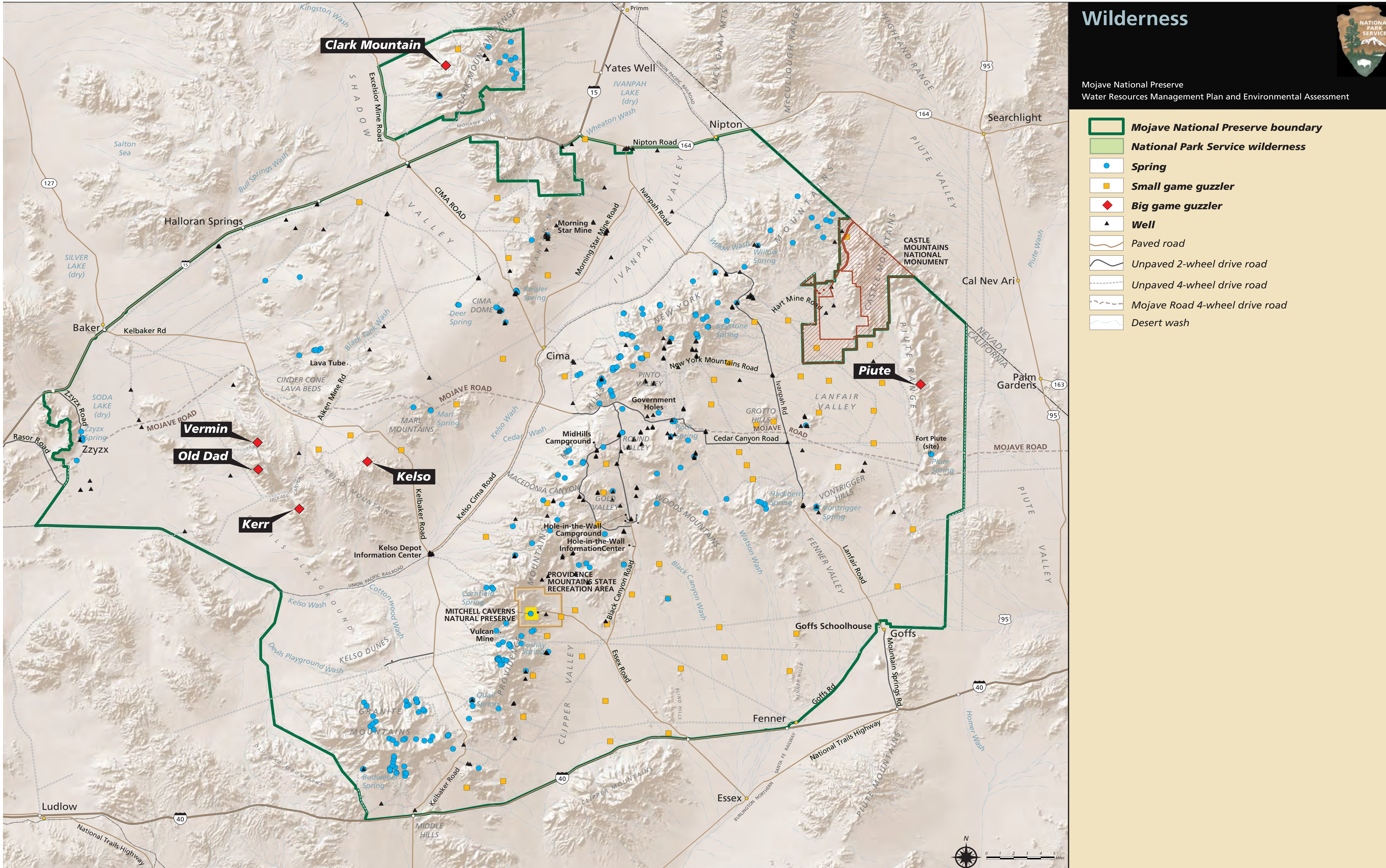

Wilderness
NATIONAL PARK SERVICE
Mojave National Preserve
Water Resources Management Plan and Environmental Assessment
Mojave National Preserve boundary
National Park Service wilderness
Spring
Small game guzzler
Big game guzzler
Well
Paved road
Unpaved 2-wheel drive road
Unpaved 4-wheel drive road
Mojave Road 4-wheel drive road
Desert wash
Clark Mountain
Vermin
Old Dad
Kelso
Kerr
Piute
Primm
Yates Well
Nipton
Searchlight
Cal Nev Ari
Palm Gardens
Halloran Springs
Baker
Zzyzx
Cima
Kelso Depot Information Center
MidHills Campground
Hole-in-the-Wall Campground
Hole-in-the-Wall InformationCenter
PROVIDENCE MOUNTAINS STATE RECREATION AREA
MITCHELL CAVERNS NATURAL PRESERVE
Vulcan Mine
Goffs Schoolhouse
Goffs
Fenner
Essex
Ludlow
CASTLE MOUNTAINS NATIONAL MONUMENT
Morning Star Mine
Government Holes
Lava Tube
Fort Piute (site)
Kelbaker Rd
Nipton Road
Ivanpah Road
Cedar Canyon Road
New York Mountains Road
Hart Mine Road
Kelso Cima Road
Kelbaker Road
Black Canyon Road
Essex Road
Lanfair Road
Goffs Rd
Mountain Springs Rd
National Trails Highway
MOJAVE ROAD
NEVADA
CALIFORNIA

For the purposes of this plan, the four qualities of wilderness in the Preserve, and the relationship of those qualities to water resources, are understood to be as follows:

- *Untrammeled* – The Mojave Wilderness is largely free of active human manipulation. However, the use of water developments, ranging from developed springs to wildlife guzzlers, negatively affects the untrammeled quality of wilderness. The presence of historic water development structures that are merely a relic from historical land management, are not actively managed for conservation purposes, and are part of the landscape is not considered an adverse impact on untrammeled qualities.

- *Natural* – The Mojave Wilderness supports a diverse array of native plant and animal species that survive in the desert environment. Part of that natural ecosystem includes desert bighorn sheep and other wide-ranging species that have been negatively affected by modern development both in the Preserve and in the surrounding ecosystem. Wildlife management and conservation activities, including the installation and management of guzzlers or other water developments, are considered an important tool to maintain the natural wildlife qualities of the wilderness (at times at the expense of other qualities).

- *Undeveloped* – Most of the Mojave Wilderness is free of modern land disturbance, structures, or vehicle access that would indicate human improvements or habitation. There are, however, a myriad of abandoned mining and ranching structures located within the wilderness that adversely impact the wilderness character and undeveloped qualities. The presence of guzzlers and other water developments and the use of motorized equipment to access and maintain those developments further adversely impact the undeveloped wilderness quality in the vicinity of those sites.

- *Opportunity for Solitude or Primitive and Unconfined Recreation* – The Mojave Wilderness provides ample opportunities for solitude and primitive recreation. Water features in the wilderness do not affect this quality, nor does the highly infrequent access to water features for the purposes of monitoring or maintenance.

Wilderness Management

Section 4(c) of the Wilderness Act states:

> Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and, except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area.

This minimum requirement concept is intended to minimize impacts on wilderness values and resources. Managers may authorize (using a documented process) the generally prohibited activities or uses listed in Section 4(c) of the Wilderness Act if deemed necessary to meet the minimum requirements for the administration of the area as wilderness.

Regarding natural resources management principles, NPS policies direct that the principle of nondegradation be used, and that natural processes be allowed to shape and control wilderness ecosystems. Management intervention in wilderness should only be undertaken to the extent necessary to correct past mistakes, the impacts of human use, and influences originating outside of wilderness boundaries. Regarding cultural resources, NPS policies direct that cultural resources that have been included in wilderness will be protected and maintained according to the pertinent laws and policies governing cultural resources, using management methods that are consistent with the preservation of wilderness character and values (NPS 2006). These wilderness management principles are important to consider in relation to water resources management in the Mojave Wilderness since many of the existing water developments in wilderness are historic, while others are important for native wildlife conservation.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Introduction

The National Environmental Policy Act (NEPA) requires that environmental documents describe the environmental impacts of a proposed federal action, reasonable alternatives to that action, and any adverse environmental effects that cannot be avoided if a proposed action is implemented. This chapter analyzes both beneficial and adverse impacts that would result from implementing any of the alternatives described in this plan. The No Action Alternative (Alternative 1) is used to compare the effects of current actions and management direction at the Preserve with those proposed in the action alternatives (Alternatives 2, 3, and 4). The resource topics presented in this chapter, and the organization of the topics, correspond to the resource discussions contained in *Chapter 3: Affected Environment*.

This chapter begins with a brief explanation of the resource topics analyzed, followed by a discussion on methods and assumptions for assessing impacts, and finally a description of the projects that make up the cumulative impact scenario. The impacts of each alternative are then analyzed by impact topic. Each impact topic includes a description of the impact of the alternative, a conclusion for each alternative, and a discussion of cumulative effects. The impacts of all alternatives are summarized in Table 22 at the end of the chapter.

Resource Topics Analyzed

The specific resource impact topics to be analyzed were determined during the internal and public scoping process and are based on the dynamics of water resources in the Preserve (this process is described in the “Scoping and Public Participation” section in *Chapter 2: Alternatives*). Resource topics analyzed include the following:

- *Wildlife – Desert Bighorn Sheep* – including the availability of dry season habitat with adequate water to sustain populations
- *Wildlife – General* – including general wildlife species, key water resource–reliant species, unique or important wildlife or wildlife habitat, nonnative and subsidized wildlife species, and threatened, endangered, or sensitive species
- *Cultural Resources* – including historic or archeological resources associated with water sources
- *Wilderness Character* – including the characteristics and qualities of designated wilderness areas

Resources that were not analyzed in depth or were dismissed from further consideration and the rationale for that dismissal are briefly described in *Chapter 1: Purpose of and Need for Action*.

Methods and Assumptions for Assessing Impacts of Alternatives

General Analysis Methods

The analysis of impacts on resources follows CEQ guidelines and DO-12 (NPS 2015). The impact analysis and conclusions are based on quantitative and qualitative assessment of changes to affected resources. The analysis is informed by the best available applicable scientific literature and studies, information and professional judgement provided by experts within the Preserve and NPS and other agency personnel, and public input.

In accordance with CEQ regulations, direct, indirect, and cumulative impacts are described (40 CFR 1502.8 and 1502.16), and the significance of the impact on a resource topic is assessed in terms of context and intensity (40 CFR 1508.27). Where appropriate, measures to mitigate potential adverse impacts are described and are incorporated into the evaluation and description of impacts. More specific methods and assumptions used to assess impacts are described under each resource topic.

Assessing Impacts Using CEQ Criteria

The impacts of the alternatives are assessed using the CEQ definition of "significantly" (1508.27), which requires consideration of both context and intensity:

- *Context* – The significance of an action must be analyzed at multiple scales, such as the specific site, the particular locale, the affected region, and the larger global affected interests. Context can be environmental or social, and may vary based on the resource being analyzed. It includes both resource-specific context and overall context.

- *Intensity* – This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about aspects of a major action. For each resource topic analyzed, the potential significance of the impacts is assessed in the conclusion section that follows the discussion of the impacts for each alternative.

Overall Context

Resource-specific context is presented under each resource topic and applies across all alternatives. The context for impacts may include any of the following scales:

- Site-specific (site of proposed action)
- Local (within the Preserve boundary)
- Regional (within the Mojave Desert, or within about 50 miles of the Preserve boundary)
- Global affected interests (beyond the Mojave Desert region)

Duration and Impact Types

Duration refers to the period over which the effects of an impact persist. Duration of impacts is defined as follows:

- *Short-term* – Impacts last less than two years, often quite less. This would include any temporary impacts, such as construction associated with the alternatives.

- *Long-term* – Impacts last for more than two years, which would include impacts that are permanent. This plan is established to serve the Preserve for the next 15 to 20 years. Therefore, the analysis period used for assessing impacts is up to 20 years.

Impact Type refers to the nature of the impacts of the proposed management actions when compared with the existing conditions (beneficial or adverse), and the relationship between the time and location of the management action and when and where impacts are experienced on resources (direct or indirect) (40 CFR 1508.8). The following definitions of impact types are used for all resource topics:

- *Beneficial* – Impacts that move the resource toward a desired condition or result in a positive change when compared to the existing conditions.

- *Adverse* – Impacts that move the resource away from a desired condition or detract from its appearance and condition when compared to the existing conditions.

- *Direct* – Effects or impacts caused by an action that would occur at the same time and place as the action.
- *Indirect* – Effects or impacts caused by the action that would be reasonably foreseeable but would occur later in time, at another place, or to another resource.

Cumulative Impacts

The CEQ regulations that implement NEPA require the assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions” (40 CFR 1508.7). Cumulative impacts are considered for all alternatives, including the No Action Alternative. Table 17 summarizes the actions that could affect the various resources being analyzed. Projects included in the cumulative impact analysis do not affect all resources equally.

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects and plans in the Preserve and, if applicable, the surrounding region. These reasonably foreseeable future actions and projects are described in greater detail in the “Regional Context” section of *Chapter 3: Affected Environment*.

For most of the impact topics, the geographic area defined for the analysis was Mojave National Preserve. In some cases, the area of consideration was the greater Mojave Desert region.

Table 17. Cumulative Impact Scenario

Activity	General Wildlife	Desert Bighorn Sheep	Cultural Resources	Wilderness Character
Past and Present Impacts				
Existing Infrastructure: • I-15 and I-40, which border the Preserve to the north and south • UPRR, which crosses through the Preserve • Numerous highways and roads • Transmission lines • Canals and aqueducts • Small towns, settlements, ranches, and population centers	Habitat fragmentation, habitat loss, mortality, reduced reproductive success	Habitat fragmentation, habitat loss, mortality, reduced reproductive success	Loss of local cultural resources at disturbed sites	Impacts on Preserve viewshed and noise levels
Land Management Plans and Actions: • Mojave Trails National Monument • Sand to Snow National Monument • Castle Mountain National Monument	Habitat connectivity and conservation	Habitat connectivity and conservation	Conservation of eligible cultural resources in the Mojave Desert region	Designation of wilderness and protected areas within the Mojave Desert region
Preserve Projects and Plans: • West Pond EA • Translocation of Bighorn Sheep to Eagle Crags Mountains FONSI • Abandoned Mine Safety Installations FONSI • Barber Peak Trail Loop Reroute FONSI • Ivanpah Desert Tortoise Research Facility	Habitat connectivity and conservation	Habitat connectivity and conservation	Conservation of eligible cultural resources in the Mojave Desert region	Restoration of native species habitat and populations (Mohave tui chub and Mojave Desert tortoise)
Land Management Plans and Actions: • Western Solar Plan • Desert Renewable Energy Conservation Plan • West Mojave Plan	Habitat fragmentation and connectivity	Habitat fragmentation and connectivity	Loss of local cultural resources at disturbance sites	Impacts on Preserve viewshed and noise levels
Solar Energy Development: • Bright Source Energy Solar Development • Silver State South Solar Project • Stateline Solar Farm Project	Habitat fragmentation, habitat loss, mortality, reduced reproductive success	Habitat fragmentation, habitat loss, mortality, reduced reproductive success	Loss of local cultural resources at disturbed sites	Impacts on Preserve viewshed and noise levels

Activity	General Wildlife	Desert Bighorn Sheep	Cultural Resources	Wilderness Character
Military, Industrial, Agricultural, and Mining Projects: • Castle Mountain Mine Water Extraction • Calnev Pipeline corrosion control prevention • Mountain Pass Rare Earth Mine (inactive since 2015)	Habitat fragmentation, habitat loss, mortality, reduced reproductive success	Habitat fragmentation, habitat loss, mortality, reduced reproductive success	Loss of local cultural resources at disturbed sites	Impacts on Preserve viewshed and noise levels
Reasonably Foreseeable Impacts				
Proposed Infrastructure: • Ivanpah Regional Airport • California-Nevada Maglev (magnetic levitation) Rail • Xpress West high-speed rail • Proposed regional transmission lines	Habitat fragmentation, habitat loss, mortality, reduced reproductive success	Habitat fragmentation, habitat loss, mortality, reduced reproductive success	Loss of local cultural resources at disturbed sites	Impacts on Preserve viewshed and noise levels
Preserve Projects and Plans: • Livestock Grazing Management Plan	Habitat connectivity and conservation	Habitat connectivity and conservation	Conservation of eligible cultural resources in the Mojave Desert region	Domestic livestock are not generally permitted in wilderness areas
Solar Energy Development: • Soda Mountain Energy Development Project	Habitat fragmentation, habitat loss, mortality, reduced reproductive success	Habitat fragmentation, habitat loss, mortality, reduced reproductive success	Loss of local cultural resources at disturbed sites	Impacts on Preserve viewshed and noise levels
Military, Industrial, Agricultural, and Mining Projects: • Fort Irwin National Training Center expansion • Twentynine Palms Marine Corps Air Ground Combat Center expansion • Cadiz Water Project	Habitat fragmentation, habitat loss, mortality, reduced reproductive success	Habitat fragmentation, habitat loss, mortality, reduced reproductive success	Loss of local cultural resources at disturbed sites	Impacts on Preserve viewshed and noise levels

Wildlife – Desert Bighorn Sheep

This analysis describes how the proposed plan alternatives could affect the quality of desert bighorn sheep habitat in the Preserve. As described in detail in *Chapter 3: Affected Environment*, desert bighorn sheep are a State of California fully protected species that use both natural and developed water sources (i.e., big game guzzlers) for survival.

Methods and Assumptions

General bighorn habitat in the Preserve is based on seven habitat patches outlined by Creech et al. (2014) (see Figure 2). The NPS created a model to better understand the relationship between landscape and environmental variables and big horn sheep use during the dry season (see *Chapter 3: Affected Environment* and Appendix B). The model indicates that dry season habitat can be understood as an area that provides suitable habitat for bighorn within 2.5 kilometers of a reliable water source (either a spring or guzzler) during the hot summer months of June, July, and August. This range was selected based on GPS collar data gathered from ewes in the Old Dad Mountain area (see Figure 18 and *Chapter 3: Affected Environment*, “Bighorn Habitat in the Preserve”), and on existing studies (Turner et al. 2004; Valdez and Krausman 1999). Ninety-three percent of the location data points for the collared ewes during dry season occurred within this radius (see Figure 18). Dry season habitat is important for bighorn sheep conservation because the availability of water during the summer months is critical for ewe and lamb survival.

The analysis quantifies and compares the dry season habitat value predicted for the separate guzzlers under each alternative. Habitat value indicates the contribution a guzzler makes to the overall quality of the Preserve’s dry season habitat based on a model to infer the habitat preferences of ewes during the dry season using radio collar data and environmental variables (see *Chapter 3: Affected Environment* and Hughson 2018—Appendix B). Proximity to water and relatively high elevations emerged as the two variables that best predicted ewes’ dry season habitat preferences, and were used to develop a habitat value index. The dry season habitat value predicted under each action alternative is expressed as a percentage of the existing conditions (No Action), which is equal to 100 percent (see Figure 21). The percent change to dry season habitat under each alternative compared to the existing conditions is summarized in Table 18 and Figure 21.

Table 18. Change to Habitat Value under Each Alternative

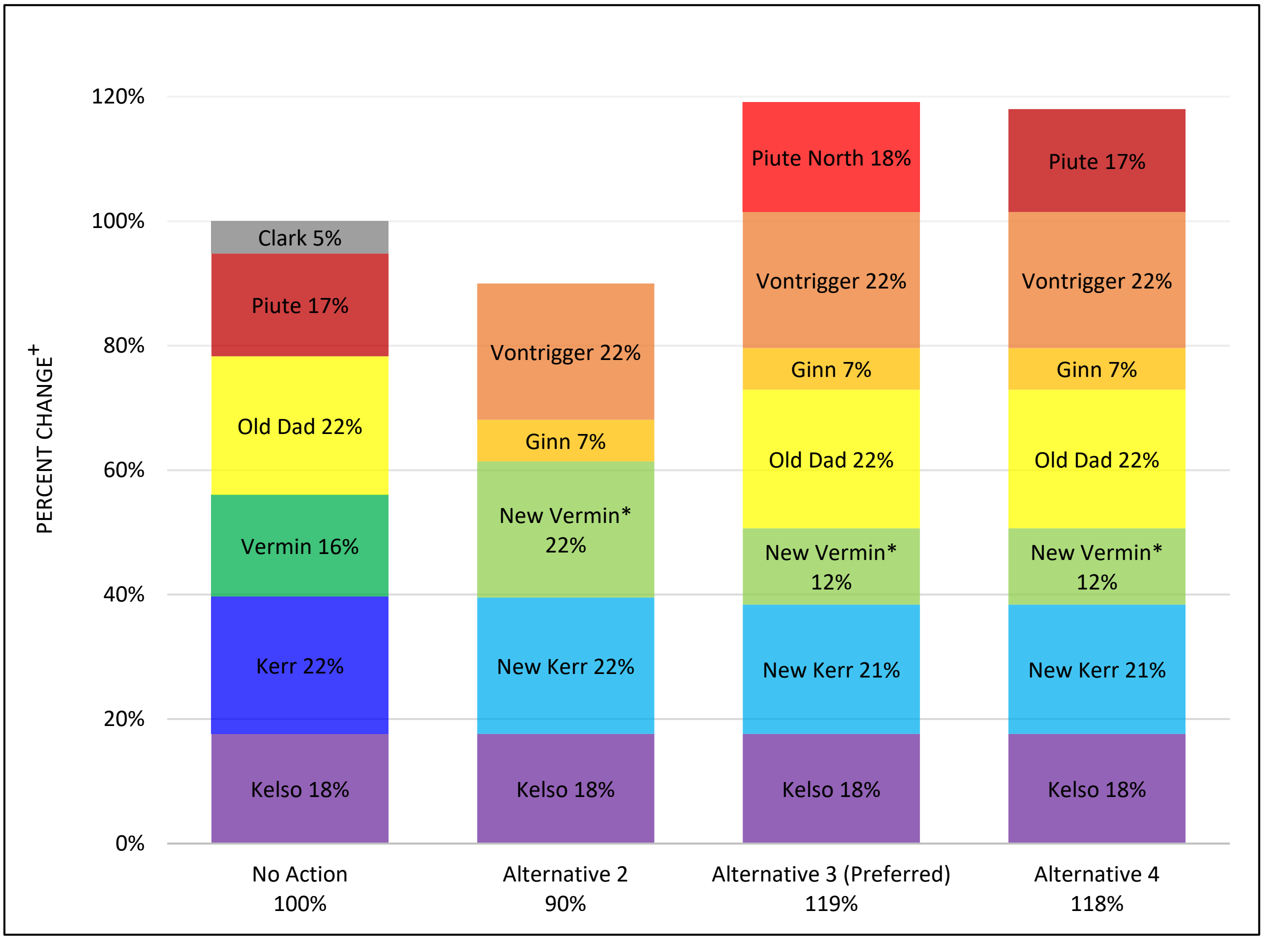
Alternative	Description of Big Game Guzzler Actions	% Change
No Action	Existing guzzler arrangement	no change
Alternative 2	3 removed, 2 relocated, 1 retained, 2 new	-10
Alternative 3 (Preferred Alternative)	2 removed, 2 relocated, 2 retained, 3 new	+19
Alternative 4	1 removed, 2 relocated, 3 retained, 2 new	+18

Context

At least six bighorn populations occur in the Preserve, each associated with rugged mountain ranges where suitable habitat exists (“habitat patches” per Creech et al. 2014; see Figure 2). While several of these habitat patches contain natural water sources, some populations use supplemental water provided by six big game guzzlers. The largest bighorn population in the Preserve—Old Dad/Kelso—uses guzzlers exclusively for water during the dry season, while the Clark Mountain guzzler is in a location that is not known to be used by sheep.

The benefits and effects of artificial water sources on bighorn populations is a debated topic. Several studies, including Longshore et al. (2009) and Bleich et al. (2010), describe the benefits of guzzlers to bighorn populations and their conservation and provide a basis for concerns about the consequences of reduced dry season habitat, such as reduced reproductive success, changes in movement and dispersal patterns, increased mortality, or increased predation. Others, including Cain (2006) and Cain et al. (2007), question the singular importance of developed water sources to bighorn population persistence, suggesting a greater importance of forage availability. This analysis adopts the cautious assumption that the availability of some type of water source during the dry season is a requisite characteristic for long-term habitat occupancy. This assumption is supported by the observations of Preserve staff and by some published literature (see citations in Hughson 2018—Appendix B). If dry season water is less important than assumed in this analysis, actual impacts of the action alternatives would be less than those predicted here.

Figure 21. Dry Season Habitat Value for Each Guzzler under No Action and Action Alternatives



+Percentages are based on the dry season habitat value index, which incorporates distance to water and elevation within 2.5 kilometers of a guzzler or water source (Hughson 2018—Appendix B). The dry season habitat value percentage for each action alternative is the sum of all guzzlers' contributions to habitat value. Action alternative percentages are in reference to existing conditions (No Action), which equals 100 percent.
*Alternative percentages for New Vermin differ due to retention of Old Dad and 2.5 km overlap with Vermin.

Looking more broadly at regional metapopulation implications, several studies, such as Bleich et al. (1996), Epps et al. (2006), Epps et al. (2007, 2010), and Creech et al. (2014), support the importance of regional bighorn connectivity and potential benefits of restoring migration corridors and unoccupied habitat patches. Longshore et al. (2009) and Bleich (2009) describe the importance of artificial water sources as mitigation for the loss of naturally occurring water sources and habitat that has resulted from development and climate change. For this analysis, it is assumed that habitat occupancy or connectivity could be encouraged by the addition of a water source or sources in areas lacking water but featuring other requisite habitat characteristics (e.g., ruggedness).

Each alternative includes a set of actions for the management or disposition of big game guzzlers in a manner that is consistent with the overall objectives of that alternative. The plans for big game guzzlers are described in detail in *Chapter 2: Alternatives* and are summarized in Table 19.

This analysis focuses on the change in modeled dry season habitat under the different alternatives. With this approach, the NPS can quantify changes in the value of available dry season habitat and can draw general conclusions about the effects of those changes on sheep populations. However, this analysis does not attempt to quantify the effects of dry season habitat value changes on the size of bighorn populations, the amount of habitat, the health of bighorn populations, or the number of individual animals that would be affected. That level of analysis would require detailed and complex multiyear studies of each bighorn population to observe and document changes in population size or health. Such studies would require time-intensive or cost-prohibitive monitoring (field observations and GPS data); would be confounded by external variables including precipitation and forage variability, long-term climate change, and disease; and would be limited to only a few population units at a time. Instead, for the purposes of this analysis, the NPS elected to analyze the change in modeled dry season habitat, which can be used as an indicator of change for bighorn populations.

Table 19. Summary of Implementation Actions for Big Game Guzzlers

Guzzler	Alternative 2	Alternative 3 (Preferred Alternative)	Alternative 4
Clark	Remove	Remove	Remove
Piute	Remove	Remove	Retain
Old Dad	Remove	Retain	Retain
Kelso	Retain	Retain	Retain
Kerr	Relocate	Relocate	Relocate
Vermin	Relocate	Relocate	Relocate
New Water Sources	Two sites outside wilderness	Three sites outside wilderness	Two sites outside wilderness
Total Guzzlers	5	7	7
Within wilderness	1	2	4
Outside wilderness	4	5	3

Cumulative Impacts Common to All Alternatives

The past, present, and reasonably foreseeable future actions that may result in cumulative impacts on bighorn sheep within the Preserve are listed in Table 17 and are discussed in *Chapter 3: Affected Environment* in the "Regional Context" section. The activities that have affected and would continue to affect desert bighorn sheep resources are human development and disturbance, which include existing and proposed infrastructure, solar energy development, and military, industrial, agricultural, and mining projects; land management plans and actions; and Preserve projects and plans, which include designation of national monuments, resource management plans, and Preserve-sponsored projects.

Human Development and Disturbance

As discussed in *Chapter 3: Affected Environment*, desert bighorn sheep tend to use lower-elevation bajadas and alluvial fans to forage, in addition to the rocky steep mountain slopes, and may move significantly among mountain ranges (Bleich et al. 1990). Human development within the Mojave Desert region poses substantial barriers to sheep migration and the ability of individuals and herds to access adequate forage during dry seasons. Human-wildlife conflict may increase as a result of development, and individuals and herds may be deterred from migration corridors by human presence and development. While these activities taken together would result in local to regional long-term adverse impacts on the species, none of the alternatives would significantly alter the level of impacts on bighorn sheep populations when compared with existing conditions.

Existing and Proposed Infrastructure

The Mojave Desert region is crossed by transmission lines and energy infrastructure that is associated with energy development, highways, railways, canals and aqueducts, and small population centers, in addition to mines, military installations, and industrial solar development (discussed below). These developments have resulted in habitat fragmentation, habitat loss, reduced reproductive success, and potential mortality of individual bighorn sheep by creating barriers for herds and individuals that may cross areas to access water and forage. While these activities taken together would result in local to regional long-term adverse impacts on the species, none of the alternatives would significantly alter the level of impacts on bighorn sheep populations when compared with existing conditions.

Solar Energy Development and Plans

The three existing and one proposed industrial-scale solar energy developments close to the Preserve, including the solar energy development zones (SEZs) identified in the Desert Renewable Energy Conservation Plan (DRECP), are located in valleys below mountain ranges both within and outside of the Preserve (see Figure 1). Solar energy development in the Mojave Desert region poses long-term adverse impacts on bighorn sheep populations similarly to the impacts from infrastructure through habitat fragmentation, habitat loss, reduced reproductive success, and potential mortality of individual bighorn sheep by creating barriers for herds and individuals that may cross areas to access water and forage.

Military, Industrial, Agricultural, and Mining Projects

The presence and development of military installations, mines, and industrial and agricultural facilities in the Mojave Desert region poses long-term adverse impacts on bighorn sheep populations similarly to the impacts from infrastructure and solar development: habitat fragmentation, habitat loss, reduced reproductive success, and potential mortality of individual bighorn sheep by creating barriers for herds and individuals that may cross areas to access water and forage.

Land Management Plans and Actions

The designation of the Mojave Trails, Sand to Snow, and Castle Mountain National Monuments establishes areas within the Mojave Desert region and close to the Preserve where desert bighorn sheep habitat would be left undeveloped, thus providing corridors for sheep to migrate for forage and water if needed. Castle Mountain, located adjacent to the east side of the Preserve, contributes to habitat connectivity between the New York, Castle, and Piute mountain ranges, as well as to the Lanfair Valley. Several water features are in the eastern portion of the Preserve close to Castle Mountain National Monument. The Mojave Trails National Monument would provide potential habitat connectivity among the mountain ranges to the south and west of the Preserve. The Sand to Snow National Monument, located west of the Preserve, would likely have a less notable effect on habitat connectivity due to its distance from the Preserve. All of the alternatives would beneficially, although not significantly, alter the level of impact from these new designations. Nuances to the ways the alternatives would alter the level of impact are discussed under each alternative below.

Impacts of the Alternatives

Alternative 1 – No Action

Under the No Action Alternative, all six big game guzzlers would remain in place. Management and repair of guzzlers, including emergency filling and repairs, would occur on an as-needed basis. Continuation of current management and existing conditions under the No Action Alternative would not affect the amount or availability of dry season habitat available to bighorn sheep populations.

Cumulative Impacts

The cumulative impacts from past, present, and reasonably foreseeable future actions that are caused by human disturbance in the region, and by the implementation of Preserve projects and plans, are the same for all alternatives and are discussed above in the “Cumulative Impacts Common to All Alternatives” section.

While human disturbance and development projects would result in local to regional long-term adverse impacts on bighorn sheep, the No Action Alternative would not alter the level of the impacts in that it would not further inhibit bighorn movement or reduce habitat availability. Likewise, the No Action Alternative, with its passive and ad hoc approach to management, would not alter the regional long-term beneficial impacts from new national monument designations.

Conclusion

Overall, the No Action Alternative would be a continuation of the existing management approach, resulting in no effects on bighorn sheep populations in the Preserve compared with the existing conditions. The No Action Alternative would beneficially but not significantly alter the level of cumulative effects from human disturbance and the implementation of other plans and projects.

Alternative 2

At full implementation, Alternative 2 would include the removal of the Clark, Piute, and Old Dad guzzlers and the relocation of the Kerr and Vermin guzzlers to outside of wilderness (Figure 22). The Kelso guzzler would remain in place. Two new potential guzzlers (Ginn and Vontrigger) would be considered outside of wilderness for native wildlife habitat connectivity, including bighorn sheep. Each of these actions would occur in a deliberate and stepwise fashion, supported by monitoring and evaluation, to ensure that the intended changes in water availability are achieved without resulting in unacceptable impacts on bighorn populations, as outlined above in *Chapter 2: Alternatives* and in Figure 3. To achieve the desired outcome of minimizing wilderness intrusion while maintaining sustainable bighorn populations, Alternative 2 focuses on the strategic relocation of existing guzzlers and establishment of new guzzlers to support bighorn populations.

Preserve-Wide Dry Season Habitat Value

At full implementation of all big game guzzler actions, Alternative 2 would result in a 10 percent decrease in dry season habitat value, compared to existing conditions (see Figure 22 and Table 18). The removal of Clark, Piute, and Old Dad would decrease habitat value by 44 percent, while the relocation of Vermin (to New Vermin) and Kerr (to New Kerr) would increase habitat value by 6 percent. The development of the Ginn and Vontrigger guzzlers would increase habitat value by 29 percent. The 10 percent decrease in the overall dry season habitat value would result in a relatively small loss of dry season habitat value in the Preserve, with more substantial local effects on dry season habitat values.

Old Dad/Kelso Mountains

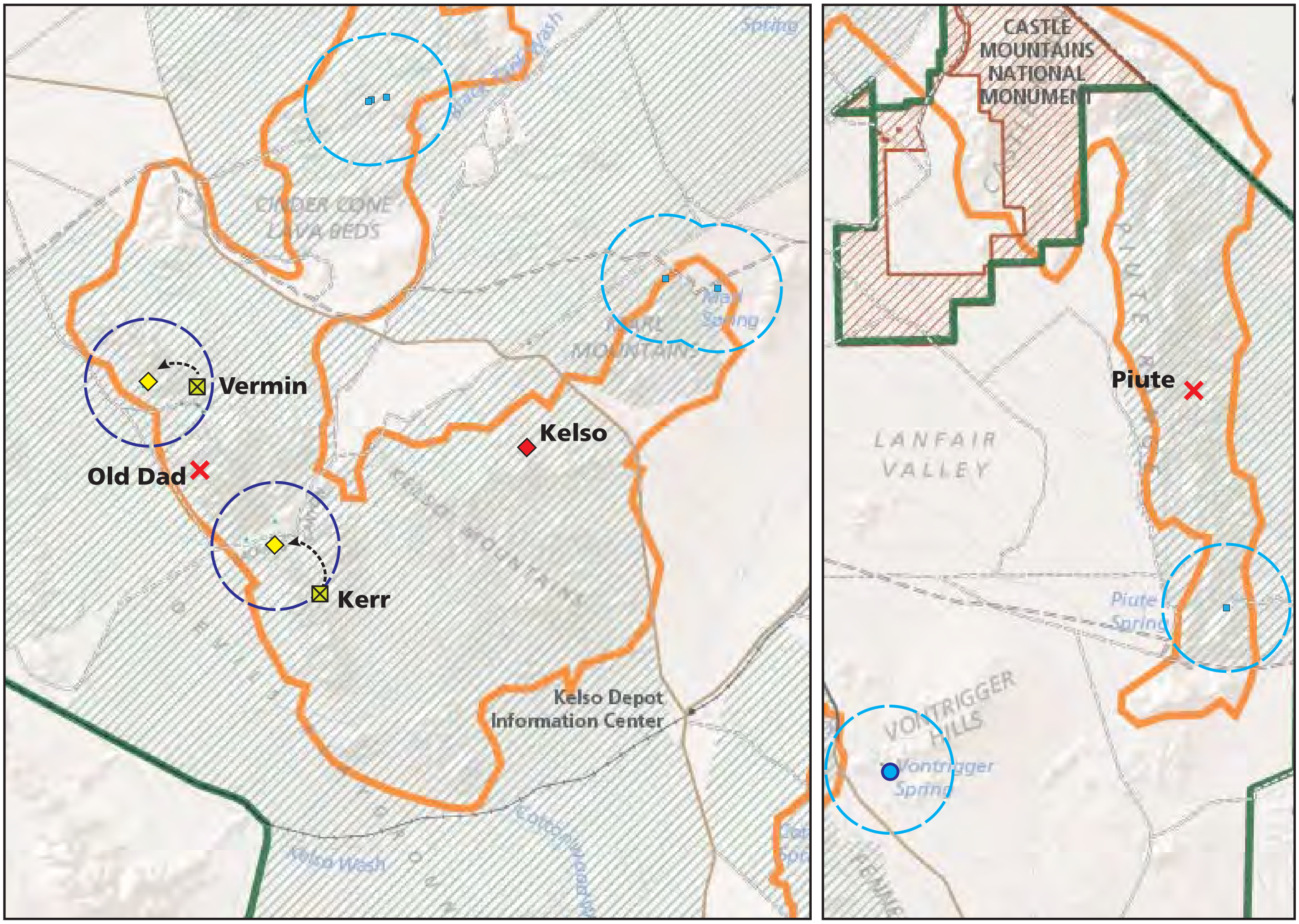
The Old Dad/Kelso Mountain area would experience a decrease of 35 percent in dry season habitat value for the area, mostly from the removal of the Old Dad guzzler. The Old Dad guzzler accounts for about 22 percent of the overall habitat value, but 28 percent of the Old Dad/Kelso Mountains habitat value. The relocation of the Vermin guzzler to New Vermin and Kerr guzzler to New Kerr would result in a combined increase of 6 percent. The Kelso guzzler would continue to support dry season habitat in its present location.

The deactivation of the Old Dad guzzler would result in short-term adverse effects on bighorn individuals and populations accustomed to that particular water source, which would likely result in potential impacts on sheep reproduction and survival of individuals and populations. The NPS expects that most animals and groups of bighorn would use the relocated New Vermin and New Kerr guzzlers, which would be located within or near the 2.5-kilometer radius of the Old Dad guzzler. The removal of the Old Dad guzzler would be completed following the implementation sequence described in *Chapter 2: Alternatives*, only after monitoring has indicated that nearly all bighorn have discovered and are using the New Vermin and New Kerr water sources.

The discovery and use transition from Vermin and Kerr to the relocated New Vermin and New Kerr guzzlers may result in short-term stress to the population, including reduced reproductive success and mortality of some individuals that do not easily adapt to the new location. These changes, however, would be followed by the implementation sequence outlined in Figure 3 and described in *Chapter 2: Alternatives*. The transition to the relocated water sources would take place over an extended period with monitoring of the existing and new guzzler sites to evaluate the discovery and use of the relocated water sources by bighorn. Therefore, while the relocation of two guzzlers would be expected to result in short-term adverse effects on some individuals, the NPS would not allow severe long-term consequences to the overall Old Dad/Kelso population by following the implementation sequence and monitoring. If monitoring indicated that long-term adverse conditions or trends in the population would occur, site-specific mitigation measures, including the reinstatement of existing guzzlers, would be used to avoid significant and adverse long-term effects.

Clark Mountains

The Clark guzzler is not heavily used by bighorn, and additional monitoring of the Clark guzzler would take place before it is deactivated and removed to ensure that bighorn use of the guzzler is rare and adverse impacts would not result. The removal of the Clark guzzler would follow the implementation sequence described in Figure 3 and outlined in *Chapter 2: Alternatives*, and would be subject to site-specific compliance under NEPA and NPS guidance.



- Retain guzzler
- Remove guzzler
- Relocate guzzler
- Guzzler relocation site
- New water source location
- Springs used by bighorn

- Mojave National Preserve boundary
- Bighorn sheep habitat patches (Creech et al. 2014)
- National Park Service wilderness
- 2,500m water source buffer

Mescal/Ivanpah Range

The addition of a water source at Ginn Mine in the Mescal/Ivanpah Range would increase the habitat value in the area. There are no existing guzzlers or developed water sources in this area. The new Ginn water source may support the establishment of a new population in this area, would increase habitat connectivity on the Preserve and the surrounding areas, and would increase the potential for habitat connectivity across I-15 to the north.

Woods/Hackberry Mountains

A new water source at Vontrigger Spring would result in an increase in habitat value in the Woods/Hackberry Mountains. There are no existing guzzlers or developed water sources in this area. The new Vontrigger water source may support the expansion, health, and viability of the area's existing bighorn population; increase habitat connectivity on the Preserve and the surrounding areas; and increase the potential for habitat connectivity across I-40 to the south.

Piute/Castle Mountains

The removal of the Piute guzzler would result in a decrease in dry season habitat value in the area. The Piute guzzler is the only existing developed water source in the area; however, the Piute Springs are nearby undeveloped water sources that support dry season habitat for bighorn. While the NPS expects that most sheep would successfully shift to Piute Springs, some short-term adverse impacts on sheep would be expected during the transition. Deactivation of the Piute guzzler would take place following the process described in *Chapter 2: Alternatives*, and may require monitoring of bighorn through deployment of GPS collars and additional studies, as well as site-specific compliance. There are currently no collared bighorn in the area. If monitoring indicates long-term adverse impacts on sheep and the overall population, or if nearly all bighorn sheep do not discover and use the spring and creek, the Piute guzzler would be reinstated to mitigate any significant impact.

New Water Sources

As discussed above, the two new potential water sources at Vontrigger Spring and Ginn Mine would increase the dry season habitat value in the Woods/Hackberry Mountains and Mescal/Ivanpah Range, respectively, and in the Preserve overall. These new water sources would contribute 29 percent to the overall value of the Preserve's dry season habitat (see Figure 20) and would have a greater impact on dry season habitat value in the areas where they are located. The increases in the area's habitat value would help support regional migration corridors within the Preserve and with other populations to the north and south. In addition, these new non-wilderness water sources could promote the expansion of existing populations in the Woods/Hackberry Mountains and the establishment of a new population in the Mescal/Ivanpah Range. Over the long term, these actions are expected to benefit desert bighorn sheep by expanding populations and improving interpopulation movement and regional metapopulation stability. The timing and magnitude of these benefits are uncertain, but could contribute to long-term bighorn conservation.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions that are considered cumulatively with the effects of Alternative 2 include human disturbance and development and changes to land management plans and actions, particularly the creation of the adjacent Castle Mountains National Monument. Human disturbance and development would continue to have long-term adverse impacts on bighorn sheep by reducing habitat and habitat connectivity in the Mojave

Desert region. Regional impacts on habitat connectivity and migration would be both adversely and beneficially impacted by Alternative 2.

The 10 percent decrease in dry season habitat value would not significantly alter the level of impact from regional human disturbance or Preserve projects and plans, compared with existing conditions. While the dry season habitat value within the Preserve and in the Old Dad/Kelso Mountain, Piute/Castle Mountain, and Clark Mountain areas may result in more pronounced local negative contributions to overall regional impacts, the increase in dry season habitat value from the new water sources at Ginn Mine and Vontrigger Spring would contribute to improved regional habitat connectivity, and to the habitat value in within the Woods/Hackberry Mountains and the Mescal/Ivanpah Range.

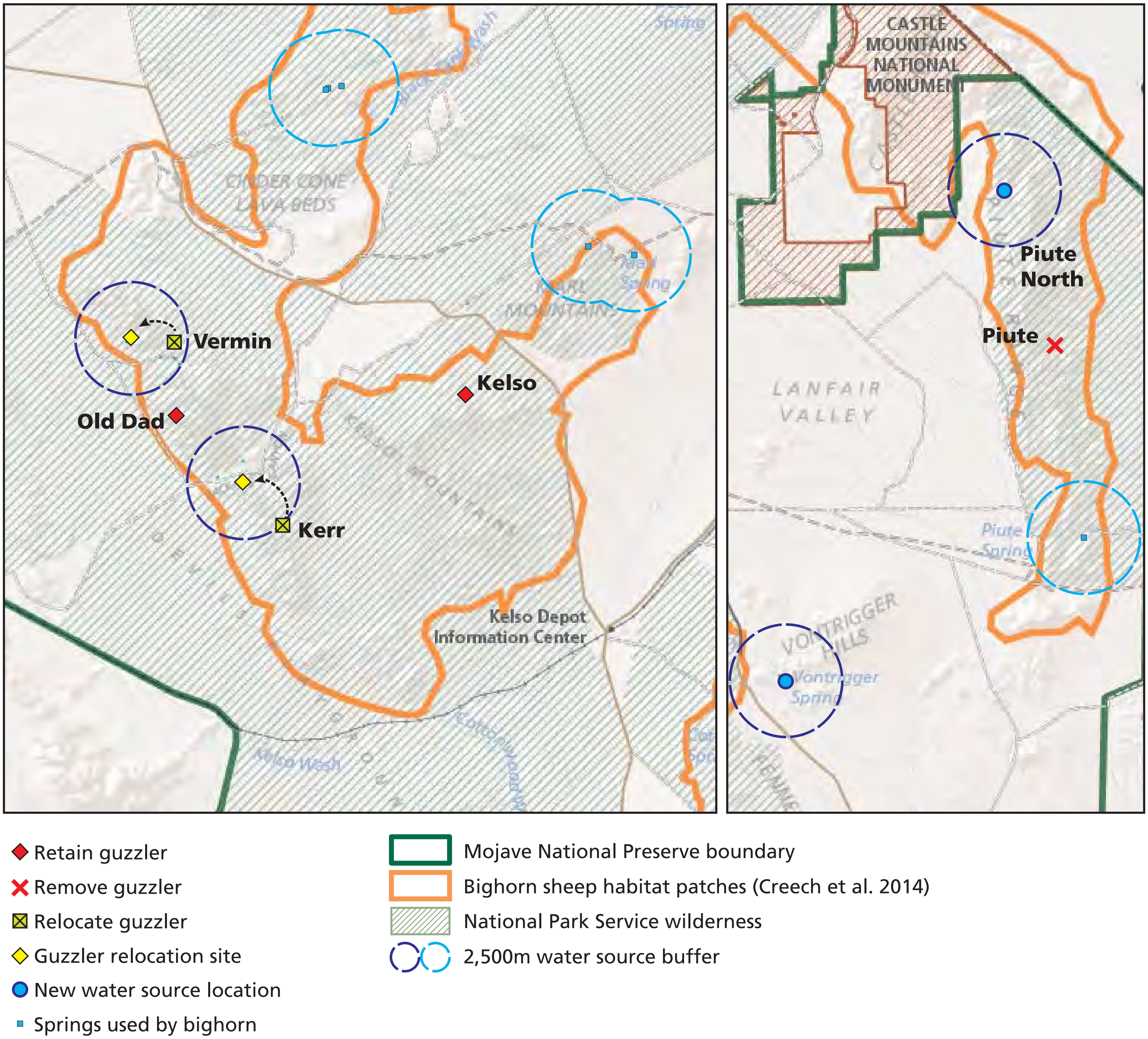
Conclusion

Full implementation of Alternative 2 would result in an overall 10 percent reduction in available dry season habitat across the Preserve. While the Old Dad/Kelso Mountains and Piute/Castle Mountains would experience decreases in dry season habitat value, the long-term improvement of dry season habitat value in the Mescal/Ivanpah Range and Woods/Hackberry Mountains could benefit bighorn populations by improving regional movement and metapopulation stability. The decrease in dry season habitat value would largely be the result of the removal of the Old Dad guzzler and the Piute guzzler. The Clark guzzler is not heavily used by bighorn and would not substantially contribute to the cumulative effects. As a result of implementation and monitoring, the increases in habitat value within the Mescal/Ivanpah Range and Woods/Hackberry Mountains areas, and strategic placement of new water sources, the reduction in dry season habitat would not result in significant adverse effects on bighorn sheep. Overall, no significant adverse cumulative effects are anticipated under Alternative 2.

The NPS expects that the relocation, deactivation, and removal of existing guzzlers could result in short-term adverse effects on some bighorn individuals, including stress, mortality, and reduced lambing rates. Each action would be planned and implemented to avoid the risk of severe impacts on populations. Short-term adverse effects would be balanced and offset by the long-term benefits that would result from relocated guzzlers. The relocation, deactivation, or removal of any guzzler would be subject to site-specific design, implementation, and monitoring, and would be subject to additional compliance under NEPA and NPS guidance (see *Chapter 2: Alternatives*).

Alternative 3 (Preferred Alternative)

Alternative 3 would be similar to Alternative 2 except that the Old Dad guzzler would not be removed, and an additional new water source, the Piute North guzzler, would be implemented in the Piute/Castle Mountains. At full implementation, Alternative 3 would include the removal of the Clark and Piute guzzlers and the relocation of the Kerr and Vermin guzzlers to outside of wilderness (Figure 23). The Old Dad and Kelso guzzlers would remain in place. Three new potential guzzlers (Ginn, Vontrigger, and Piute North) would be considered outside of wilderness for native wildlife habitat connectivity, including bighorn sheep. Each of these actions would occur in a deliberate and stepwise fashion, supported by monitoring and evaluation, to ensure that the intended changes in water availability are achieved without resulting in unacceptable impacts on bighorn populations, as outlined above in *Chapter 2: Alternatives* and Figure 3 and Figure 4. To achieve the desired outcomes of ensuring stable wildlife populations, reducing water developments in wilderness, and improving regional habitat connectivity, Alternative 3 utilizes a blended strategic approach of removals, relocations, retained guzzlers, and new water sources.


CINDER CONE LAVA BEDS
Vermin
Old Dad
Kelso
Kerr
MOUNTAINS
Kelso Depot Information Center
Kelso Wash
CASTLE MOUNTAINS NATIONAL MONUMENT
Piute North
Piute
LANFAIR VALLEY
Piute Spring
VONTRIGGER HILLS
Vontrigger Spring
Retain guzzler
Remove guzzler
Relocate guzzler
Guzzler relocation site
New water source location
Springs used by bighorn
Mojave National Preserve boundary
Bighorn sheep habitat patches (Creech et al. 2014)
National Park Service wilderness
2,500m water source buffer

Preserve-Wide Dry Season Habitat Value

At full implementation of all big game guzzler actions, Alternative 3 would result in a 19 percent increase in dry season habitat value on the Preserve, compared with existing conditions (see Figure 21 and Table 18). The removal of Clark and Piute would decrease habitat value by 23 percent. The relocated New Vermin and New Kerr guzzlers would have slightly less habitat value than the existing Kerr and Vermin guzzlers, due to the continued value of the Old Dad guzzler within proximity to the relocated guzzlers.

The addition of the Piute North, Ginn, and Vontrigger guzzlers would increase habitat value by 47 percent. The increase in the overall dry season habitat value would result in a substantial beneficial overall effect on dry season habitat value on the Preserve, while a variation of effects would occur at smaller scales.

Old Dad/Kelso Mountains

The Old Dad/Kelso Mountain area would experience a decrease of 7 percent in dry season habitat value for the area when compared to the No Action Alternative. This decrease would come from the relocation of the Kerr (to New Kerr) and Vermin (to New Vermin) guzzlers, which would have slightly lower dry season habitat value compared to the existing guzzlers. The Kelso and Old Dad guzzlers would continue to support dry season habitat in their present locations.

As with Alternative 2, the discovery and use transition from Vermin and Kerr to the relocated New Vermin and New Kerr guzzlers may result in short-term stress to the population, including reduced reproductive success and mortality of some individuals that do not easily adapt to the new location. These changes, however, would be followed by the implementation sequence outlined in Figure 3 and Figure 4 and described in *Chapter 2: Alternatives*. The transition to the relocated water sources would take place over an extended period with monitoring of the existing and new guzzler sites to evaluate the discovery and use of the relocated water sources by bighorn. Therefore, while the relocation of two guzzlers would be expected to result in short-term adverse effects on some individuals, the NPS would not allow severe long-term consequences to the overall Old Dad/Kelso population. If monitoring indicated that long-term adverse conditions or trends in the population would occur, mitigation measures, including the reinstatement of existing guzzlers, would be used to avoid significant and adverse long-term effects.

Clark Mountains

The effects on the Clark Mountains would be identical to Alternative 2. The Clark guzzler is not heavily used by bighorn, and additional monitoring of the Clark guzzler would take place before it is deactivated and removed to ensure that bighorn use of the guzzler is rare and adverse impacts would not result. The removal of the Clark guzzler would follow the implementation sequence described in Figure 3 and outlined in *Chapter 2: Alternatives*, and would be subject to site-specific compliance under NEPA and NPS guidance.

Mescal/Ivanpah Range

The effects on the Mescal/Ivanpah Range would be identical to Alternative 2. The addition of a water source at Ginn Mine in the Mescal/Ivanpah Range would increase the habitat value in the area. There are no existing guzzlers or developed water sources in this area. The new Ginn water source may support the establishment of a new population in this area, would increase habitat connectivity on the Preserve and the surrounding areas, and would increase the potential for habitat connectivity across I-15 to the north.

Piute/Castle Mountains

The addition of the Piute North guzzler would increase the habitat value in the Piute/Castle Mountains area by about 7 percent, compared to the habitat value in the area under the No Action Alternative. The loss of habitat value from the removal of the exiting Piute guzzler would be offset by the installation of Piute North, resulting in an increase in dry season habitat value for the area.

As with Alternative 2, the removal of the Piute guzzler would result in a decrease in dry season habitat value in the area. The existing Piute guzzler is the only developed water source in the area; however, the Piute Springs are nearby undeveloped water sources that support dry season habitat for bighorn. The Piute North guzzler would be installed before the Piute guzzler was deactivated and removed, providing an additional water source for bighorn in the area. While the NPS expects that most sheep would successfully shift to Piute Springs and Piute North, some short-term adverse impacts on sheep would be expected during the transition.

Deactivation of the Piute guzzler would take place following the process described in *Chapter 2: Alternatives*, and may require monitoring of bighorn through deployment of GPS collars and additional studies, as well as site-specific compliance. There are currently no collared bighorn in the area. If monitoring indicates long-term adverse impacts on sheep and the overall population, or if nearly all bighorn sheep do not discover and use the spring and creek, the Piute guzzler would be reinstated to mitigate any significant impact.

New Water Sources

As discussed above, the development of three new potential water sources at Vontrigger Spring, Piute North, and Ginn Mine would increase the Preserve's dry season habitat value by 47 percent and could help support regional migration corridors within the Preserve and to other populations to the north and south. In addition, these new non-wilderness water sources could promote the expansion of existing populations in the Piute/Castle Mountains and Woods/Hackberry Mountains, and the establishment of a new population in the Mescal/Ivanpah Range. The Piute North guzzler would offset the loss of habitat value from the deactivation and removal of the existing Piute guzzler. Over the long term, these actions are expected to benefit desert bighorn sheep by expanding populations and improving interpopulation movement and regional metapopulation stability. The timing and magnitude of these benefits are uncertain, but they could contribute to long-term bighorn conservation.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions that are considered cumulatively with the effects of Alternative 3 include human disturbance and development and changes to land management plans and actions, particularly the creation of the adjacent Castle Mountains National Monument. Human disturbance and development would continue to have long-term adverse impacts on bighorn sheep by reducing habitat and habitat connectivity in the Mojave Desert region. Those regional impacts would be reduced by efforts in Alternative 3 to improve regional migration corridors and connectivity.

The 19 percent increase in dry season habitat value under Alternative 3 may benefit regional habitat conditions, potentially offsetting some of the impacts from regional human disturbance or Preserve projects and plans, compared with existing conditions. The decreases in dry season habitat value within the Old Dad/Kelso and Clark areas are not likely to result in substantial contributions to the regional trends. The decrease in habitat value in the Old Dad/Kelso area would be slight, and the Clark guzzler is not heavily used by bighorn. Increases in habitat value in the Piute/Castle, Mescal/Ivanpah, and Woods/Hackberry areas may result in local beneficial contributions to overall regional impacts. The increase in dry season habitat value from the new water sources at Piute North, Ginn Mine, and Vontrigger Spring would contribute to improved regional habitat connectivity, as well as to the habitat value in the Woods/Hackberry Mountains and the Mescal/Ivanpah Range.

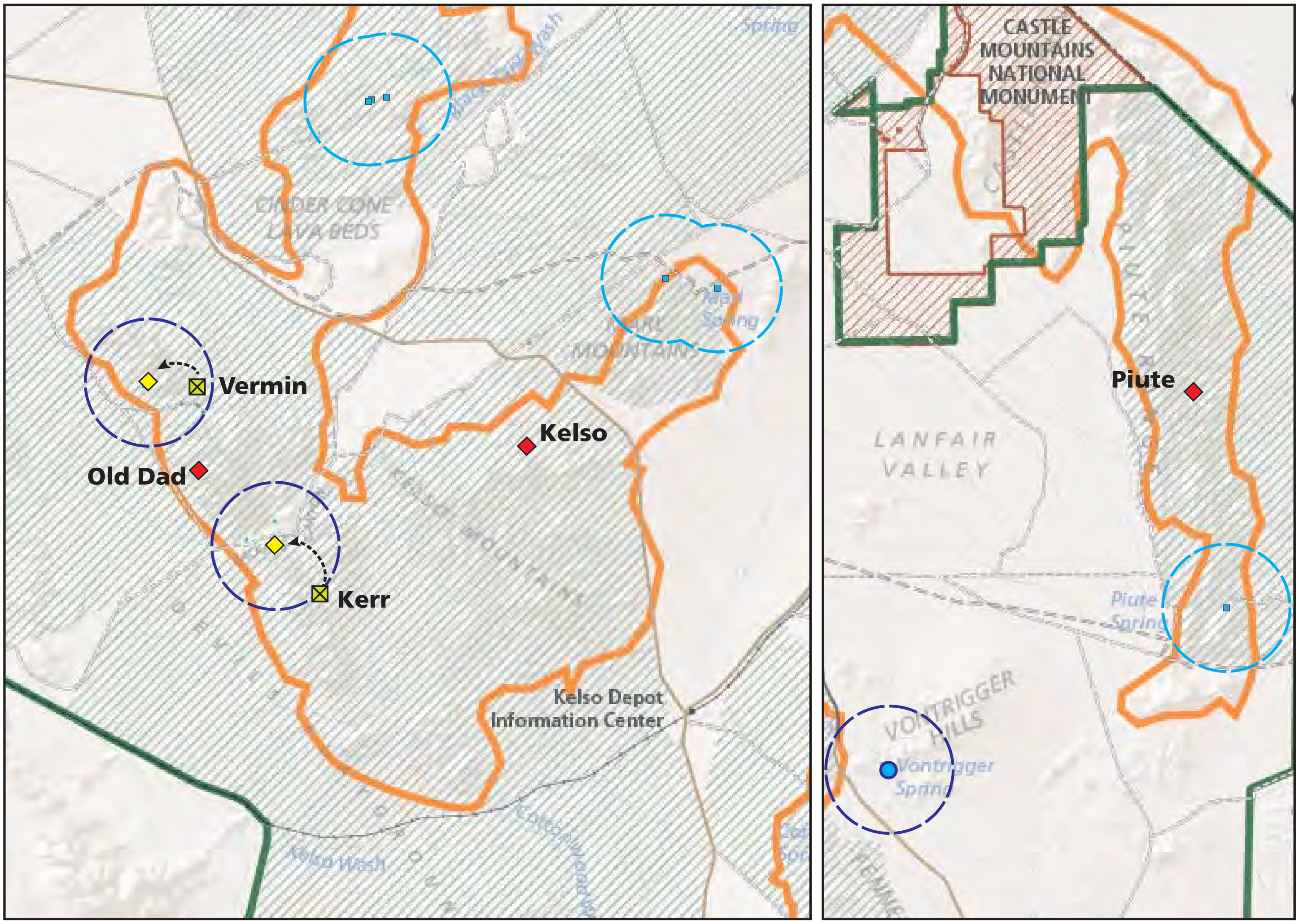
Conclusion

Full implementation of Alternative 3 would result in a 19 percent increase in dry season habitat value across the Preserve. While the Old Dad/Kelso Mountains would experience a slight decrease in dry season habitat value, the long-term improvement of dry season habitat value in the Piute/Castle Mountains, Mescal/Ivanpah Range, and Woods/Hackberry Mountains could benefit bighorn populations by improving regional movement and metapopulation stability. The Clark guzzler is not heavily used by bighorn and would not substantially contribute to the cumulative effects. This expansion in dry season habitat, combined with the implementation and monitoring protocol, would benefit bighorn sheep in the Preserve. As a result of the increases in the Preserve's overall habitat value through strategic placement of new water sources, Alterative 3 would result in significant beneficial effects on bighorn sheep in the Preserve. The increase in dry season habitat and connectivity in Alternative 3 would potentially offset some of the cumulative effects of regional habitat loss, though the overall cumulative benefit on regional populations would be limited.

The NPS expects that the relocation, deactivation, and removal of existing guzzlers could result in short-term adverse effects on some bighorn individuals, including stress, mortality, and reduced lambing rates. Each action would be planned and implemented to avoid the risk of severe impacts on populations. Short-term adverse effects would be balanced and offset by the long-term benefits that would result from relocated guzzlers. The relocation, deactivation, or removal of any guzzler would be subject to site-specific design, implementation, and monitoring, and would be subject to additional compliance under NEPA and NPS guidance (see *Chapter 2: Alternatives*).

Alternative 4

Alternative 4 would be similar to Alternative 3 except that the Piute guzzler would not be removed, and the Piute North guzzler would not be implemented. At full implementation, Alternative 4 would include the removal of the Clark guzzler and the relocation of the Kerr and Vermin guzzlers to locations outside of wilderness (Figure 24). The Kelso and Old Dad guzzlers would remain in place. Two new potential guzzlers (Ginn and Vontrigger) would be considered outside of wilderness for native wildlife habitat connectivity, including bighorn sheep. Each of these actions would occur in a deliberate and stepwise fashion, supported by monitoring and evaluation, to ensure that the intended changes in water availability are achieved without resulting in unacceptable impacts on bighorn populations, as outlined above in *Chapter 2: Alternatives* and in Figure 3. To achieve the desired outcome of augmenting existing habitat in the Preserve and maintaining or developing connections between the Preserve and surrounding habitat in the larger landscape, Alternative 4 focuses on the strategic relocation and maintenance of existing guzzlers, and establishment of new guzzlers to support bighorn populations.



- ◆ Retain guzzler
- ✕ Remove guzzler
- ⊠ Relocate guzzler
- ◇ Guzzler relocation site
- ● New water source location
- ▪ Springs used by bighorn

- Mojave National Preserve boundary
- Bighorn sheep habitat patches (Creech et al. 2014)
- National Park Service wilderness
- 2,500m water source buffer

Preserve-Wide Dry Season Habitat Value

At full implementation of all big game guzzler actions, Alternative 4 would result in an 18 percent increase in dry season habitat value, compared to existing conditions (see Figure 21 and Table 18). The removal of the Clark guzzler would decrease in habitat value by 5 percent, while the relocation of Vermin (to New Vermin) and Kerr (to New Kerr) would decrease habitat value by 5 percent. The addition of the Ginn and Vontrigger guzzlers would increase habitat value by 29 percent. The increase in the overall dry season habitat value would result in a substantial beneficial overall effect on dry season habitat value on the Preserve, while a variation of effects would occur at smaller scales.

Old Dad/Kelso Mountains

The effects on the Old Dad/Kelso Mountain area would be identical to Alternative 3, with a slight decrease of 7 percent in dry season habitat value for the area when compared to the No Action Alternative. This decrease would come from the relocation of the Kerr (to New Kerr) and Vermin (to New Vermin) guzzlers, which would have slightly lower dry season habitat value compared to the existing guzzlers. The Kelso and Old Dad guzzlers would continue to support dry season habitat in their present locations.

As with Alternative 3, the discovery and use transition from Vermin and Kerr to the relocated New Vermin and New Kerr guzzler sites may result in short-term stress to the population, including reduced reproductive success and mortality of some individuals that do not easily adapt to the new locations. These changes, however, would be followed by the implementation sequence outlined in Figure 3 and Figure 4 and described in *Chapter 2: Alternatives*. The transition to the relocated water sources would take place over an extended period with monitoring of the existing and new guzzler sites to evaluate the discovery and use of the relocated water sources by bighorn. Therefore, while the relocation of two guzzlers would be expected to result in short-term adverse effects on some individuals, the NPS would not allow severe long-term consequences to the overall Old Dad/Kelso population. If monitoring indicates that long-term adverse conditions or trends in the population would occur, mitigation measures, including the reinstatement of existing guzzlers, would be used to avoid significant and adverse long-term effects.

Clark Mountains

The effects on the Clark Mountains would be identical to Alternatives 2 and 3. The Clark guzzler is not heavily used by bighorn, and additional monitoring of the Clark guzzler would take place before it is deactivated and removed to ensure that bighorn use of the guzzler is rare and adverse impacts would not result. The removal of the Clark guzzler would follow the implementation sequence described in Figure 3 and outlined in *Chapter 2: Alternatives*, and would be subject to site-specific compliance under NEPA and NPS guidance.

Mescal/Ivanpah Range

The effects on the Mescal/Ivanpah Range would be identical to Alternatives 2 and 3. The addition of a water source at Ginn Mine in the Mescal/Ivanpah Range would increase the habitat value in the area. There are no existing guzzlers or developed water sources in this area. The new Ginn water source may support the establishment of a new population in this area, would increase habitat connectivity on the Preserve and the surrounding areas, and would increase the potential for habitat connectivity across I-15 to the north.

Woods/Hackberry Mountains

The effects on the Woods/Hackberry Mountains would be identical to Alternatives 2 and 3. A new water source at Vontrigger Spring would result in an increase in habitat value in the Woods/Hackberry Mountains. There are no existing guzzlers or developed water sources in this area. The new Vontrigger water source may support the expansion, health, and viability of the area's existing bighorn population; increase habitat connectivity on the Preserve and the surrounding areas; and increase the potential for habitat connectivity across I-40 to the south.

Piute/Castle Mountains

There would be no change to dry season habitat value in the Piute/Castle Mountains. The Piute guzzler is the only existing developed water source in the area and would remain in its present location and be maintained as needed. The Piute Springs are nearby undeveloped water sources that also support dry season habitat for bighorn.

New Water Sources

The effects of the new water sources would be identical to Alternative 2. The two potential new water sources at Vontrigger Spring and Ginn Mine would increase the dry season habitat value in the Woods/Hackberry Mountains and Mescal/Ivanpah Range, respectively, and in the Preserve overall. These new water sources would contribute 29 percent to the overall value of the Preserve's dry season habitat (see Figure 21) and would have a greater impact on dry season habitat value in the areas where they are located. The increases in the areas' habitat values would help support regional migration corridors within the Preserve and with other populations to the north and south. In addition, these new non-wilderness water sources could promote the expansion of existing populations in the Woods/Hackberry Mountains and the establishment of a new population in the Mescal/Ivanpah Range. Over the long term, these actions are expected to benefit desert bighorn sheep by expanding populations and improving interpopulation movement and regional metapopulation stability. The timing and magnitude of these benefits are uncertain, but they could contribute to long-term bighorn conservation.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions that should be considered cumulatively with the effects of Alternative 4 include ongoing human disturbance and development in the region, creation of the adjacent Castle Mountains National Monument, and implementation of Preserve projects and plans. Human disturbance and development would continue to have long-term adverse impacts on bighorn sheep by reducing habitat and habitat connectivity in the Mojave Desert region. Those regional impacts would be reduced by efforts in Alternative 4 to improve regional migration corridors and connectivity.

The 18 percent increase in the Preserve's dry season habitat value under Alternative 4 may benefit regional habitat conditions, potentially offsetting some of the impacts from regional human disturbance or Preserve projects and plans, compared with existing conditions. The decreases in dry season habitat value within the Old Dad/Kelso and Clark areas are not likely to result in substantial contributions to the regional trends. Increases in habitat value in the Piute/Castle, Mescal/Ivanpah, and Woods/Hackberry areas may result in local beneficial contributions to overall regional impacts. The increase in dry season habitat value from the new water sources at Ginn Mine and Vontrigger Spring would contribute to improved regional habitat connectivity, as well as to the habitat value in the Woods/Hackberry Mountains and the Mescal/Ivanpah Range.

Conclusion

Full implementation of Alternative 4 would result in an 18 percent increase in dry season habitat value across the Preserve. The Old Dad/Kelso Mountains would experience a slight decrease in dry season habitat value, and the Piute/Castle Mountains would experience no change to dry season habitat value. The long-term improvement of dry season habitat value in the Mescal/Ivanpah Range and Woods/Hackberry Mountains could benefit bighorn populations by improving regional movement and metapopulation stability. The Clark guzzler is not heavily used by bighorn and would not substantially contribute to the cumulative effects. This expansion in dry season habitat, combined with the implementation and monitoring protocol, would benefit bighorn sheep in the Preserve. As a result of the increases in the Preserve's overall habitat value through strategic placement of new water sources, Alterative 4 would result in significant beneficial effects on bighorn sheep. The increase in dry season habitat and connectivity in Alternative 4 would potentially offset some of the cumulative effects of regional habitat loss, though the overall cumulative benefit on regional populations would be limited.

The NPS expects that the relocation, deactivation, and removal of existing guzzlers could result in short-term adverse effects on some bighorn individuals, including stress, mortality, and reduced lambing rates. Each action would be planned and implemented to avoid the risk of severe impacts on populations. Short-term adverse effects would be balanced and offset by the long-term benefits that would result from relocated guzzlers. The relocation, deactivation, or removal of any guzzler would be subject to site-specific design, implementation, and monitoring, and would be subject to additional compliance under NEPA and NPS guidance (see *Chapter 2: Alternatives*).

Wildlife – General

This section describes how the proposed plan alternatives would affect general wildlife species (excluding desert bighorn sheep) in the Preserve. This analysis is focused on native and introduced species that commonly occur in the various habitat types in the Preserve including more than 300 bird, 49 mammal, 38 reptile and amphibian, and 1 native fish species. Special status species, including federally or state-listed threatened and endangered species, are also discussed in this analysis. Desert bighorn sheep are analyzed separately above.

Methods and Assumptions

This analysis discusses the potential effects of proposed changes to water resource management on both general and special status wildlife species. For general wildlife, the primary focus of the analysis is the continued availability of surface water sources and how changes to surface water availability may affect both native and introduced species. Potential changes to water resource management that may affect wildlife include the removal, relocation, or maintenance of big game or small game guzzlers, the maintenance and management of select springs and water developments, and the continued neglect of water features.

The evaluation of potential effects of changes to surface water availability to wildlife is based on assumptions about the reliance of wildlife species on developed or artificial water sources. The specific context of wildlife in the Preserve is described below. Based on the understanding of the reliance of general wildlife species on artificial water sources, the following assumptions were used in this analysis:

- The presence of artificial water sources, such as guzzlers and developed springs, may support stopover habitat for migratory birds and localized habitat for small mammals, herpetofauna, and mule deer.

- Changes to or loss of individual water sources could negatively affect individual animals or groups in localized areas, but are less likely to affect regional population stability or species diversity; this is true for both terrestrial wildlife and migratory birds.
- Changes to or loss of individual guzzlers or water sources could negatively affect individual and localized groups of game birds (e.g., quail), while others would be less affected.
- Changes to or loss of small groups of water sources in the Preserve are expected to have limited effects on regional wildlife populations considering the above points and the presence of about 450 known water sources.
- All of the plan alternatives, including No Action, include continued loss and deterioration of many guzzlers and springs due to long-term neglect. This condition, and its effects, would largely continue under the plan alternatives and would be exacerbated under Alternatives 2 and 3.
- Any impacts on general wildlife that do occur would be indirect, due to alteration of habitat or water availability, and would occur over the long term—no proposed actions would directly impact or take individual animals.
- Maintenance or improvement of developed springs would benefit local wildlife, but those benefits would be proportionally small and localized and would not affect regional population stability or species diversity.

Small game guzzlers would be evaluated for their ecological importance through monitoring and evaluation. The impacts from implementation of non-wilderness small game guzzler actions on resident, migratory, and game birds would include reducing water levels of and blocking access to randomly selected guzzlers, observing the age ratios of Gambel's quail at guzzlers, tracking the locations of GPS-fitted quail in relation to the location of water sources, and conducting point counts of avian species at random locations within 3.2 kilometers of guzzlers during the month of April. Age ratios would help the NPS understand if neglecting small game guzzlers impacts the mortality and survival of Gambel's quail. Location data would help the NPS understand habitat selection in relation to water sources. Recorded call count surveys would help the NPS understand the importance of water sources for the diversity of bird species in the Preserve. Based on the results of the monitoring for ecological importance of 10 to 25 guzzlers (dependent on the alternative), individual guzzlers would be maintained, improved, removed, or neglected (see "Implementation of Alternatives by Water Feature Type" in *Chapter 2: Alternatives*).

Context

The evaluation of potential effects of changes to surface water availability on wildlife is based on assumptions about the reliance of wildlife species on developed or artificial water sources. The general effects that wildlife may experience from the removal of developed water features is discussed in depth in *Chapter 3: Affected Environment* in the "Other Wildlife Species" section and outlined in Table 20. A brief review of potential impacts on general wildlife species groups is discussed below.

Table 20. Effects from Removal of Developed Water Features by Species Group

Species Group	Use Guzzlers?	Use Springs?	Notes
Herpetofauna, small mammals, and carnivores	Yes	Yes	Local impacts on affected sites
Migratory and resident birds	Migratory – No Resident – Yes	Yes	Migratory bird local impacts on riparian habitat and raptors Open water appears to be preferred by resident bird species
Game birds	Yes	Yes	Greater impact on dove species
Bats	No	Yes	Localized—spring sites with open troughs or pools
Ungulates	No*	Yes	Mule deer use springs/free-standing water; *Clark guzzler used by mule deer

Cumulative Impacts Common to All Alternatives

The past, present, and reasonably foreseeable actions that may result in cumulative impacts on wildlife within the Preserve are listed in Table 17 and are discussed in “Regional Context” in *Chapter 3: Affected Environment*. The activities that have affected and would continue to affect general wildlife are human development and disturbance, which include existing and proposed infrastructure, solar energy development, and military, industrial, agricultural, and mining projects; land management plans and actions; and Preserve projects and plans, which include designation of national monuments, resource management plans, and Preserve-sponsored projects.

Human Development and Disturbance

The existing and proposed human development in the region are the same as discussed above in the “Wildlife – Bighorn Sheep” section. Industrial-scale solar projects in particular have resulted in desert tortoise mortality and habitat loss, and tortoise relocation is often a mitigation requirement for these projects. Human-wildlife conflict may increase as a result of development, and individuals from various species may be deterred from migration corridors by human presence. These activities taken together have resulted in long-term adverse impacts on birds, mammals, herpetofauna, and mule deer in both the Preserve and the Mojave Desert region.

Land Management Plans and Actions

The designation of the Mojave Trails, Sand to Snow, and Castle Mountain National Monuments establishes areas within the Mojave Desert region and close to the Preserve where general wildlife habitat would be left undeveloped, thus providing corridors wildlife migration, habitat for displaced wildlife from human disturbance, and refugia for species impacted by climate change. Castle Mountain, located adjacent to the east side of the Preserve, would provide general wildlife habitat connectivity among the New York, Castle, and Piute mountain ranges, as well as to the Lanfair Valley. Several water features are located in the eastern portion of the Preserve. The Mojave Trails National Monument would provide potential habitat connectivity among the mountain ranges to the south and west of the Preserve. The Sand to Snow National Monument, located southwest of the Preserve, would likely have a less notable impact on wildlife habitat connectivity due to its distance from the Preserve.

Impacts of the Alternatives

Common and Distinguishing Features among All Alternatives

Special Status Wildlife Species

As stated in the "Special Status Wildlife Species" section of *Chapter 3: Affected Environment*, two federally listed species are confirmed year-round residents of the Preserve: Mohave tui chub (endangered) and desert tortoise (threatened). The management approach for water resources as they pertain to these species is the same for all alternatives, including No Action.

The Mohave tui chub would be managed at several sites in the Preserve, including MC Spring and Lake Tuendae at Soda Springs and the Morningstar Mine Pit Lake. Under all alternatives, management would be a continuation of current practices and is expected to result in long-term benefits to the species by supporting its conservation.

Small game guzzlers have been considered in the past to be a threat to desert tortoises, which have potential to become trapped and drown in them (Hoover 1995). While some research disputes the threat guzzlers may pose to tortoises (see Rosenstock et al. 2004), it has become common practice to install escape ramps in small game guzzlers to minimize the potential for entrapment. All proposed alternatives, including No Action, include the installation of escape ramps in all retained small game guzzlers that occur in designated desert tortoise habitat to reduce this potential threat.

Discussion of Effect by General Wildlife Species Group

Effects on these somewhat ubiquitous species are difficult to predict under any of the alternatives because the relationship of these species to water sources is not well understood and because the change from current management would be minor. It is assumed, based on existing conditions and management practices, that many constructed water features, primarily in wilderness, would fall into disrepair over time, eventually reaching a point where they would no longer produce water that is accessible to wildlife. It is not known when or where various neglected water structures would reach this failure point, but it is reasonable to assume that it would occur in different locations over a long period and that failure would occur to some fraction of the guzzlers (and developed springs) that are neglected.

In terms of comparing the effects of the alternatives, there are only minor differences between the action alternatives and No Action. The action alternatives assume that all water features would be neglected in wilderness, most small game guzzlers in the front country would function within the 20-year period of this analysis, and developed springs would be managed in the front country on an ad hoc basis, based on ecological selection factors. Only minor distinctions differentiate the alternatives in terms of the number of water features that would be removed, relocated, evaluated, or maintained. Table 21 summarizes the expectations for small game guzzlers that would be likely to function through the lifespan of this plan.

Table 21. Summary of Small Game Guzzler Actions by Alternative

Existing Status of Guzzlers	
Total Small Game Guzzlers	131
Wilderness	60
Non-wilderness	71
Non-wilderness: Rebuilt 2006–2013	64
Non-wilderness: Subject to Rebuild	Up to 8 (2 are near roads; 6 are not vehicle accessible)

Existing Status of Guzzlers				
NPS Actions	No Action	Alternative 2	Alternative 3 (Preferred Alternative)	Alternative 4
Neglect – Wilderness	60	60	60	60
Neglect – Non-wilderness	0	8	6	0
Non-wilderness: Rebuild (+)	Up to 8	Up to 2	Up to 2	Up to 8
Non-wilderness: Remove (-)	0	Up to 16	Up to 16	Up to 8
Maximum Change from NPS Actions	+8	-16	-14	0
Total Functional Non-wilderness Guzzlers at Full Implementation	72	40	42	64

Herpetofauna, Small Mammals, and Carnivores

Terrestrial wildlife species are known to use developed water sources for drinking, cover, forage, and predation; therefore, these sites function as congregation sites for a variety of wildlife species. Many species will drink free-standing water when available, even if they are adapted to obtain their moisture from forage or prey. Smaller animals may use the water structure itself as cover or use vegetation supported by the water source as cover. Predators are attracted to water sources both for drinking and to take advantage of the higher density of prey. As a result, the gradual long-term loss of some of these water sources from neglect—which would occur at less than half of these water sources under all alternatives—would result in a site-specific impact in terms of reduced wildlife presence at these sites. Each alternative also includes a subset of water sources that would be maintained; these water sources would be expected to remain congregation sites for a variety of wildlife species.

While many species use these water sources, they are not believed to depend on them for hydration or other uses. As a result, there is little basis to conclude that neglecting (or in rare cases, removing) guzzlers or modified springs would have a substantial effect on terrestrial wildlife at the population level. Nonetheless, the question of population-level effects cannot be answered conclusively based on the existing research.

Migratory and Resident Birds

Developed springs that support riparian vegetation are used by migratory bird species as stopovers during migration. Migratory birds are not associated with small game guzzlers or developed springs that lack this riparian vegetation. Over time, in the absence of maintenance, some developed springs would deteriorate to a point where water flows sufficient to support riparian vegetation would fail. These sites would then cease to function as stopover locations for migratory birds. While this would impact site-specific migratory bird presence, it is not clear if migratory birds would be affected more broadly. All alternatives involve the potential that some developed springs with riparian vegetation would be maintained; these would continue to function as stopover sites.

Resident bird behavior more closely resembles that of small mammals and herpetofauna, although the most heavily used sites are developed springs with riparian vegetation and open water; guzzlers are less commonly used. All alternatives could affect resident bird presence at sites that fail to produce surface water due to long-term neglect. Broader effects at the population level are not well understood. Where sites are in good condition, higher densities of resident birds are anticipated.

Game Birds

Game birds, such as Gambel's quail and chukar, primarily rely on succulent vegetation for their hydration requirements. The abundance of this vegetation is a function of winter precipitation as opposed to dry season surface water, but these species are nonetheless known to use and congregate near small game guzzlers and springs, particularly during dry periods. It appears that free-standing water may be important for these species during droughts when vegetation is scarce. Other species, such as mourning and white-winged doves, require some limited surface water throughout the year.

Under all action alternatives, many small game guzzlers and springs would continue to be neglected, as they are now, and would deteriorate over time, leading to failure of some fraction of them over the life of this plan. As with migratory and resident birds, this pattern of neglect, primarily in wilderness, would have an adverse effect on game bird presence at sites that fail to produce surface water. The effects on game bird populations beyond the site-specific scale are more speculative, but adverse effects are possible as time passes and functional supplemental water sources become less common at the scale of the Preserve. Where non-wilderness sites are rebuilt, there would be corresponding benefits to game bird presence at those sites. (However, only a small fraction of guzzlers—up to, but likely fewer than eight—are likely to be rebuilt under any alternative.) Impacts on species that require surface water may be greater than for species adapted to hydrate from vegetation. In the latter case, the impact of reduced availability of surface water may take the form of increased drought risk.

Bats

Bats are known to use water developments with open tanks and troughs. It is unknown whether bats use guzzlers with enclosed tanks or springs that lack open pools. The latter represents a subset of the various types of developed springs in the Preserve. The impacts of the alternatives on bats would be similar to those described for birds: site-specific impacts would occur under all alternatives due to neglect of spring sites that are used by bats. Those impacts would be similar under all alternatives, including No Action, and would occur over time as individual spring sites deteriorate and fail to produce water. These site-specific and periodic impacts on springs are not anticipated to affect regional bat populations.

Ungulates

Like desert bighorn sheep, ungulate species (primarily mule deer and nonnative burro) appear to depend on free-standing water during hot summer months. Since the impact of failing springs would occur in disparate locations over a very long period, the long-term impact of those changes on mobile species like mule deer and burro populations is speculative. However, it is possible that the loss of springs due to long-term neglect could have negative impacts on ungulate populations. At the Clark guzzler site, which would be removed under all action alternatives, mule deer presence would decline. Maintenance of select springs would benefit ungulates in the area of the maintained spring, but the consequences to populations over longer periods are less clear. In any case, the long-term effects of the action alternatives would be similar to those of No Action.

Cumulative Impacts to Wildlife

The cumulative impacts from past, present, and reasonably foreseeable future actions that are caused by human disturbance in the region and by implementation of Preserve projects and plans would be the same for all alternatives and are discussed above in the "Cumulative Impacts Common to All Alternatives" section and outlined in Table 17.

Conclusion

The effects on special status species and general wildlife species under the No Action Alternative and the action alternatives are anticipated to be very similar, of limited scale, and of low magnitude. The primary impact would be reduced wildlife presence at sites that cease to produce surface water or riparian vegetation. However, many other managed sites that have these properties of surface water, cover, and vegetation would still be available in the Preserve. While significant impacts do not appear likely, population-scale effects are uncertain.

Cultural Resources

This analysis identifies how the proposed plan alternatives would affect historic water features associated with managed springs and small game guzzlers in the Preserve. Big game guzzlers are not considered historic and are not discussed in this section. Most of the managed springs are located in designated historic ranching districts or cultural landscapes in the Preserve, including the Rock Springs Land and Cattle Company Cultural Landscape (NPS 2007a), the 7IL Ranch Cultural Landscape (Livingston 2005), and those springs documented under an ethnographic report prepared for the BLM (Bengston Consulting 2010).

Methods and Assumptions

The analysis of potential impacts on historic springs and small game guzzlers assumes that each meets the NPS's 50-year age criterion for a potential historic property and is furthermore potentially eligible for listing on the NRHP, either individually or as a contributing element of a National Register District or Cultural Landscape. Since very few of these water features have been evaluated for NRHP significance, they are all treated as unevaluated and therefore are potentially eligible for listing on the NRHP. In order for the NPS to meet its Section 106 obligations and resolve anticipated adverse effects on historic properties, the NPS intends to enter into consultation with the SHPO, American Indian tribes, and other potentially interested parties.

This analysis assumes that NPS consultation with the SHPO would result in stipulations for continued Section 106 compliance regardless of the selected alternative. The SHPO would stipulate procedures for the documentation and significance evaluation of water features currently unevaluated for listing on the NRHP and the identification, documentation, and evaluation of other potential historic properties, including known and unknown prehistoric archeological sites that have been preliminarily identified at natural springs.

Most of water development features within managed springs have not been formally documented and evaluated for NRHP significance. For purposes of this plan, all unevaluated water development features that meet the NPS 50-year age criterion are considered potential historic properties. The NPS understands that all managed springs and some of the small game guzzlers meet the age criterion. This analysis assumes that, before implementation of activities that have the potential to affect historic properties—whether through neglect, removal, or disabling—all affected potential historic properties will be documented, evaluated for NRHP significance, and assessed for effects in consultation between the NPS and SHPO.

For this analysis, any activity that results in the alteration, removal, or deterioration of potentially eligible water features is considered an adverse effect. This includes the ongoing neglect and deterioration of water features. Activities that maintain, improve, or stabilize potentially eligible water features are considered beneficial effects, provided that those activities are undertaken in a manner that preserves or replaces in kind elements of the water features (e.g., design and materials) that contribute to the significance of those features and does not diminish character-defining elements.

Cumulative Impacts Common to All Alternatives

Cumulative impacts on cultural resources were determined by combining the No Action Alternative with other past, present, and reasonably foreseeable future actions as described in Table 17. Actions that could affect cultural resources are human development and disturbance, which include solar energy development and military, industrial, agricultural, and mining projects; and Preserve projects and plans, which include designation of national monuments, resource management plans, and Preserve-sponsored projects. These activities are described above and in *Chapter 3: Affected Environment*.

None of the alternatives would significantly alter the level of impact on cultural resources or result in long-term adverse cumulative effects on cultural resources when combined with the other development projects throughout the Mojave Desert region. Under all alternatives, including No Action, cultural resources would be evaluated for eligibility under NHPA Section 106 and in accordance with NPS policy and SHPO guidance to avoid, mitigate, and reduce adverse impacts on cultural resources.

The cumulative impacts from past, present, and reasonably foreseeable future actions that are caused by human disturbance in the region, and by implementation of Preserve projects and plans, are the same for all alternatives and are discussed above in the "Cumulative Impacts Common to All Alternatives" section and outlined in Table 17.

Impacts of the Alternatives

Alternative 1 – No Action

Under the No Action Alternative, current management practices, including the management of water features, would continue on a case-by-case basis. Proposed projects that would affect water features would be reviewed by the NPS as individual undertakings with the potential to affect historic properties as defined under Section 106 of the NHPA (36 CFR 800.3). The NPS would review the undertaking for potential effects on water features, consult with the SHPO regarding project effects on potential historic properties, and implement measures to resolve anticipated adverse effects.

Small Game Guzzlers

Ad hoc maintenance of small game guzzlers outside of wilderness would continue under the No Action Alternative. Small game guzzlers would continue to be maintained, as needed, by the NPS and authorized volunteers. No new guzzlers would be constructed. The small game guzzlers in wilderness would be left to naturally deteriorate, resulting in a long-term adverse effect on those features, as it would ultimately result in the loss of potentially eligible features.

Springs and Water Developments

Under the No Action Alternative, management or maintenance of springs and related water features would be limited to infrequent efforts as needed to prevent resource damage and to protect visitor safety. Most springs and water developments would be neglected and would be allowed to continue to deteriorate over time, resulting in long-term adverse effects on those features.

Cumulative Impacts

The No Action Alternative would be a continuation of current management practices and would not result in a significant alteration of the level of impact from any of the activities identified above (see "Cumulative Impacts Common to All Alternatives").

Conclusion

The No Action Alternative, which represents a continuation of existing conditions, would result in long-term adverse effects on small game guzzlers and developed water features left to naturally deteriorate in wilderness because potentially eligible features would not be preserved. Ad hoc maintenance of guzzlers and select springs outside of wilderness would result in benefits to the few sites that are maintained. Maintenance activities would preserve but not alter characteristics of guzzlers or water features that potentially contribute to their historic significance.

Alternative 2

Under Alternative 2, water development features would be managed to reduce human interference within a desert ecosystem. The overall number of water features in the Preserve would be reduced through natural deterioration and neglect and through the select disabling of noncritical water features; repair and maintenance of remaining water features would be undertaken on an as-needed basis to support native wildlife populations.

Small Game Guzzlers

In Alternative 2, all small game guzzlers in wilderness would be neglected and left to naturally deteriorate over time, actively disabled or removed. This would result in an adverse effect on those features, similar to the No Action Alternative. Select non-wilderness guzzlers would be maintained to support native wildlife populations, and up to two may be rebuilt. The neglect, disabling, or removal of small game guzzlers in wilderness would result in the loss of those features and long-term adverse effects on potential historic properties, while the rebuilds outside of wilderness would result in benefits to potential historic properties, as potentially eligible features would be preserved.

Springs and Water Developments

Under Alternative 2, up to about 10 water development features at managed springs would be considered for maintenance and stabilization to help support native wildlife populations. Stabilized or maintained water development features would result in beneficial effects on historic properties from long-term preservation. Stabilization or maintenance activities would be undertaken in a manner that preserves or replaces in kind those characteristics or elements that contribute to significance, including design and materials. The remaining water development features would continue to deteriorate over time, resulting in long-term adverse effects on historic properties from the ultimate loss of those potentially eligible features.

Cumulative Impacts

The impacts of Alternative 2 on cultural resources would alter the level of long-term adverse cumulative effects, although not significantly (see “Cumulative Impacts Common to All Alternatives” above).

Conclusion

The actions under Alternative 2 would result in long-term adverse effects on water development features in the Preserve from neglect, natural deterioration, or active disabling. Adverse effects on historic properties would be resolved under consultations between the NPS and SHPO. The neglect and removal of cultural resources under Alternative 2 would alter the level of adverse cumulative impacts, although not significantly.

Alternative 3 (Preferred Alternative)

Under Alternative 3, water development features would be managed to support native wildlife conservation through maintenance and stabilization.

Small Game Guzzlers

Under Alternative 3, management of small game guzzlers in wilderness would be the same as under Alternative 2—all guzzlers would be neglected, some would be actively disabled or removed. Select non-wilderness guzzlers would be maintained to support native wildlife populations, and up to two may be rebuilt. The neglect, disabling, or removal of small game guzzlers in wilderness would result in the loss of those features and long-term adverse effects on potential historic properties, while the rebuilds would result in benefits to potential historic properties, as potentially eligible features would be preserved.

Springs and Water Developments

Under Alternative 3, management of springs and water development would be the same as under Alternative 2—up to about 10 water development features at managed springs would be considered for maintenance and stabilization to help support native wildlife populations. Stabilized or maintained water development features would result in beneficial effects on historic properties from long-term preservation. Stabilization or maintenance activities would be undertaken in a manner that preserves or replaces in kind those characteristics or elements that contribute to significance, including design and materials. The remaining water development features would continue to deteriorate over time, resulting in long-term adverse effects on historic properties from the ultimate loss of those potentially eligible features.

Cumulative Impacts

The impacts of Alternative 3 on cultural resources would alter the level of long-term adverse cumulative effects, although not significantly (see “Cumulative Impacts Common to All Alternatives” above).

Conclusion

Under Alternative 3, the maintenance and stabilization of about 17 developed water features and select small game guzzlers would benefit those historic properties. The continued neglect and deterioration of remaining water features would result in adverse effects on historic properties from the loss of those features. These effects would be similar to Alternative 2 and would be resolved through consultations between the NPS and SHPO.

Alternative 4

Under Alternative 4, water development features would be managed to expand native wildlife habitat.

Small Game Guzzlers

Management of small game guzzlers in wilderness in Alternative 4 would be the same as Alternatives 2 and 3—all would be neglected, while some would be actively disabled or removed. Non-wilderness guzzlers would be maintained to support native wildlife populations. The removal and neglect of small game guzzlers in wilderness would result in long-term adverse effects on potential historic properties from the ultimate loss of those features. Active maintenance of guzzlers outside wilderness, and the potential rebuilds of up to eight guzzlers, would result in beneficial effects on potential historic properties, as potentially eligible features would be preserved.

Springs and Water Developments

Under Alternative 4, up to about 15 water development features at managed springs would be maintained and restored to support wildlife habitat. Maintained water development features would result in beneficial effects on historic properties from long-term preservation. Restoration activities would be undertaken in a manner that preserves or replaces in kind those characteristics or elements that contribute to their significance, including design and materials. The remaining water development features would continue to deteriorate over time, resulting in long-term adverse effects on historic properties from the ultimate loss of those potentially eligible features.

Cumulative Impacts

The impacts of Alternative 4 on cultural resources would alter the level of long-term adverse cumulative effects, although not significantly (see “Cumulative Impacts Common to All Alternatives” above).

Conclusion

Similar to Alternative 3, the maintenance and stabilization of several developed water features and select small game guzzlers in Alternative 4 would benefit historic properties, while the continued neglect and deterioration of other water features would result in adverse effects from the loss of potentially eligible features. As described for Alternatives 2 and 3, these effects would be resolved through consultations between the NPS and SHPO.

Wilderness Character

This analysis identifies how the proposed plan alternatives would affect wilderness character in the Preserve. As described in *Chapter 3: Affected Environment*, the 1994 CDPA designated nearly half of the Preserve (804,949 acres) as wilderness. Many of the water features addressed in this plan are located in wilderness, including all of the big game guzzlers, most of the small game guzzlers (60 percent), and most of the springs (70 percent).

Methods and Assumptions

This analysis describes the potential effects of the proposed alternatives on the five qualities of wilderness character that are to be protected under the Wilderness Act. Since the NPS has not completed a wilderness character baseline or stewardship plan for the Preserve, the wilderness qualities as they pertain to water resources are described in *Chapter 3: Affected Environment* and are summarized as follows:

- *Untrammeled* – Water developments, including developed springs and guzzlers, negatively affect the untrammeled quality of wilderness. These effects stem from the presence of the water developments themselves, in addition to the influence of water features on the management of wildlife.
- *Natural* – Native wildlife conservation activities, including the management of guzzlers or other water developments, support the natural quality of wilderness. These beneficial effects are the result of the contribution of water developments to wildlife conservation, particularly desert bighorn sheep.

- *Undeveloped* – The presence of guzzlers and water developments, and motorized access to maintain those developments, negatively affects the undeveloped quality of wilderness. The effects are limited to the immediate footprint of the water developments.
- *Opportunity for Solitude or Primitive and Unconfined Recreation* – Water features in wilderness do not affect this quality.
- *Other Features and Values* – No other features or values related to water resources have been identified.

For analysis purposes, each water feature (e.g., guzzler or developed spring) is assumed to have an impact footprint of about 0.1 acre. This includes the developed features themselves, along with associated ground disturbance surrounding the feature. The area in which water features are immediately visible to visitors is assumed to be about 4 acres.

Minimum Requirement Analysis

Section 4(c) of the Wilderness Act prohibits certain activities in designated wilderness, including motor vehicles, motorized equipment, landing of aircraft, other forms of mechanical transport, and structures or installations, except as necessary to meet minimum requirements for the administration of the area for the purposes of the act. The National Park Service conducts a Minimum Requirement Analysis (MRA) to determine if a proposed 4(c) prohibited use is necessary.

For the proposal contemplated in this plan, the NPS will complete an MRA that addresses the necessity to retain one or more big game guzzlers in designated wilderness, as these guzzlers qualify as structures or installations under the meaning of the Wilderness Act (a draft MRA is provided in Appendix A). The plan also acknowledges that in the past, maintenance of these structures has involved the use of motor vehicles, motorized equipment, and landing of aircraft, and it is possible that a future maintenance need will necessitate one of these prohibited uses. However, it is not possible to address the question of necessity for a prohibited use in the absence of information about specific maintenance needs, and it is assumed that a variety of maintenance needs could be resolved without resort to a 4(c) prohibited use. For these cases, future maintenance projects would be addressed with appropriate site-specific NEPA compliance and, if a 4(c) prohibited use is contemplated, with a site-specific MRA. The proposal contemplated also examines a number of other structures in wilderness that predate designation. In many cases, the proposed course of action is to neglect these structures and take no action to use or maintain them. Neglect of existing structures in wilderness would not be addressed in an MRA.

Cumulative Impacts Common to All Alternatives

The past, present, and reasonably foreseeable actions that may result in cumulative impacts on wilderness character within the Preserve are listed in Table 17 and are discussed in the "Regional Context" section of *Chapter 3: Affected Environment*. The activities that have affected and would continue to affect wilderness character are human development and disturbance, which include existing and proposed infrastructure, solar energy development, and military, industrial, agricultural, and mining projects; land management plans and actions; and Preserve projects and plans, which include designation of national monuments, resource management plans, and Preserve-sponsored projects.

The cumulative impacts from past, present, and reasonably foreseeable future actions that are caused by human disturbance in the region and by the implementation of Preserve projects and plans are the same for all action alternatives and are outlined in Table 17. All action alternatives would beneficially, although not significantly, alter cumulative impacts on the local wilderness character in that guzzlers located within wilderness would be neglected, removed, or relocated outside of wilderness.

Human Disturbance and Development

Cumulative impacts from human development and disturbance in the Mojave Desert region may result in visual and noise impacts within the Preserve. The existing solar energy developments and mining projects are visible from areas within the Preserve, including the Clark, New York, and Piute Mountains. Noise from existing and proposed highways and railways may be audible within the Preserve, as well as noise from construction and use of existing and proposed infrastructure. The proposed Ivanpah Regional Airport would likely result in an increase in airplane traffic over the Preserve, while existing and proposed transmission lines may impact the viewshed from wilderness areas within the Preserve.

Land Management Plans and Actions

The designation of the Mojave Trails, Sand to Snow, and Castle Mountain National Monuments would have a long-term beneficial impact on the wilderness character within the Mojave Desert region. Under these designations, areas of the Mojave Desert close to the Preserve would be protected as wilderness or as national monuments and therefore would be excluded from development.

Impacts of the Alternatives

Alternative 1 – No Action

Under the No Action Alternative, current management practices, including the management of water features, would continue on a case-by-case basis. Projects involving water resources in wilderness would be reviewed in a MRA and would be allowed to proceed only if it is determined that the minimum level of activity and disruption of wilderness qualities would be used.

Big Game Guzzlers

Under the No Action Alternative, access to and maintenance of big game guzzlers would continue. The presence of guzzlers at six sites in wilderness would adversely affect the untrammeled and undeveloped qualities of wilderness in their immediate location and from nearby areas where they are visible. The impact on undeveloped qualities would be limited to the footprint of the guzzlers (up to about 0.6 acre) and the areas of wilderness in which they are potentially visible to wilderness visitors (up to about 24 acres), as well as the access routes used to maintain the guzzlers. By either measure, the magnitude of effect is small (24 acres, or 0.00086 percent) when compared with the size of the total wilderness area (804,949 acres). In addition, these water developments in wilderness are generally inaccessible to visitors.

The presence of the guzzlers and their importance to the support and conservation of desert bighorn sheep populations would have conflicting effects on wilderness qualities. Because the guzzlers are important to the survival and persistence of some existing herds and therefore influence their behavior and distribution, they could be considered an adverse effect on the untrammeled quality of wilderness in the Preserve. Conversely, the importance of the guzzlers for the conservation of sheep populations may also be considered a benefit to the natural quality of wilderness.

The adverse effect would be substantial in the immediate area of the guzzlers, but would be small on a Preserve-wide scale. Big game guzzlers have a relatively small footprint within the Preserve's vastly larger wilderness landscape. The continued ability to conserve and sustain desert bighorn sheep populations that depend on guzzlers, as well as other native wildlife species that use these guzzlers, would benefit the natural quality of wilderness. This direct benefit to natural qualities would be relatively large as it pertains to desert bighorn sheep populations, but would be inconsequential for other wildlife and natural qualities.

Small Game Guzzlers

Under the No Action Alternative, approximately 60 existing small game guzzlers would remain in wilderness but would not be managed or maintained. Their presence would have ongoing adverse impacts on the undeveloped quality of wilderness, but those effects would be limited to about six total acres or about 0.1 acre each, which is equivalent to about 0.00086 percent of the designated wilderness in the Preserve. Their presence, as long as they function without maintenance, would also have the potential to affect a variety of smaller wildlife species. This can be viewed as an adverse effect in terms of the untrammeled quality, by influencing animal behavior, or as a beneficial effect in terms of the natural quality, by improving hydration, but the effects are speculative.

Springs and Water Developments

Management or maintenance of springs or other water developments in wilderness would be limited to infrequent efforts (as needed) to prevent resource damage or protect visitor safety. These activities would not affect the wilderness character (undeveloped, untrammeled, and natural) in the Preserve.

Wells

Wells that are not needed would be destroyed according to state regulations, both within and outside of wilderness. This would have a slight beneficial impact on the untrammeled wilderness character of the area.

Cumulative Impacts

Under the No Action Alternative, guzzlers and developed water features located within wilderness would continue to be maintained on an ad hoc basis using a MRA. The impacts on wilderness character under the No Action Alternative would not affect the regional long-term benefits of other management designations and Preserve projects and plans (see “Cumulative Impacts Common to All Alternatives” above).

Conclusion

The No Action Alternative would result in the continuation of current water resource management and the associated impacts on the untrammeled and undeveloped qualities of wilderness resulting from the presence of and access to up to 6 big game and about 60 small game guzzlers. These impacts would be detectable in the immediate vicinity of the guzzlers, but would represent a very small portion of the total wilderness area. The big game guzzlers would continue to benefit the natural quality of wilderness character, while the limited management of springs and water developments in this alternative would not affect wilderness qualities. Overall, the No Action Alternative would result in adverse effects on wilderness character in the Preserve due to the continued management of guzzlers within wilderness.

Alternative 2

Under Alternative 2, water resources would be managed to minimize intrusion into wilderness while supporting native wildlife populations.

Big Game Guzzlers

At full implementation, five of the six big game guzzlers would be removed or relocated from wilderness. This would benefit the untrammeled and undeveloped qualities of wilderness, in the vicinity of the five guzzlers, by removing the guzzlers (with a total footprint of about 0.5 acre) and eliminating the need for motorized access for maintenance. As described above in the "Wildlife – Desert Bighorn Sheep" section, the reduction in dry season habitat value for desert bighorn sheep (-10 percent) would have a negative impact on the natural quality of wilderness in the Preserve, since the support for bighorn habitat that is provided by the guzzlers is considered to benefit the natural quality of native wildlife.

Small Game Guzzlers

Under Alternative 2, most small game guzzlers in wilderness would be neglected, while some would be actively removed, and a few outside of wilderness would be maintained based on wildlife use. The continued neglect of most guzzlers would result in no change to wilderness qualities when compared with the No Action Alternative. The active removal of select small game guzzlers would benefit the untrammeled and undeveloped qualities in localized areas by reducing the presence and visibility of these structures in wilderness. The natural qualities of wilderness, including the value to habitat for native wildlife, could be adversely affected by the neglect and removal of guzzlers, but those effects would be of a limited scale and at a low magnitude.

Springs and Water Developments

Under Alternative 2, several springs in wilderness would be considered for ongoing maintenance and management of water delivery structures to support wildlife habitat. A MRA would be conducted before implementation to ensure that any methods or treatments used would minimize potential adverse impacts on wilderness qualities.

Wells

The actions and effects would be the same as under the No Action Alternative.

Cumulative Impacts

Alternative 2 would beneficially, although not significantly, alter cumulative impacts on the local wilderness character in that guzzlers located within wilderness would be neglected, removed, or relocated outside of wilderness (see "Cumulative Impacts Common to All Alternatives" and Table 17).

Conclusion

The removal of five big game guzzlers and select small game guzzlers from wilderness would contribute to the untrammeled and undeveloped wilderness qualities in the Preserve. These benefits would be considerable in the immediate vicinity of guzzler sites (covering about 0.5 acre of wilderness), but would still be inconsequential at a Preserve-wide scale. The natural qualities associated with bighorn conservation would be negatively affected due to a reduction in available dry season habitat. The continued neglect of springs and water developments in wilderness would not affect wilderness character in the Preserve. Overall, implementation of Alternative 2 would have beneficial effects on the undeveloped and untrammeled aspects of wilderness character in the Preserve from the reduction of human development in wilderness, but at a consequence to the natural character provided by wildlife habitat.

Alternative 3 (Preferred Alternative)

Under Alternative 3, water resources would be managed to support native species populations while reducing the number of water developments within wilderness.

Big Game Guzzlers

At full implementation, four big game guzzlers would be removed or relocated from wilderness, and two would be retained in place. The removal or relocation of four guzzlers would substantially benefit the untrammeled and undeveloped qualities of wilderness in the vicinity of those sites (affecting up to about 0.4 acre). The continued presence and maintenance of the Old Dad and Kelso guzzlers would adversely affect untrammeled and undeveloped qualities of wilderness in the Preserve. However, the impact would be limited to the footprint of the guzzlers (about 0.2 acre) and the areas of wilderness in which they are visible (up to about 8 acres). Additionally, the adverse effect on untrammeled qualities would likely be offset by the beneficial effects on the natural quality of wilderness that would result from continued bighorn sheep conservation.

Small Game Guzzlers

Under Alternative 3, management of small game guzzlers in wilderness would be the same as Alternative 2—all small game guzzlers would be neglected, while some would be actively disabled or removed. Likewise, the effects on wilderness qualities would be the same as described for Alternative 2: no change resulting from neglect and localized benefits from limited disabling or removal.

Springs and Water Developments

Under Alternative 3, management of springs and water developments in wilderness would be the same as Alternative 2—the several springs in wilderness would be considered for ongoing maintenance and management of water delivery structures to support wildlife habitat. A MRA would be conducted before implementation to ensure that any methods or treatments used would minimize potential adverse impacts on wilderness qualities.

Wells

The actions and effects would be the same as under the No Action Alternative.

Cumulative Impacts

Alternative 3 would beneficially, although not significantly, alter cumulative impacts on the local wilderness character in that guzzlers located within wilderness would be neglected, removed, or relocated outside of wilderness (see “Cumulative Impacts Common to All Alternatives” and Table 17).

Conclusion

The removal or relocation outside wilderness of four big game guzzlers would benefit the untrammeled and undeveloped qualities of wilderness in the Preserve, with considerable benefits in the immediate vicinity of affected guzzler sites. The benefits of select removal of small game guzzlers from wilderness would be the same as for Alternative 2. The potential maintenance of springs and water developments to support wildlife could result in small adverse impacts on wilderness qualities at those sites, but those impacts would be minimized through a MRA. Implementation of Alternative 3 would have minimal adverse effects on the untrammeled wilderness qualities in the Preserve from benefits of big game guzzler removal. There would also be a slight adverse local effect on the untrammeled quality from spring maintenance.

Alternative 4

Under Alternative 4, water resources would be managed to augment native wildlife habitat and connectivity.

Big Game Guzzlers

Under Alternative 4, three big game guzzlers would be removed or relocated from wilderness, while the remaining three would be retained in place. This would benefit the untrammeled and undeveloped qualities of wilderness in the vicinity of the removed and relocated guzzlers, while the adverse impacts on those qualities would persist in the vicinity of the other three sites (up to about 0.3 acre of wilderness). The adverse effect on untrammeled qualities would likely be offset by the beneficial effects on the natural quality of wilderness that would result from continued bighorn sheep conservation.

Small Game Guzzlers

Under Alternative 4, management of small game guzzlers in wilderness would be the same as Alternatives 2 and 3—all small game guzzlers would be neglected, while some would be actively disabled or removed. Likewise, the effects on wilderness qualities would be the same as described for Alternative 2: no change resulting from neglect and localized benefits from limited disabling or removal.

Springs and Water Developments

Under Alternative 4, 5 to 7 springs in wilderness per year would be considered for maintenance and management to support wildlife habitat. In each case, a MRA would be conducted to ensure that any methods or treatments used would minimize potential impacts on wilderness qualities. While the number of sites that would be considered for maintenance is almost double the number in Alternative 3, the impact on wilderness qualities would remain small due to the dispersed nature of the sites and the fact that the sites are already disturbed, and the MRA process would minimize additional impacts resulting from maintenance activities.

Wells

The actions and effects would be the same as under the No Action Alternative.

Cumulative Impacts

Alternative 4 would beneficially, although not significantly, alter cumulative impacts on the local wilderness character in that guzzlers located within wilderness would be neglected, removed, or relocated outside of wilderness (see “Cumulative Impacts Common to All Alternatives” and Table 17).

Alternative 4 would adversely, but not significantly, alter the level of impact from human disturbance on the wilderness character in that three big game guzzlers and all small game guzzlers located within wilderness would be removed, relocated, or neglected, potentially leading native wildlife populations to shift outside of wilderness areas in the Preserve. However, the remaining three guzzlers and most of the other water developments within wilderness would remain in place for native wildlife to use, thus supporting the natural characteristic of wilderness.

Conclusion

The removal and relocation of three big game guzzlers outside wilderness would benefit wilderness character. The ongoing neglect of small game guzzlers in wilderness would not affect wilderness character in the Preserve, while the maintenance of up to 15 springs and water developments to improve wildlife habitat may result in localized small adverse impacts on the untrammeled and undeveloped qualities of wilderness. Overall, implementation of Alternative 4 would result in localized small adverse effects on wilderness character due to the continued presence and maintenance of developed water structures. However, Alternative 4 would also result in localized benefits on the natural qualities of wilderness in the Preserve from the continued presence of water developments to support native wildlife populations.

Table 22. Summary of Water Resource Management Alternatives Environmental Consequences

Resource	No Action (Existing Conditions)	Alternative 2	Alternative 3 (Preferred Alternative)	Alternative 4
Wildlife – Desert Bighorn Sheep	• No effects • No strategy for long-term management	• Guzzler removal, relocation, and new guzzler implementation would result in a potential 10% decrease in the Preserve's dry season habitat value • Decreased habitat value would occur in the Old Dad/Kelso Mountains and Piute/Castle Mountains. A slight decrease would occur in the Clark Mountains • Increased habitat value in the Mescal/Ivanpah Range and Woods/Hackberry Mountains • Two new water sources would increase dry season habitat value, support migration corridors, and support the expansion and establishment of populations • Guzzler removal/relocation would result in short-term adverse effects on individual sheep • Implementation sequencing to reduce adverse effects, site-specific planning, and monitoring would guard against significant adverse impacts (see Figure 3). • Overall, potential for long-term adverse effects on bighorn sheep is low, due to careful implementation, monitoring, and increased habitat connectivity	• Guzzler removal, relocation, and new guzzler implementation would result in a potential 19% increase in the Preserve's dry season habitat value • Slight decrease in habitat value would result in the Old Dad/Kelso Mountains and Clark Mountains • Increased habitat value in the Piute/Castle Mountains, Mescal/Ivanpah Range, and Woods/Hackberry Mountains • Three new water sources would increase dry season habitat value, support migration corridors, and support the expansion and establishment of populations • Guzzler removal/relocation would result in short-term adverse effects on individual sheep • Implementation sequencing to reduce adverse effects, site-specific planning, and monitoring would guard against significant adverse impacts (see Figure 3). • Overall, some short-term adverse impacts on sheep with the potential for long-term benefits	• Guzzler removal, relocation, and new guzzler implementation would result in a potential 18% increase in the Preserve's dry season habitat value • Slight decrease in habitat value would result in the Old Dad/Kelso Mountains and Clark Mountains • No change to habitat value in the Piute/Castle Mountains • Increased habitat value in the Mescal/Ivanpah Range and Woods/Hackberry Mountains • Two new water sources would increase dry season habitat value, support migration corridors, and support the expansion and establishment of populations • Guzzler removal/relocation would result in short-term adverse effects on individual sheep • Implementation sequencing to reduce adverse effects, site-specific planning, and monitoring would guard against significant adverse impacts (see Figure 3). • Overall, some short-term adverse impacts on sheep with the potential for long-term benefits

Resource	No Action (Existing Conditions)	Alternative 2	Alternative 3 (Preferred Alternative)	Alternative 4
Wildlife –General	• Benefits to Mohave tui chub and desert tortoise • Localized benefit from ad hoc maintenance • Localized and low-magnitude impacts from long-term deterioration of water sources • Uncertain wildlife population effects	*Common to All Action Alternatives:* • Benefits to Mohave tui chub and desert tortoise • Localized and small impacts from long-term deterioration of water sources and limited removal of water sources • Localized and small benefits from limited maintenance of non-wilderness water sources • Uncertain wildlife population effects		
Cultural Resources	• Adverse effects on features that are left to deteriorate • Benefits from ad hoc maintenance of historic water features • No comprehensive strategy or compliance approach for treatment of historic water features	*Common to All Action Alternatives:* • Adverse long-term effects from neglect, deterioration, and disabling of other historic water features • Benefits to non-wilderness water features that are maintained and stabilized • Effects would be resolved through a consultation with the State Historic Preservation Office (SHPO)		
Wilderness Character	• Adverse impacts on untrammeled and undeveloped qualities due to the presence of developed guzzlers in wilderness • Benefits to natural qualities from the conservation value of guzzlers to desert bighorn sheep • Overall, small adverse effect on wilderness character	• Benefits to untrammeled and undeveloped qualities from the removal of five big game guzzlers from wilderness • No impacts on natural qualities associated with bighorn conservation • Some adverse impacts associated with spring maintenance in wilderness • Overall benefit to wilderness from the reduction of active guzzler development and maintenance in wilderness	• Benefits to untrammeled and undeveloped qualities from the removal of four big game guzzlers from wilderness • No impacts on natural qualities associated with bighorn conservation • Some adverse impacts associated with spring maintenance in wilderness • Overall benefit to wilderness from the reduction of active guzzler development and maintenance in wilderness	• Benefits to untrammeled and undeveloped qualities from the removal of three big game guzzlers from wilderness; but adverse effects from three guzzlers that would remain • Benefits to natural qualities associated with bighorn conservation • Overall, small adverse effects on wilderness character due to retention of big game guzzlers and maintenance of select springs in wilderness

CHAPTER 5: CONSULTATION AND COORDINATION

The intent of NEPA is to encourage the participation of federal and state involved agencies and affected citizens in the assessment procedure, as appropriate. This section describes the consultation that occurred during development of this plan, including consultation with scientific experts and other agencies. This chapter also includes a description of the public involvement process and a list of the recipients of the draft and final plan and EA.

History of Public Involvement

The public involvement activities for this plan and EA fulfill the requirements of NEPA and NPS DO-12 (NPS 2015).

The Scoping Process

The NPS divides the scoping process into two parts: internal scoping and external or public scoping. Internal scoping involved discussions among NPS personnel regarding the purpose of and need for management actions, issues, management alternatives, mitigation measures, the analysis boundary, appropriate level of documentation, available references and guidance, and other related topics.

Public scoping is the early involvement of the interested and affected public in the environmental analysis process. The public scoping process helps ensure that people have an opportunity to comment and contribute early in the decision-making process. For this planning document and environmental impact statement, project information was distributed to individuals, agencies, and organizations early in the scoping process, and people were given opportunities to express concerns or views and identify important issues or even other alternatives.

Taken together, internal and public scoping are essential elements of the NEPA planning process. The following sections describe the various ways scoping was conducted for this plan.

Internal Scoping

An internal scoping meeting was held November 3 and 4, 2010, and included a full-day site visit and a full-day meeting. The purpose of the meeting was to identify the purpose, need, and objectives for the action; identify issues related to the action; determine the proper NEPA path; discuss a range of preliminary alternatives; and identify data needs. Representatives from the Preserve, the NPS Environmental Quality Division (EQD), the NPS Biological Resources Division (BRD), the NPS Water Resources Division (WRD), and ERO Resources Corporation (ERO; contractor) were in attendance. The results of the meetings were captured in detailed notes now on file as part of the administrative record.

Public Scoping

Public scoping efforts for this planning process focused on the means or processes to be used to include the public, the major interest groups, and local public entities. Based on past experience, park staff place a high priority on meeting the intent of public involvement in the NEPA process and giving the public an opportunity to comment on proposed actions.

Public Notification

The public scoping process began on May 11, 2011, with the publication of a Notice of Intent in the Federal Register (FR) (FR, Volume 76, Issue 27344). A 60-day public scoping comment period was announced and began on May 11, 2011; this date was extended an additional 30 days. Public scoping ended on August 12, 2011.

A newsletter was mailed in early May 2011 to the project's preliminary mailing list of government agencies, organizations, businesses, and individuals. The newsletter announced the public scoping meetings and provided background on the project. It also summarized the plan's objectives, purpose and need. The newsletter included information about the project and alternatives and invited the public to comment and attend the public scoping meetings. Public service announcements were provided to local television and radio news agencies and local newspapers, and an announcement was posted on the NPS Planning, Environment and Public Comment (PEPC) site to notify the public of these meetings.

The NPS hosted four public scoping meetings in the vicinity of the Preserve to present the preliminary alternative concepts and potential management tools and solicit feedback on a range of questions developed specifically on these topics. Public scoping meetings were held in 2011 on June 27 (Henderson, Nevada), June 28 (Needles, California), June 29 (San Bernardino, California), and June 30 (Barstow, California).

Public Meetings and Comments

Meetings were organized in an open-house format, allowing the public to browse informational posters, interact with park staff, and listen to a brief presentation at their own pace. Meetings were available to the public between 6:00 p.m. and 10:00 p.m. A series of full-color display boards was presented to help illustrate the project vicinity and background and an overview of water resources in the Preserve. These display boards also provided an overview of the NEPA process. Preserve staff, NPS staff, and contractors were located at the display boards to answer questions, facilitate discussions, and record thoughts, ideas, and concerns raised by the public.

During each open house, the NPS offered brief slideshow presentations defining the proposed timeline of the project; background of the Preserve; current wildlife and water resources management strategies; the purpose, need, and objectives of the plan and EA; and the preliminary range of alternatives. The public was offered a variety of opportunities to provide feedback or submit questions, including flip charts, comment forms (and drop box), and preaddressed comment forms for postal delivery. Participants were given information regarding accessing PEPC and were encouraged to submit their comments electronically using this system. The addresses for submitting comments were printed on all news releases and the project newsletter for the benefit of people who could not attend the open houses but still wanted to provide comments. During the scoping period, 67 pieces of correspondence were received.

Comments and input received during the public scoping period were compiled for review and evaluation by the planning team. This analysis process assisted the team in organizing, clarifying, and addressing technical information pursuant to NEPA regulations and identifying the topics and issues to be evaluated and considered throughout the planning process.

The process included seven steps:

1. Entering correspondence into the database that was not input directly into PEPC;
2. Reviewing all correspondence;
3. Developing a coding structure;
4. Identifying and coding comments pulled from correspondence;
5. Analyzing the comments to identify issues and themes;

6. Creating concern statements; and
7. Preparing the Public Scoping Analysis Report.

A coding structure was developed to help sort comments into logical groups by topic and issue. The coding structure was derived from an analysis of the range of comments received based on the "Questions to Consider" that were provided in the distributed newsletter and presented at the meetings. The coding structure was designed to capture all comments and content, rather than restrict or exclude any content.

Analysis of the public comments involved the assignment of codes to statements made by the public in their letters, email messages, and written comment forms. Codes were assigned in the PEPC database for each individual comment in a correspondence. All comments were read and analyzed including those of a technical nature; opinions, feelings, and preferences of one element or one potential alternative over another; and comments of a personal or philosophical nature. All comments were considered, whether they were presented by several people saying the same thing or by a single person expressing a unique viewpoint. After reviewing and categorizing all of the comments within each correspondence received during the public review process, 518 comments were identified and coded appropriately for scoping and 76 for the preliminary draft alternatives review.

The 518 comments received during the scoping period were organized into 51 codes. Of the 51 codes assigned, 7 were related to the alternatives, 29 were concerned with the issues the NPS should consider when evaluating the possible management actions for water resources, 10 were concerned with impact topics, and 5 were related to the NEPA and regulatory process. Of the 29 codes related to issues the NPS should consider, eight were directly related to water resources, seven were related to wildlife management, three were related to cultural resources, four were related to recreation and access, one was related to wilderness, two were related to Preserve management, and four were related to the regional context including land development, ecosystem function, and climate change. Of the 10 codes concerning impact topics, one was related to water resources, five were related to wildlife, one was related to cultural resources, and three were related to visitor use.

Administrative Draft Plan and NEPA Pathway Change

This project was initially scoped as an Environmental Impact Statement (EIS) due to uncertainty regarding the significance of impacts to desert bighorn sheep. In February 2017, an Administrative Draft Plan and EIS was submitted to NPS and CDFW reviewers. Comments on the Administrative Draft Plan/EIS resulted in a revised and updated analytical model of bighorn habitat and change to the action alternatives. Based on updates to the habitat model and action alternatives, as well as the application of an adaptive implementation sequence, the uncertainty regarding impacts to desert bighorn sheep is resolved.

Because there is no potential for significant adverse impacts, the NEPA pathway was changed from an EIS to an EA in late 2017. Preparing an EA rather than an EIS will allow for a more timely and efficient approach to the NEPA process that provides a streamlined path to a decision document and project implementation. This pathway change is consistent with agency efforts to streamline the NEPA process by employing the most efficient approach to NEPA review that is possible under current policy.

Agency Consultation

California Department of Fish and Wildlife

Consultation with the CDFW, a cooperating agency, has been ongoing throughout this planning process. In 2017, CDFW provided detailed comments and feedback on an internal review version of the plan and NEPA analysis, resulting in substantial changes and improvements to the alternatives and analysis.

California State Historic Preservation Officer

Consultation with the California SHPO also occurred in 2017, as the NPS determined the appropriate framework for compliance with Section 106 of the National Historic Preservation Act.

U.S. Fish and Wildlife Service

A biological assessment of this plan/EA has been provided to the U.S. Fish and Wildlife Service for review and comment.

Tribal Consultation

The NPS has initiated tribal consultation with the following tribes: Colorado River Indian Reservation, Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, and Twentynine Palms Band of Mission Indians. Tribal consultation is ongoing and copies of this EA will be forwarded to the tribes for review or comment.

Technical Contributors

The following individuals with specific knowledge of the resources and issues addressed in this plan/EA provided technical feedback during the plan development process:

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APPENDICES

Appendix A

Minimum Requirements Analysis

Draft Minimum Requirements Analysis for Mojave National Preserve Management Plan for Developed Water Sources

Background

Mojave National Preserve is preparing an Environmental Assessment in support of a Management Plan for Developed Water Sources in Mojave National Preserve. Among the issues being addressed in the plan is the disposition of six big game guzzlers, which are systems of catchments, tanks, and drinker boxes that were built and maintained to provide desert bighorn sheep with access to drinking water. While the guzzlers that are now present in Mojave National Preserve were constructed prior to wilderness designation in 1994, they have remained in use since then as part of the Preserve's bighorn sheep management efforts. The guzzlers have been repaired periodically, often by volunteers, to keep them operational. They have also been manually refilled on occasion when water levels became low during dry periods.

Whether to use some number of guzzlers to support bighorn sheep populations is one of the decisions to be made in the Developed Water Sources Plan. The Wilderness Act prohibits structures and installations in wilderness except as necessary to meet the minimum requirements for the administration of the area as wilderness. It also prohibits the use of motorized equipment unless necessary to meet the minimum requirements for the administration of wilderness. The National Park Service's Management Policies require the completion of a Minimum Requirements Analysis for any management decision that affects wilderness. (Management Policies 6.3.5) This Minimum Requirements Analysis has been prepared to assist NPS decision makers in determining whether continued use of guzzlers is necessary for administration of the area as wilderness, and if so, how to minimize impacts on wilderness character. "Use" in this context is understood as the decision to retain the structure or installation for a particular purpose, maintain the structure through both routine and urgent repairs, and actively monitor and operate the structure or installation, for example, by refilling empty tanks when necessary.[1]

Analytical Framework

The following questions have been developed to assess whether the use of some number of guzzlers to further bighorn sheep conservation is consistent with the Wilderness Act.:

1) Is the project's purpose, conservation of bighorn sheep, consistent with the Wilderness Act?

2) Are there other conservation strategies, alone or in combination, that could achieve bighorn sheep conservation objectives without the need to use guzzlers?

3) If using guzzlers is necessary, what number (or range) of guzzlers and what maintenance and operating activities are the minimum necessary to administer the area for the purpose of the Act?

4) How would use of guzzlers impact the recreational, scenic, scientific, educational, historical, and other public purposes of wilderness, including other conservation purposes? Are impacts to these other purposes outweighed by the need to conserve bighorn sheep?

[1] This contrasts with the case in which a structure or installation is present at the time of wilderness designation, but is not actively used or maintained for an administrative purpose, and therefore does not require a Minimum Requirements Analysis. As an example, Mojave National Preserve Wilderness contains a number of small game guzzlers, but these are neither maintained nor used for conservation purposes, and no Minimum Requirements Analysis has been developed.

5) Is using guzzlers consistent with the Wilderness Act requirement to preserve wilderness character and avoid impairment to the same?

Analysis

1) Is the project's purpose, conservation of bighorn sheep, consistent with the Wilderness Act?

The Wilderness Act directs agencies to administer wilderness areas to preserve their wilderness character and to devote wilderness areas to six identified public purposes, namely, recreational, scenic, scientific, educational, conservation, and historical use." One of the objectives of the Water Resources Management Plan is to "conserve desert bighorn sheep populations in a manner that complements regional sheep conservation goals and is consistent with wilderness values."

Desert bighorn sheep are an emblematic species in the Mojave Desert region. Conservation of this iconic species is a purpose rooted in law and policy regarding the Mojave National Preserve and is consistent with the administration of Mojave National Preserve wilderness under the Act.

The National Park Service Organic Act (1916) identifies wildlife conservation as a primary aspect of the NPS mission, stating that the "fundamental purpose" of national parks is "to conserve the scenery, natural and historic objects, and wild life [therein] and to provide for the enjoyment of the scenery, natural and historic objects, and wild life in such manner and by such means as will leave unimpaired for the enjoyment of future generation" 54 U.S.C. § 100101(a).

National Park Service Management Policies (2006) reinforce this mandate and provide specific direction regarding the conservation of native species. Section 4.4.1 General Principles for Managing Biological Resources states, "The National Park Service will maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems." The Management Policies identify several approaches to achieving this purpose, namely by "preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur; restoring native plant and animal populations in parks when they have been extirpated by past human-caused actions; and minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them." The Water Resources Management Plan proposes to conserve desert bighorn sheep by preserving dry season habitat, which will help offset impacts from habitat fragmentation and climate change.

This minimum requirements analysis, and the impacts analysis in the EA, focuses on changes in sheep habitat, and specifically functional dry season habitat, as opposed to changes to sheep populations, for several reasons:

- **Biological Importance:** All wildlife population require habitat, and loss of habitat is a common threat to many species. Sheep are particularly vulnerable to habitat loss (Epps et al. 2005; Longshore et al. 2009; Creech et al. 2014). Also, for sheep, we know that water availability is a key habitat variable that affects lambing rates, which is crucial for herd persistence (Wehausen 2005).

- **Management Efficacy:** Water is a habitat component that is subject to direct management by the National Park Service. Other habitat elements, such as topography and forage, are not, and other population factors, such as disease, are similarly difficult to control or predict. Section 2), below, discusses the limitations of a variety of other management approaches.
- **Accessibility for Analysis:** Habitat analysis is far easier than analysis of changes to sheep populations, which are naturally variable, occur over long time periods, and are costly to measure. Using the analysis completed for the EA, the National Park Service can make strong predictions about the effects of changing water supply location on functional dry season habitat. In contrast, predictions about changes to sheep populations are confounded by many other variables that influence population dynamics, such as disease events, and are dependent on data that must be collected over impractically long time frames at great cost. These data generally involve sheep collaring and tracking, including aircraft use. The proposed approach is to use these types of methods on a more limited basis as a monitoring tool to observe sheep responses to new guzzler locations.

The California Desert Protection Act added public lands in the California desert to the National Park System and the National Wilderness Preservation System in order to "preserve unrivaled scenic, geologic, and wildlife values associated with these unique natural landscapes." Specifically, Mojave National Preserve was created to protect "the particular ecosystems and transitional desert type found in the Mojave Desert area" lying between Death Valley and Joshua Tree National Parks. Congress further directed that "the wilderness within the Mojave Desert should receive maximum statutory protection by designation pursuant to the Wilderness Act."

The Mojave National Preserve General Management Plan (2002) elaborates the Preserve's role in protecting resource values related to wildlife generally and desert bighorn sheep in particular, stating:

> Native populations of Nelson's bighorn sheep (Ovis canadensis nelsonii) are found in most of the mountainous terrain of the park, with population estimates as of 1994 at between 400 and 675 or more animals (Torres, S. G. et al. 1994). The population is listed as "fully protected" by the state, primarily due to the fragmentation of habitat throughout its range. It is not a federally listed species. Mojave National Preserve provides substantial protected habitat for desert bighorn sheep and is also one of the few places in California where bighorn sheep hunting is allowed.

The Foundation Document for Mojave National Preserve (2013) reinforces the importance of native wildlife and the need to preserve wildlife by addressing habitat fragmentation with measures to improve habitat connectivity.[2] In describing the resources that merited the Preserve's designation as a unit of the national park system and that are a focus of management action, the Foundation Document explains that, "Mojave National Preserve protects a large, relatively intact ecosystem of the eastern Mojave Desert from continuing threats associated with expanding development and provides connectivity between other protected natural areas within the larger Mojave Desert ecoregion." The Foundation Documents identifies the "full range of biological diversity of native species representative of the eastern Mojave Desert ecosystem, minimally disturbed by humans" as one of the Preserve's fundamental values and indicates

[2] A Foundation Document for a unit of the National Park System identifies the purposes for which the park area was established, the fundamental resources and values that it protects, and the significant features that make the park worthy of inclusion in the National Park System.

that protecting this “fundamental resource will help sustain a relatively intact desert ecosystem, maintain the connectivity of the preserve to the larger ecoregion, and uphold the intent of the enabling legislation (the California Desert Protection Act).” Threats to NPS’s ability to protect this fundamental value emanate from, “habitat fragmentation and edge effects from through-roads, renewable energy developments, and power lines have adverse effects on the biodiversity (e.g., blocked sheep movement, birds injured in flight, tortoise translocation) and cause direct habitat loss outside the preserve boundaries.”

As discussed above, Congress established the Preserve and designated large portions of it as wilderness in order to preserve “unrivaled … wildlife values” and the area’s unique and transitional ecosystem. Desert bighorn sheep are an iconic wildlife species in the Preserve, and the habitat that sustains them is an integral component of the Mojave Desert ecosystem. For these reasons, plans and policies that direct NPS management efforts for the Preserve identify bighorn sheep and their habitat as fundamental resources and values to be protected. Conservation efforts directed at bighorn and their habitat are therefore consistent with the purposes for which Congress established wilderness in Mojave National Preserve.

Desert bighorn sheep are also the subject of a draft California Department of Fish and Wildlife (CDFW) Conservation Plan (2012) that addresses the herds found in the preserve. Particular emphasis is placed on the importance of free surface water as a habitat component, and for the Old Dad/Kelso herd, the plan states that, in order to keep a stable population of desert bighorn sheep, “[m]anagement needs in this herd unit are limited to enhancing the reliability of existing water developments.” The special status of desert bighorn sheep is not straightforward. They are neither listed as threatened or endangered on federal or state lists, although a peninsular subpopulation, once considered a distinct species, is listed as federally endangered and state threatened. As mentioned in the Mojave GMP, the official status according to CDFW is “fully protected,” despite being legally hunted under state law. In addition, the United States Forest Service and Bureau of Land Management identify desert bighorn as a sensitive species in California, which is defined as a species that could easily become endangered or extinct in the state in the absence of special management.

2) Are there other conservation strategies, alone or in combination, that could achieve bighorn sheep conservation objectives without the need to use guzzlers?

This analysis examines whether there are means to achieve big horn sheep conservation without resorting to actions that are identified as a prohibited use in Section 4(c) of the Wilderness Act, namely, the use and maintenance of water provisioning structures in wilderness.

<u>Predator (mountain lion) control</u>

Predation by even a small number of mountain lions, where they have established this hunting behavior, can be a significant source of adult sheep mortality. This predation pattern is most common where bighorn sheep habitat overlaps with that of mule deer or other cervids, mountain lions’ main prey.

Predator control has also long been considered repugnant in national park units. For example, as early as 1963, in *Wildlife Management in the National Parks,* Aldo Leopold wrote about the destructive past practice of predator control, its contribution to unnatural conditions in parks, and the need for NPS to intensify predator conservation as opposed to control. National Park Service Management Policies (2006) generally rejects predator control as a management practice in Section 4.4.3, Harvest of Plants and Animals by the Public: "The Service does not engage in activities to reduce the numbers of native species for the purpose of increasing the numbers of harvested species (i.e., predator control), nor does the Service permit others to do so on lands managed by the National Park Service." Mountain lions are a native species at Mojave Preserve, and desert bighorn sheep are both a harvested species and native species. In the view of NPS Management Policies, the appropriate approach in national park units is to manage prey species such that predation by other native species is sustainable. This is also consistent with the Wilderness Act duty to preserve the natural quality of wilderness character.

Section 4.4.2, Management of Native Plants and Animals, does contemplate certain circumstances in which the Service may intervene to manage a native species. Among the circumstances are when a "population occurs in an unnaturally high or low concentration as a result of human influences (such as loss of seasonal habitat, the extirpation of predators, the creation of highly productive habitat through agriculture or urban landscapes) and it is not possible to mitigate the effects of the human influences". Desert bighorn sheep, at the regional scale, do exist in unnaturally low concentrations as a result of habitat fragmentation and a drier, hotter climate. Indeed, addressing this condition is a central purpose in providing ample free water during the dry season by using and maintaining guzzlers. Conceivably, the service could intervene by controlling predator conservation if this addressed the root cause of the native species' unnaturally low concentration.

However, in Mojave Preserve, mountain lion predation is considered an important source of mortality *only* in the Granite Mountain area (in the far southern part of the Preserve). It is not considered an important source of mortality in the habitat areas where guzzlers currently exist or are being contemplated. Predator control would therefore not achieve the desired conservation objectives for the populations of bighorn sheep in designated wilderness where maintenance of water provisioning structures is proposed.

Controlling mountain lion predation therefore runs counter to the general direction of NPS policy regarding predator control, and if pursued as an exceptional case in which intervention is warranted for the sake of a native species occurring in unnaturally low concentrations, would fail to improve conservation of that species. It is not considered an effective alternative to dry season water provisioning.

<u>Reducing or eliminating translocations</u>

Translocations have occurred only once, when Mojave National Preserve allowed one translocation of 13 ewes to China Lake Naval Air Weapons Station in 2006. In the future, the preserve would consider proposals that would increase resiliency of the Mojave desert bighorn sheep metapopulation, provided that did not jeopardize the preserve's source population, but these would at most be uncommon cases involving a small number of animals. Currently, no translocations are planned. Thus, reducing or eliminating translocation practices is unlikely to have a detectable effect on sheep populations over the life of this plan, and does not obviate the need for habitat conservation to maintain a stable population of bighorn sheep.

Reducing or eliminating hunting of bighorn sheep in the Preserve

The California Desert Protection Act directs the Secretary to permit hunting within the Preserve in accordance with applicable state and federal law. It further allows the Secretary, acting through the NPS, to limit the periods and locations where hunting can occur.

> The Secretary shall permit hunting, fishing, and trapping on lands and waters within the preserve designated by this Act in accordance with applicable Federal and State laws except that the Secretary may designate areas where, and establish periods when, no hunting, fishing, or trapping will be permitted for reasons of public safety, administration, or compliance with provisions of applicable law.

Because state law permits bighorn sheep hunting, the NPS does not have the authority to prohibit hunting of bighorns within the Preserve, although NPS could further regulate hunting in terms of location and season. However, NPS has not done so, and hunting, as currently practiced pursuant to state regulations is extremely limited in scope. Additional regulation of this limited activity is not considered to be warranted at this time.

Currently, state law allows the hunting of bighorns only in the Kelso Peak area and the Old Dad Mountains. The hunting season is short, usually two to three months during the winter, and a limited number of tags are available for mature rams only. In some years, such as the 2017-2018 seasons, no tags are available for hunting within the Preserve.[3] Over the last ten years, the state has authorized between 3 and 5 tags annually.

The removal of 3-5 rams annually has a negligible impact on lambing rates and population stability. CDFW develops tag limits based on the concept of “compensatory mortality”, in which “hunting mortality will be substituted for, rather than added to, natural mortality” (CDFW 2011). CDFW conducts annual aerial surveys to ensure that hunting mortality does not have a depressing effect on bighorn sheep populations. Moreover, protecting this small numbers of rams would not address the important conservation purpose of preserving functional dry season bighorn sheep habitat.

Reducing or eliminating human disturbance

The Mojave National Preserve is the third largest national park unit in the contiguous United States, after Yellowstone National Park and Death Valley National Park. For comparison, Yellowstone receives more than 4 million visitor annually, Death Valley almost 1.3 million, and Mojave National Preserve less than 600,000. As with other large parks, the majority of visitor use is confined to developed areas and backcountry locations with maintained trails. In Mojave, visitor use of these remote sheep habitat areas is known to be very infrequent, and data is not collected regarding the number and destination of foot travelers in these areas. There is no data to suggest that bighorn sheep are affected by human disturbance. In general, sheep habitat areas do not contain maintained trails. The Kelso guzzler is located on an old road stem that could provide access to walkers. The Old Dad guzzler is located in an extremely rugged and remote terrain.

[3] California Code of Regulations, 14 C.C.R. Section 362 and https://www.wildlife.ca.gov/Hunting/Bighorn-Sheep..

Reducing or eliminating disease mortality

Disease transmission from domestic sheep or goats to bighorn is believed to be a major cause of bighorn population declines in the late nineteenth and early twentieth centuries, and remains a major concern for bighorn sheep populations. Preventing contact between domestic animals and wild sheep has been and remains the primary management approach recommended by CDFW and NPS (CDFW 2012, NPS 2017). In Mojave Preserve, domestic sheep and goats are not permitted, and occasional stray or feral animals are removed when detected.

In 2013, a respiratory disease outbreak (Mycoplasma ovipneumoniae) occurred in the Old Dad area. Ewe estimates at the Kerr and Old Dad guzzlers before (2012) and after (2014) the outbreak suggest declines of greater than 50% at Kerr and 40% at Old Dad (Wehausen, conference presentation, April, December 2017). This is the only known episode since the Preserve was established in 1994. While the specific source of this transmission is not known, the disease is not native to wild sheep, and it is widely understood that all cases of this disease originate through domestic animal contact. Once contracted by wild sheep, the disease can be transmitted rapidly between animals. It has been speculated that the scarcity of water sources in the southern Mojave Desert may exacerbate disease transmission by causing infected animals to congregate at water sources (Epps 2016). This is a concern with both guzzlers and natural water sources. However, because the guzzlers increase the number of water sources, and the distribution of the guzzlers increases functioning habitat, this issue of congregation would be worse if guzzlers were to be eliminated. In addition, ewe to lamb transmission is both common and of special importance in terms of population impacts because it suppresses lamb recruitment. This form of transmission does not depend on congregation points. Finally, it is possible to explore guzzler designs that would limit the nose-to-nose contact that is most likely to result in transmission of this disease.

The proposed use of guzzlers, therefore, is not believed to be a contributor to future disease outbreaks, and may mitigate them. Efforts to reduce wild sheep contact with domestic sheep will continue to be the primary mechanism for avoiding disease transmission, but does not function as an alternative means of conserving sufficient desert bighorn habitat.

Reducing or eliminating burro competition

Burros, a nonnative species in the Preserve, occupy similar habitat as bighorn sheep and compete for forage and water resources where populations overlap. This competition is understood to be a significant threat to bighorn sheep populations, and increasing burro populations have been correlated with declining sheep populations. Burros are known to damage spring sites with manure, urine, and trampling, and monopolize springs sites by hazing sheep.

Wildlife management agencies including NPS and CDFW have identified burro removal as a strategy for many areas in the Mojave region. The 2002 GMP contained a detailed program for burro removal as a means to protect resources; similar proposals are contained in the CDFW draft conservation plan for many areas in the Mojave region. In Mojave Preserve, NPS funded burro removal from 1998 to 2003, and held an additional round up in 2005. In subsequent years, burro populations reached a low point in the Preserve.

More recently, burros have again become an issue in the Wood Mountain area, where they have damaged and monopolized a spring formerly used by bighorn sheep. The preserve is considering removal options for burros in the Wood Mountain area, and is working on an agreement with a non-profit to manage a round-up and adoption program. If successful, this could help with sheep conservation efforts in that area.

Burro competition is not, however, currently a problem in the areas where guzzlers are present. The NPS would remove burros from areas where guzzlers are present if they are detected, but this is not a substitute for water provisioning in areas where developed water sources are necessary for maintaining dry season habitat.

Use of the previously discussed measures in combination

Because sheep translocation, hunting, and disturbance by humans are not believed to be important factors in sheep population dynamics or sheep habitat function, combining these measures would at most have a marginal impact on conserving and maintaining bighorn sheep populations. Burros and domestic sheep and goats pose real risks to sheep, but removal is already the preserve's management response. Mountain lion predation can be a significant pressure on sheep populations, but in Mojave it does not appear to be a factor for the sheep populations that use guzzlers. Moreover, other policy considerations would make this form of predator control an action of last resort even if it was believed to be potentially effective as a conservation measure. It is therefore not believed that addressing any of these factors in combination represents a meaningful alternative to ensuring conservation of bighorn sheep populations, on the same level that maintenance of dry season habitat would, which requires dry season water sources.

Relocating guzzlers outside wilderness

Several of the existing guzzlers do have potential relocation sites outside of wilderness, primarily along "cherry-stemmed" road corridors. Therefore, each of the action alternatives contemplates relocation of some number of the existing guzzlers, consistent with the habitat objectives on which the alternatives are founded. The process of relocating water sources is described in detail in the EA (see page 41). In all cases, the process would involve some experimentation to ensure that sheep begin to use the new sites before the old sites are decommissioned. The conclusion of the impact analysis in the EA is that removal of all guzzlers from wilderness would result in potentially significant adverse effects. This alternative was therefore considered but dismissed from full analysis in the EA.

Conclusion

Based on this review of alternative (non-prohibited) conservation approaches, the conclusion of this analysis is that none of these alternative conservation approaches represents a viable alternative to water provisioning as a means of conserving functioning dry season desert bighorn sheep habitat. As discussed in the Management Plan for Developed Water Sources/EA, this is understood to be an important factor in lambing success and therefore population stability. Water provisioning at some level is considered necessary to maintain habitat during dry seasons, and particularly during dry seasons of drought years.

However, there are believed to be alternatives in terms of non-Wilderness locations for guzzlers that would provide the habitat component currently provided by a guzzler location. Additional discussion of guzzler relocation is provided below.

3) If using guzzlers is necessary, what number (or range) of guzzlers and what maintenance and operating activities are the minimum necessary to administer the area for the purpose of the Act?

Number of guzzlers

Water provisioning, by the retention of some number of tank and drinker guzzlers, is considered necessary for desert bighorn sheep conservation in the Mojave National Preserve. The Management Plan for Developed Water Sources/EA explores three alternatives, each of which contains a different proposal in terms of the number and location of guzzlers that would be retained in wilderness and outside wilderness.

The development of these alternatives was based on a number of factors that inform the feasibility of achieving the Plan's bighorn sheep conservation goals. These factors include:

- The importance of dry season water access in terms of lambing rates and lamb survival
- The regionally fragmented state of desert bighorn sheep habitat, which reduces species resiliency
- The prediction that climate will continue to change in the Mojave Desert region, and that these changes are likely to involve longer, drier, and more frequent droughts
- The need to consider impacts to wilderness character, including the impact from the presence of guzzlers on the undeveloped quality of wilderness, and the impact of active water provisioning for desert bighorn sheep on the untrammeled quality
- The availability of alternative, non-wilderness locations for guzzlers that provide for sufficient functional dry season desert bighorn sheep habitat

These factors lead to three alternatives in terms of the trade-off between the amount of dry season habitat that is conserved and the manner in which wilderness values are protected. In the EA preferred alternative (Figure 1), the preserve would adopt a no-net-loss-of-functional-dry-season-habitat objective, and would take actions to reduce wilderness impacts given this habitat objective. Based on this objective for bighorn sheep habitat, the preserve determined:

- One guzzler does not does not appear to be used by sheep, and can most likely be eliminated without consequence to sheep habitat function (Clark Guzzler)
- Two guzzlers have potential relocation sites outside of wilderness near to the existing guzzler sites (Vermin and Kerr Guzzlers).
- One guzzler does not have alternative, non-wilderness relocation sites, but is located in an area where other water sources provide coverage for that habitat, allowing removal without jeopardizing the no-net loss of habitat objective (Piute Guzzler)
- Two guzzlers in wilderness cannot be eliminated without jeopardizing the no-net-loss-of-functional-habitat objective (Kelso and Old Dad Guzzlers)
- In addition, three new guzzler/developed spring sites outside of wilderness will be considered to provide habitat connectivity between habitat areas (New Piute Guzzler, Ginn Spring, Vontrigger Spring)

Chapter 2 of the Management Plan for Developed Water Sources/EA contains additional detail about the re-location sites, processes, and monitoring approach for the Preferred Alternative (see page 41).

Based on that impact analysis, the NPS has identified Alternative 3, which would allow for the redesign and maintenance of two guzzlers in wilderness, as the minimum necessary for administering the area for conservation purposes.

Maintenance and Operating Activities

Guzzlers that are retained and used in wilderness will require occasional inspection and repair when damage is detected, both to keep them working and to protect the animals that use them. The majority of repairs will be performed on an as-needed basis, and it is therefore not possible to identify the case-specific factors that would be used to determine if a particular prohibited use is necessary to accomplish a particular repair.

However, past experience provides some insight into the types of repairs and operations that are probable in the future, and several projects have been recently approved through separate NEPA processes. In 2015, Mojave National Preserve completed a Categorical Exclusion (CE) and Minimum Requirements Decision Guide (MRDG) for various repair and maintenance work at all six existing guzzlers, including repairing and replacing float valves, repairing and replacing damaged pipe, replenishing water tanks, cleaning debris out of check dams, cleaning out blocked pipes, and adjusting water level instrumentation. Some of these tasks require the use of motorized vehicles or power tools. Another proposed project is to mitigate the risk to sheep from a cracked tank at the Old Dad Guzzler by building a wooden platform that can support the weight of sheep. In the past, an incident occurred in which a bighorn fell through the top of the Old Dad Guzzler and drowned, causing a botulism outbreak that killed a number of other sheep. This project will require pickup truck access and power tools, and is documented with a CE and MRDG.

In addition to as-needed repairs, the Kelso Guzzler has limited water capacity relative to its heavy use by sheep, and it is typically necessary to refill the storage tanks at that site once or twice during the dry summer season. This is accomplished by making a trip with five to seven light 4wd pickup trucks with water tanks secured in the pickup beds. These trucks traverse an unmaintained jeep road about 2 miles beyond the wilderness boundary. They then run hoses from the truck tanks to the guzzler tanks and pump the water with generator power. At present there is no alternative means to refill these tanks that does not involve another prohibited use, such as aircraft landing. In the future, additional storage tanks could be added to increase the storage capacity, and this could reduce or eliminate the need to refill tanks at Kelso Guzzler. However, this potential project would also require minimum requirements analysis, and the impacts of such a project on wilderness character would need to be compared to the impact of the current practice.

For each as-needed repair, a minimum requirements analysis using the MRDG form will be completed to review the necessity for any proposed 4(c) prohibited use. For refilling the Kelso Guzzler, a programmatic CE and MRA will be completed and reviewed every 3 years.

4) How would use of guzzlers impact the recreational, scenic, scientific, educational, historical, and other public purposes of wilderness, including other conservation purposes? Are impacts to these other purposes outweighed by the need to conserve bighorn sheep?

As disclosed in the Mojave National Preserve Water Resources Plan Environmental Assessment, under the current preferred alternative, four big game guzzlers (Clark, Kerr, Vermin, and Piute) would be removed from wilderness at full implementation. Two (Kelso and Old Dad) would be used and maintained in their current location.

In terms of the agency's balancing of multiple purposes, this proposal is intended to ensure that the conservation purpose of wilderness continues to be fulfilled by taking a cautious approach to reducing the number of installations in wilderness that native bighorn sheep have come use for dry season water needs. This is expressed both by the adoption, in the EA Preferred Alternative, of a no-net-loss-of-functional-dry-season-habitat objective, and by cautiously phasing the removal and relocation of guzzlers to ensure that unacceptable impacts do not occur. While the proposal would serve the scenic purpose of wilderness by removing, in the long term, a number of visible installations, it balances this purpose with the desire to avoid potentially unacceptable impacts to bighorn sheep from loss of dry season water sources. Guzzlers do not have a direct recreational purpose, but they do support sheep, which are subject to very limited hunting. Chapter 1 of the EA considered but dismissed impacts on "Recreation and Hunting". The conclusion is that due to the very small number of tags issued each year, which typically result in 100% success rate, in combination with the overall expansion of desert bighorn sheep habitat under the Preferred Alternative, no adverse impact on hunting would result. No changes to the location or timing of hunting are proposed. Insofar as desert bighorn sheep in the preserve remain available for study by wildlife biologists, the project also serves the scientific purpose of wilderness. The monitoring proposals that accompany guzzler relocation would probably result in improved understanding of bighorn sheep distribution and response to changing water availability. The big game guzzlers do not have an educational or historical component. There are no impacts to other wilderness purposes that outweigh the need to conserve desert bighorn sheep.

5) Is using guzzlers consistent with the Wilderness Act requirement to preserve wilderness character and avoid impairment to the same?

The removal, deactivation, or relocation of four guzzlers from wilderness would improve wilderness character in terms of the untrammeled and undeveloped qualities, removing longstanding impacts that have existed since the Preserve was established and the area designated as wilderness. Because the overall changes associated with the proposal lead to improvement in wilderness character, by reducing impacts from current levels, the proposal meets the Wilderness Act mandate to preserve wilderness character, as expressed in the Wilderness Act Section 4(b), and leaves the area unimpaired for future use and enjoyment as wilderness, as required by Sections 2(a) and (c).

Some of the impacts to wilderness character that are occurring now as a result of guzzler use would continue in order to avoid adverse impacts to desert bighorn sheep habitat and the natural quality of wilderness, and in order to meet the Wilderness Act's conservation purpose. The use and maintenance of the Kelso and Old Dad guzzlers would continue to adversely affect the untrammeled and undeveloped qualities of wilderness. However, this ongoing impact would be limited to the footprint of the two guzzlers (about 0.2 acres, or .00000025% of the Preserve's 804,949 wilderness acres) and the areas of wilderness in which they are visible (up to about 8 acres, or .00001% of the Preserve's 804,949 wilderness acres). Notwithstanding these ongoing impacts, the Preserve's enormous wilderness area will continue to have scant evidence of human development and management control.

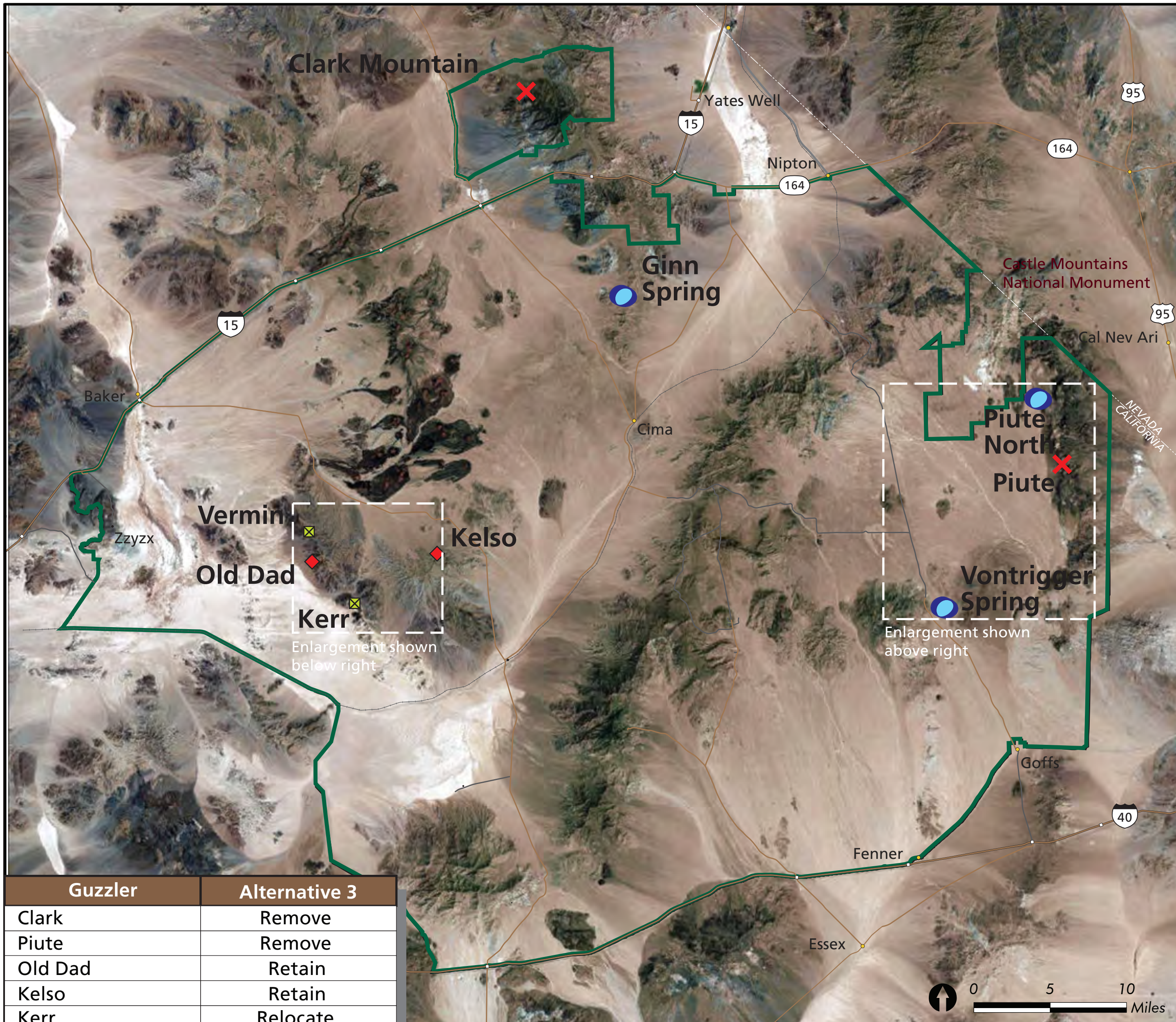
These limited ongoing adverse impacts on the untrammeled and undeveloped qualities must be weighed against the need to preserve the natural quality of wilderness by avoiding net loss of bighorn sheep habitat. These animals are of great importance to conservation in the Preserve and in the Mojave region, their presence enriches the wilderness character of the area, and the large area of undeveloped habitat that these animals depend on is a deliberate consequence of wilderness designation. In the agency's view the proposal to maintain the Kelso and Old Dad guzzlers represents the optimum balance in terms of preserving multiple wilderness character qualities and fulfilling the public purpose of managing this wilderness area for conservation use. A complete discussion of environmental effects of the proposal, including effects on the four qualities of wilderness character, can be found in Chapter 4 of the EA for the Management Plan for Developed Water Sources.

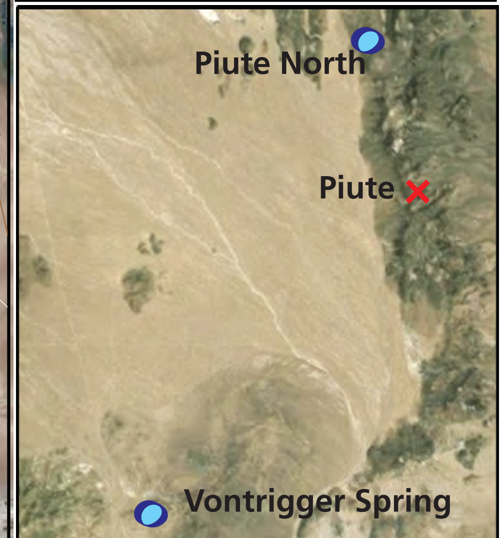
Conclusion

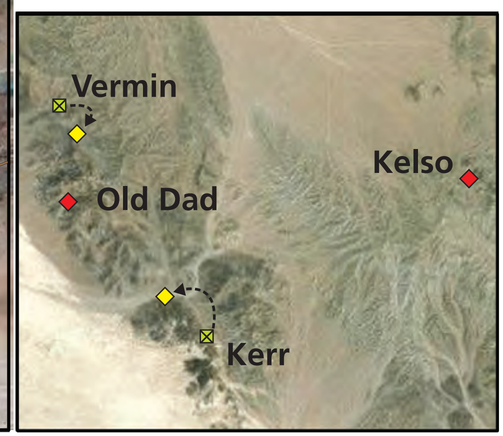
The conclusion of this analysis is that the NPS Preferred Alternative, Alternative 3, as described in detail in the Environmental Assessment, represents the minimum requirement for guzzlers to be used and maintained in wilderness in order to administer the area for the purposes of the Wilderness Act, and specifically for the purpose of preserving sufficient dry season habitat for desert bighorn sheep. This approach will reduce the total number of guzzlers in wilderness from six to two. In arriving at this conclusion, the agency considered the consistency of the project with wilderness purposes, other approaches to desert bighorn sheep that do not involve prohibited uses, ways to minimize the number of guzzlers and associated maintenance and operating activities, the balancing of the project's conservation purpose with other wilderness purposes, and potential adverse effects on wilderness character.

Alternative 3
Big Game Guzzlers

Mojave National Preserve
Water Resources Management Plan and
Environmental Assessment







Guzzler	Alternative 3
Clark	Remove
Piute	Remove
Old Dad	Retain
Kelso	Retain
Kerr	Relocate
Vermin	Relocate
New Water Sources	Yes – Three sites outside wilderness
Total Guzzlers	7
Within wilderness	2
Outside wilderness	5

Alternative Actions

- Retain guzzler
- Remove guzzler
- Relocate guzzler
- Guzzler relocation site
- New water source location
- Mojave National Preserve boundary
- Wilderness*

*Vermin relocation site is within a non-wilderness area associated with an existing road

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Appendix B

Desert Bighorn Sheep Habitat Analysis

Desert Bighorn Sheep Habitat Analysis

Management Plan for Developed Water Sources in Mojave National Preserve (Debra Hughson, Feb. 8, 2018)

The purpose of this analysis is to quantitatively compare bighorn sheep habitat in Mojave National Preserve in relation to provisioned water, i.e. guzzlers. Its objective is to minimize wilderness intrusions while precluding net loss of habitat. Various new guzzler locations are proposed outside of wilderness as compensation for moving other guzzlers out of wilderness.

Methods

I used Resource Utilization Functions (RUF, Long et al. 2009) to relate animal locations to variable components of habitat (Marzluff et al. 2004, Hoglander et al. 2015). A utilization distribution (UD) can be created from a set of animal relocation points by a kernel density function that weights neighboring relocation points within some area described by a bandwidth smoothing parameter (Calenge 2015, Worton 1989), the correct selection of which has been a subject of discussion (Walter et al. 2011). Nonetheless, the UD is a spatial probability density that represents a probabilistic measure of animal use of a given location (Marzluff et al. 2004) and can be related to habitat variables such as slope and elevation through techniques of multiple linear regression (Marzluff et al. 2004) or mixed linear effects models (Hoglander et al. 2015).

The kernel density estimator assumes animal relocations are independent and identically distributed (*iid*), which is a condition seldom met in nature and especially with frequent GPS data. I used the continuous time movement model (Calabrese et al. 2016) to account for temporal correlation of GPS locations in an auto-correlated kernel density estimator (*akde*). Bandwidth in the *akde* is the minimum mean integrated squared error of the estimate (Flemming et al. 2015). Spatial auto-correlation of the UD can be included in a linear mixed effects model as implemented in the R package *nlme* (Pinheiro and Bates 2000, R Core Team 2017).

Available Data

This analysis has been made possible by a cooperative effort between California Department of Fish and Wildlife and the National Park Service, Mojave National Preserve that initiated May 20, 2013 in response to an outbreak of pneumonia caused by the bacteria, *Mycoplasma ovipneumoniae.* Collars were in place on at least 11 bighorn ewes the following November with 4 added in 2015. A summary of those data is presented in Table 1.

Additional data included:

- USGS digital elevation model at 10-m pixel resolution. Variables derived from the DEM included ruggedness, slope, aspect, and hillshade.
- Vegetation alliance polygons with 5 ha resolution (Thomas et al. 2004).
- Geology (Theodore 2007).

- A complete inventory of perennial water sources. No naturally occurring perennial water sources exist in the Old Dad Mountain area. The only water sources there are the Kerr, Old Dad, and Vermin guzzlers.

Data omitted from the model included precipitation and forage quality. An exploratory study of remotely sensed bighorn nutrition is in a preliminary phase of the NASA PROJECT program. Inclusion of this and reviewer recommended precipitation data is left to pending future efforts. As another reviewer noted, hillshade represents a particular angle (time) of the sun and collars were reporting periodically throughout the day. The absence of any relationship between hillshade and utilization was confirmed by modeling. Quadratic forms of the variables were not included.

The collar data from 15 ewes in the Kerr/ Old Dad area were filtered to include only locations during the summer months of June, July, and August. Euclidean distance to the nearest water was calculated from each location. A utilization distribution (UD) for each ewe was calculated by the auto-correlated kernel density estimate using the *ctmm* package for R (Calabrese et al. 2016, R Core Team 2017) clipped at the 95% volumetric isocline. Ruggedness index was calculated using the vector ruggedness measure (VRM) method (Sappington et al. 2007) from a USGS Digital Elevation Model (DEM) with a 10-m pixel resolution. Slope and aspect were obtained from the DEM using algorithms in ArcGIS 10.2.

Values of each UD within its 95% volumetric isocline as well as elevation, ruggedness (VRM), slope, and aspect were selected at 500 spatially random locations generated using the Generalized Random Tessellation Stratified (GRTS) method (Stevens et al. 2004) as implemented in the *spsurvey* package for R (Kincaid and Olsen 2011, Kincaid 2012, R Core Team 2017). Values of the dependent variable (UD) and covariate candidates (elevation, ruggedness, slope, aspect, geology, and vegetation) were picked from the data layers at these random points. Distance to water was calculated as the Euclidean distance from the center of the 10-m square DEM pixel to the known guzzler location. The dependent variable UD was log-transformed. A highly skewed distribution and the possibility of predicting negative probabilities otherwise motivated this decision. VRM was log-transformed (with a few sparse zeros replaced by the mean) and arcsine square root transforms were applied to slope and aspect after normalizing by 90 and 360 respectively. All of the explanatory variables were standardized by the z-transform. Plotted histograms indicated that the transforms greatly improved the central tendency of the data. The linear mixed effects modeling function *lme()* in R (R Core Team 2017) was used for parameterizing models. Information theory model selection techniques were used to compare models (Symonds and Moussalli 2010). The *predict.lme()* function in R was used to obtain estimates of log(UD) within a 2.5 km radius of each water source given covariates from the DEM raster and distance to a proposed new water source. The UD was assumed to be zero within vegetation polygons of woodland areas (pinyon, juniper, fir, and Joshua tree). Overlap between guzzlers closer than 5 km was assigned to the older guzzler. Habitat at each water source was compared by summing the estimated UD, after back transforming, to give an index of habitat. Validity of the underlying distributional assumptions was checked using methods in the *nlme* library (Pinheiro and Bates 2000, R Core Team 2017), namely plots of the residuals, fitted values, and estimated random effects. Although some minor deviations from normality were observed, overall the assumptions of normality and independence in the model seemed plausible.

Results

Distance to Water

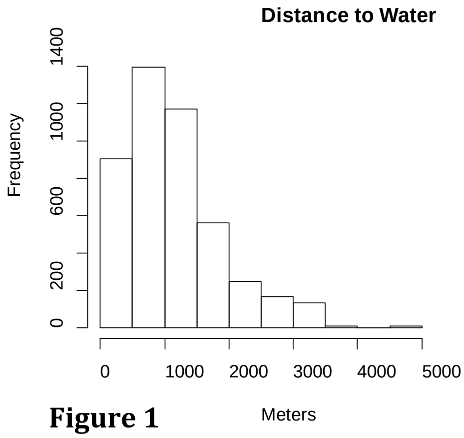


Figure 1

The collared bighorn ewes were likely to be located within a few km of Kerr, Old Dad, and Vermin during the months of June, July, and August. Figure 1 shows the empirical distribution of the distance to the nearest water source for 4613 collar locations from 15 ewes that are temporally correlated on day to monthly scales. Table 1 shows the beginning and end of the period of record for each ewe, total number of locations, and number of locations associated with the nearest water source. The maximum distance was 4.85 km with a median of 1001 m. 93% of the locations were within 2.5 km of a water source. A radius of 2.5 km from water sources was used in this analysis as representing summer habitat for bighorn ewes.

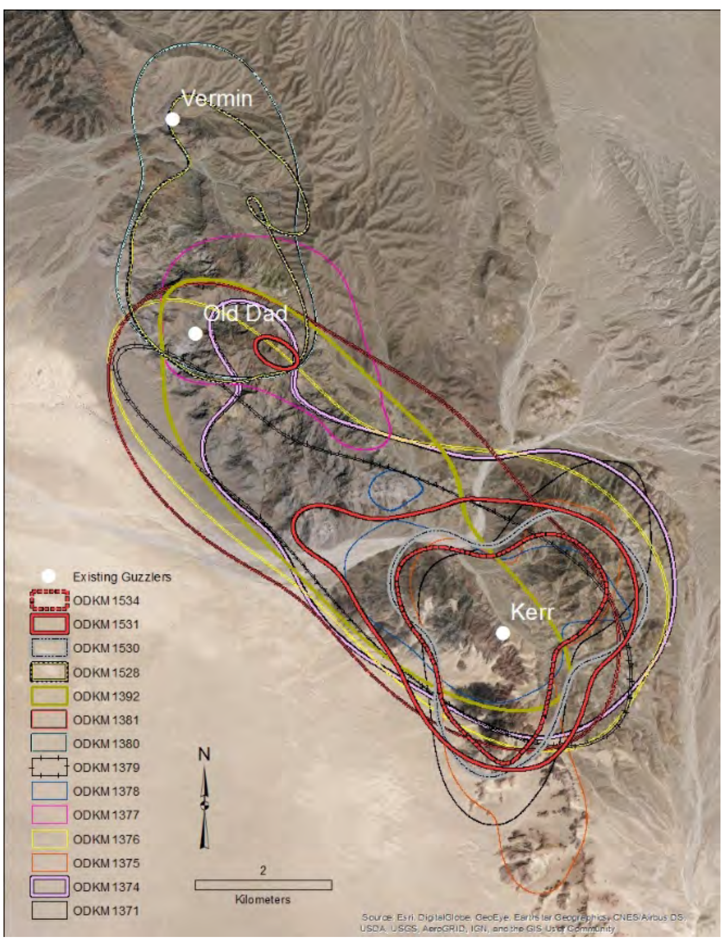


Figure 2. 95% volumetric isoclines individually for 15 ewes in the Old Dad Mountain area are shown for the months of June, July, and August. Casual observation suggests the ewes tend to stay together in groups.

Temporal association of individuals and ram-ewe interactions might be a topic of future research using these and data from collared rams.

Interestingly, the 95% volumetric isoclines also include sand dunes on the southwest side and alluvial fans on the northwest side in addition to the rugged, rocky terrain. Although most of the collar locations occur in the rocky outcrops, a few points in the sandy areas suggest occasional use or crossing.

Table 1. Collared ewes (15) are identified by collar number with beginning and ending dates of available record and total number of relocations. The number of relocations in the summer months of June, July, and August are indicated according to the closest water source.

Collar #	Guzzler	Begin	End	N total	N summer	Summer/Total
1371	Kerr	11/15/2013	10/31/2014	2008	518	0.2580
1373	Kerr	5/01/2014	5/13/2016	232	58	0.2500
1374	Kerr	4/30/2014	6/15/2016	235	58	0.2809
	OldDad				8	
1375	Kerr	11/06/2013	07/31/2016	5755	1361	0.2365
1376	Kerr	4/30/2014	4/23/2016	215	48	0.3116
	OldDad				19	
1377	OldDad	4/30/2014	5/31/2016	273	64	0.2344
1378	Kerr	4/30/2014	6/05/2016	282	62	0.2199
1379	Kerr	4/30/2014	5/17/2016	148	25	0.1959
	OldDad				4	
1380	Old Dad	11/15/2013	8/31/2014	1642	301	0.3076
	Vermin				204	
1381	Kerr	11/15/2013	10/31/2014	1861	208	0.1940
	Old Dad				153	
1392	Kerr	11/15/2013	12/9/2015	2131	253	0.2379
	Old Dad				254	
1528	Old Dad	11/12/2015	7/19/2017	1097	178	0.1923
	Vermin				33	
1530	Kerr	11/12/2015	7/19/2017	1163	264	0.2270
1531	Kerr	11/12/2015	7/19/2017	1168	256	0.2192
1534	Kerr	11/13/2015	7/19/2017	1141	257	0.2270
	Old Dad				2	

Variogram analysis of the residuals showed a spatial correlation structure with range of approximately 500 m and a sill of 1.13 that I modeled as exponential.

The Pearson correlation matrix for continuous covariates within models, and calculated directly from the data selected at random locations, showed a correlation between elevation and elevation squared and between distance to water and its square of close to one. Elevation squared and distance to water squared were not included in the model. All other variable correlations were less than |0.5|.

Candidate models ranked by increasing Akaike information criterion (AIC) are listed in Table 2. I included uninformative models to illustrate their relative ranking and AIC step size.

Table 2. Comparison of candidate models where D is distance to water, E is elevation, S is slope, V is VRM, G is geology, Vg is vegetation, and A is aspect, transformed and normalized. The plus (+) symbol combines covariates and the asterisk (*) includes covariate interactions.

#	Model	AIC	ΔAIC	Relative Likelihood
1	D * S + E * V + G + Vg	-14408.19	0.00	1.0000
2	D * S + E * V + G	-14405.73	2.46	0.2923
3	D * S + E * V	-14399.41	8.78	0.0124
4	D * S + E * V + Vg	-14399.37	8.82	0.0122
5	D * S + E * V * A	-14393.13	15.06	0.0005
6	D * S + E + V	-14387.09	21.10	0.0000

7	D * S + E	-14383.52	24.67	0.0000
8	D + E + S	-14377.63	30.56	0.0000
9	D + E	-14371.37	36.82	0.0000
10	D * E	-14370.63	37.56	0.0000
11	D + G	-14279.00	129.19	0.0000
12	Distance to water (D)	-14248.57	159.62	0.0000
13	Elevation E	-12655.41	1752.78	0.0000
14	Geology (G)	-12583.10	1825.09	0.0000
15	Slope (S)	-12571.28	1836.91	0.0000
16	Ruggedness VRM (V)	-12562.92	1845.27	0.0000
17	Intercept only, with spatial correlation range = 500 m	-12552.99	1855.20	0.0000
18	Aspect (A)	-12552.08	1856.11	0.0000
19	Hillshade (H)	-12551.39	1856.80	0.0000
20	Vegetation (Vg)	-12547.09	1861.10	0.0000
21	Intercept only, no spatial correlation	19590.98	33999.17	0.0000

Models attempting a random slope of distance to water (i.e. the formula for random effects with the form ~ D|Ewe in *lme()*), thereby allowing both the slope and intercept of distance to water to vary by ewe, did not converge.

Model parameters for the best approximating model (model #1), lower and upper 95% confidence intervals, and probabilities are shown in Table 3.

Table 3. Estimated model coefficients for environmental variables from the best approximating model (#1) with lower and upper 95% confidence intervals. Prob. is the probability of the t-statistic, which is the estimated coefficient divided by the standard error. The colon symbol (:) indicates interaction between variables. Letters in braces following the geological description are the map unit symbols in Theodore (2007).

Variable	**Coefficient**	**Lower**	**Upper**	**Prob.**
Distance to water	-0.76965	-0.80395	-0.73535	0.0000
Slope	0.00277	-0.00015	0.00570	0.0637
Elevation	0.05461	0.04442	0.06479	0.0000
VRM	0.00198	-0.00037	0.00432	0.0989
Jurasic Sands granite (Js)	-0.03947	-0.11760	0.03867	0.3228
Mesozoic volcanic and sedimentary rocks (Mzv)	0.01031	-0.00734	0.02796	0.2528
Quaternary alluvium (Qaf)	0.02408	0.01021	0.02408	0.0007
Tertiary gravel (Tg)	-0.00619	-0.01801	0.00563	0.3056
Triassic Moenkopi limestone and shale (TRm)	-0.01573	-0.03457	0.00311	0.1021
Late Miocene vents and flows (Tv1)	0.00478	-0.03318	0.04274	0.8053
Early Proterozoic gneiss and granitoids (Xg)	-0.01754	-0.04362	0.00854	0.1881
Late Proterozoic and Cambrian silici-clastic rocks (€Zs)	-0.00974	-0.02456	0.00507	0.1981
Jurasic sandstone (Ja)	0.02044	0.00084	0.04005	0.0414
Permian to Devonian limestone (PDl)	0.01499	-0.02230	0.05229	0.4313

Cambrian dolomite (Cd)	0.01406	-0.00156	0.02968	0.0782
Creosote	-0.07004	-0.15805	0.01798	0.1194
Galleta-Creosote	0.00235	-0.02956	0.03425	0.8856
Low Elevation Wash System	0.00581	-0.11862	0.13025	0.9272
Creosote-Brittlebush	0.01723	-0.01600	0.05045	0.3101
Creosote-Mojave Yucca	0.04410	-0.00336	0.09156	0.0690
Galleta	0.00055	-0.05368	0.05478	0.9842
D2water:Slope	0.00331	0.00051	0.00612	0.0209
Elev:VRM	-0.00403	-0.00630	-0.00176	0.0005

Even though the geology of Theodore (2007) provides some information regarding utilization it cannot be used in predictive models unless the geology of the target area consists of the same, or at least a subset of the geological units of the modeled area. Likewise vegetation alliances in the predicted area must be the same, or a subset of the vegetation in the modeled area. The modeled area includes 11 geological units and 7 vegetation alliances. Predictions were made at the 13 locations shown in Figure 3 and listed in Table 4, five of which were a subset of both geology and vegetation in the model, six were a subset of just geology, and six were just a subset of vegetation, Predictions using models 1, 2, 3, and 4 are shown in Table 4.

The predicted response variable (log-transformed UD) was exponentiated and summed over the modeled area (2.5 km radius with woodland areas omitted) to create an index ($H=\sum UD(x,y)\Delta x \Delta y$) where $\Delta x = \Delta y = 10$ m is the pixel area. Existing and potential guzzlers were then ranked and compared based on this index.

Table 4. Index H by location for the top four models.

Location	Model 1	Model 2	Model 3	Model 4
Kerr	0.1202621	0.1199739	0.11986445	0.1200822
Old Dad		0.1209407	0.12013399	
Vermin			0.08798352	0.08815095
Kelso			0.09480965	
Piute			0.08859304	
Clark			0.02824119	
New Kerr no Old Dad	0.1193032	0.1189963	0.11814993	0.1184363
New Kerr with Old Dad	0.1134609	0.1131627	0.11237880	0.1126573
New Vermin no Old Dad	0.1180774	0.1177946	0.11882654	0.1190182
New Vermin with Old Dad	0.06553302	0.06532478	0.06629790	0.06641454
New Piute			0.09531018	
Vontrigger			0.11874796	
Ginn			0.03633760	

Comparison of all existing and potential guzzler locations can only done using the same model. Since the geology and vegetation at eight locations included units and alliances not found in the modeled area, only data consistently available across all locations derived from the DEM can be used for comparison. Even though the model based only on DEM data (model 3) is one percent of the relative likelihood of model 1, the differences in H between all models where geology and vegetation data are available is small.

Various arrangements of existing and potential guzzler locations were compared to the current arrangement (Alternative 1, No Action) that consists of the existing guzzlers named Kerr, Old Dad, Vermin, Kelso, Piute, and Clark. These and the locations of potentially new guzzlers are shown in Figure 3. Various arrangements of guzzlers (Table 5) were compared to the existing arrangement by summing index H over the guzzler lists and calculating percent change as compared to Alternative 1.

Table 5. Various arrangements of guzzlers from the Administrative Draft Water Plan Alternatives are shown in the first row indicated by numbers 1 – 4. Other arrangements compared in this analysis are given in the second row of Table 5, labeled arbitrarily W – Z. The locations of existing and proposed guzzlers are shown in Figure 3.

Alternative 1	***Alternative 2***	***Alternative 3***	***Alternative 4***
Old Dad	New Kerr no Old Dad	New Kerr no Old Dad	New Kerr with Old Dad
Kerr	New Vermin no Old Dad	New Vermin no Old Dad	Old Dad
Vermin		Kelso	New Vermin with Old Dad
Kelso		Vontrigger	Kelso
Piute		Ginn	Piute
Clark			Vontrigger
			Ginn
Alternative W	***Alternative X***	***Alternative Y***	***Alternative Z***
New Kerr no Old Dad	New Kerr with Old Dad	New Kerr with Old Dad	Kerr
New Vermin no Old Dad	Old Dad	Old Dad	Old Dad
Kelso	New Vermin with Old Dad	New Vermin with Old Dad	New Vermin with Old Dad
	Kelso	Kelso	Kelso
	Vontrigger	New Piute	New Piute
	Ginn	Vontrigger	Vontrigger
		Ginn	

Table 6. Percent change in H, summed over the guzzlers considered in each alternative, as compared to Alternative 1.

Alternative	**Description**	**% change in summed H**
Alternative 1, No Action	Existing arrangement	0
Alternative 2	2 moved, 4 removed	-56
Alternative 3	2 moved, 3 removed, 2 new, 1 in place	-10
Alternative 4	2 moved, 1 removed, 2 new, 3 in place	+18
Alternative W	2 moved, 3 removed, 0 new, 1 in place	-39
Alternative X	2 moved, 2 removed, 2 new, 2 in place	+2
Alternative Y	2 moved, 2 removed, 3 new, 2 in place	+19
Alternative Z	1 moved, 2 removed, 2 new, 3 in place	+14

Discussion

Linear mixed effects models (Pinheiro and Bates 2000) can be used to infer the relative importance of various environmental covariates (Hoglander et al. 2015). In the case of these 15 ewes in the Old Dad Mountain area during the months of July, August, and September, distance to water was the dominant factor (Table 3). Elevation appears to be the most important covariate after distance to water. The model is apparently telling us that, during the summer, the ewes prefer to be in high places near water. Slope and VRM both showed weak effects.

Surprisingly, Quaternary alluvium (Qaf), showed the strongest positive relationship of all the geological units (Table 5). If this relationship is reproduced in future analyses, further investigations might look for a forage interaction since alluvial soils tend to support more vegetation than rocky slopes. Vegetation alliances overall; however, seemed to generally be uninformative except perhaps a weak effect of Creosote-Mojave Yucca.

The model with the lowest AIC could not be used for predictions and comparisons given the geological units and vegetation alliances that were unknown to the model at some of the prediction locations. One approach could be to group geological units into two categories: alluvium and hard rocks. Grouping vegetation alliances could be more challenging, however, given that bighorn tend to avoid wooded areas (CDWF personal communication) and the modeled area is mostly barren of vegetation. I decided to set modeled UD to zero in woodland polygons to address this concern. If bighorn do in fact utilized wooded areas as one reviewer indicated, H for Clark, Kelso, Ginn, and New Piute would be higher. This assumption is conservative for potential new guzzler locations since it does not take credit for questionable habitat.

According to model 3, based solely on the DEM and distance to water, Old Dad and Kerr are the two best guzzlers with Kelso third. Clark ranks last (Table 5). Kelso and Piute are approximately equivalent. Moving Vermin to the south would improve its score except for the overlap with Old Dad. Moving Kerr north to Jackass Canyon would reduce its score and any overlap with Old Dad would make that reduction even greater. Regarding the proposed locations; it's no surprise that Ginn scores low. A water development at Ginn could encounter a low probability of success, but one could argue that it should be attempted given the potential for improved habitat connectivity. It is a surprise, at least to me, that New Piute appears to be as good as, or perhaps better than, Piute. The New Piute site is perhaps worthy of more attention. I'm puzzled by the relatively high H at Vontrigger but note that I located the guzzler at an existing spring (where water is inaccessible) that emerges in a steep-walled canyon with excellent escape terrain nearby. This potential should be explored.

Alternatives

Alternative 2

The ultimate configuration in Alternative 2 has only two guzzlers remaining, New Kerr and New Vermin, both of which are outside designated wilderness. The model indicates that this would result in a 56% reduction from the existing state, which is unacceptable. Alternative 2 is not the agency's preferred alternative.

Alternative 3

The NPS preferred alternative in the administrative draft plan assumed additional habitat would result from new water sources at Ginn and Vontrigger. This model indicates that even if both were fully successful there would still be a 10% loss.

Alternative 4

Alternative 4 of the administrative draft plan left three guzzlers in wilderness (Old Dad, Kelso, and Piute) and assumed success at both Vontrigger and Ginn. The model indicates an 18% improvement with this arrangement.

Alternative W

Alternative 3 in the administrative draft plan assumed that new water sources at Ginn and Vontrigger would contribute substantial new habitat. Alternative W looks at the consequences if that assumption turns out to be wrong. If both proposed sites, Ginn and Vontrigger failed, and with only Kelso, New Kerr, and New Vermin in place, the result would be a 39% loss.

Alternative X

CDFW recognizes the importance of Old Dad and this model supports that view. The model indicates that leaving two guzzlers inside wilderness, Old Dad and Kelso, and assuming success at both Ginn and Vontrigger, would result in a 2% increase. However, should Ginn and Vontrigger both fail, there could be a loss of 27% (not shown in Table 6).

Alternative Y

A more cautious alternative for bighorn conservation might be found that still leaves only two guzzlers in wilderness (Old Dad and Kelso) but could have a better chance of not losing habitat. If New Piute and Vontrigger could replace Piute, habitat could increase by 13% (not shown in Table 6). Should Ginn be successful as well, habitat could increase by 19%. Collaring bighorn in the Piute area and monitoring for a period of at least 3 years should be a prerequisite. In the event that all three new locations (New Piute, Vontrigger, and Ginn) were to fail and Piute were to remain as one of three guzzlers in wilderness (Old Dad, Kelso, and Piute), the net loss would be 11% (not shown in Table 6).

Alternative Z

Kerr is in a poor location for hydrology but an excellent location for ewes. Alternative Z looks at an arrangement of three guzzlers in wilderness (Old Dad, Kerr, and Kelso) with the assumption of success at both New Piute and Vontrigger but failure at Ginn. The net change would be a 14% improvement.

Many other combinations of habitat improvements could be envisioned if existing guzzlers are to be left in wilderness and additional new water sources created. One alternative could be to move Vermin to New Vermin (or not) and leave the rest in place except for Clark, which receives no use by bighorn that we have been able to detect. Then adding both New Piute and Vontrigger could result in an improvement of 31%. If Ginn were successful, and it probably should be tried, the improvement could be 39% (not shown in Table 6).

Recommendation

The objective of this analysis was to minimize the number of guzzlers in wilderness subject to the constraint of no net loss of habitat, but not necessarily to limit the total number of guzzlers. Even though alternatives X and Y meet this objective, Y provides more flexibility to maintain habitat in the face of changing conditions and is thus preferable. The +19% in alternative Y could mean maintaining important movement corridors to offset anthropogenic fragmentation. The following sequence might be considered:

1. Rebuild Old Dad.
2. Move Clark to the Vontrigger location.
3. Build New Piute
4. Build Ginn
5. Relocate Kerr and Vermin
6. Remove Piute

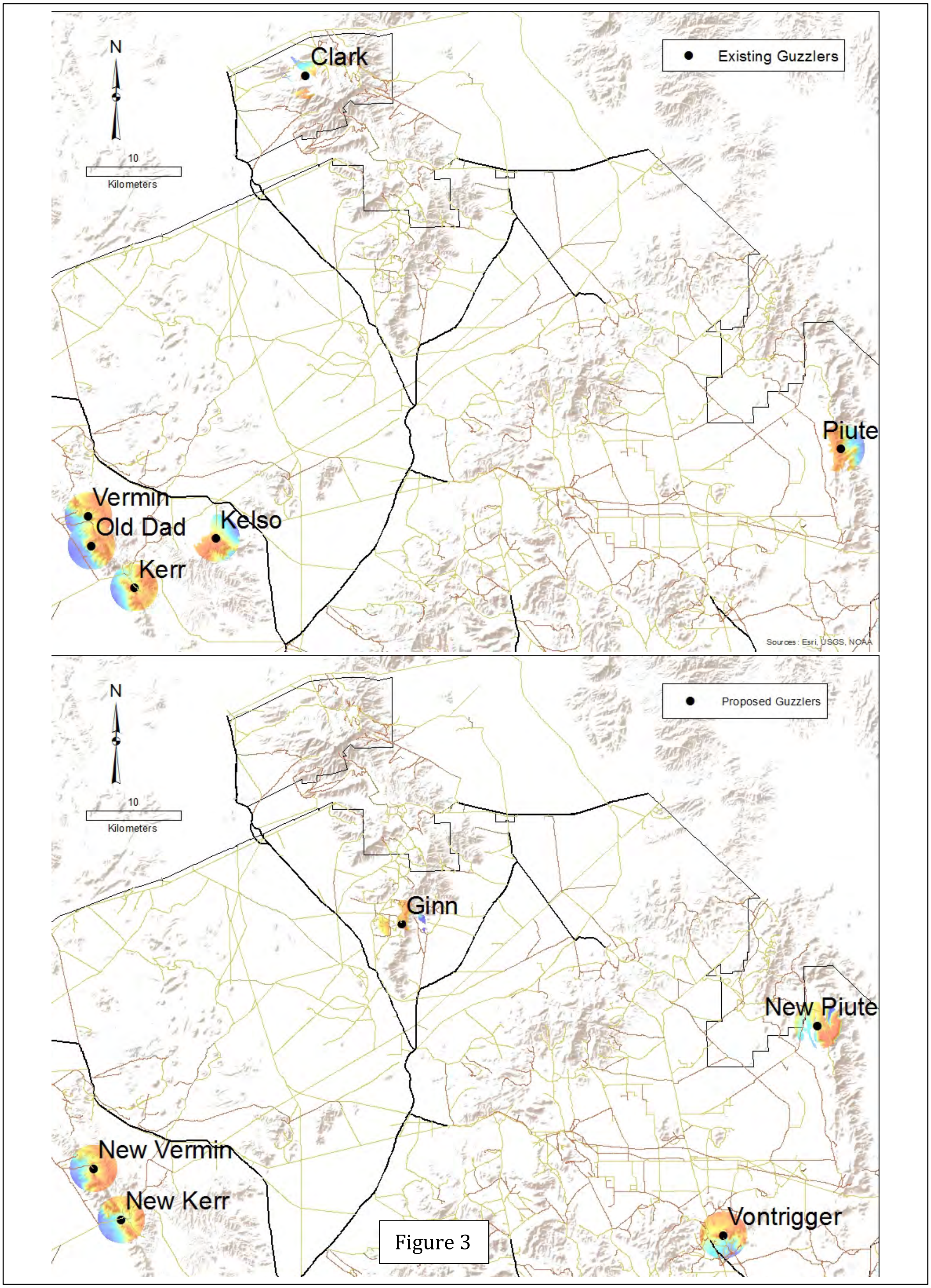
Each step should be accomplished within an experimental design, with adequate monitoring, and to the highest engineering design standards. Methods to increase storage capacity, such as buried tanks, will be explored as this will be a means of reducing or eliminating water hauling.

New data could, and should, change these conclusions if, after analysis, the change appears warranted.

Topics of interest for plan implementation include (not a complete list):

- The role of sandy areas in nutrition and their relationship to guzzler placement,
- Optimal guzzler location for connectivity. This is most relevant for Piute, New Piute, Ginn, and perhaps Vontrigger. The model indicates that New Piute ranks higher than Piute, but the latter could be in a better location for connectivity. This model does not account for habitat connectivity.
- The pace of implementation should be set by the bighorn. Discovery and adoption of new and relocated guzzlers are key. Conversely fealty to an existing guzzler location to be moved or removed should motivate consideration of a reverse action.
- Adequacy of the modeling approach is uncertain. Many avenues were left unexplored in this analysis. For example, I followed the lead of Hoglander et al. (2015) in using 500 randomly selected locations, but this might not be enough. I didn’t treat year as a random effect thinking it would become more relevant with temporal data, such as precipitation and remotely sensed forage data. Model evolution and improvement should, of course, follow the data.

Figure 3. Existing guzzlers are indicated in the top map and proposed guzzler locations are indicated in the bottom map.



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