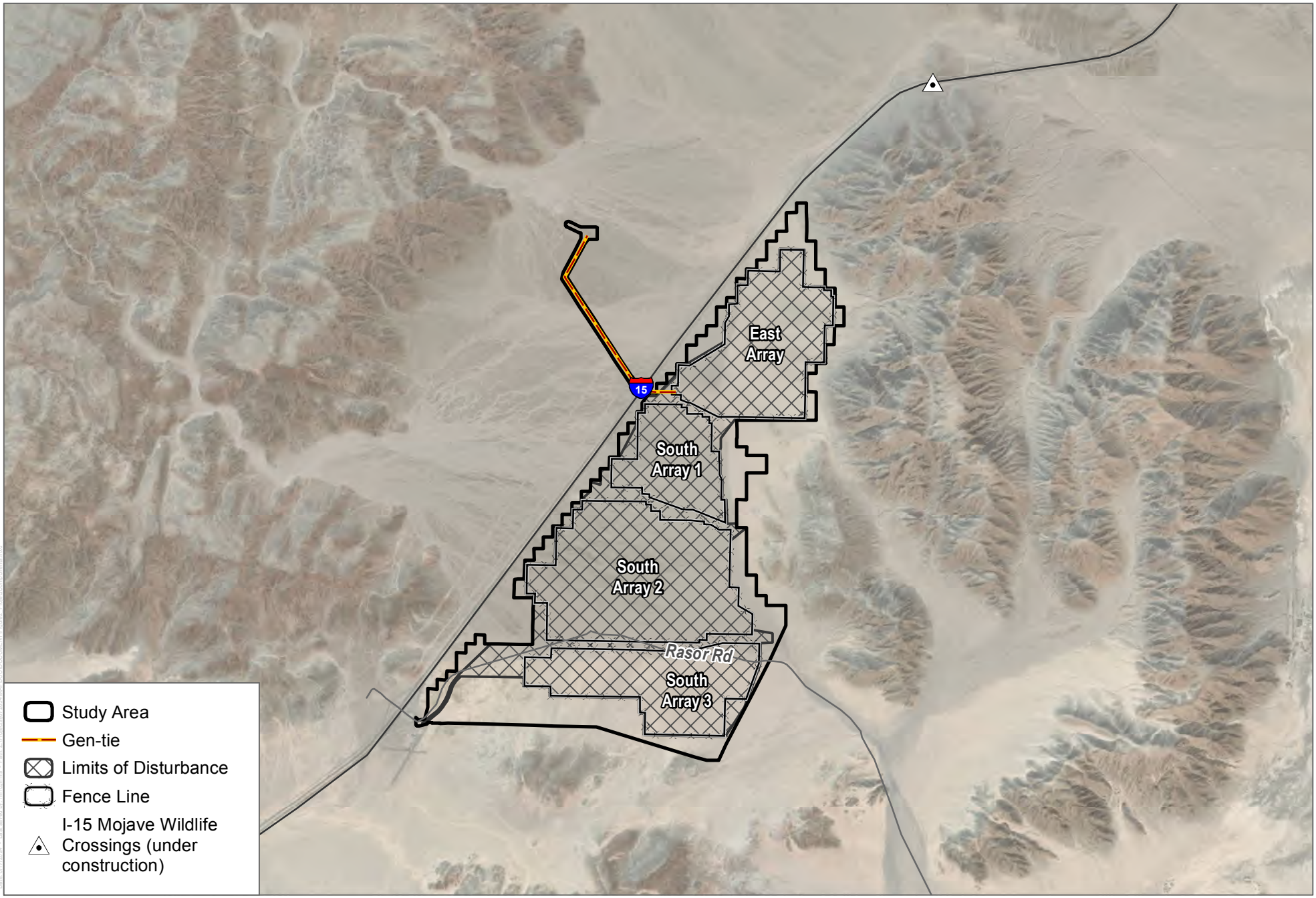
DUDEK

0 2,500 5,000 Feet

FIGURE 1

Project Location

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023

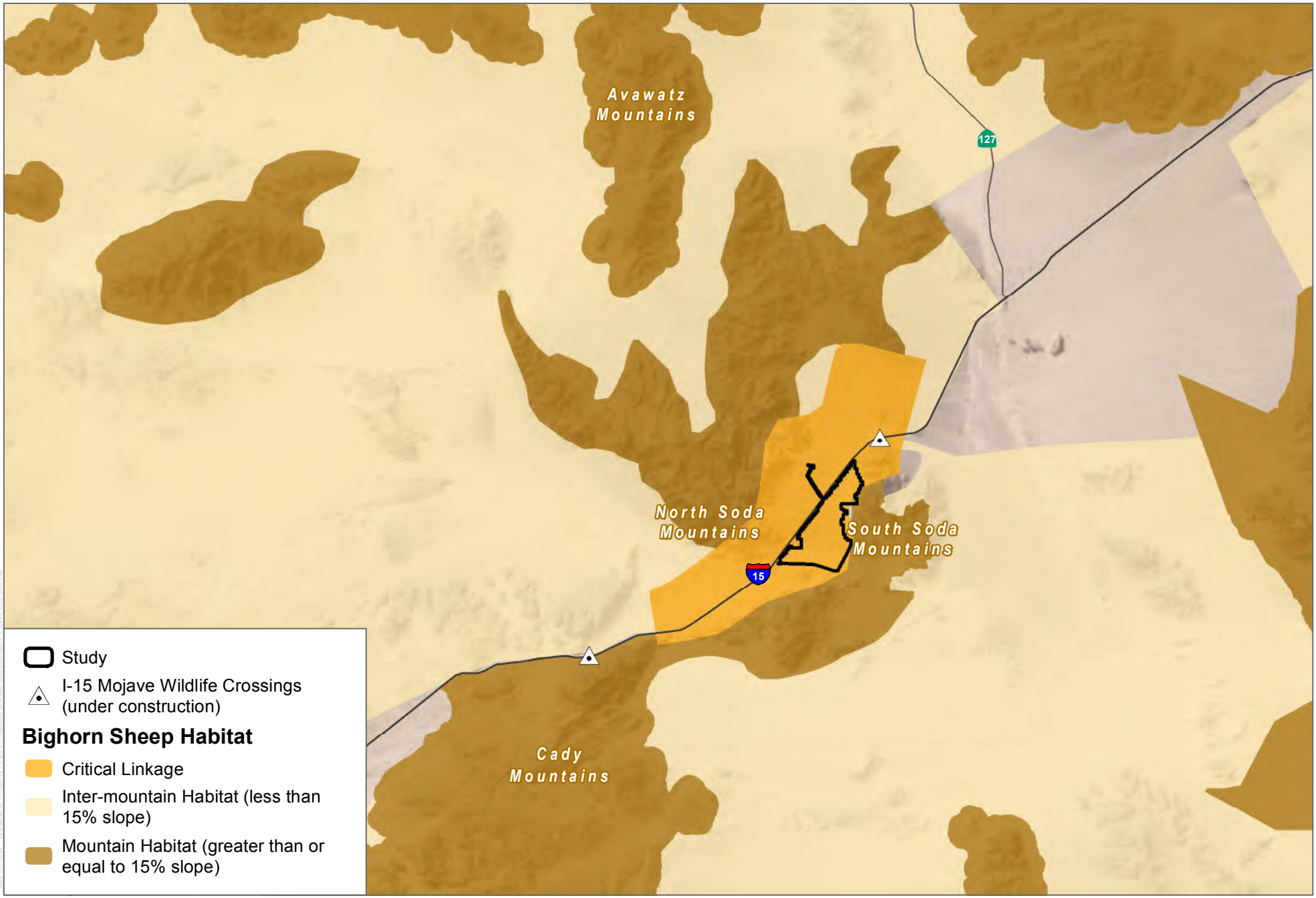
DUDEK

0 2,250 4,500 Feet

FIGURE 2

Project Design

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; CEC 2012

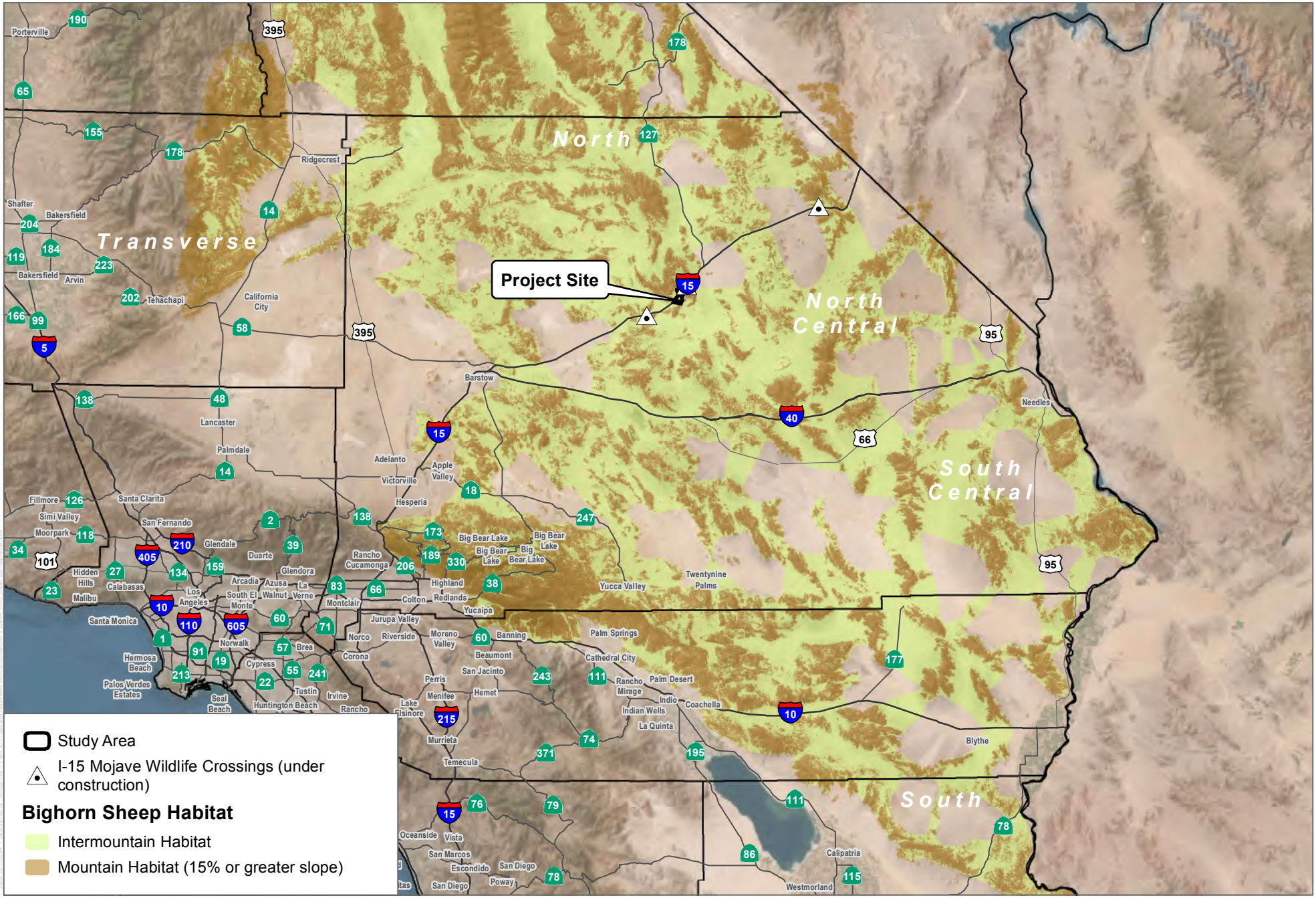
DUDEK

0 11,500 23,000 Feet

FIGURE 3

Bighorn Sheep Terrain

Bighorn Sheep Study for the Soda Mountain Solar Project



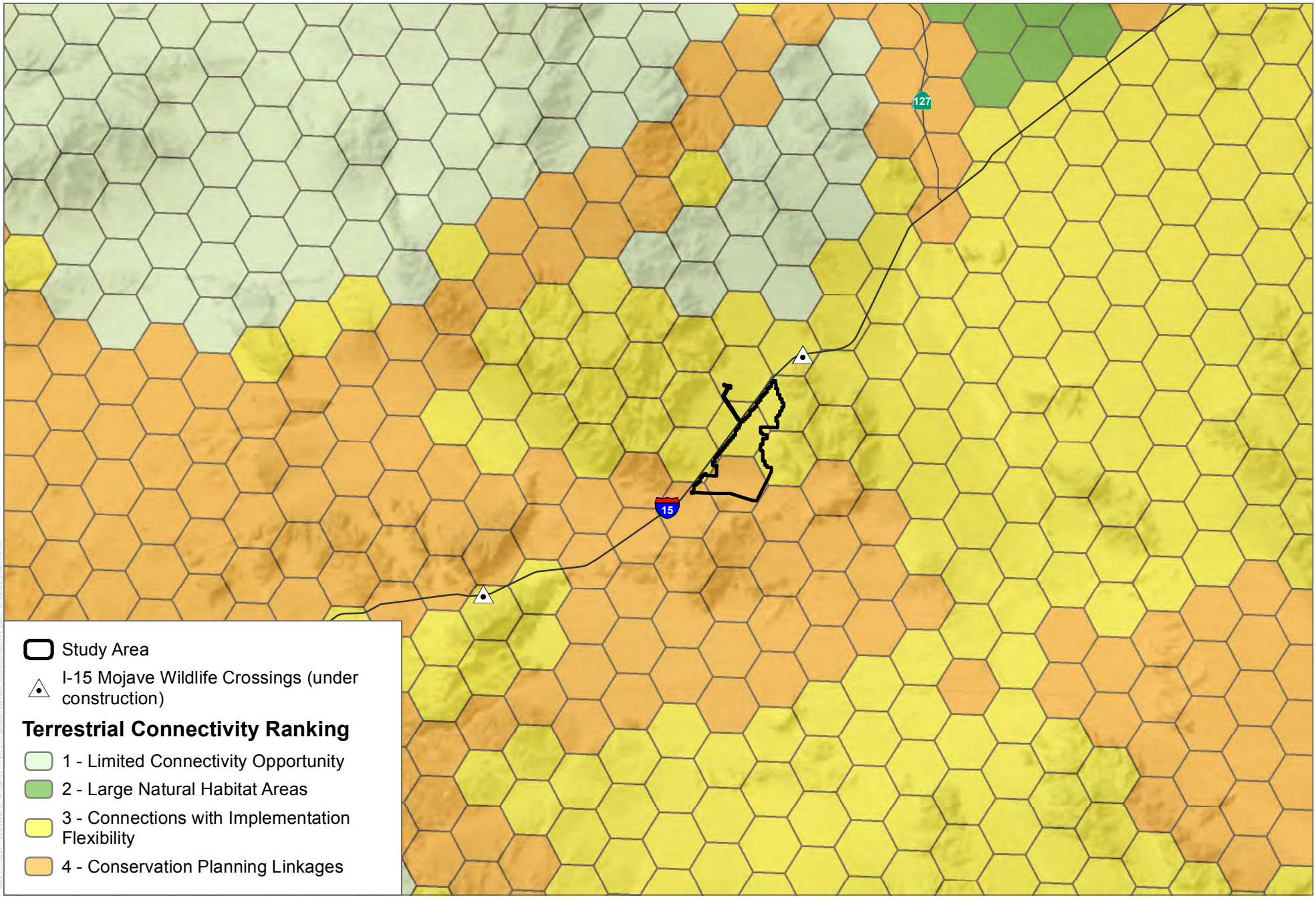
SOURCE: ESRI 2023; CDFW 2012

DUDEK

FIGURE 4

Desert Bighorn Sheep Metapopulation Fragments and Populations in California

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; CDFW 2019

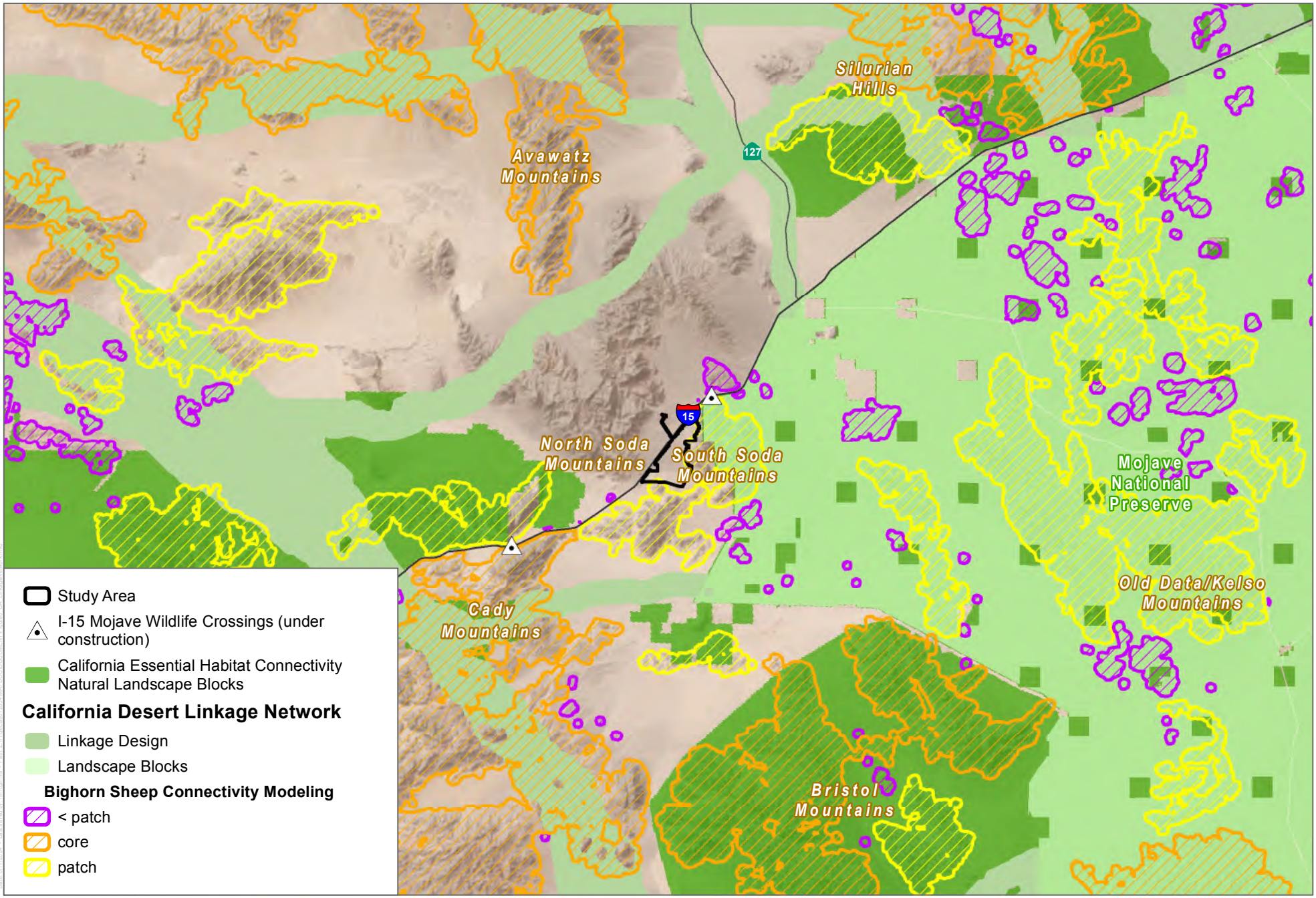
DUDEK

0 10,500 21,000 Feet

FIGURE 5

Terrestrial Connectivity Map

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; Penrod 2012; Spencer 2010

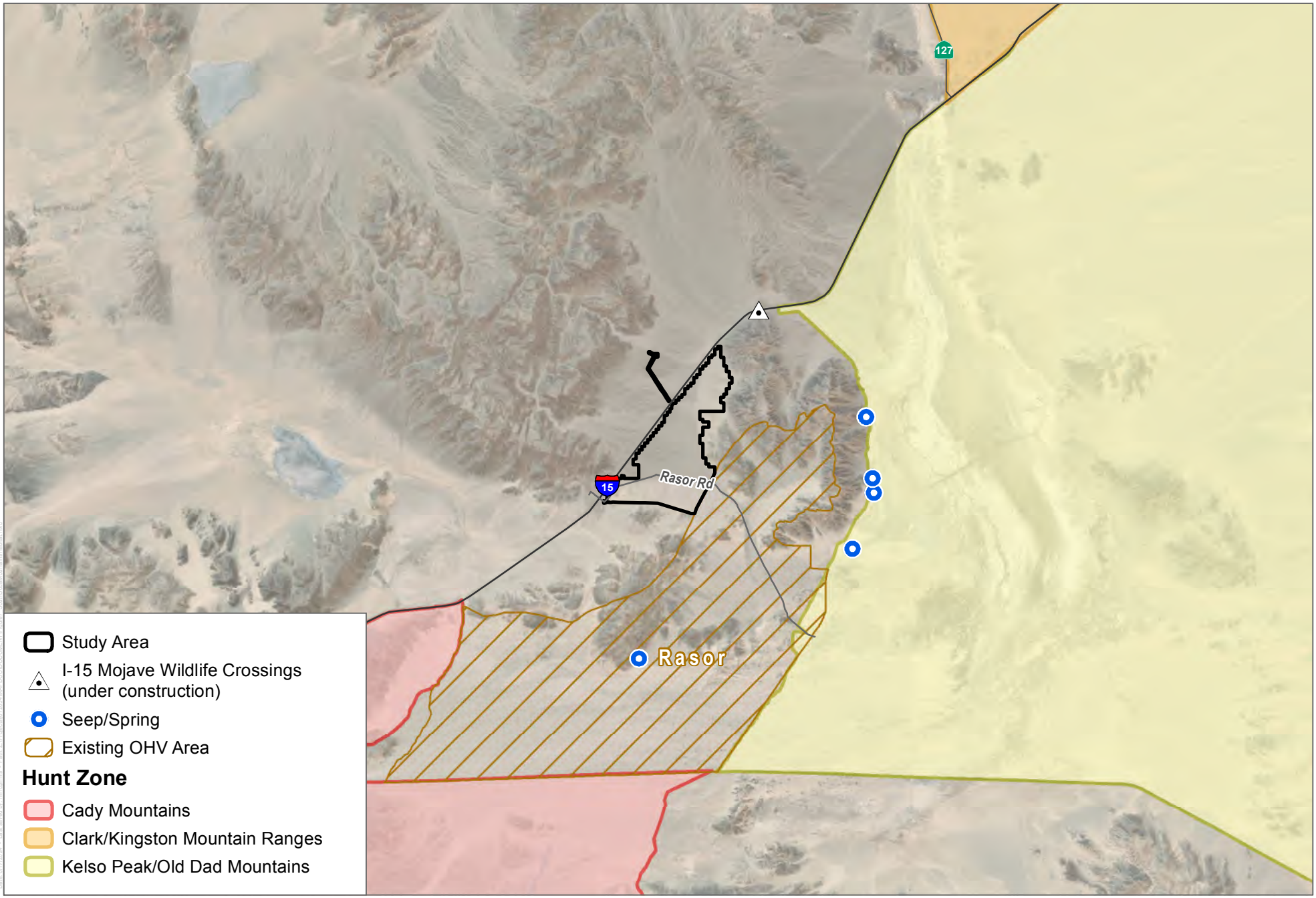
DUDEK

0 16,500 33,000 Feet

FIGURE 6

Wildlife Linkage and Connectivity Modeling

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024

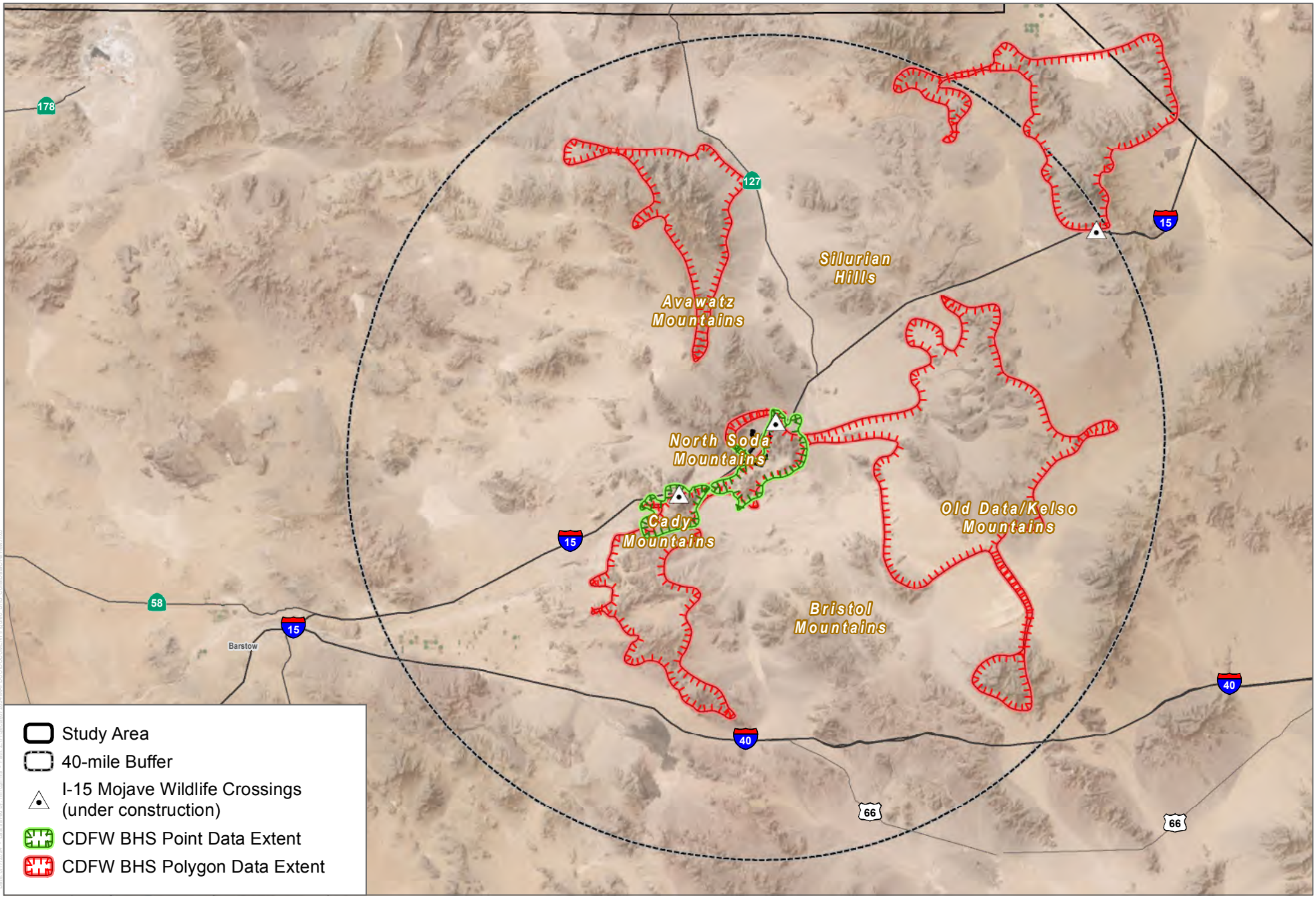
DUDEK

0 7,500 15,000 Feet

FIGURE 7

Recreational Access in Project Vicinity

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; CDFW 2023

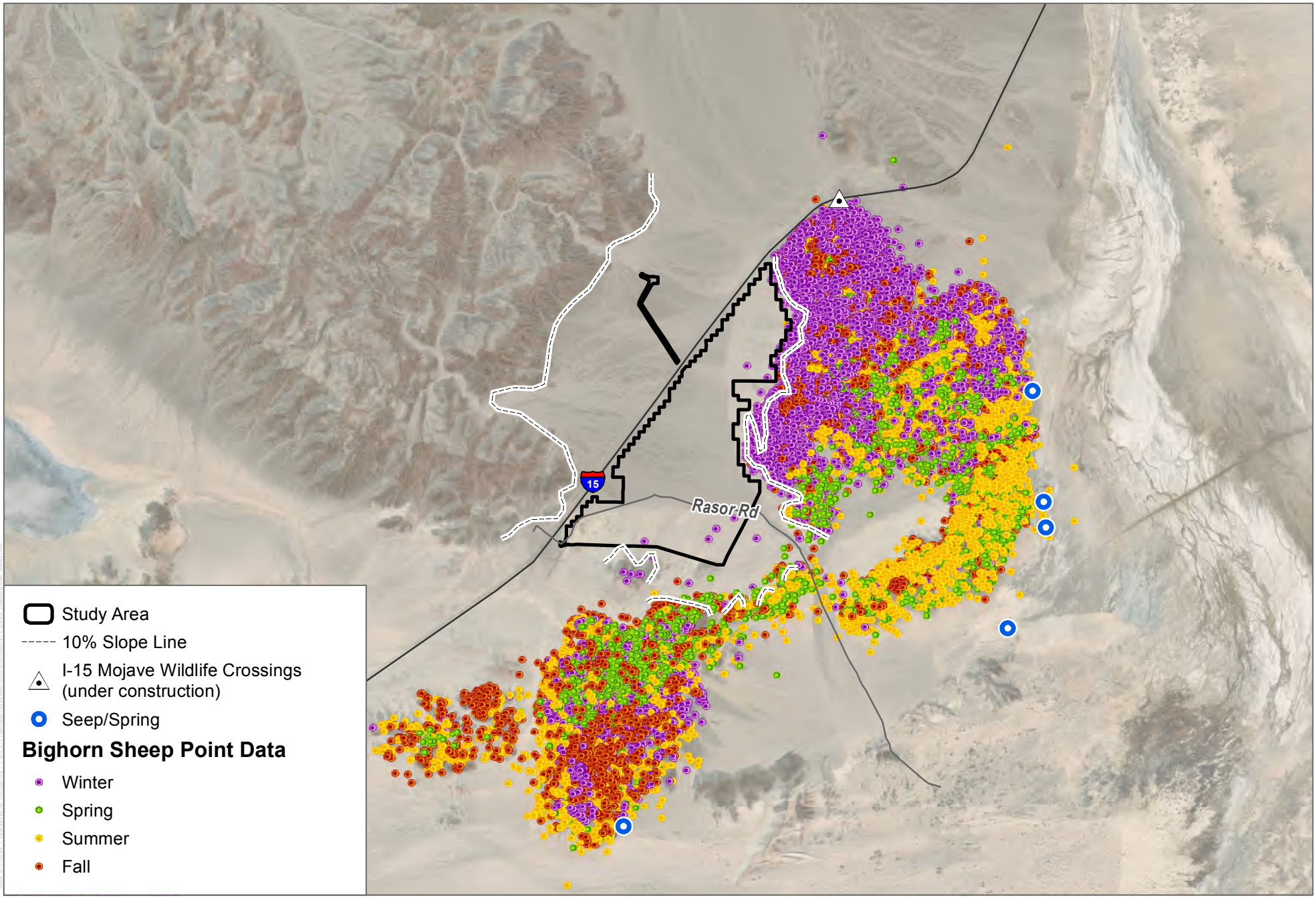
DUDEK

0 35,000 70,000 Feet

FIGURE 8

Bighorn Sheep Collar Data Overview Map

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

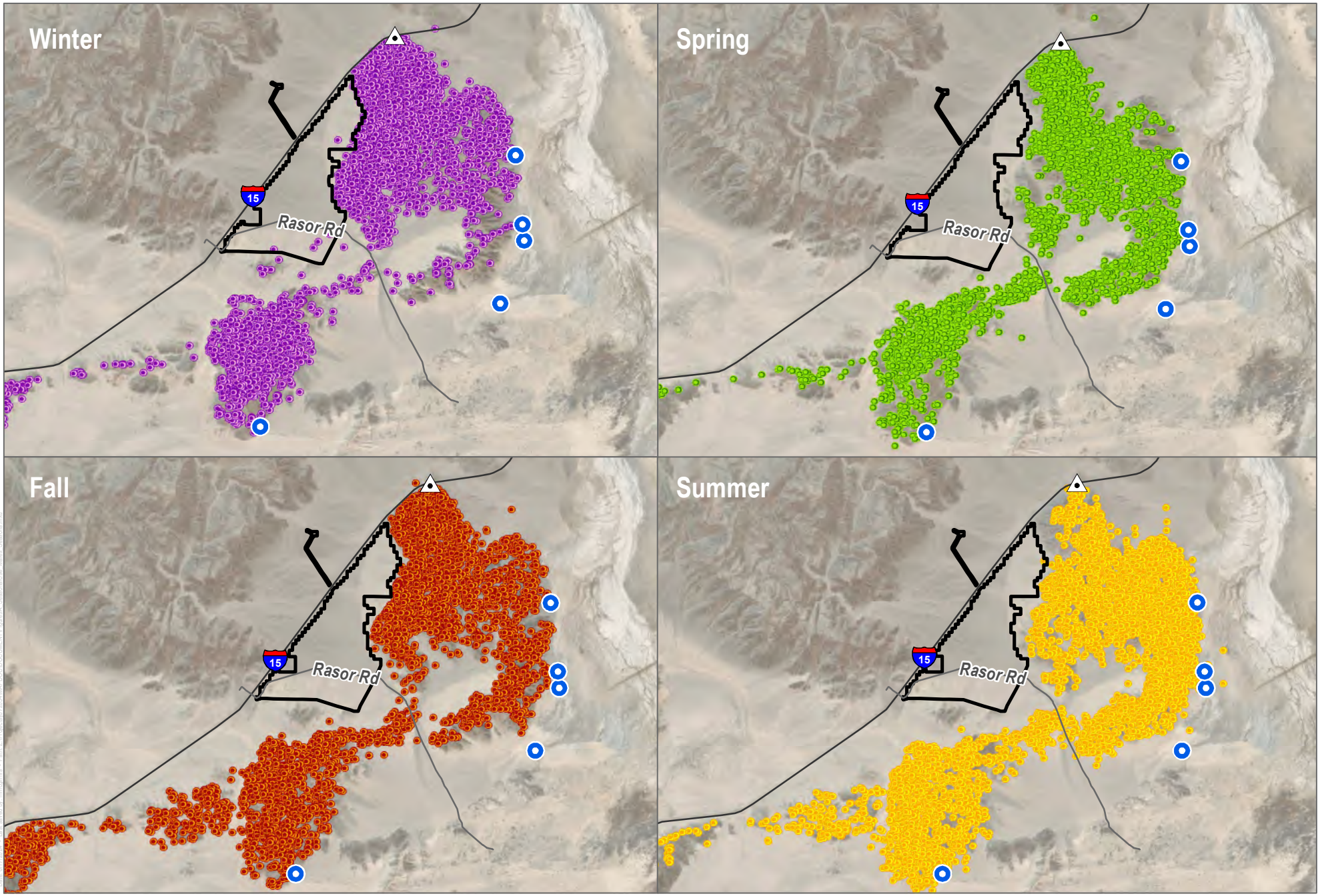
DUDEK

0 4,200 8,400 Feet

FIGURE 9

Seasonal Use of Habitat by Males

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

Study Area

I-15 Mojave Wildlife Crossings (under construction)

Seep/Spring

Bighorn Sheep Point Data

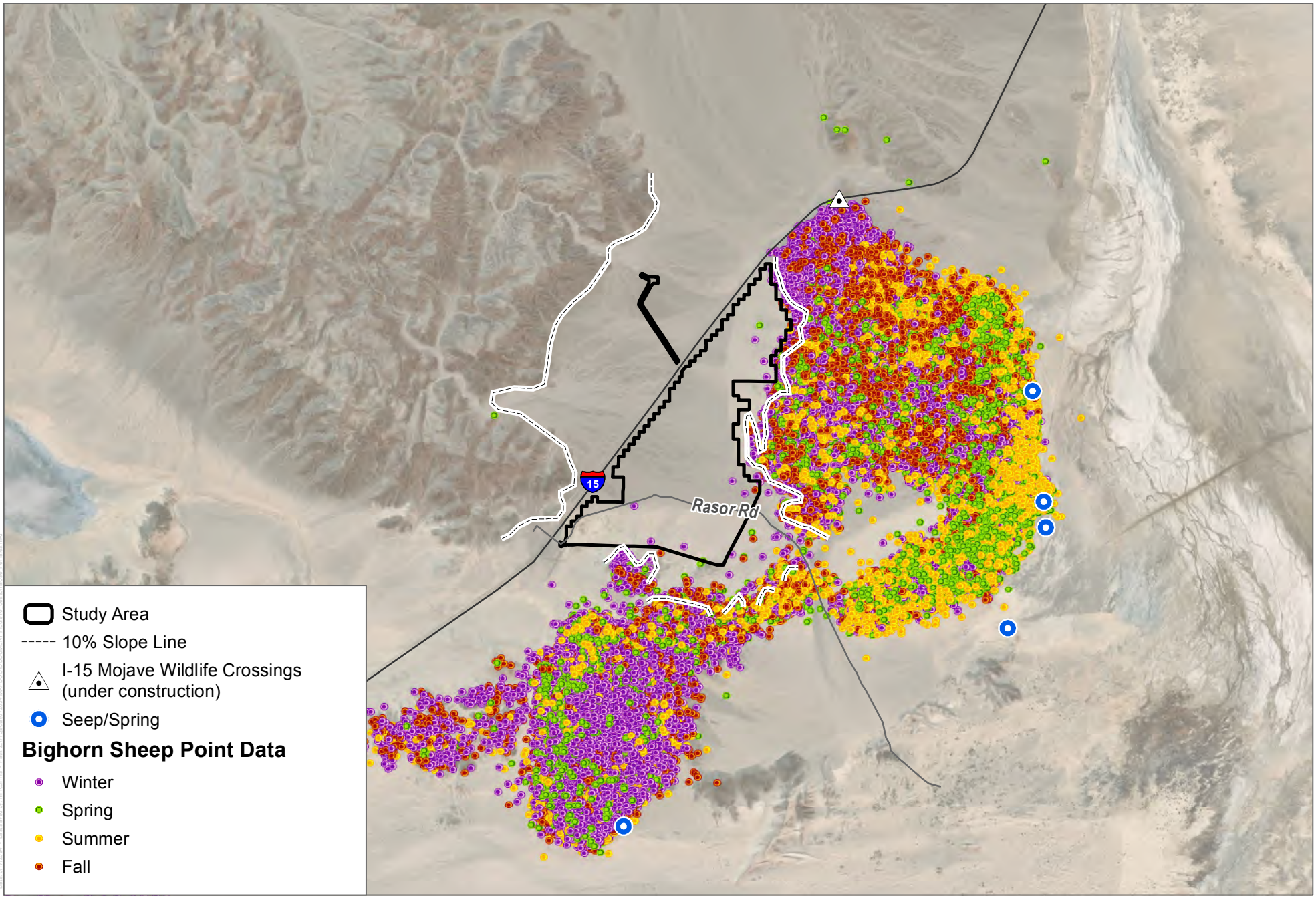
- Winter
- Spring
- Summer
- Fall

0 6,500 13,000 Feet

FIGURE 9A

Seasonal Use of Habitat by Males

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

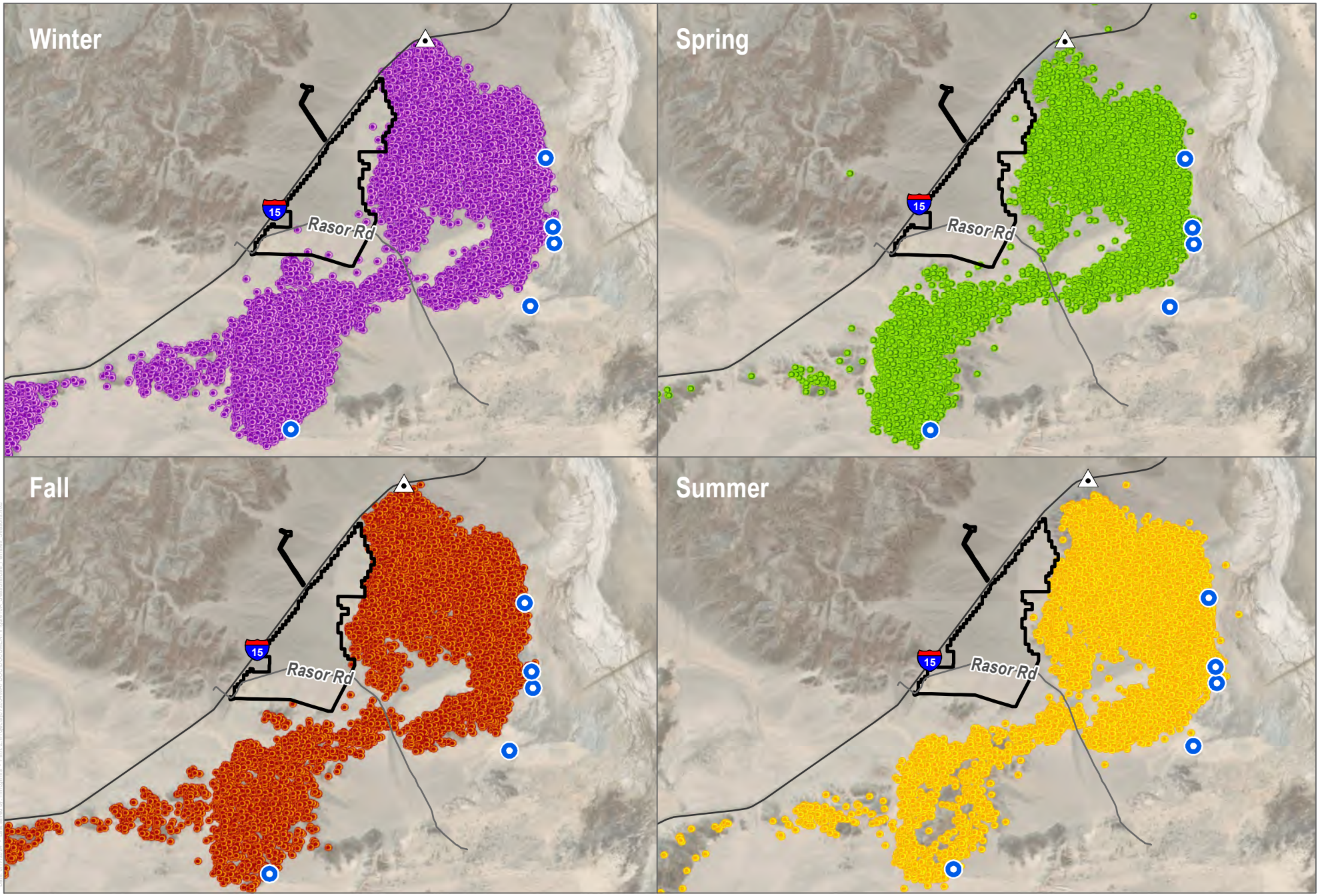
DUDEK

0 4,200 8,400 Feet

FIGURE 10

Seasonal Use of Habitat by Females

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

Study
I-15 Mojave Wildlife Crossings (under construction)
Seep/Spring

Bighorn Sheep Point Data
Winter
Spring
Summer
Fall

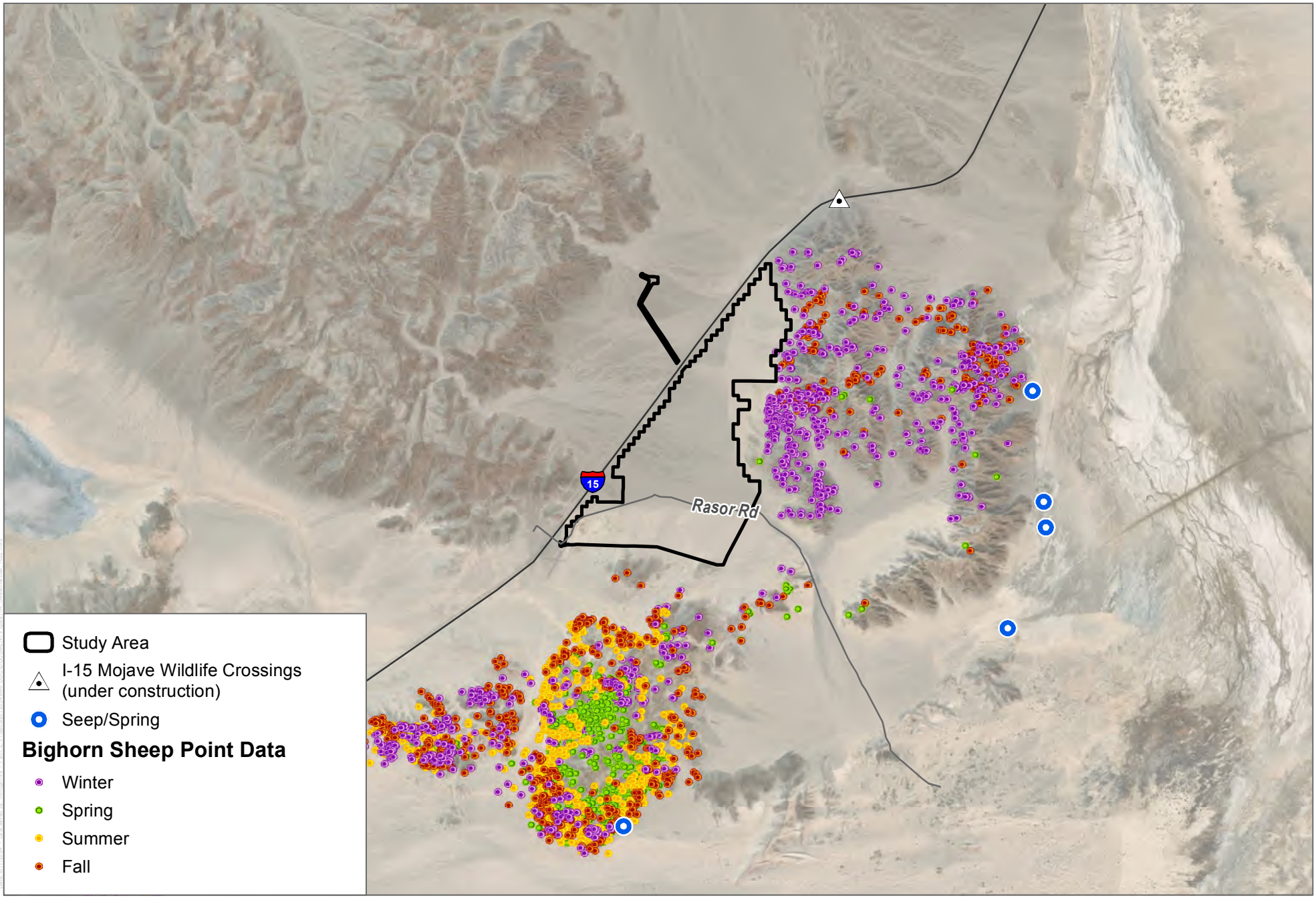
DUDEK

0 6,500 13,000 Feet

FIGURE 10A

Seasonal Use of Habitat by Females

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

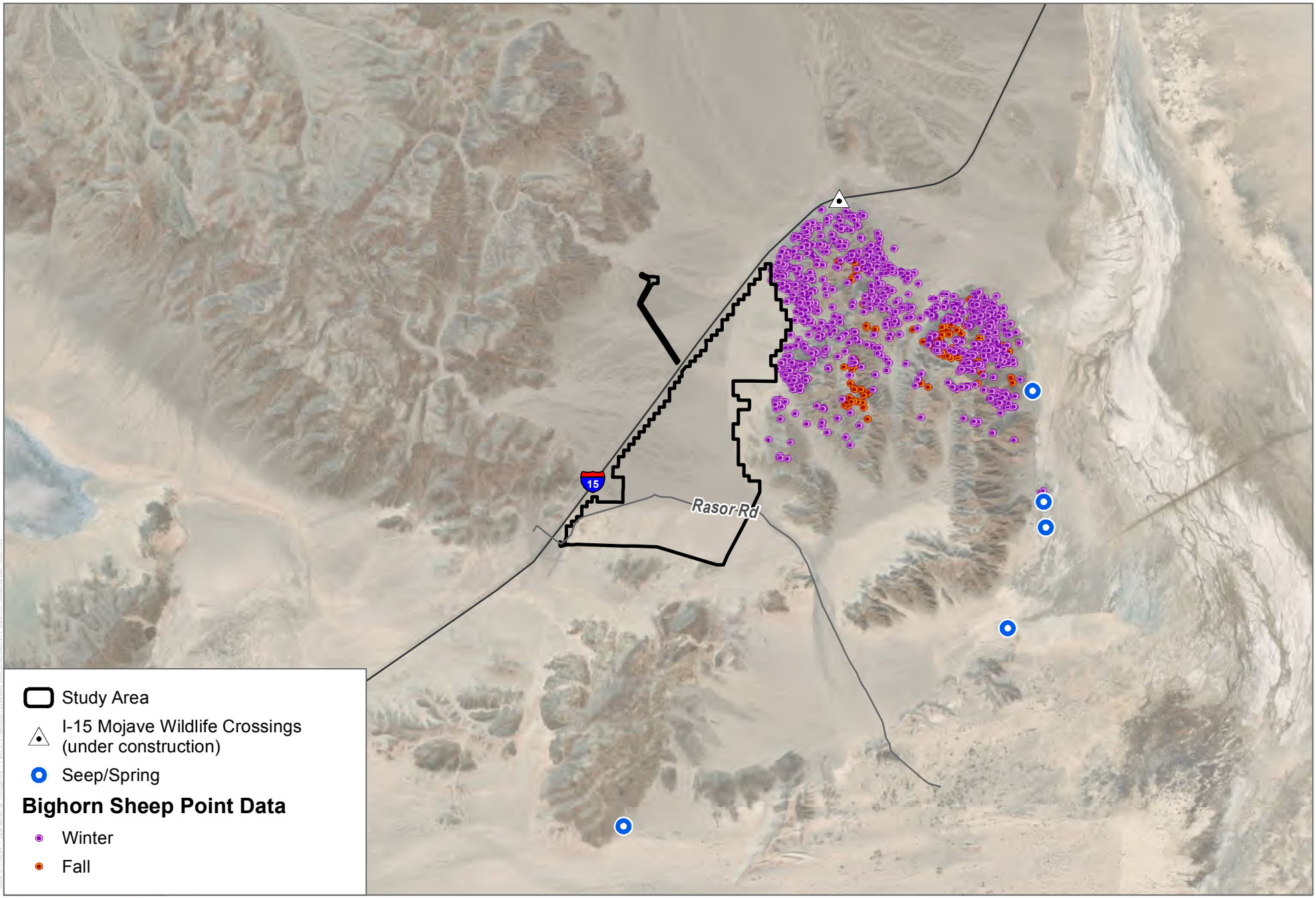
DUDEK

0 4,200 8,400 Feet

FIGURE 11A

Individual Bighorn Sheep Habitat Use Maps - ID 1822

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

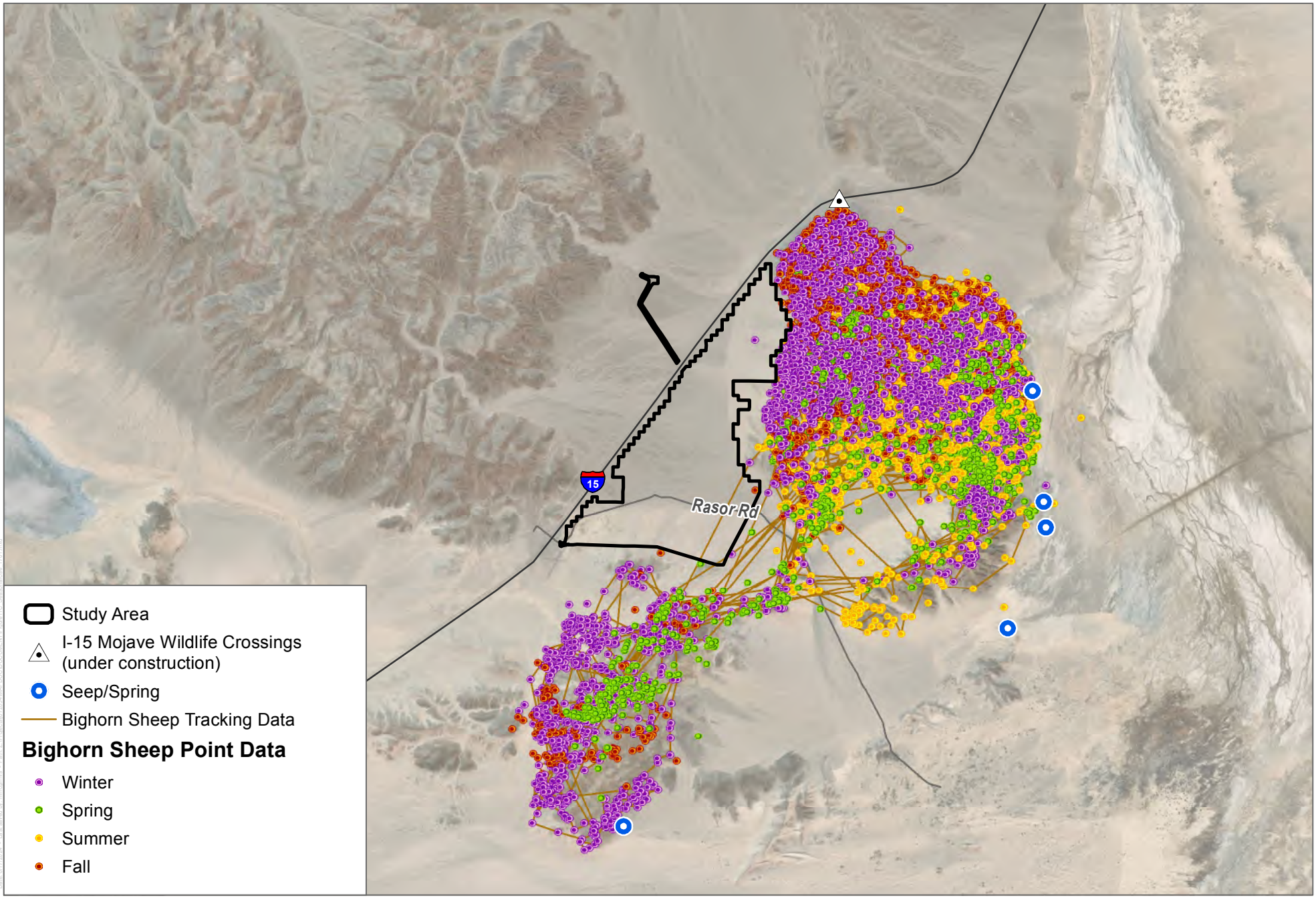
DUDEK

0 4,200 8,400 Feet

FIGURE 11B

Individual Bighorn Sheep Habitat Use Maps - ID 1826

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

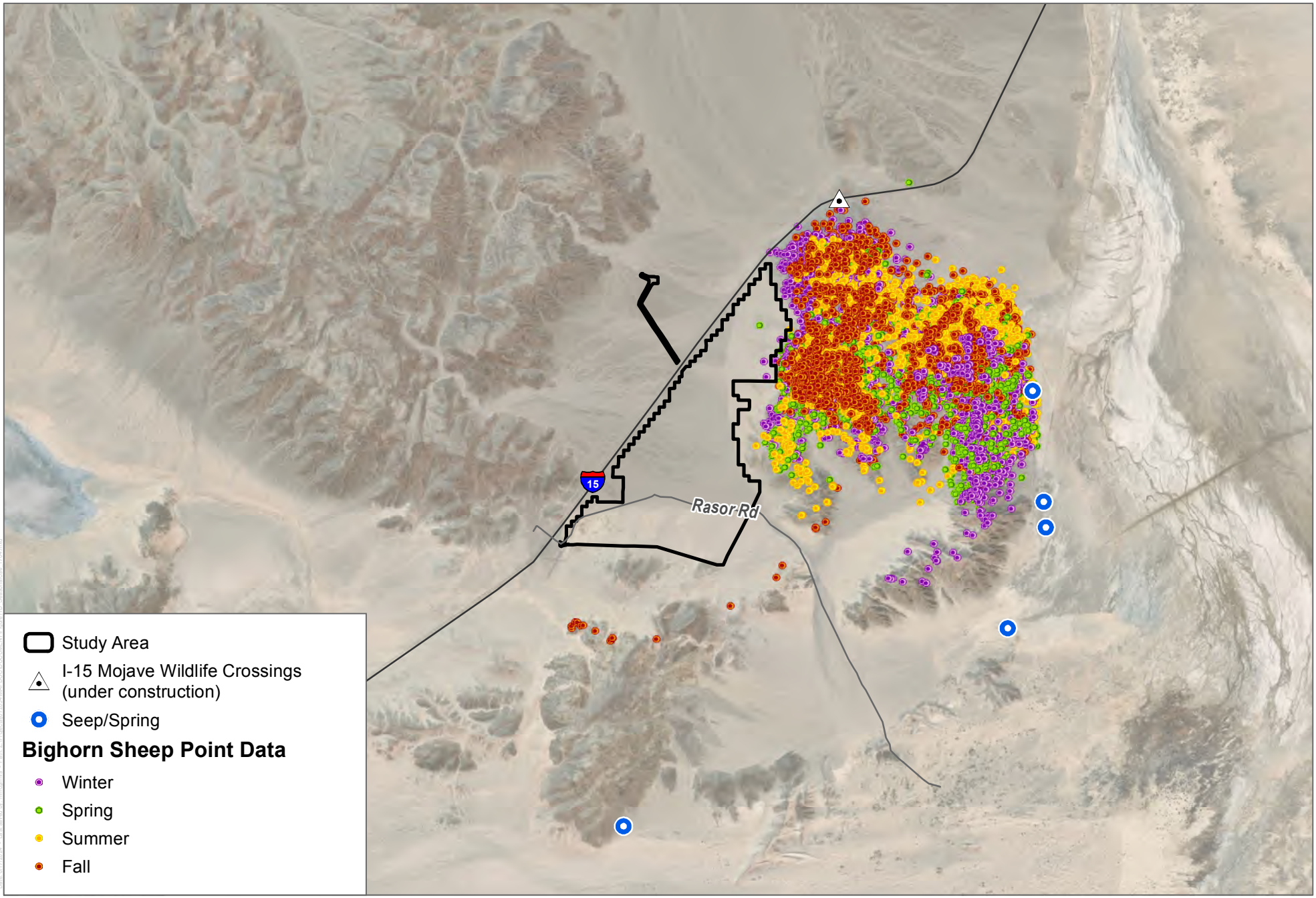
DUDEK

0 4,200 8,400 Feet

FIGURE 11C

Individual Bighorn Sheep Habitat Use Maps - ID 1701

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

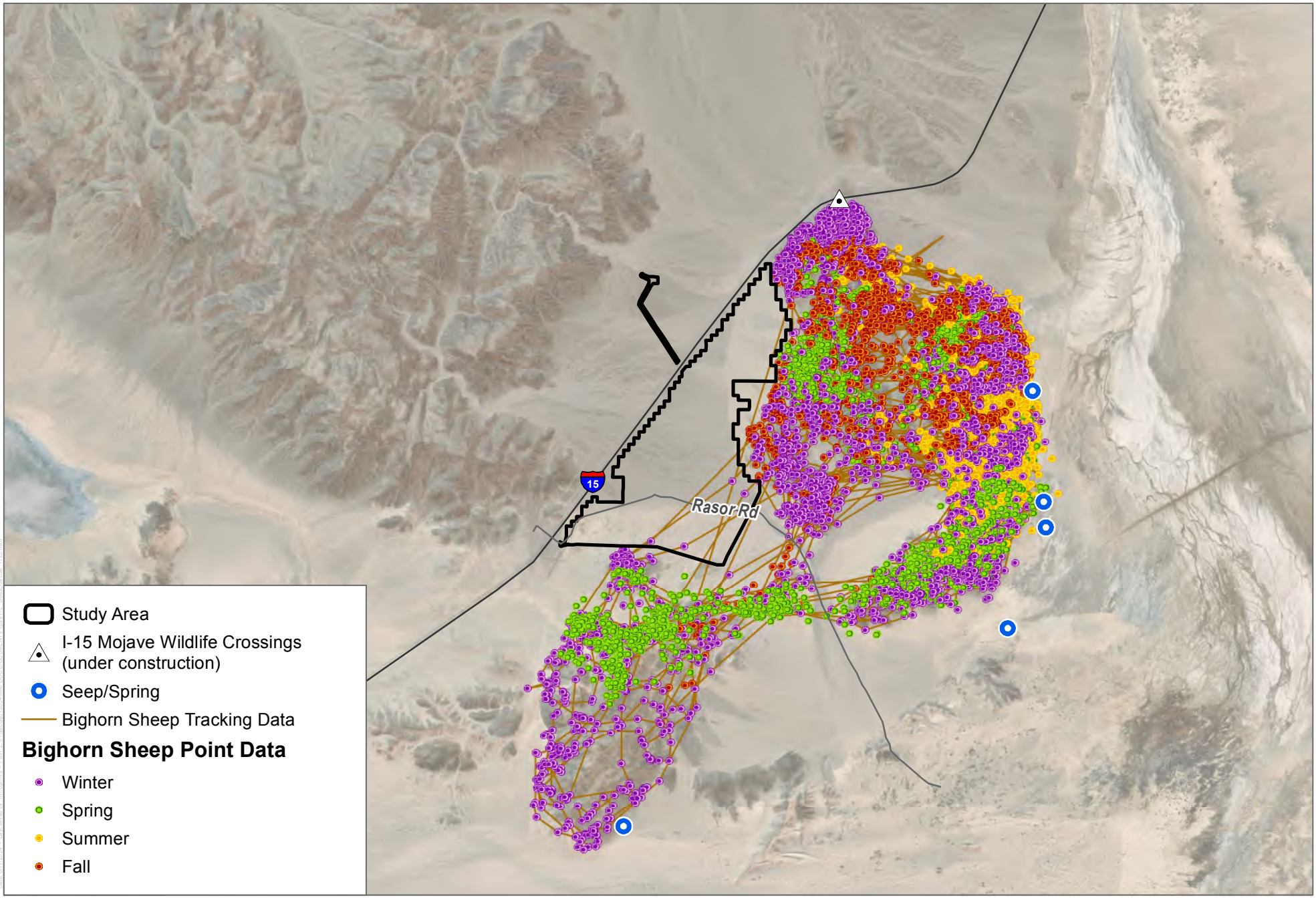
DUDEK

0 4,200 8,400 Feet

FIGURE 11D

Individual Bighorn Sheep Habitat Use Maps - ID 1704

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

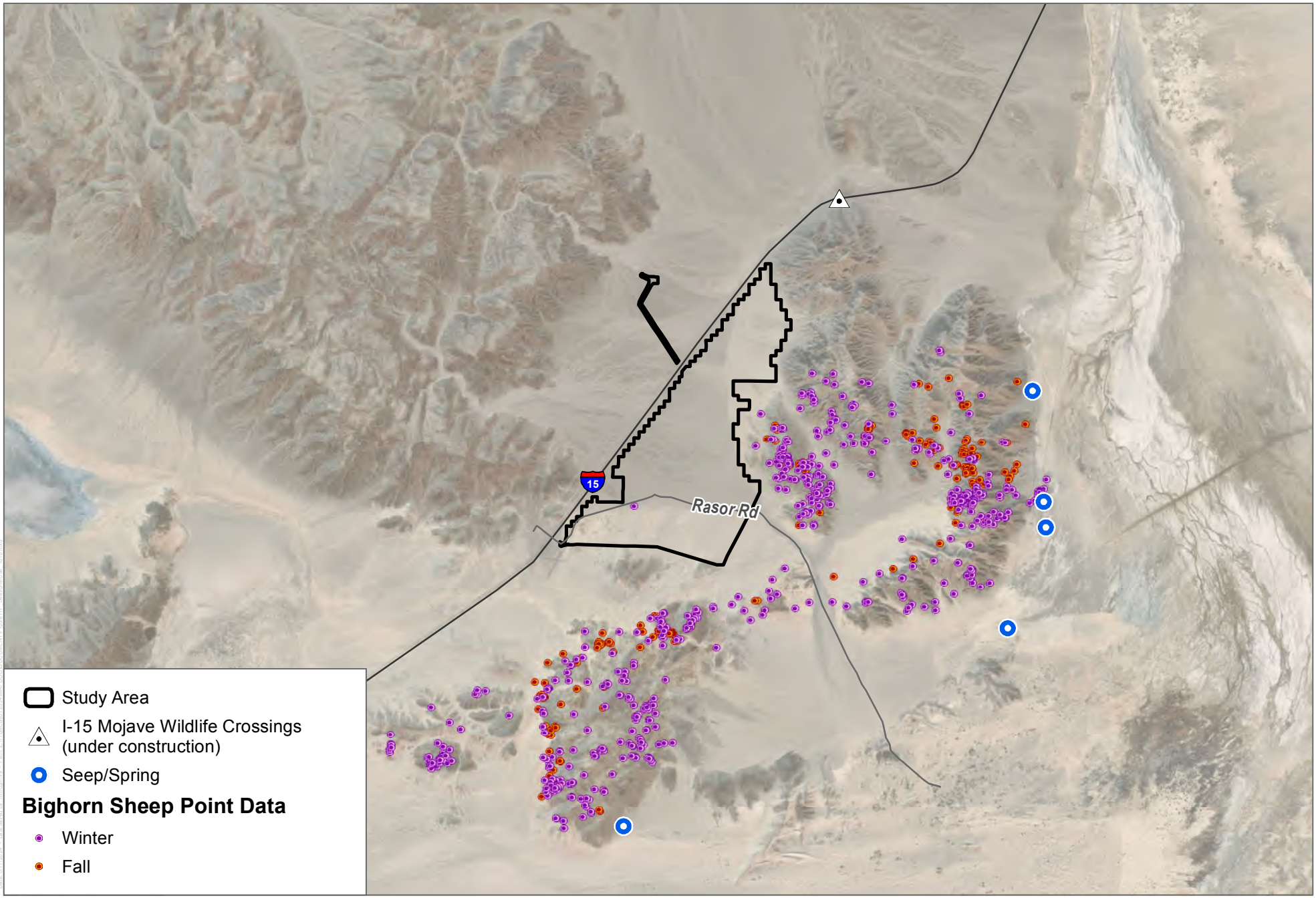
DUDEK

0 4,200 8,400 Feet

FIGURE 11E

Individual Bighorn Sheep Habitat Use Maps - ID 1723

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

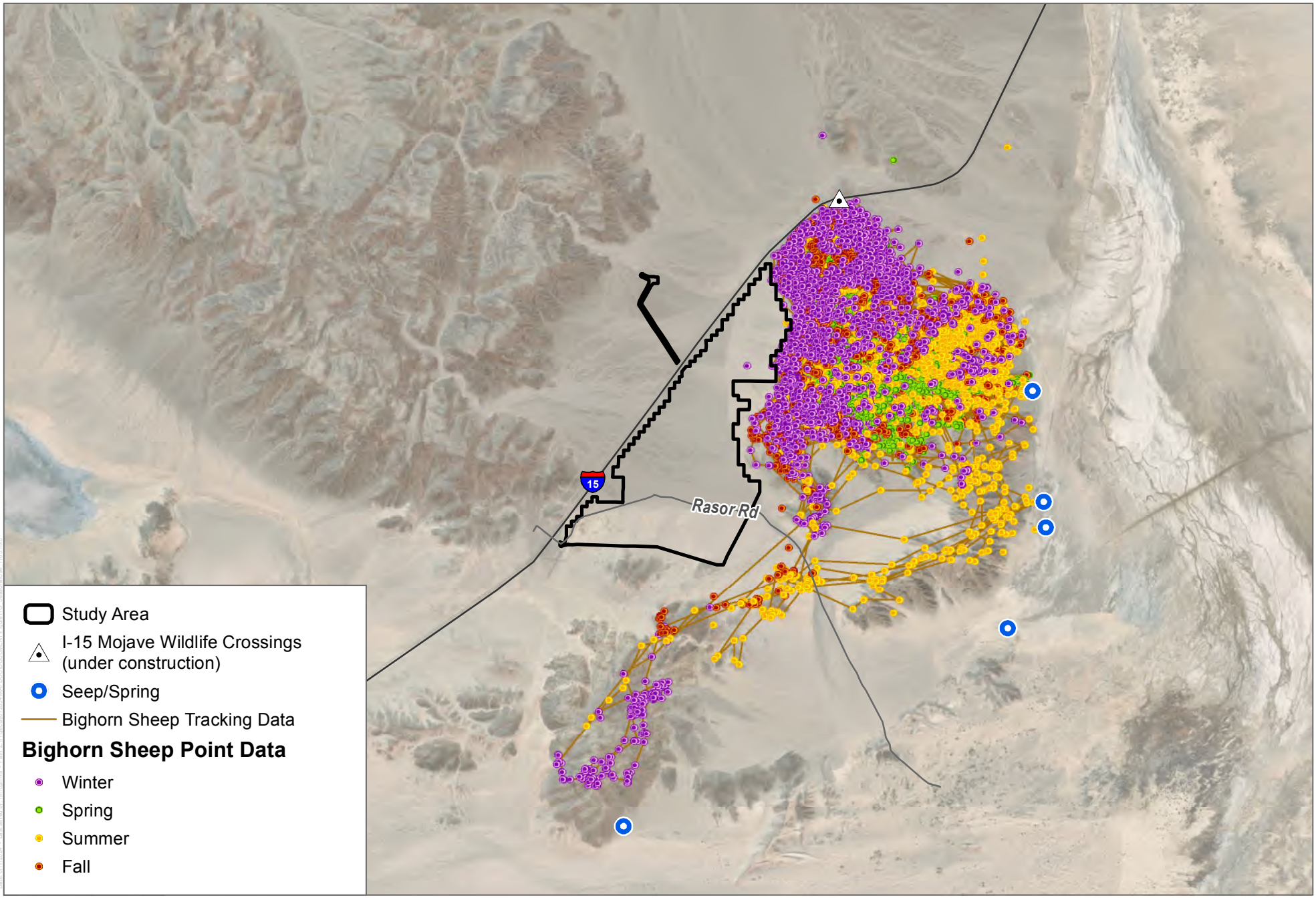
DUDEK

0 4,200 8,400 Feet

FIGURE 11F

Individual Bighorn Sheep Habitat Use Maps - ID 1810

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

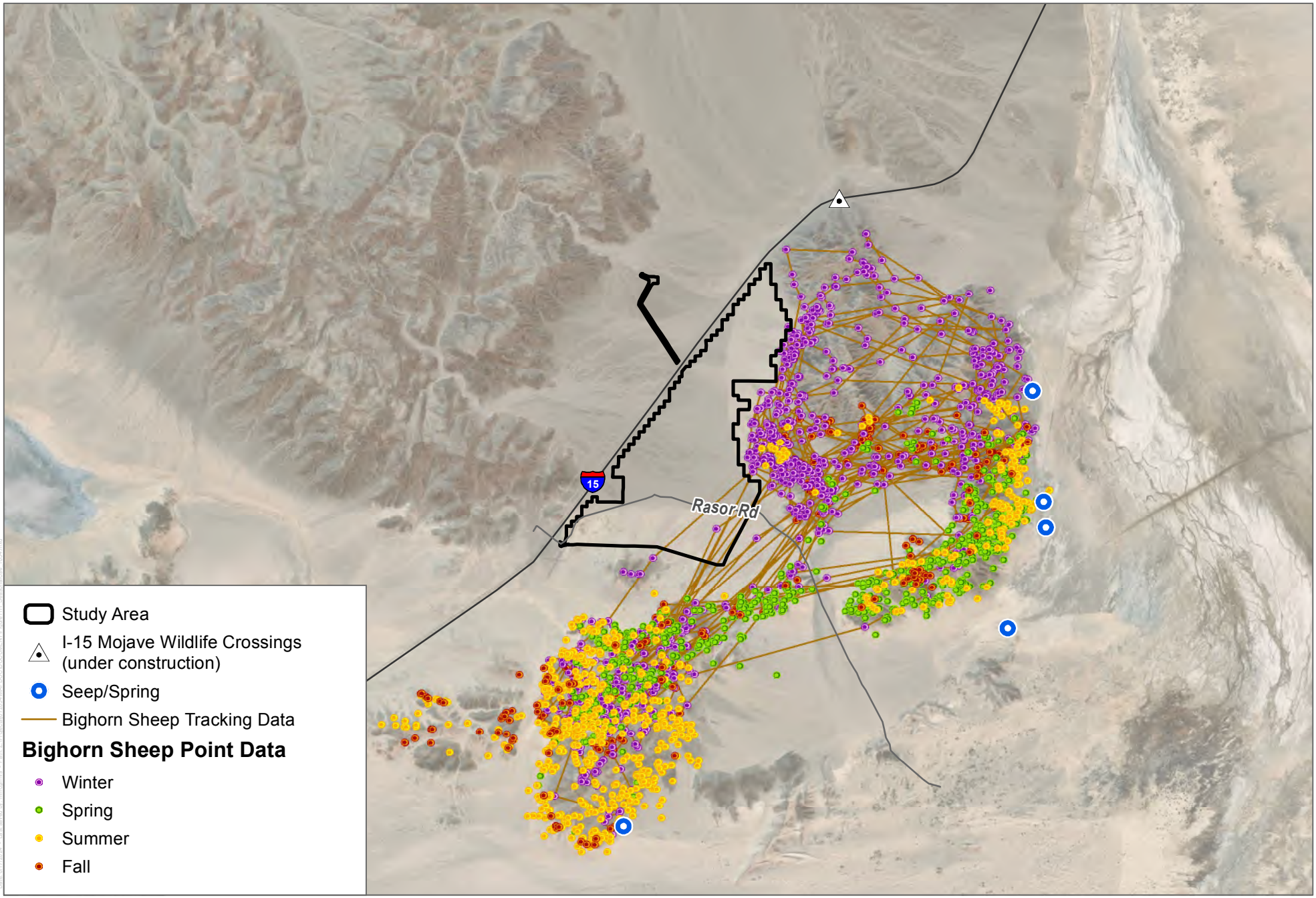
DUDEK

0 4,200 8,400 Feet

FIGURE 11G

Individual Bighorn Sheep Habitat Use Maps - ID 1703

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

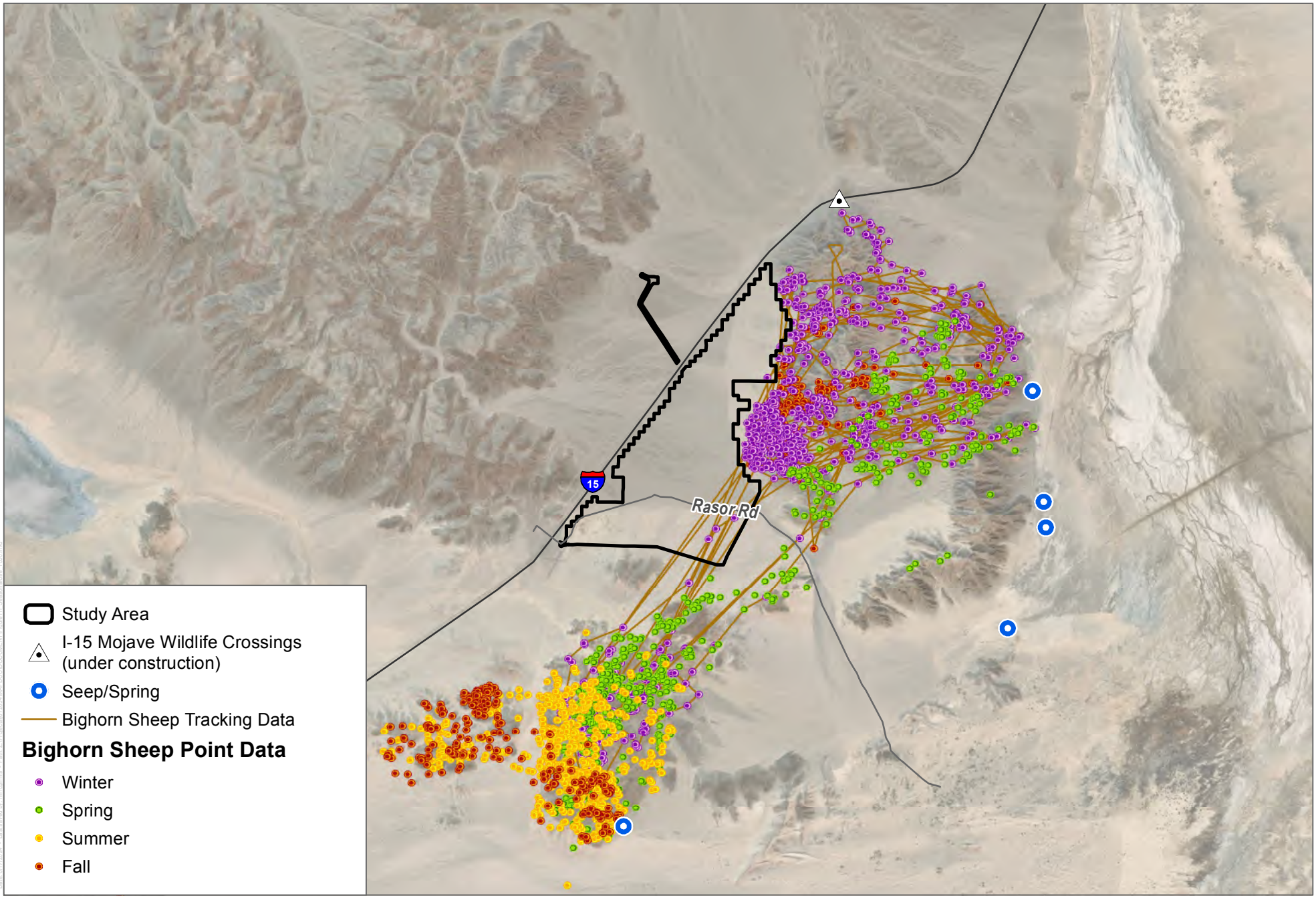
DUDEK

0 4,200 8,400 Feet

FIGURE 11H

Individual Bighorn Sheep Habitat Use Maps - ID 1834

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

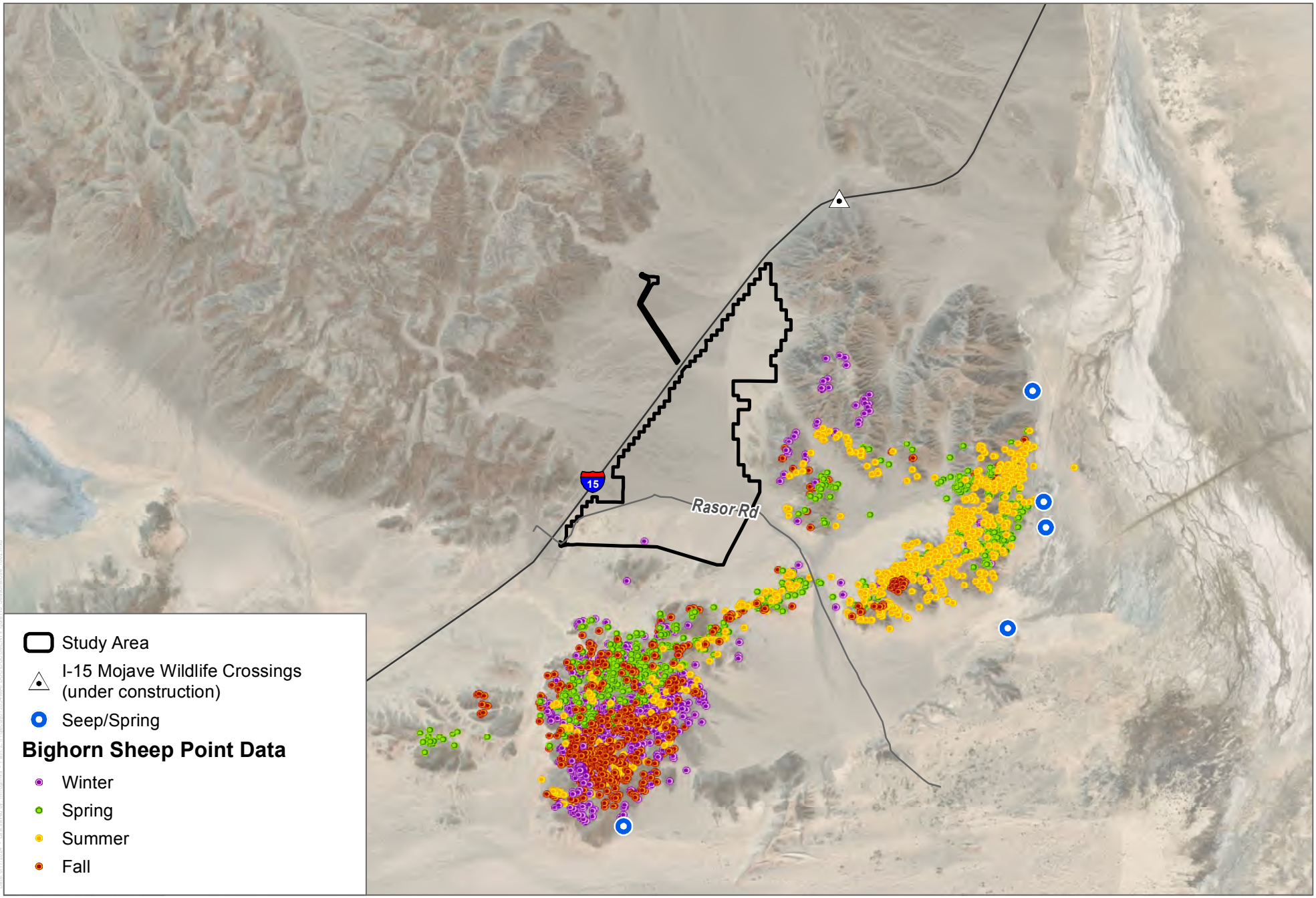
DUDEK

0 4,200 8,400 Feet

FIGURE 11I

Individual Bighorn Sheep Habitat Use Maps - ID 1836

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

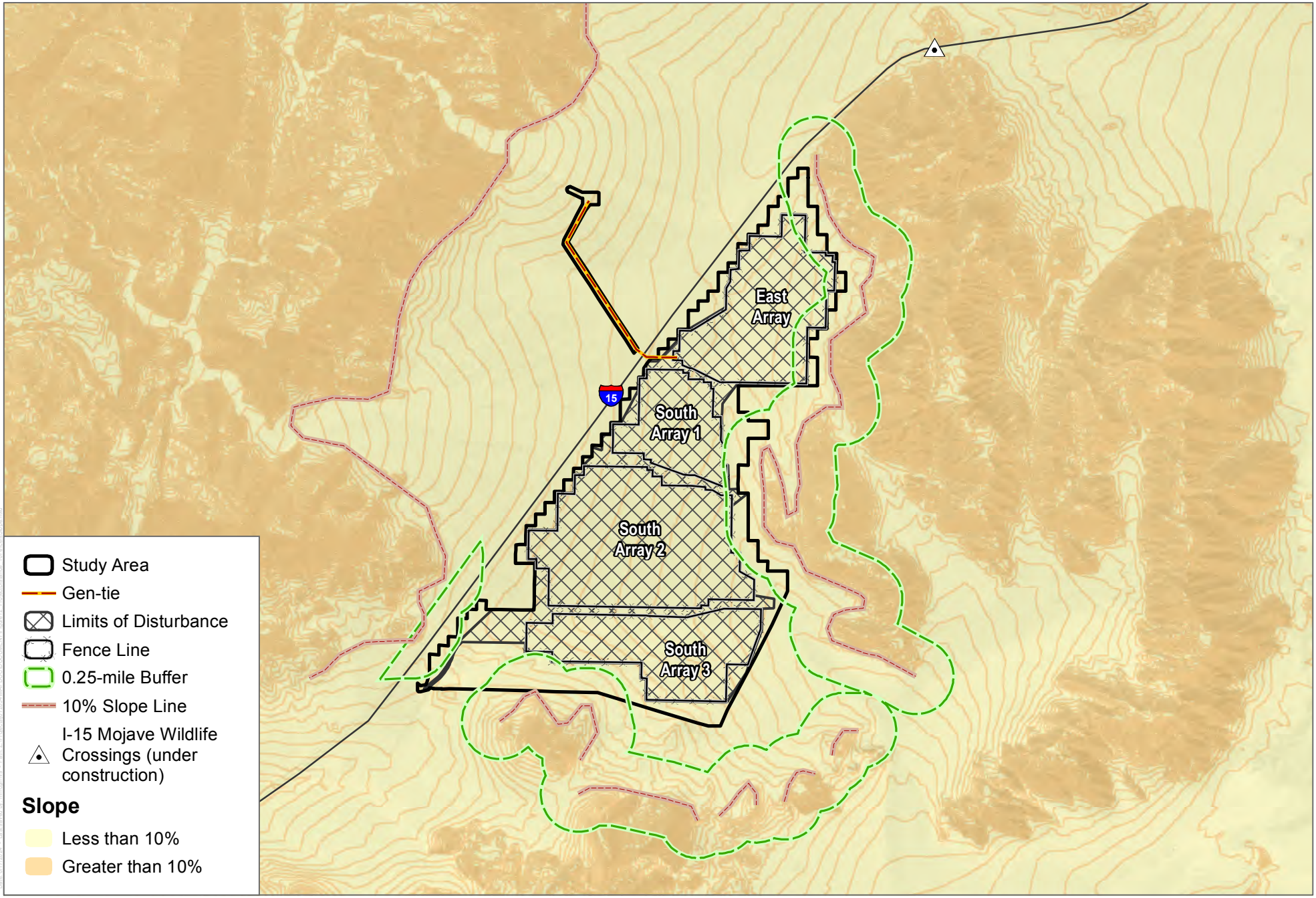
DUDEK

0 4,200 8,400 Feet

FIGURE 11J

Individual Bighorn Sheep Habitat Use Maps - ID 1862

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023

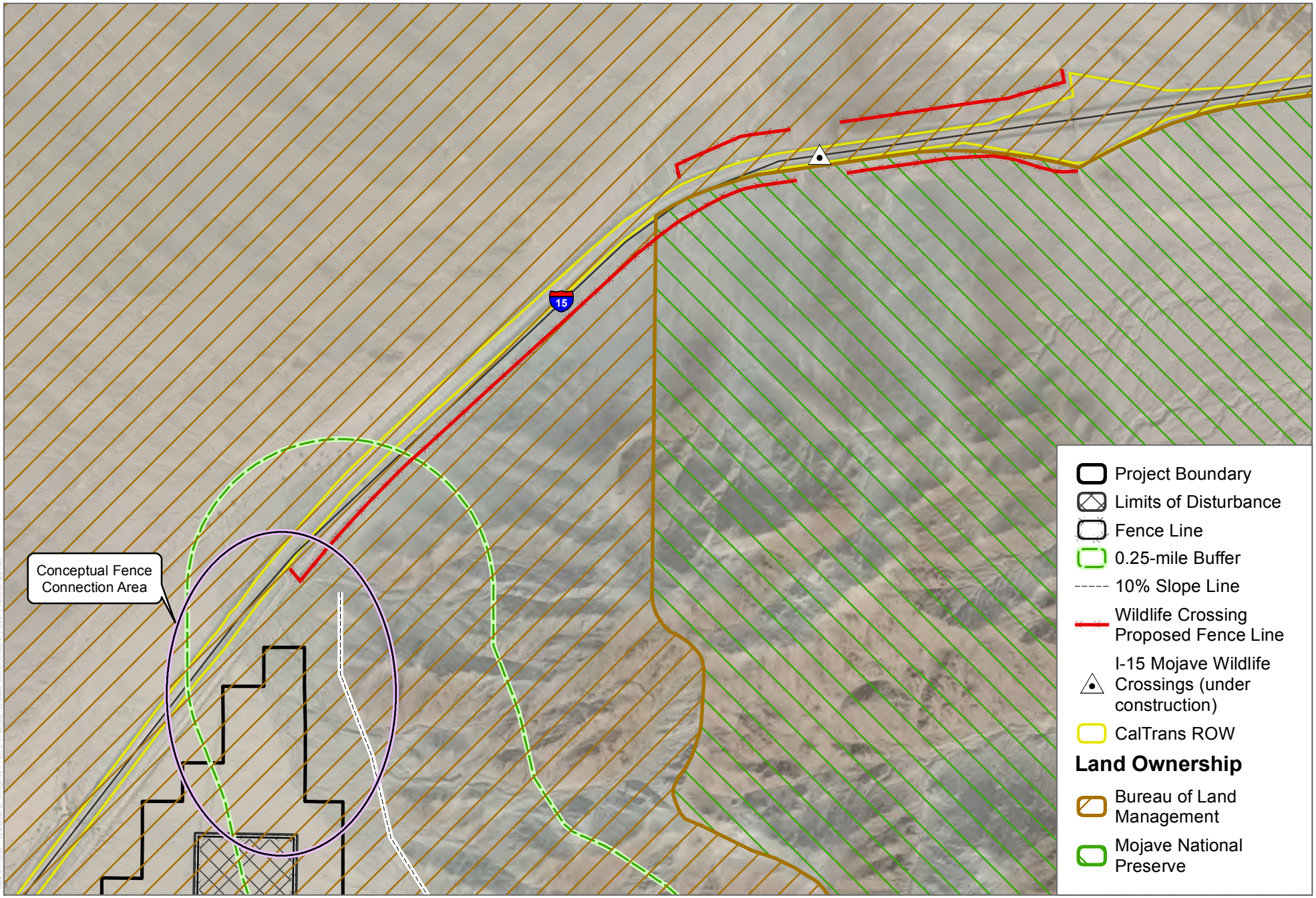
DUDEK

0 2,250 4,500 Feet

FIGURE 12

Project Distance to 10% Slope

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023

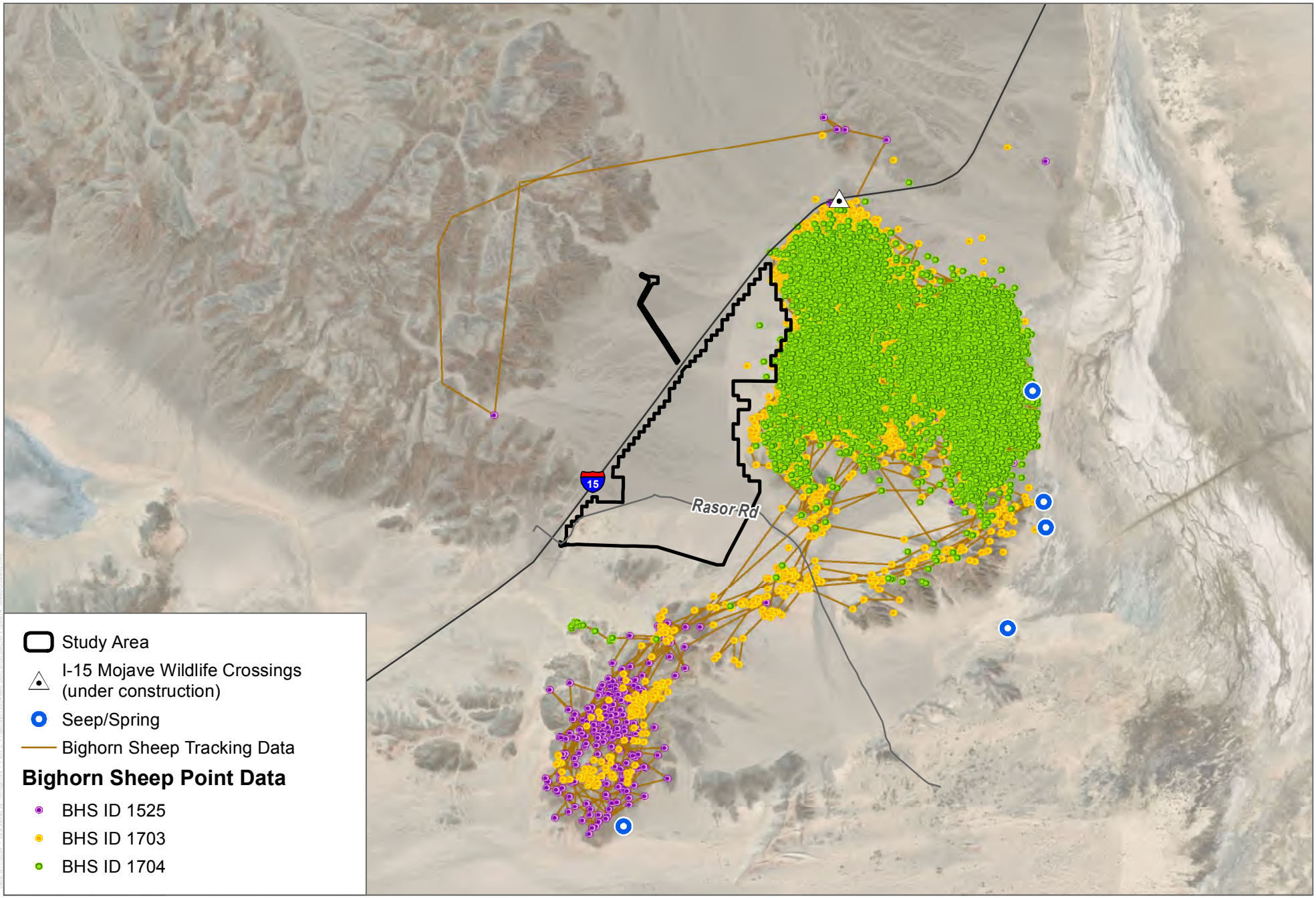
DUDEK

0 550 1,100 Feet

FIGURE 13

Fencing Plans

Bighorn Sheep Study for the Soda Mountain Solar Project



SOURCE: ESRI 2023; USGS 2022; BLM 2024; CDFW 2023

DUDEK

0 4,200 8,400 Feet

FIGURE 14

Sheep Crossing I-15

Bighorn Sheep Study for the Soda Mountain Solar Project

Appendix B
Site Photographs

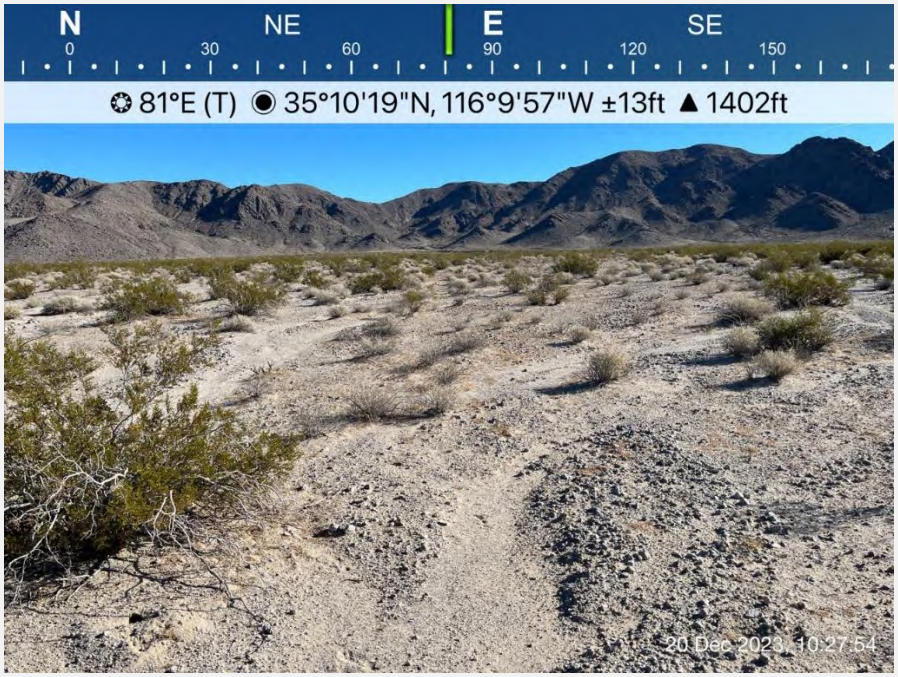


Photo 1. Image shows creosote scrub community in the intermountain habitat located within the study area. The south Soda Mountains appear in the background.

Photo 2. Image shows cheesebush-sweet bush community within a desert wash flowing out of the south Soda Mountains in the northeastern portion of the study area.

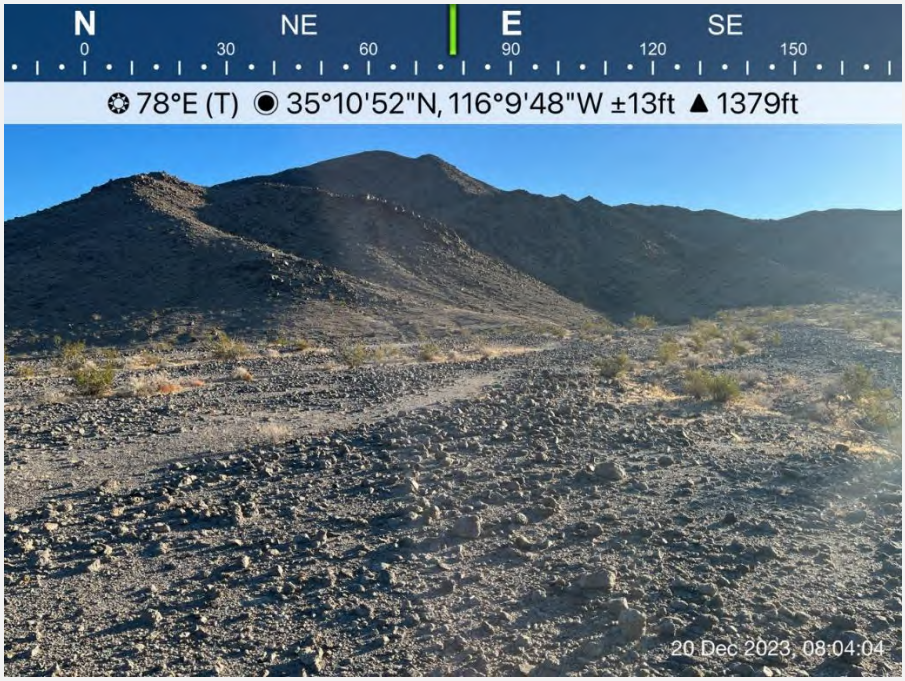


Photo 3. Image shows intermountain habitat located in northern portion of the study area with the south Soda Mountains in the background.

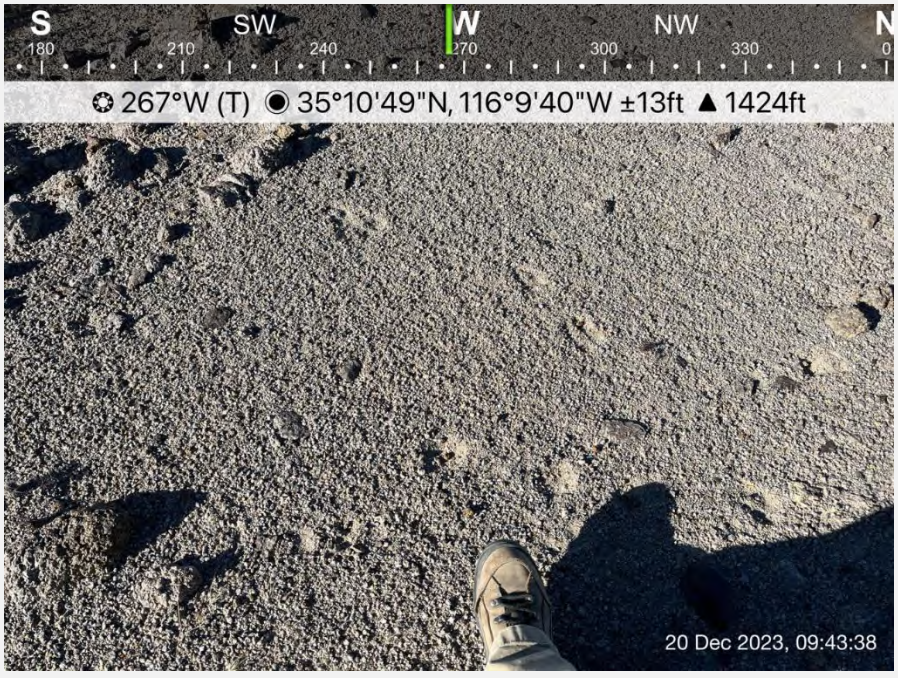


Photo 4. Image shows desert bighorn sheep tracks observed within the northern portion of project site in intermountain habitat during December 2023 site visit.

Photo 5. Image shows desert bighorn sheep scat found near the hinge point of the slope within the northern portion of the study area.

Photo 6. Image shows a desert bighorn sheep bedding spot located within the mountain habitat above the northern portion of the study area.

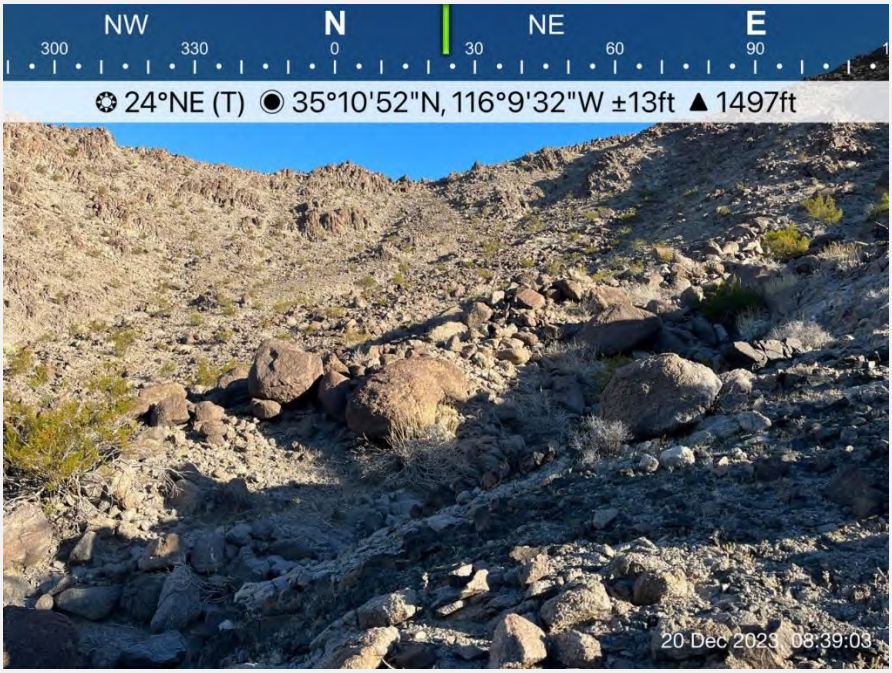


Photo 7. Image shows representative mountain habitat within the south Soda Mountains taken near the northern portion of the study area.

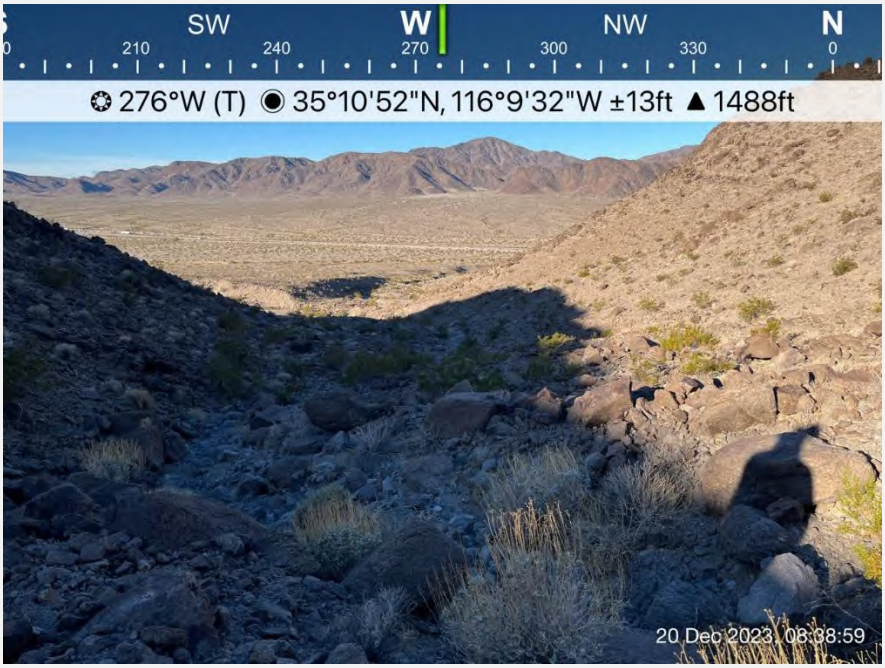


Photo 8. Same image location as above; however, this image is looking down from the mountain habitat toward I-15 and the project site.

Photo 9. Image of intermountain habitat located in the southeastern portion of the study area. The south Soda Mountains are shown in the background and Rasor Road is in the foreground.

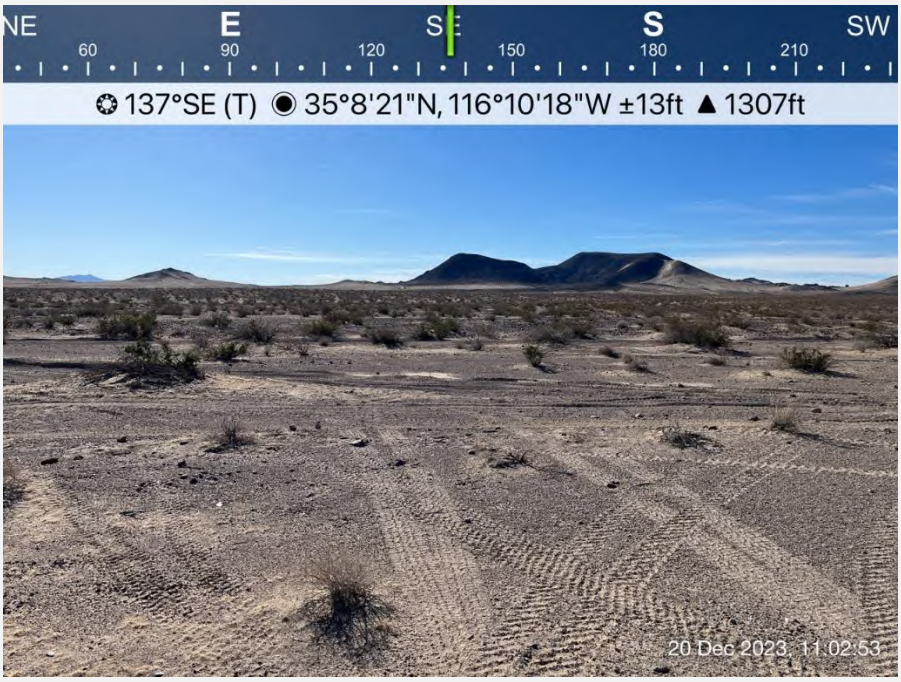


Photo 10. Same image location as above; however, this image faces southeast, and the Cave Mountains are shown in the background.

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Appendix C

History of CDFW Guidance for the Project Regarding Desert Bighorn Sheep

Mitigation Measures	Meeting Notes Dated 1/25/13 Subject: Meeting between CDFW & Bechtel	Memo to CDFW Dated 4/15/13 Subject: Memo from V. Bleich to R. Abella	CDFW Comment Letter Dated 4/19/13 Subject: Possible Mitigation Strategies for Potential Impacts to big horn sheep in the 2013 Bighorn Sheep Report by Panorama	CDFW Comment Letter Dated 1/6/14 Subject: Comments on EIR	CDFW Letter Dated 3/3/14 Sujject: Update on Desert Bighorn Sheep Disease	CDFW Comment Letter Dated 7/7/15 Subject: Comments on Final EIR	CDFW Comment Letter Dated 3/28/16 - 5/16/16 Subject: Comments on ROD	CDFW Letter to County Board of Supervisors Dated 7/7/16	PowerPoint Presentation to CDFW by Applicant Dated 8-1-2016 Subject: Project Revisions	CDFW Memo Dated 8/4/16 Subject: South Soda Mtn Ewe Hwy Crossing
Summary of Document/ Comment Letter			CDFW commented on 2013 BHS report and concluded that the applicant proposed MMs are inadequate, the report fails to cite peer reviewed studies and relies too heavily on personal communication; the report fails to provide evidence that the proposed MMs would mitigate impacts to less than significant; HOWEVER, CDFW wrote the proposed MMs combined with CDFW recommended MMs MAY reduce potential impacts to less than significant - ends with report should be revised to include and adequately reflect all MMs proposed		CDFW states the intention of this letter is to update the Lead Agency on new and developing info re: BHS in southern Soda Mtns 11/2014 in response to disease outbreak, CDFW and partners captured and collared BHS in several mtn ranges - 4 adult females were collared with VHF and GPS in south Sodas - remote download of the sheep revealed use of range near Rasor Rd - a great distance from where capture - suggests BHS use low elevation land to move between rocky slopes; CDFW recommends consideration be given to allow BHS to move freely and not further restrict movement opportunities - CDFW once again recommends 0.25-mi from 10% slope set-back of fence; CDFW writes Lead Agency is recommended to require applicant to implement this MM as well as those previously discussed	CDFW commented that there is a discrepancy between project acreage and impact acreages; CDFW commented that in their comment letter dated 1/6/14 for the DEIR, the MMs listed were recommended to be implemented in conjunction with each other, not implemented on an individual basis as is mentioned in the FEIR	CDFW commented in general the the APMs and MMs adopted in the ROD do not reflect CDFW's recommendations outlined in its previously letters or talked about during project meetings - in reviewing the ROD, it is clear the Adopted MMs are not adequate and do not meet CDFWs fully mitigated standard	expressed concerns - primary purpose of letter is to draw attention to 1. FEIR approach to wildlife mitigation, particularly for BHS, is piecemeal and uncoordinated and will likely not reduce significant impacts to vulnerable species like BHS 2. CDFW is concerned the CEQA review may be insufficient to support permit issuance and additional CEQA review would be required if applicant were to seek ITP under CESA and they believe an ITP is necessary 3. BHS are fully protected and afforded the highest level of protection under the state - no take can be authorize for project; CDFW	Notes: went through most of slides, discussed how project was scaled back, north arrays (north side of I-15) have been dropped	5/23/16 - a radio collared ewe crossed I-15 along north end of the S. Sodas, near Zzyzzx Road Exit - headed to low-lying hills NE of where Zzyzzx road crosses Arrowhead Trail and stayed for 2 days before moving 2.5 miles west across wash into N. Sodas - spent 4 days moving around eastern N. Sodas - headed back north and crossed I-15 again 5/29/16, directly after crossing - mortality alert from GPS collar - on 5/30/16 during investigation, ewe was found on NW side of S. Sodas just south of I-15 Ewe had been shot in the chest, blood trail traced from mortality site 200 years north where she crawled through hole in highway fence after crossing interstate. Necropsy showed blunt trauma and bullet would in chest - udder on ewe

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								concerned that FEIR may permit impacts to this species under CEQA but fail to provide sufficient protection to meet the standards in the Fully Protected standards - CDFW has no means by which to permit impacts to Fully Protected species		appeared full but no lamb present Possible she made large movement with lamb in tow
WEAP			BHS-1 - CDFW requests further clarification regarding what will be included in the WEAP and how this will mitigate impacts to BHS							
Biological Monitor			BHS-2 - CDFW requests further clarification regarding what will be included in the WEAP and how this will mitigate impacts to BHS							
Restriction of Pets			BHS-3 - CDFW requests measure be further clarified, as in the current form it suggests pets will be restricted to the project site only - CDFW recommends that pets not be allowed on the project site							

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Water Resources	1/25/13 Mtg - discussed establishing water sources near crossing and in the South Soda Mtns to facilitate movement	Says 2 water sources is not nearly enough - recommends 6 water sources as follows: 1. one in the north end of the North Soda Mtns 2. one further south, but still within North Soda Mtns (for stair-step expansion) 3. two sources near or at selected culverts or over passes on north side of I-15 4. two more water sources at the south end of each of the previously noted overpasses or culverts	BHS-4 - CDFW commented that a single water source, one on each side of I-15, is inadequate; CDFW commented that multiple water sources are necessary to encourage use by BHS on a year-round basis in the south end of the North Soda Mtns and to encourage use in the vicinity of the CDFW recommended wildlife bridges and existing culverts; CDFW recommended the development of 6 water sources	CDFW said development of a single water sources is inadequate; said multiple sources are necessary and recommends 6 sources be developed as recommended by V. Bleich			ROD adopted MM 3.4-3a states that Applicant/Owner shall provide funding for CDFW or other entity to install 3-5 guzzlers in north Soda/ Avawatz Mtns and provide funding to refill them through the life of the project. CDFW commented/reiterated that the MMs were recommended to be implemented in conjunction with eachother and not on an individual basis as mentioned in the ROD		Revised project proposes 3-5 guzzlers; CDFW agreed to work together on location and number of guzzlers	
Desert Bighorn Sheep Movement Under I-15	1/25/13 - during meeting noted land bridges likely be more conducive to movement than underpasses - but both work exploring CDFW said they would re-evaluate whether the project lies across	Noted that the proposed mitigation in the current document (2013) is inadequate in terms of its potential to enhance use of existing routes of travel in the form		1. emphasized importance of re-establishing and maintaining connectivity between south Soda Mtns and north Soda Mtns - but demographically and genetically			CDFW commented on MM3.4-3e and MM3.4-3b saying BHS is a fully protected species and CDFW cannot authorize take for project purposes, nor will CDFW accept the money as a form of			

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	a linkage given the revisions to the project site - however, noted they expected no change from their original eval.	of culverts or freeway underpasses, and must be substantially revised.		to maintain metapopulation function 2. emphasized importance of preventing any additional restrictions to movement in vicinity of these mtn ranges 3. noted it is important that existing underpasses along I-15 must not be finished, even though crossing by BHS is low			mitigation for a fully protected species, as doing so would imply CDFW authorizes such impacts			
Desert Bighorn Sheep Movement Over I-15	1/25/13 - during meeting noted land bridges likely be more conducive to movement than underpasses - but both work exploring CDFW said they would re-evaluate whether the project lies across a linkage given the revisions to the project site - however, noted they expected no change from their original eval.	Noted that the proposed solar site (i.e., when both sides were proposed for development) is of critical importance to maintaining the potential for connectivity between the Soda Mtns and the South Soda Mountains, and must be retained as an area of importance in the DRECP. Also notes that any further blockage of the potential for movement by BHS will be detrimental		CDFW recommends 2 overpass crossings - one in the south of the project and one north of the project					proposes $250k bond to CDFW for connectivity restoration efforts (including wildlife bridge; applicant agrees to removed translocation language due to fully protected status)	

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		to the persistence of that species.								
Wildlife Fence Design			BHS-5 - CDFW commented that opportunities for BHS to move through existing underpasses must not be hindered and would appreciate the opportunity to consider and comment on the proposed wildlife fencing; but it is not clear at this stage what design of wildlife fencing is being proposed - CDFW requested the Applicant provide additional details with regard to wildlife fence design							
Fence Set Back Distance	CDFW said they need an updated map of the proposed arrays to eval implications for potential BHS use of areas near "hinge points"	Notes fencing will be problematic and likely preclude the use of existing underpasses - even if the proposed project is buffered outward from the toe of slope greater than or equal to 10%	BHS-6 - CDFW commented that they have identified a wildlife bridge location and that the project would preclude the sheep access to that bridge; the project as proposed reduced BHS access to foraging habitat and escape terrain; CDFW recommends placing the project perimeter fence 0.25-mi from the 10% slope and leaving Rasor Rd in its existing location	Commented that the project, as proposed, would reduce access to foraging habitat and escape terrain. Recommended placing the perimeter fence 0.25 miles from the 10% slope and leaving Rasor Rd in its existing location					applicant asked CDFW to reconsider request to avoid all foraging habitat (i.e., 0.25 mi from 10% slope - said given reduction in project site, 328 acres represents less than 2% of foraging habitat - also they broke apart the arrays to allow for connectivity (SG and BO think not wide enough and unlikely sheep will use these), and final fencing plan to direct sheep from mountains to	

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									culverts - they believe mitigation is appropriate They were proposing 1:1 restoration or looking at retiring grazing rights (look at 17k acres in grazing prime BHS habitat in Mojave National Preserve) - they understand if us the Durability agreement and use retirement of grazing rights, they would have to provide greater than 1:1 ratio - asked if CDFW knew of any mitigation banks or private lands that meet the MM requirement	
Mitigation and Monitoring Plan			CDFW wrote that in addition to the Applicant proposed MMs in the Report, CDFW requests wildlife bridges, water sources and all other implemented MMs be monitored for a minimum of 8 years						Proposes to fund a 10-year study monitoring responses of BHS to project. Noted two other projects to compare to which were Ocotillo Wind (located in PBS foraging habitat and adjacent to critical habitat for PBS), and Desert Sunlight (located in BHS foraging habitat) Also proposed adaptive	

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									management based on monitoring results BHS monitoring during construction with stop work for any sheep within 1,000 feet	
Compensatory Mitigation	1/25/13 Mtg - verified that project did not qualify for SB34 mitigation lands Also discussed the difficulty of assigning off-setting mitigation benefit of retiring grazing allotment		BHS-7 - CDFW commented that conserving BHS habitat in perpetuity is a benefit to the species generally and will compensate for the loss of foraging habitat as a results of project impacts; however, CDFW commented that they cannot over-emphasize the importance of connectivity between South and North Soda Mountains relating to BHS genetics and compensatory mitigation will not mitigate for this impact, as such CDFW wrote they do not concur with Measure BHS-7 to mitigate impacts to habitat and connectivity.				CDFW commented that they cannot authorize take of BHS for project development and CDFW does not accept habitat compensation for fully protected species as doing so would imply CDFW authorized such impacts			

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