BLM

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
NEEDLES FIELD OFFICE

ENVIRONMENTAL ASSESSMENT

PROPOSED INSTALLATION, USE AND MAINTENANCE OF THE SHEEP HOLE MOUNTAINS S.D. BIG GAME ARTIFICIAL WATER SOURCE SAN BERNARDINO COUNTY, CALIFORNIA

CA-690-EA05-25

BLM/CA/GI-2006-013+ 1790

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INTRODUCTION

The California Department of Fish and Game (CDFG) proposes to install one big game artificial water source in the Sheephole Valley Wilderness. The S.D. big game artificial water source would be located on the western side of the Sheep Hole Mountains near Sheep Hole Pass. The proposed water development would consist of a small dam, a pipeline, a buried 10,000-gallon fiberglass storage tank, and a wildlife accessible subterranean drinker. An access way, an existing, former mining road, would also be utilized for the construction, use and maintenance of the site.

1. CONTROL NUMBER:

CA-690-EA05-25

2. CASE FILE / SERIAL NUMBER:

CA42960

3. PROPONENT:

California Department of Fish and Game

4. PROJECT:

S.D. Big Game Artificial Water Source

5. LOCATION:

Sheep Hole Mountains; T. 2 N., R. 12 E., NE1/4 Section 34, SBBM

6. AFFECTED ACREAGE:

1.4 acres

7. 7.5' QUADRANGLE:

Dale Lake

8. MULTIPLE-USE CLASS:

Limited and Controlled

9. LAW ENFORCEMENT SECTOR:

92

10. LAND STATUS:

Public

11. SPECIAL DESIGNATION AREA(s):

California Desert Conservation Area; Sheephole Valley Wilderness; Desert Training Center/California - Arizona Desert Maneuver Area

12. AUTHORITY:

16 United States Code (U.S.C.) 410 (*California Desert Protection Act of 1994*), 16 U.S.C. 670 (*The Sikes Act of 1960, as amended* 1978) and 16 U.S.C. 1131(Wilderness Act of 1964) and, 43 U.S.C. 1701 (*Federal Land Policy Management Act of 1976*)

The California Desert Protection Act (CDPA) provides the overriding management guidance for the Sheephole Valley Wilderness. The CDPA Title 1, section 103, (e) Fish and Wildlife states "As provided in section 4(d)(7) of the Wilderness Act, nothing in this title shall be construed as affecting the jurisdiction of the State of California with respect to wildlife and fish on the public lands located in that state", and Section 103(f) Fish and Wildlife Management states: "Management activities to maintain or restore fish and wildlife populations and the habitats to support such populations may be carried out within wilderness areas designated by this title and shall include the use of motorized vehicles by the appropriate State agencies."

13. LAND USE PLAN, STATUTE AND GUIDELINE CONFORMANCE:

LAND USE PLAN CONFORMANCE

The proposed action is subject to and in conformance with the *California Desert Conservation Area Plan of 1980* (CDCA Plan), as amended, in accordance with Title 43 Code of Federal Regulations 1610.5-3.

Objective #1 of the Wildlife Element of the CDCA Plan is to "Avoid, mitigate or compensate for impacts of conflicting uses on wildlife populations and habitats and to promote wildlife populations through habitat enhancement projects so that balanced ecosystems are maintained and wildlife abundance provides for human enjoyment."
Objective #2 of the Wildlife Element of the CDCA Plan, in part, is to "Develop and

implement detailed plans to provide special management for: “b) areas with habitat which is sensitive to conflicting uses…”

Objective #3 of the Wildlife Element of the CDCA Plan is, in part, to “Manage those wildlife species on the Federal and State lists for threatened and endangered species and their habitats so that the continued existence of each is not jeopardized.”

Objective #4 of the Wildlife Element of the CDCA Plan is to “...manage those wildlife species officially designated as sensitive by the BLM [Bureau of Land Management] for California and their habitats so that the potential for Federal or State listing is minimized.” The desert bighorn sheep is a California State “sensitive species” and is cited on Table 3 in the Wildlife Element of the CDCA Plan. The CDCA further states that “Projects to improve wildlife habitat may be allowed subject to environmental assessment.”

Applicable provisions of the 2002 *Northern and Eastern Colorado Desert Plan Amendment* (NECO) include:

2.3.1 Desert Bighorn Sheep Conservation—Goals and Objectives

Planning Area-wide Decisions and Management Strategy Common to All Alternatives

“Artificial waters proposed for consideration in any given year would (1) be submitted by June 1 and considered as a group, by metapopulation, for both sheep and deer, and (2) be supported by two levels of monitoring population trends, and impact trends to tortoise or other status species. The latter should include both direct monitoring (water hazards) and indirect monitoring (population dynamics/ecosystem changes).”

Currently, CDFG monitors bighorn sheep populations at both the deme and metapopulation levels. The Sheep Hole Mountains deme (sub-population) is currently monitored annually by helicopter (Appendix A). This information is integrated and analyzed approximately every 5-10 years with data collected from other demes within the greater South Mojave Metapopulation area (Torres et al. 1994, Epps et al. 2003).

In addition to the S.D. big game artificial water source proposed herein, two future artificial waters would be constructed in the Sheep Hole Mountains, and three future artificial water sources would be constructed in the Calumet Mountains (Appendix B). Site specific designs for the five water sources not included in this proposed action would be proposed as funding and staffing levels permit.

Determining the need for and location of additional reliable water sources for wildlife within the Sheephole-Calumet Mountains sheep deme and greater South Mojave Metepopulation planning area was a result of CDFG examining historic and current information about topics such as sheep distribution, sheep demography, important

elements of sheep habitat, human impacts to sheep and their habitat, the juxtaposition of demes relative to other demes in the metapopulation, location of viable land corridors, and current water quality and availability.

Specific sites within the Sheephole Mountains were further refined by CDFG based on additional information such as range specific habitat modeling, conduciveness of physical environment to this drinker design (i.e. geology), vehicle and equipment access, and specific sheep observations and sign in that portion of the range.

Impact trend data to tortoise and other status species include site photo monitoring, periodic examinations of drinkers for wildlife mortalities, and long-term study plot analysis. CDFG monitoring of the DWU-style water source proposed for this site has not documented any tortoise mortalities (Andrew et al. 2001) or raven attraction. This area is Category 3 habitat, and long-term study plot data from Amboy, the closest plot to the project area, indicate low densities of desert tortoise. See Biology sections for more information.

2.3.1.2 Proposed Plan

Objective a—Identify and Protect Essential Habitat

Action "Delete Herd Management Area Plans for the Marble Mountains, Whipple Mountains, Sheep Hole Mountains, Chuckwalla Mountains, and Orocopia Mountains…, all of which are captured inside the WHMAs."

Objective b—Maintain, Improve, and Restore Habitat Quality

Action "New water developments would be constructed to expand usable habitat for bighorn sheep." "The remaining 12 waters in wilderness areas that would not be authorized at this time may be authorized at a later time without further amendment but must be supported with additional biological justification (e.g., the completion of the Sonoran Meta-Population Plan being developed by CDFG) and site-specific NEPA analysis."

The CDFG's "South Mojave Metapopulation Management Objectives: Sheep Hole-Calumet Mountains Subpopulation" (Appendix C), as well as the environmental assessment's Purpose and Need For Proposed Action section, and Affected Environment, Biological Resources, Desert Bighorn Sheep section provide the biological justification supporting the proposed action.

CONFORMANCE WITH OTHER STATUTES AND GUIDING DOCUMENTS:

BLM-Federal

The proposed action is in conformance with the following statutes and guidelines:

Section 404 of the Clean Water Act: [A U.S. Army Corps of Engineers (USACE)

Section 404 determination of jurisdiction is currently pending. USACE assertion of jurisdiction for this project is not anticipated. However, should the USACE assert jurisdiction, Section 404 Permit provisions will be incorporated into the environmental assessment prior to issuance of a Decision Record for the project.]

"Rangewide Plan for Managing Habitat of Desert Bighorn Sheep on Public Lands." BLM, 1988;

"Mountain Sheep Ecosystem Management Strategy in the 11 Western States and Alaska." Fish and Wildlife 2000 series. BLM, 1995; and,

"Wildlife Water Catchment Construction in Nevada", Technical Note No. 397, by William R. Brigham and Craig Stevenson, BLM- National Applied Resource Sciences Center, 1997

CDFG-State

The proposed action is in conformance with the following statutes and guidelines:

Section 401 of the Clean Water Act: (Should the USACE not assert Section 404 jurisdiction, Section 401 Certification will not be required. If USACE does assert jurisdiction, the California Regional Water Quality Control Board would issue the 401 Certification. Provisions of any Section 401 Certification requirements will be incorporated into the environmental assessment prior to issuance of a Decision Record for the project);

State of California Streambed Alteration Program (Fish and Game Code section 1602);

California Environmental Quality Act (Appendix D);

"Bighorn in California, A Plan to Determine Current Status and Trends", 1982 "Plan for Bighorn Sheep" 1984 revised in 1993; and

"Bighorn Sheep Management Plan: Sheephole Mountains Management Unit", 1991.

14. PURPOSE AND NEED FOR PROPOSED ACTION:

The purposes of the proposed action to construct, use and maintain an artificial water source in the Sheep Hole Mountains are:

1. To satisfy the objectives of the CDFG South Mojave Metapopulation Management Objectives; and,

2. To enhance the stability of this desert bighorn sheep deme and the South Mojave metapopulation (see maps Appendix E) in the California Mojave Desert, where

feasible and appropriate, through increased dispersion and interaction of the herds throughout their ranges. The proposed action will encourage the Sheep Hole deme to increase its range which could result in increased utilization of available forage. The development of permanent water sources in appropriate sheep habitat (as determined by CDFG) where there is no water is a means of encouraging population dispersal. One result of increased dispersal between isolated demes is greater genetic exchange.

A minimum of 50 adult females is needed within individual demes for a stable sustainable population based on recommendations by Franklin (1980). Fifty females help guarantee a minimum effective population size of > 50, assuming that all adult females breed each year. Since systematic population monitoring began (1997) this deme's adult female population has not reached this threshold.

The 40:100 ratio ensures that there are enough mature rams in the population to breed with the females. These numbers also help to ensure adequate numbers of mature males in the population from a genetics and behavioral perspective (Geist 1975).

In order to accomplish these purposes, there is a need to minimize the limiting habitat factors, including available water, that repress the resident sheep population numbers in the Sheep Hole Mountains, and to allow the numbers to increase to levels which meet the Department's minimum population criteria.

The need for the water source's construction is:

1. To fulfill the statutory requirement of Fish and Game Code Sections 1800 - 1801 which describe maintaining, in perpetuity, "… species of wildlife and their habitat…" and Sections 4900 - 4901 which specifically address bighorn sheep by stating: "…it is the policy of the State to encourage the preservation, restoration, utilization, and management of California's bighorn sheep population."

2. To provide an additional permanent and dependable water source for bighorn sheep. The CDFG intends to construct six new waters in the Sheep Hole Mountains and Calumet Mountains, of which one is presently proposed. Currently, two waters are in place in the Sheep Hole Mountains. The five waters not included in this proposed action will be designed and proposed as funding and staffing levels permit. See (map) Appendix B.

3. To mitigate the historical effects of habitat fragmentation by highways, mining on Bristol, Dale and Cadiz Dry Lakes, past and present military use, and residential use and development in Wonder Valley (Epps et al. 2005).

4. To encourage both the seasonal and year-round use of additional habitat within these mountains currently limited by lack of available water. Through increased distribution of sheep and anticipated population growth, the likelihood of intermountain movement of sheep between the mountain ranges composing the

South Mojave Sheep Metapopulation Area will be increased. Intermountain movement will increase the probability of sheep persistence in this desert region.

5. To ensure that the Sheep Hole Mountains deme remains viable in both the short- and long-term. This is the largest deme within this metapopulation and is essential for its persistence. This deme will most likely be the source population for any future translocation. The probability of any sheep emigrating to other demes is directly linked to size and distribution of this deme. Because of its size and central location relative to the other demes, the Sheep Hole deme is critical to the health of the metapopulation.

6. To increase the distribution of sheep within the range and produce population growth that will help ensure the protection of this component of the California desert wilderness. Available habitat outside of designated wilderness is extremely limited.

7. To maintain viable deme numbers across the South Mojave Metapopulation area, thus creating the greatest probability for its long-term persistence.

See Appendix F for discussions of the history of the demise of sheep in California and specific history about the Sheep Hole Mountains deme.

15. PROPOSED ACTION AND ALTERNATIVES:

15.1 Proposed Action:

The CDFG proposes to construct, use, and maintain one Desert Wildlife Unlimited (DWU) type artificial water source (Lesicka and Hervert, 1995), to be named S.D., in the western portion of the Sheephole Valley Wilderness. See Appendix G for a schematic and photo of a DWU type water source and a schematic of the proposed facility. The proposed water development would consist of a small concrete dam, a metal pipeline, a buried 10,000 gallon storage tank, and a 2,500 gallon wildlife accessible subterranean drinker. The total area of surface disturbance for the construction site would include a 100 x 140 feet area around the installation (dam, tank and drinker) site, as well as an existing 50 X 50 feet vehicle turnaround area currently adjacent to the work site. A total of 0.6 acres (0.5 mile) along a set path on a pre-existing dirt vehicle way once utilized as access to a former mine site would be utilized for vehicle access. Sand outside the wilderness would be borrowed to protect the walls of the drinker and tank from punctures (Appendix G).

Unique to the DWU system are a number of factors that contribute to the efficiency and reduction of required maintenance. The design simplicity, lack of mechanical parts, and the ability to collect and store large amounts of water from small rain events has reduced costly repairs and or replacements experienced by different water source designs. The number of inspections, monitoring visits and water hauling is also minimized. Additional attributes include low visual impact as the system is completely buried except for the drinker and small dam (and occasionally short sections of pipe which are exposed at ground level), increased availability of

water for multiple species use, and tortoise compatibility.

1. Excavation of Site

A trench would be excavated and backfill materials would be placed to the side of the trench adjacent to the wash. The tank and drinker would be placed in the trench below the dam area and the excavated rock and soil would be replaced and smoothed back to the surrounding gradient, with the installation buried as described below.

The installation site would be excavated for the burial of a 10,000 gallon fiberglass tank and a 2,500 gallon drinker. Both would be completely buried, except for a 1.5 inch diameter screened U-vent pipe on the storage tank, as well as the drinker lip, opening and concrete overflow apron which would be exposed at ground level. The tank would be covered to a depth of two feet while the drinker top would be buried to ground level. In the event that the underlying geology is rock material that cannot be fractured and removed to the required depth, the tank and drinker would be placed at the greatest obtainable depth. Thus, the excavated material would then be mounded to cover the tank and or built up to support the drinker. All excavated materials from the cavity formed for the installation of the tank and drinker would be stored on the turnaround. The tank would be placed at the rear of the cavity, which would be excavated to a depth lower than the slope wall (if obtainable) adjacent to the wash. The drinker would be set 10 feet away at or just slightly below the level of the tank. Excavated rock and soil would be replaced, smoothed and contoured to best reflect the surrounding surface contours so that the buried tank and drinker would become part of the slope. If additional fill material (maximum of 25 cubic yards) is needed to either line the bed of the drinker and tank or to cover the tank, then fill material would be removed from the wash west of the project site, outside the wilderness from the designated location. Any additional fill would be trucked in by dump-truck over the existing access route. This borrow site would then be reclaimed and raked.

Forty feet of the 80-foot wide wash would be partially dammed. Construction of this dam would require mixing of 25 bags of Portland cement. The construction material storage site would be located approximately 25 feet away from the wash, on flat ground located adjacent to and west of the wash area. Approximately 10 feet of buried perforated ABS pipe would run to the dam base, be connected to a “Y” connector and second screened intake in the dam face and then piped to both storage tank and drinker. Approximately 150 feet of pipe between the dam and tank would consist of both ABS and corrugated galvanized steel pipe at a 6” diameter and anchored with rebar. Any exposed pipe surface would be painted to match the existing soil color.

2. Storage Tank and Drinker

The 10,000 gallon storage tank would be a 30 foot long x 8 foot diameter fiberglass cylinder. The drinker would be comprised of a 2,500-gallon, 16 foot long by 4 foot wide by 8 foot deep fiberglass tank with a ramp. The drinker would be buried

underground, up to10 feet from the tank, and the two would be connected by a 2 inch flexible schedule 40 PVC jacuzzi pipe to allow for naturally occurring soil movement such as settling or earthquakes. Only the walk-in drinker opening would be exposed. The concrete overflow apron is at the entrance of the drinker opening and would be the width of the drinker, fanning from 4 feet to 8 feet in width. The entrance to the drinker would be a ramp with steps so that animals having access to the water can escape easily. Steps would descend into the drinker at 1 foot intervals and be 2.5 feet wide. The remaining 0.75 foot on each side of the steps would be roughed, and allow for small animal ingress and egress. The concrete steps would be constructed on-site, utilizing approximately eight bags of Portland cement for the ramp.

3. Dam

Runoff from seasonal rainfall would be detained behind the short dam and capture water flow through a buried 6-inch ABS and exposed corrugated galvanized steel pipe into the tank. Ten feet of ABS perforated pipe would be buried upstream at the base of the dam catchment to collect subterranean flows. This pipe would connect at the dam via a “Y” connector to the corrugated pipe in the dam face to collect surface flows. The exposed intake at the dam would be covered with wire mesh to prevent entry of debris or animals. Water would be gravity fed through the corrugated pipe to the tank and drinker. The corrugated pipe would be anchored with rebar to prevent shifting. After the tank and the drinker are filled, excess runoff would flow out of the drinker or over the dam and return to the wash.

The dam would be constructed of reinforced concrete and faced with native stone collected at the site to blend into the surrounding landscape. The dam would partially block water flow in the wash and be no more that 2.5 feet at the highest point. Approximately 20 five-gallon buckets of sand from this site would be used in the dam’s construction. A mobile water tank would be utilized to haul all water for construction purposes and would be towed to the site by vehicle. Concrete would be mixed using a gasoline engine cement mixer and conveyed to the dam and drinker site by wheelbarrow. Approximately 20 gallons of concrete rinse water would be generated and disposed of onsite. Natural forces are expected to fill in the upstream side of the dam with wash materials and replace those removed for construction and for mixing concrete.

4. Construction Equipment, Vehicles, Access

Excavation equipment would consist of a Case 680 rubber-tired backhoe and a model 270 John Deere flat-tracked excavator (or equivalents). Attachments for the excavator would include a 36” wide bucket and hydraulic chisel hammer. A trailer-mounted 1,000 gallon water tank (gravity-fed or with a gasoline-powered motorized pump if necessary) would be used for the initial charging of the 2,500 gallon drinker. An additional 300 gallons would be used for mixing concrete. A 3 to 5 cubic yard 4-wheel drive dump truck would be used to haul additional fill from outside the wilderness, if needed.

Passenger vehicles would be utilized to carry work tools (shovels, picks, rakes) as well as materials, tow one 1,000 water tank, one 10,000 gallon fiberglass tank and one 2,500 gallon drinker (both on trailers), one portable gas-powered cement mixer, and one chemical toilet, as well as to transport staff to the site. All but one of the vehicles would then be parked outside of wilderness adjacent to Amboy Road and the project access route, returning only when the project is finished to transport out trailers and equipment. One passenger vehicle would be on site available for emergencies and utilized to transport workers in and out each day. Access to the site by all vehicles and equipment would be via an existing mining road and by desert wash (a total of approximately 0.5 miles). A maximum of 40 round trips of motorized vehicles to the project site would be associated with the construction activity. Motorized equipment would be shut down when not in use to minimize noise disturbance.

Prior to mobilization on the site, all equipment would be inspected to be sure it is operating correctly and free of leaks. Equipment would be inspected daily to ensure that there are no discharges. Fuels would be contained within the equipment or stored in containers until ready for use. Spill media consistent with specifications in the CDFG Wildlife Operations Plan for California will be carried in vehicles to ensure rapid clean-up response to any spills of oil, chemicals, concrete-residues, or other materials resulting from the project.

5. Post Construction Activities

The project area, including the wash access, would be flagged prior to construction activities and flagging would be removed upon project completion. Upon completion of the project, areas disturbed by the project would be returned to as close to a natural state as possible. All disturbed soil surfaces would be contoured and raked to match the surrounding terrain. Any rocks that would be removed would be scattered over the disturbed area. Upon completion of the project, the route to the site would be blocked with native boulders effectively eliminating illegal access into the wilderness. The existing abandoned mine access would be left as it was prior to the project. All vehicle tracks from the wash would be raked out.

6. Personnel

A total of up to 20 people would be at the work area for a maximum of five days for the installation. Site personnel would be briefed daily on the project plan and site safety. Personnel would not camp onsite or on public lands. All trash created on site would be removed daily when leaving. Supplies, tools and materials would be stored, when not in use, at this location and a first-aid/safety area would be established. Law Enforcement personnel would provide site security. Personnel sanitation would be provided by means of a portable fiberglass toilet facility and disposal of items would follow standard Leave No Trace/Wilderness Practices. Sufficient potable water to provide for sanitation for cleansing of hands and drinking would be provided and replenished daily.

7. Monitoring

CDFG and/or its agents would walk into the site from the wilderness boundary to monitor the new artificial water source twice each year for water level and quality. Other monitoring would consist of pellet transects, photographic data, and water source operation.

Monitoring reports would be sent to the CDFG Desert Waters Coordinator and, the BLM, Needles Field Office and California Desert District Office.

8. Repair and Refill

The anticipated lifespan of the tank (when buried underground, protected from UV light) is greater than 50 years. Other components of the system (i.e. concrete dam, concrete steps, and ABS pipe) may deteriorate or require repair due to infrequent environmental events.

Refill activities are anticipated when storm events do not provide sufficient water to the system. When the system is full, the water would be expected to last for approximately two and a half years without needing any natural recharge or refill. The BLM would cooperatively provide equipment and staff to refill this water source using a water pumping truck outside wilderness and hoselay to the drinker. Although expected to occur less frequently, the worst case scenario would require three refills per decade.

9. Health and Safety

The CDFG would comply with California Occupational Safety and Health Administration Title 8 requirements for ensuring employee safety and health. Additionally, a site-specific health and safety plan (HASP) for this project is attached (Appendix H).

15.2 Alternatives Considered But Eliminated From Detailed Analysis:

Eliminated Alternatives:

1) An alternative considered but eliminated from detailed analysis was the installation of the water source as described in the proposed action, but no mechanized equipment would be used for installation and no motorized ground vehicles would be used. Installation activity would take longer and more workers would be required than with the proposed action. Workers would walk to the work site and all materials and supplies would be carried or packed in, except for the tank, drinker and water, which would be flown to the site using a helicopter. Monitoring, maintenance, and repair would be the same as in the proposed action; however all access would be by foot or horseback. This alternative was eliminated from detailed analysis due to lack of feasibility because of excessive weight and dimensions of components, increased risk to employees from helicopter use, challenges of working in bedrock and large boulders without mechanized

equipment, and longer project duration.

2) The installation of a water source located outside of wilderness was considered but eliminated from detailed analysis. This alternative does not meet the purpose and need of the project because locations outside wilderness would not be associated with steep terrain and would not provide adequate escape terrain for the sheep, thus potentially increasing levels of predation. Also, the plant community in the flat, open desert outside the wilderness area is less diverse and of less nutritional value than those found in the washes, bajadas and upland areas within the wilderness area. Finally, human related disturbances, including mechanized machinery, are greater outside the wilderness boundary.

3) The installation of a water source consisting of an above-ground storage tank and drinker, as opposed to the DWU-style water source, was also considered. This alternative was eliminated from detailed analysis because the system consists of more mechanical parts (i.e. float valve); would require more trips into wilderness for repairs and monitoring; have a shorter functional life span; and have a greater visual impact on wilderness characteristics of the area.

15.3 No Action Alternative:

The proposed new water source would not be constructed. The two existing artificial water sources in the Sheep Hole Mountains would continue to be maintained. Existing management and use of the sites would continue, subject to applicable statutes, policy, and land use plans.

16. AFFECTED ENVIRONMENT

The following elements of the human environment, subject to review specified in statute, regulation or executive order, are not located within the project area and are not addressed further in this document: Ecologically Critical Area, Floodplains, Prime or Unique Farm Lands, Wetlands and Riparian Zones, and Wild and Scenic Rivers.

16.1 Air Quality

The Mojave Desert Air Quality Management District has state air quality jurisdiction over the project area, rules that apply to this project, and permitting requirements. Air quality throughout the project area is generally good. At times, the area does not meet air quality standards due to locally-generated and/or wind transported pollutants. The vicinity in which the proposed action is located is currently classified as a federal non-attainment area for ozone and PM-10 under national standards.

16.2 Biological Resources

Threatened and Endangered Species

Mojave populations of the desert tortoise (*Gopherus agassizii*) were listed as threatened on April 2, 1990, and the U. S. Fish and Wildlife Service (USFWS) designated Critical Habitat for the species on February 8, 1994. The proposed project is not located within designated critical habitat (USFWS 1994), or BLM designated Desert Wildlife Management Area (DWMA). A survey of the proposed access route and project site was conducted according to the USFWS *Field Survey Protocol for any Federal Action that May Occur within the Range of the Desert Tortoise* (1992). No desert tortoise individuals or sign were observed during the survey. However, the remains of a desert tortoise shell were seen in the wash north of the proposed access route. Given this tortoise sign and the presence of desert tortoise habitat primary constituent elements, (i.e. cover shrubs, forage, and adequate burrowing substrate), it is classified as Category 3, meaning low density desert tortoise habitat. See Table 1 for acres of desert tortoise habitat potentially impacted by the proposed action.

Results of permanent density transects completed by Berry (1984) in the Amboy region north of the proposed project site indicate "the presence of no or few tortoises" in the area. The Amboy study plot was removed from future studies due to the fact that few or no tortoises were present.

Table 1: Acres of Desert Tortoise Habitat Potentially Affected by the Action

Area	Acres of Habitat Potentially Affected
Project Access Way Proposed Project	1.12 0.28
Total Habitat	1.40

BLM Sensitive Wildlife and California Species of Special Concern (SSC) as identified in NECO

1. Prairie Falcon *(Falco mexicanus)* -- SSC, Le Conte's thrasher *(Toxostoma lecontii)* – SSC and BLM Sensitive

The proposed project is within the range of these species. There is suitable nesting and foraging habitat present for prairie falcon but not for Le Conte's thrasher.

2. Chuckwalla *(Sauromalus obesus)* – SSC, Rosy Boa *(Lichanura trivirgata*) – SSC, Mojave fringe-toed lizard (*Uma scoparia*) – SSC and BLM Sensitive

The proposed project is within the range of these species, and there is habitat for the chuckwalla and rosy boa in broken rock areas at and adjacent to the site. Habitat is not optimum for these species, and none were seen on or within broken

rock or rock face areas during examinations of the site. There is limited habitat available for Mojave fringe-toed lizard in the wash along the portion of the access route closest to the highway. However, no fringe-toed lizards were seen during surveys in the area and the habitat is not optimum for this species.

3. Pallid bat (*Antrozous pallidus*) – SSC and BLM Sensitive, Townsend's western big-eared bat (*Plecotus townsendii*) – SSC and BLM Sensitive, Pocketed free-tailed bat (*Tadarida femorosaccus*) – SSC, California leaf-nosed bat (*Macrotus californicus*) – SSC and BLM Sensitive, and Fringed myotis (*Myotis thysanodes*) – BLM Sensitive

The proposed project is within the range of these species. Suitable seasonal foraging and roosting habitat are present near the project area. No known hibernacula or maternity roosts are present in the area.

4. Desert Bighorn Sheep (*Ovis canadensis nelsoni*) – BLM Sensitive

Metapopulation Theory and California's Bighorn Sheep

Metapopulation biology has become one of the foremost paradigms of conservation biology (Hanski & Gilpin 1997) and metapopulation theory provides a framework for spatial analysis (e.g. Gutiérrez & Harrison 1996), particularly for species with a naturally fragmented distribution. Bighorn or mountain sheep of California fit general definitions of a metapopulation (e.g. McCullough 1996), as argued by Schwartz et al. (1986), Bleich et al. (1990), Bleich et al. (1996), and Krausman (1997). Bighorn sheep have a naturally fragmented distribution, populations that are demographically independent, as demonstrated by concurrent increases and decreases in population estimates in the past sixty years (Wehausen 1999), and documented population extinction and colonization events (Torres et al. 1994; Bleich et al. 1996). While Harrison (1994) argued that evidence for bighorn traversing non-habitat areas is circumstantial, thus applicability of metapopulation theory may be limited, Krausman (1997), Bleich et al. (1996), and others provide clear evidence of intermountain movements by both sexes. Based on these characteristics, bighorn sheep provide a better fit to classic metapopulation theory than many species.

There are many biological consequences of the small population size and fragmented distribution of bighorn sheep in California that a successful management policy must consider. These include the need for dispersal and gene flow, the role of empty habitat patches and the matrix of desert flats, regional environmental factors, and human modification to metapopulation structure.
The distinction between dispersal and gene flow is crucial. Because of sex-biased dispersal, these two similar processes can occur on different scales. Female bighorn sheep are more philopatric than rams; that is, they are more reluctant to move large distances, particularly across open desert that lacks escape terrain (Geist 1971; Ramey 1993). Therefore ewes typically limit dispersal leading to recolonization, and metapopulations should be defined by the distance that ewes

are able to disperse. However, gene flow itself should also be considered in management. Long-term genetic isolation of small populations can lead to inbreeding, with possible demographic consequences (Ralls & Ballou 1983), or the fixing of deleterious alleles and loss of advantageous alleles through the random action of genetic drift (Wright 1969). The deleterious effects of inbreeding or drift can be prevented by migration from outside gene pools: even one immigrant per generation can theoretically mediate problems resulting from low genetic diversity (Wright 1969). Rams contribute the genetic variation that they carry to their offspring, thus rams ranging widely from their native populations play an important role in maintaining genetic diversity. For this reason, management should identify where ram movements occur and maintain these processes (Bleich et al. 1990), recognizing that this may encompass larger areas than the "metapopulations" defined on the basis of ewe dispersal (e.g. Bleich et al. 1996). Since most bighorn sheep populations in California are small (Torres et al. 1994), and many may have resulted from only a few colonizing individuals, genetic diversity may already be low. Indeed, Ramey (1995) found generally low levels of nucleotide diversity of mitochondrial DNA in bighorn sheep across the southwestern United States.
One of the most important recommendations of metapopulation theory for conservation is to preserve empty habitat patches and the matrix between habitat patches (Hanski & Simberloff 1997). If recolonization is to offset population extinction, mountain ranges that have lost populations of bighorn sheep must be maintained as bighorn habitat. Empty habitat patches can be identified by several strategies: Hanski (1999) recommends that, in absence of other knowledge, any habitat patch as large as the smallest extant population should be considered potential habitat. In the case of bighorn sheep, historical records or old sheep trails and bedding sites can identify sites of former populations (Torres et al. 1994; R. Weaver, personal communication). Furthermore, dispersal routes between mountain ranges should be preserved. Human-made barriers such as fenced interstate highways and canals may prevent most bighorn sheep from using former dispersal routes in these areas, and new barriers should be minimized (Schwartz et al. 1986). Use of corridors by domestic livestock should also be avoided as potential for disease transmission to bighorn sheep may be high (Krausman 1996). Where natural recolonization processes are disrupted, human translocation of sheep may be needed to reestablish populations in empty habitat patches, as has been used to reestablish populations in the Whipple, Sheep Hole, Bullion, Eagle Crags, North Bristol and San Rafael Mountains, and other populations in California (Ramey 1993). Krausman (1997) argues that disruption of natural dispersal has contributed to the decline of a metapopulation of bighorn sheep near Tucson, Arizona.

However, dispersal is a two-edged sword. Metapopulations are most stable when there is a balance of dispersal: too little, and recolonization cannot offset extinction, too much, and synchronous population declines may occur. Furthermore, disease and predators can also travel across dispersal corridors. Disease (Foreyt & Jessup 1982; Jessup 1985) and predation (Wehausen 1996; Hayes et al. 2000) have caused sharp declines in individual populations of bighorn sheep, but population isolation may have prevented even greater catastrophes.

Other factors besides connectivity affect metapopulation stability. One is simply the number of extant populations: Hanski (1991) argues that many metapopulations may have a persistence threshold of patch occupancy, below which, metapopulation extinction is inevitable. Another concern is correlated regional environmental variation (Harrison & Quinn 1989). Metapopulation persistence may be reduced, particularly if mean and variance of extinction rates are high, if environmental variation affects populations across the metapopulation in a similar manner. Weaver and Mench (1971) argued that drought contributed to numerous population extinctions in southeastern California. In the last 60 years, population extinction of desert bighorn sheep was more common in mountain ranges with low precipitation and low elevation (thus higher temperatures) (Epps et al. 2004). If bighorn sheep populations are regulated strongly by environmental variation, then periods of drought may result in depressed population dynamics across large regions leading to greatly increased risk of metapopulation extinction. This risk may be particularly critical as global climate patterns change rapidly in the 21st century (Epps et al. 2004). In the face of these threats, maintaining low extinction rates and population connectivity is especially crucial for conservation management. Higher-elevation populations may also serve as "refugia" in these cases, providing better water and forage even in drought times, and serving as a source for recolonization into more marginal habitat during periods of reduced drought (Epps et al. 2004). Conservation of these areas is therefore strongly advised.

Defining metapopulations for management purposes

Bleich et al. (1996) defined metapopulations of bighorn sheep in California as groups of populations (also known as demes) separated by less than 15km. Interstate highways were also considered to be barriers dividing modern metapopulations. This defining distance was chosen based on a spatial analysis of population distribution, and because it corresponded well with known inter-mountain movements by ewes. Mitochondrial DNA (mtDNA) haplotype frequency (Ramey 1993) varied significantly between metapopulations identified by this method (Bleich et al. 1996). As mtDNA is maternally inherited, these differences in haplotype frequency suggest that ewes rarely move between metapopulations, supporting the use of the 15km definition.

The metapopulations defined with the 15km barrier were therefore used as the basis for the regional metapopulation plans for bighorn sheep in California. Within each putative metapopulation, however, available radio-telemetry and aerial survey data are used to validate these definitions and provide more detailed information about movement and habitat use.

The use of the term "metapopulation" for these landscape-scale management units does not imply, however, anything about the actual structure and nature of each individual "metapopulation". Indeed, under the 15km definition, some populations of bighorn sheep are completely isolated. Therefore caution is strongly advised when making any inference about metapopulation dynamics in each putative metapopulation. In fact, intermountain movements occur as a continuum: movements of much greater than 15km are possible. Any analysis of

metapopulation persistence should examine the whole network of populations and "metapopulations" as defined by Bleich et al. (1996). Moreover, these definitions are not based on male movements, and management should embrace the possibility that gene flow between metapopulations may occasionally occur and be an important biological process. Essentially, metapopulations currently defined serve as solid hypotheses that should be subjected to further examination.

While genetic studies have examined both mtDNA (ewe-mediated) and nuclear gene flow (ram and ewe-mediated) in some areas of California (Ramey 1993, 1995; Boyce et al. 1998), extrapolation to all populations has been difficult. However, detailed mtDNA sequence analysis and microsatellite markers are currently being used to examine dispersal and gene flow across most populations of bighorn sheep in California (see Epps et al. 2004 for results). These data provide much more explicit evidence for both ewe and ram dispersal where it occurs, as well as testing and improving the current spatial definition for metapopulations. Radio-telemetry observation of various populations of bighorn sheep in the state is also ongoing. Therefore, metapopulation management of bighorn sheep in California must incorporate these and other new sources of data and modify plans as necessary.

Natural History of California's Bighorn Sheep

The following life history description is adapted from several sources including: The Desert Bighorn Sheep: Its Life History, Ecology and Management, Recovery Plan for Bighorn Sheep in the Peninsular Ranges, California, and Mountain Sheep: A Study in Behavior and Evolution.

Nelson's bighorn sheep are an indigenous species found within the Sheephole Valley Wilderness. Bighorn sheep are essentially associated with mountainous areas. Important features of their habitat include topography (elevation, slope aspect, connectivity to other mountain ranges), forage (quality and quantity), the availability of water, visibility and predation, and prevalence of disease and parasites.

Topography

Bighorn sheep use the topography of their mountainous terrain in several ways. First the topographic relief affords them greater visibility to detect predators and provides escape terrain (steep rugged terrain) to climb through to avoid predation. Sheep are seasonally associated with different types of terrain. During lambing season ewes use lambing habitat, (rugged and remote terrain), in which to give birth and sequester their lambs until they are old enough to rejoin their ewe group. During the spring, sheep may use lower areas such as washes and bajadas to forage. Sheep make daily diurnal movements to different types of topography for thermoregulation. Rams and ewes also use topographically differing habitats at different times of the year for behavioral reasons.

Crucial components of bighorn sheep habitat and its persistence is flat terrain, such as valley floors, that are used as movement corridors between adjacent

mountainous regions. Inter-mountain movement via these corridors allows sheep access to resources (e.g., water, forage, predation avoidance) in neighboring areas. This movement allows gene flow to occur between subpopulations and is imperative to sustain the genetic variability within the sheep metapopulation. Mountain ranges not permanently occupied or not used by sheep even yearly, are no less important and must be recognized as potential seasonal habitat and 'stepping stones' for dispersal along migratory corridors within the metapopulation.

Forage

Bighorn sheep are foraging generalists and will consume shrubs, forbs, cacti, grasses, etc. Their diets vary seasonally, as well as throughout their geographic range. Location, timing, quality, quantity and availability of forage are all affected by the spatial and temporal relationships between environmental factors such as temperature, precipitation, soil type, slope, aspect, and microclimate. Sheep have differing nutritional needs by gender, age, and seasons. For example, pregnant and lactating ewes have greater needs for high quality forage and water than do males. Animals may migrate over long distances seeking appropriate resources. Generally, the poorer the forage quality, the larger the area needed by sheep to meet their nutritional requirements. This is confounded by the fact that during times of drought, when plant moisture levels are low, sheep require more water for effective ruminating and are more closely tied to forage near water, which effectively limits their total range. Like all ruminants, bighorn sheep do best with highly nutritious forage and therefore can be adversely affected by poor range conditions where the quality, quantity, and diversity of forage are low and water is limiting.

Water

Sheep like other diurnal mammals cannot persist on metabolic water and thus must take water into their system. Taking in pre-formed water (e.g. dew on rocks or plants, forage moisture) when available may assist sheep in maintaining their internal water balance. However, the vast majority of sheep meet their needs by drinking water. Generally, sheep need more water during the hot, dry times of the year, but may also be found closer to water during any time of the year when environmental conditions and/or their physiological conditions are such that they need water. Numerous studies have shown that desert bighorn sheep select areas closer to water during summer than other seasons. Lactating ewes and lambs often are more dependent on water. However, these patterns have not been observed in all habitats (summarized by Andrew 1999). During periods of high rainfall, sheep may be less strongly associated with permanent water sources and may meet a greater proportion of their water requirement with preformed water. However, during these periods, ephemeral water sources (such as tinajas) are also available and may be a more important source of free water. Some small populations apparently exist without permanent sources of water (Krausman et al. 1985, Krausman and Leopold 1986), but this does not mean that sheep do not require water. The preponderance of scientific writings indicate that "…most populations of bighorn sheep will drink regularly when water is available and concentrate near water during summer months, and it is likely that lack of water is a limiting factor for

some populations" (USFWS 2000).

Visibility and Predation

Sheep have evolved physical and behavioral traits to help them reduce and/or avoid predation. Visibility is an important component of their habitat that affects predation risk. Sheep prefer open habitats with greater visibility and coupled with their keen eye sight, helps them to detect predators from a distance. Sheep avoid habitats (usually dense vegetation) with reduced visibility. Along with keen visual acuity they use open habitats in close proximity to "escape terrain' and use their excellent running and climbing skills to out maneuver and/or outrun predators in steep rugged areas. Predators of sheep include mountain lion *(Felis concolor*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), and occasionally golden eagles (*Aquila chysaetos*). The presence of mountain lions is not documented within the proposed project area. The density of the other predators is considered to be low based on animal sightings (aerial and ground) and sign (tracks, scat, etc.) Based on direct observations, coyotes likely are the main predator upon sheep in this range. Golden eagles and bobcats may occasionally prey upon lambs.

Diseases and Parasites

Desert bighorns can suffer from numerous infectious diseases, many of which are thought to have been contracted from domestic livestock. Diseases include those that are bacterial, viral, fungal, and parasitic in nature. The effect of these diseases on individuals and populations depends upon many factors, foremost the presence of the infectious agent, and the nutritional status of sheep, animal density, climatic conditions, etc. CDFG completes a wide range of biological sampling on animals that have been captured and maintains an extensive database of the results of these samples.

Sheep in this range show low exposure to diseases. Blood samples were collected from bighorn sheep translocated from the Kelso/Old Dad Peak Management Unit to the Sheep Hole Mountains in 1984, 1985, and 2000. Thirteen percent showed evidence of exposure to parainfluenza-3, two percent to bluetongue, and 39 percent to contagious ecthyma (Clark et al. 1985). Tests of exposure to other diseases all were negative, including fecal examinations for lungworm larvae.

See Appendix F for discussions of: the history of the demise of bighorn sheep in California, the Department's implementation of metapopulation principles in order to recover California's sheep resources, and specific history about the Sheep Hole Mountains deme.

Other Wildlife Species

Wildlife species anticipated for the area include small and large mammals, birds, and reptiles. Small mammals of this area include cottontail rabbits (*Sylvilagus audubonii*) and black-tailed jackrabbits (*Lepus californicus*). Several rodents inhabit

the area, including the antelope ground squirrel (*Ammospermophilus leucurus*), and several species of pocket mice (*Perognathus* spp.) The kangaroo rat (*Dipodomys* spp.) is found in the more sandy areas. Carnivores include coyotes (*Canis latrans*), foxes (*Vulpes* spp.), bobcats (*Lynx rufus*), and badgers (*Taxidea taxus*). No ungulate species' sign other than bighorn sheep (*Ovis canadensis nelsoni*) were noted within the proposed project area.

Avian species of the area include mourning dove (*Zenaida macroura*), Gambel's quail (*Callipepla gambelii*), common raven (*Corvus corax*) Wilson's warbler (*Wilsonia pusilla*), various sparrow species (*Spizella* sp., *Amphispiza* sp.) and other passerines common to creosote scrub and wash communities. Raptor species that may inhabit the area include red-tailed hawks (*Buteo jamaicensis*) and turkey vultures (*Cathartes aura*).

Reptiles such as western whip-tailed lizards (*Cnemidophorus tigris*), desert horned lizard (*Phrynostoma platyrhinos*), side-blotched lizard (*Uta stansburiana*), gopher snakes (*Pituophis melanoleucus*), and rattlesnakes (*Crotalus sp.)* have ranges and habitat overlapping the proposed project area. No amphibians are likely to occur in this community.

Plant Species

The plant assemblage is a creosote bush-white bursage series (Sawyer and Keeler-Wolfe, 1995), which is a component of the Sonoran Creosote Bush Scrub and characteristic of the Colorado Desert.

Plants found in the immediate area include creosote bush (*Larrea tridentata*), Pursh plantain (*Plantago purshii*), red three awn (*Aristida longiseta*), *Euphorbia* spp., brittlebush (*Encelia farinosa*), range ratany *(Krameria parvifolia*), desert lavender (*Hyptis emoryi*), desert milkweed (*Asclepias* sp.), white bursage (*Ambrosia dumosa*), beavertail cactus (*Opuntia basilaris*), pencil cactus (*Opuntia ramosissima*), cholla (*Opuntia* spp.), and *Cryptantha* spp.

Invasive/Nonnative Plant Species

Several invasive species such as Mediterranean grass (*Schismus* sp.), Sahara mustard (*Brassica tournefortii*), canary grass (*Polypogon monspeliensis)*, and red-stemmed filaree (*Erodium cicutarium*) are already established in the vicinity of the proposed project.

Plant Species of Concern

The range of foxtail or beehive cactus, *Coryphantha vivipara var alversonii*, a plant species of Federal concern, falls within the Sheephole Valley Wilderness, but was not observed in the proposed project area.

Wild and Free-Roaming Horses and Burros

There are no wild and free-roaming horses or burros present in the vicinity of this proposed action.

16.3 Cultural Resources and Native American Religious Values

A cultural resources records and literature search of documents and maps on file at the Needles Field Office (NFO), was conducted by the NFO Archaeologist in August 2001. A records and literature search of the project area was also conducted by the San Bernardino County Archaeological Information Center, San Bernardino County Museum, Redlands, California. The results of both records and literature searches were negative, no historic or prehistoric archaeological resources have been previously identified within, or adjacent to, the proposed project area.

Archaeological pedestrian surveys were conducted by the NFO Archaeologist on the proposed project site area on August 21, 2001 and October 12, 2005. As a consequence of the intensive pedestrian surveys one historic resource, an historic era temporary tent campsite, was identified outside of the boundaries of the project area. The campsite, situated on a low-lying ridge within the large drainage at the base of the Sheep Hole Mountains, is comprised of a light metal can and debris scatter, and four to five cleared tent pads. Surface artifacts at the temporary campsite suggest that it may have been utilized sometime between 1920 and 1950. The historic campsite was, in all likelihood, occupied by workers employed at a mine prospect site situated within the unnamed canyon above the proposed water source construction location.

The existing road that provides access from the drainage/wash at the base of the Sheep Hole Mountains, upslope to the proposed project location, was probably constructed to provide access to the historic mining operations deep within the canyon east of the project area. A vehicle “turnout” was constructed at the base of the canyon walls adjacent to the proposed guzzler location. It is theorized that the turnout was graded on a ridge adjacent to the road to provide a means for vehicles going up or down the single lane way to turn out, or pass one another prior to entering the canyon on the single land road.

The historic campsite is located outside of the project area. The access road and the vehicle turnout adjacent to the project area were determined to be not eligible for nomination to the National Register of Historic Places. No impacts to cultural resources are foreseen as a consequence of this proposed action.

A review of the sacred lands base data revealed no sacred or traditional resources values within the proposed project area. Accordingly, no impacts to Native American religious values are foreseen.

16.4 Environmental Justice

The highly dispersed residential community of Wonder Valley, 5-acre homesteads established in the 1950's, is located approximately five miles west of Sheep Hole Pass, however, no minority communities or low income communities are located within or adjacent to the proposed project area. The proposed action would not impact distinct Native American cultural practices or result in disproportionately high or adverse human health or environmental effects on minority communities.

16.5 Geology, Minerals, and Soils

A pre-Cenozoic sequence of granitic and metamorphic rocks dominates the Sheep Hole Mountains. The metamorphic rocks in this sequence consist of gneiss and schist with scattered inclusions or pendants of marble and quartzite. Many of the mines, prospects and mineralized areas in the Sheep Hole Mountains are associated with contact zones of the Cadiz Valley Batholith where it intrudes meta-igneous and meta-sedimentary rocks. Only small sub-economic base and precious metal vein type deposits are known to exist. Scant past mining was limited to small hydrothermal fissure fill gold veins. There has been no documented production from any mine or prospect in the Sheep Hole Mountains. The area was withdrawn from mineral entry, except for valid existing rights, with the passage of the California Desert Protection Act in 1994. Soils of the area are thin and poorly developed with boulders strewn over much of the proposed project area.

16.6 Hazardous and Solid Wastes

The proposed action is located within the 18,000 square mile Desert Training Center/California - Arizona Desert Maneuver Area, used from 1942 through 1944 for military servicemen training and weapons testing. Unexploded ordnance associated with this training area may be encountered in the project area.

16.7 Health and Safety

Numerous safety and health issues are present at the site and in association with the project: remote location and restricted access make an emergency medical response difficult; heat stress; heavy manual material handling and rough terrain; excavation and trenching operations; chemical hazards associated with concrete operations such as dermal irritation and inhalation, noise, and biologicals (snakes, spiders, valley fever). The nearest hospital to the proposed project site is located 24 miles to the west in Twentynine Palms.

16.8 Land Use

Livestock Grazing

The Sheep Hole Mountains are not located within a BLM grazing allotment.

Public Services and Utilities

No rights-of-way for public services or utilities are located within the project area.

Recreation

Recreation use within the Sheephole Valley Wilderness is dispersed and at low levels. The area is accessible throughout the year for recreation, however, the use season is typically from September through April. Activities include big and small game hunting, hiking, and camping. There are no developed trails or facilities within or adjacent to this wilderness area. Nearly the entire boundary is defined by vehicle routes including Highway 62, a paved 2-lane highway.

16.9 Noise

Given the proximity of the site to Amboy Road, vehicular traffic can be heard from the project site approximately ½-mile distant. In addition, occasional military and private overflights can be heard at the site at various times.

16.10 Surface and Ground Water Quality

Surface Water

No perennial streams occur in the proposed project area. Stream runoff may or may not occur during periods of precipitation. The nearest rainfall record is from the National Weather Service station in Twentynine Palms, approximately twenty miles from Sheephole Valley Wilderness (Table 2). Precipitation data from the last twelve years range from 0.58 inches to 9.88 inches, demonstrating a high variability of rainfall in the area. While the last three years of rainfall have been substantially above average, according to the Hereford et al. (2004), "Recent trends in Mojave Desert precipitation and the PDO [Pacific Decadal Oscillation] suggest that climate of the region may become drier for the next two to three decades in a pattern that could resemble the mid-century dry conditions". Precipitation increases significantly with elevation in the mountain ranges of the Mojave Desert area during both winter and summer precipitation events.

Table 2 – Precipitation within the Sheep Hole – Calumet Range Area

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	**Annual**

													Total
1994	0.15	0.47	0.50	0.00	0.31	0.00	0.00	1.06	0.20	0.00	0.16	0.88	**3.73**
1995	2.13	0.86	0.29	0.18	0.00	0.00	0.07	0.03	0.13	0.00	0.00	0.00	**3.69**
1996	0.05	0.03	0.12	0.00	0.02	0.00	0.49	0.37	0.00	0.03	0.25	0.06	**1.42**
1997	0.51	0.01	0.00	0.38	0.64	0.01	1.05	1.34	3.96	0.00	0.17	0.47	**8.54**
1998	0.25	1.25	0.82	0.01	0.03	0.00	0.65	0.00	0.28	0.04	0.03	0.15	**3.51**
1999	0.03	0.40	0.00	1.37	0.02	0.02	1.11	0.03	0.39	0.00	0.00	0.00	**3.37**
2000	0.02	0.33	0.16	0.00	0.00	0.00	0.00	2.28	0.03	0.47	0.00	0.00	**3.29**
2001	0.86	1.33	0.29	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.01	0.46	**3.55**
2002	0.00	0.00	0.12	0.14	0.00	0.00	0.00	0.00	0.02	0.00	0.30	0.00	**0.58**
2003	0.18	0.93	0.24	0.00	0.00	0.00	0.09	3.66	0.50	0.00	1.02	0.29	**6.91**
2004	0.14	0.92	0.76	0.42	0.00	0.00	0.00	1.02	0.07	0.38	1.32	2.13	**7.16**
2005	1.14	3.19	0.06	0.00	0.00	0.00	2.77	2.07	0.18	0.47	0.00	0.00	**9.88**

Source: National Weather Service, California Department of Water Resources, California Data Exchange Center

Groundwater

Depth to ground water at the proposed site is unknown. No existing human uses of ground water occur in close proximity to the proposed site. Recharge to ground water occurs during periods of precipitation from runoff along stream courses and washes.

16.11 Visual Resources

The Sheep Hole Mountain range is a steep, boulder-strewn, granite mountain mass. The highest elevation reaches 4,600 feet. Common landscape features include steep and rocky slopes with boulder strewn washes running down to open, flat and sandy valleys. Vegetation is a sparse and patchy element in the landscape.

The Sheephole Valley Wilderness Area falls within the definition of Visual Resource Management (VRM) Class I according to BLM Policy (H-8410-I – Visual Resource Inventory and H-8431-1 – Visual Resource Contrast Rating dated 1/17/86). The Class I Objective, as stated in H-8431-1, is “to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.” However, no provisions for VRM were incorporated into the existing land use management plan (CDCA Plan 1980).

Key observation points for the proposed project include Amboy Road to the west (Photo 1, below) and in the wash just above the proposed diversion dam (Photo 2, below).

Photo 1: Looking east from Amboy Road.

Photo 2: Above proposed location of diversion dam.

The project area is located in view of Amboy Road on the south side of Sheep Hole Pass. Observation of the site would be from viewpoints in the immediate area. The area has landscape features altered by human activity, which include an historic way to a now-abandoned mine site and the features associated with a small hard-rock mining operation.

16.12 Wilderness

The Sheephole Valley Wilderness boundary encompasses 194,847 acres of land including 185,722 acres of BLM administered public lands, 2,396 acres of California State lands and 6,729 acres of private lands. This Wilderness is located 20 miles east of Twentynine Palms, California. The Sheephole Valley separates the Sheep Hole and Calumet Mountains. The Sheep Hole Mountains are a steep, boulder-strewn, granitic mass.

Bighorn sheep and desert tortoise are found in this wilderness and as BLM sensitive

species and federally listed threatened species, respectively, are special features within this wilderness. The area lacks known permanent springs or other permanent natural water sources. Presently, there are two big game artificial water sources and three small game artificial water sources within the wilderness. There are impacts from pre-wilderness designation mining activities. There are approximately 57 miles of pre-designation vehicle tracks within the wilderness. Upon designation (1994) there were a total of 34 individual vehicle access ways into the wilderness of which 28 have received restoration treatments. Restoration efforts occurred on approximately one mile of the vehicle ways bringing the existing vehicle ways within the Sheephole Valley Wilderness to approximately 56 miles. CDFG currently uses approximately 14 miles of these vehicle ways for motorized access to the five existing artificial water sources (two large game and three small game water sources). Vehicle use on the remaining 42 miles of un-restored vehicle ways is prohibited. Impacts from mining activity include several adits, mine tailings and at least one abandoned mine site. With the exception of existing vehicle ways, old mining impacts and the five artificial water sources the Sheephole Valley Wilderness are being managed consistent with the definition of wilderness in Section 2c of the Wilderness Act, "…retaining its primeval character and influence, without permanent improvements or human habitation which is protected and managed so as to preserve its natural condition…"

The proposed artificial water source would be on the northwest side of the Sheep Hole Mountains, located in a narrow granitic rock and sand wash, approximately 80 feet wide, with steep and rocky side slopes that support little vegetation, at an elevation of approximately 2,000 feet. The wash egresses directly onto the bajada above the Dale Lake area. An abandoned mining way exists that leads to a small abandoned mine with features at and within one mile of the proposed site. The site is about 0.5 mile from Amboy Road, a paved two-lane road between Amboy and Twentynine Palms. Vehicular noise can be heard from Amboy Road at the proposed site.

The Sheephole Valley Wilderness has been difficult to close to illegal vehicle use. Gates, barriers, boundary signing, and restoration treatments have been installed or completed by Needles Field Office to prevent the illegal use of approximately 57 miles of vehicle ways. In addition, vehicle way restoration has occurred on 28 individual sites removing approximately one mile of vehicle ways along the Wilderness boundaries. These measures have been damaged and/or removed by unknown individuals. Vehicle ways into the wilderness continue to be used illegally. Illegal cross country motorized vehicle use (motorized vehicle use other than on existing vehicle ways) in wilderness also occurs. Education, boundary signing and an active law enforcement presence are the primary tools used to prevent this illegal cross country motorized use.

At least three low level military flight paths exist above the wilderness with military overflights occurring routinely throughout the year. Private and commercial overflights occur on a less frequent basis.

CDFG conducts activities in the wilderness related to desert bighorn sheep

management. These activities include the inspection and maintenance of the existing artificial water sources twice annually, an annual aerial overflight for population census, three releases of translocated bighorn sheep, and one bighorn sheep radio collaring operation in the last 20 years.

17. ENVIRONMENTAL CONSEQUENCES: Proposed Action

17.1 Air Quality

The project's excavation activities would generate small amounts of PM-10 emissions for the few day period of construction. The operation of engines to power the backhoe, cement mixer, and trucks would generate unknown levels of particulate and other emissions during the period of construction. Vehicle use on the access way would generate PM-10 emissions during the monitoring period. However, due to the short period of construction and minimal maintenance activities the quantity of PM-10 and other emissions would be minimal. Control measures are not necessary to reduce emissions. The proposed action would not exceed deminimus emission levels and no further conformity determination is necessary. No impacts are anticipated regarding air quality for the proposed action.

17.2 Biological Resources

Threatened and Endangered Species

The habitat is not optimal for desert tortoises (Category 3) and their densities are low near the project site. Adherence to tortoise mitigation measures would minimize impacts to desert tortoise. If maintenance activities are required and involve mechanized equipment, the same mitigation measures should be applied.

Impacts to desert tortoise due to the creation of a permanent water source are also expected to be minimal. While some tortoise mortalities have been associated with small game water sources (Hoover 1995), CDFG monitoring of DWU-style water sources has revealed no tortoise mortalities (Andrew et al. 2001).

It has been speculated that raven densities would increase around artificial water sources in the desert, which may be problematic as some ravens are known to prey on juvenile tortoises. However, ravens exist in low densities (approximately 2 per 100 transect miles compared to 40 per 100 transect miles in the West Mojave Desert) in this portion of the desert (FaunaWest Wildlife Consultants 1989). Most ravens in the area were found near a landfill at Amboy which the BLM cleaned and covered in 2002. The observed low density of ravens is also supported by CDFG water source photography data from eastern Riverside and Imperial Counties. Photographs collected from 1995 to 2005 show the presence of ravens in only 19 of 11,187 wildlife photos (N. Andrew, CDFG, in preparation). Neither is there evidence that raven densities have increased around artificial water sources per se nor that the construction of this water source would result in greater raven numbers.

BLM Sensitive Wildlife and California Species of Special Concern (SSC) as identified in NECO

1. Prairie Falcon *(Falco mexicanus)* -- SSC, Le Conte's thrasher *(Toxostoma lecontii)* – SSC and BLM Sensitive

Temporary disturbance could cause avoidance of the area by prairie falcons during construction. Nesting may be disrupted or nest sites abandoned if noise or activities occur during the breeding season. Project scheduling should be modified if nests are present within ¼ mile of the project area. Frequency and activity levels associated with monitoring and maintenance activities are low and not expected to affect prairie falcons. Desert water developments are known to provide a source of drinking water for lagomorphs and birds (Andrew et al. 2001). Availability of this food source could attract prairie falcons.

2. Chuckwalla *(Sauromalus obesus)* – SSC, Rosy Boa *(Lichanura trivirgata*) – SSC, Mojave fringe-toed lizard (*Uma scoparia*) – SSC and BLM Sensitive

While the proposed project is within the range of these species, habitat is sub-optimal and none of these species were detected during examinations of the site. (G. Mulcahy, CDFG, personal communication, 2005). Should these species be present during construction, temporary displacement could occur. Maintenance and monitoring may have a temporary minimal effect upon individuals. Notable disruptions in foraging and or breeding behavior are not anticipated due to short duration of site visits. The introduction of a water source is not anticipated to affect these species.

3. Pallid bat (*Antrozous pallidus*) – SSC and BLM Sensitive, Townsend's western big-eared bat (*Plecotus townsendii*) – SSC and BLM Sensitive, Pocketed free-tailed bat (*Tadarida femorosaccus*) – SSC, California leaf-nosed bat (*Macrotus californicus*) – SSC and BLM Sensitive, and Fringed myotis (*Myotis thysanodes*) – BLM Sensitive

Given that construction, monitoring, and maintenance of the water source would occur during the day, and these species are all crepuscular or nocturnal, there would be no impacts to bat species from these activities. The creation of a permanent water source may be beneficial to these species (Rosenstock et al. 2004) as it would attract insects and serve as a foraging location for bat species.

4. Desert Bighorn Sheep (*Ovis canadensis nelsoni*) – BLM Sensitive

Under the proposed action, the construction phase of this project would involve up to five days for the initial placement of the structures. This disturbance may temporarily displace sheep to other portions of the range.

Maintenance and monitoring activities could result in temporary disturbance of bighorn. Monitoring would not entail the use of a vehicle, however, maintenance may require mechanized equipment if an unforeseen problem develops. Human

disturbance associated with monitoring would not exceed two days per year. DWU-design water sources infrequently require maintenance. Accordingly, impacts due to maintenance are anticipated to be minimal.

Under the proposed action, range expansion and better habitat utilization are anticipated to occur for bighorn sheep. By providing dispersed water sources to bighorn sheep, individual and herd dispersal should occur and allow access to otherwise unused range on varying spatial and temporal scales. This is expected to result in herd expansion with associated beneficial effects such as increased probability of emigration and immigration allowing for more stable demographic conditions. More dispersed populations are less prone to the potential devastating effects of disease outbreaks and other stochastic events.

By developing more reliable water sources, the effects of catastrophic system failures in artificial drinkers or insufficient precipitation at natural sources can be ameliorated. For example, during conditions or poor forage quality (e.g. low forage moisture), bighorn sheep need more water to digest the material in the rumen to thus receive the possible greatest benefit. During drought conditions sheep need more water to simply maintain their internal water balance to avoid succumbing to dehydration and possible death.

While negative effects of water sources have been hypothesized by some, they have not been substantiated by research (Rosenstock et al. 2004). Misconceptions about water sources regarding predator abundance and predation, competition, water quality, wildlife diseases, wildlife mortality etc. have been addressed by several researchers (Ballard et al. 1998, Leslie and Douglas 1979, Rosenstock et al.1999, Rosenstock et al. 2004, Bleich et al. in submission) and have not been born out as problematic. Additional research in these areas is on-going.

Other Wildlife Species

The project may result in mortality and/or displacement of small mammals such as desert kangaroo rats, (*Dipydomys* sp.) and deer mice (*Peromyscus* sp.*),* which have burrows adjacent to some construction areas. Other small wildlife species, such as snakes, lizards and small bird species could be impacted as a result of an increase in vehicular travel, both directly and indirectly associated with the proposed project. Small birds, reptiles, and mammals would be expected to benefit from a permanent water source within an area where no permanent water presently exists or has existed in the past.

Plant Species

No threatened or endangered plants have been identified at the site. Therefore no effects from construction are anticipated. Perennial and ephemeral plants present at the site could be utilized by bighorn sheep as forage. Construction activities, including use of vehicles, could affect existing vegetation along the proposed route. However, as the wash access would be flagged prior to construction activities, plant impacts along the access route are expected to be minimal.

Invasive/Nonnative Plant Species

Seeds of invasive or nonnative species may be introduced during activities involving soil disturbance. Equipment may also inadvertently transport seeds. If invasive or nonnative species become established as a result of this proposal, impacts to native plant communities in the area may reduce natural biodiversity.
Adherence to the mitigation measures would result in minimal impacts.

Wild and Free-Roaming Horses and Burros

The proposed action is not within an established Herd Management Area and no wild and free-roaming horses or burros are known to be present in the area. Accordingly, no impacts are anticipated regarding wild and free-roaming horses and burros in association with the proposed action.

17.3 Cultural Resources and Native American Religious Values

Driving vehicles up and down the access way comprises adaptive reuse of the former road, and would not have an effect on the historical integrity of the access. The temporary mining campsite at the base of the Sheep Hole Mountains would be avoided by project design, and would not be impacted as a consequence of the proposed project.

A review of the sacred lands base data revealed no sacred or traditional Native American Values within the proposed project area. No impacts to Native American Religious Values are foreseen.

17.4 Environmental Justice

The proposed action would not impact distinct Native American cultural practices or result in disproportionately high or adverse human health or environmental effects on minority communities.

17.5 Geology, Minerals, and Soils

No impacts are anticipated regarding minerals or the general geology in regard to the proposed action.

Soils

During the construction the B (surface layer) and C soil horizons would be excavated. The subsurface soils would become disturbed by equipment use, and the very small fine textured soils would be susceptible to accelerated wind erosion and surface runoff from storm events. There would be some change in the soil surface profile, which may increase the potential for soil erosion. Due to the short period of construction activities stabilization of the disturbed area will occur naturally

in a short period of time. Erosion is expected to be minimal and mitigation for the disturbance would not be required. Soil contamination by hydraulic fluids, oils, or other lubricants may occur.

17.6 Hazardous and Solid Wastes

The proposed action would utilize construction equipment that uses fuels, oils, and lubricants. While routine use of this equipment should not result in the generation of hazardous wastes, use of the construction equipment presents the potential for a fuel, engine oil or lubricant release to the environment during construction activities. However, the action's proposed spill prevention and containment measures sufficiently address potential impacts.

The site-specific health and safety plan sufficiently addresses measures to be taken in the event that unexploded ordnance is encountered.

17.7 Health and Safety

The proposed action sufficiently addresses health and safety provisions. The proposed action is supported by health and safety procedures and controls addressing hazard recognition and mitigation, communications, and emergency response (Appendix H and California Title 8 Regulations).

17.8 Land Use

Public Services and Utilities

While, no impacts associated with the proposed action are anticipated regarding public services and utilities, "Dig Alert" should be contacted (1-800-227-2600) as a precautionary measure prior to project initiation.

Recreation

Impacts to recreation visitors are anticipated to be low during and after construction activities due to low visitor use levels. Impacts would be most noticeable to visitors during construction, inspection, maintenance, and re-filling activities. At other times, the low visibility of the completed facility would leave it unnoticed to most observers.

If the proposed action results in increases in wildlife populations within the vicinity of the artificial water sources, it is anticipated that wildlife viewing and hunting opportunities would be improved.

17.9 Noise

Motorized vehicles, heavy excavation equipment, including the associated attachments (such as the hydraulic chisel hammer), hand tools, and the gasoline-powered concrete mixer used in the project's construction would temporarily

increase noise levels in the wilderness. Sound levels of the vehicles and construction activities would vary according to distance from the site and weather conditions, but could be expected to be in excess of 105 decibels at the site near the operating equipment and cause temporary displacement of wildlife and disrupt the solitude of the area.

Sounds from post-construction activities, such as non-routine maintenance, if needed would be less than those associated with the construction phase. Inspections would be non-intrusive, as personnel would walk in to the site.

17.10 Surface and Ground Water Quality

Surface waters

The diversion dam would collect water from less than half of the stream valley width. The maximum volume of water that would be captured at any time would be 12,500 gallons if the drinker and tank were completely empty prior to a precipitation event. Experience with other similar drinker with storage tanks in similar environments has shown that water collected remains in the drinker and tank for a substantial period of time and are seldom completely empty. All diverted water in excess of a full drinker and tank would overflow back to the stream drainage. During small precipitation events little water would be captured by the drinker as little runoff would occur and most would percolate into the stream bed. During larger precipitation events where runoff occurs, only a very small portion (less than 12,500 gallons) of the total runoff of the stream watershed would be diverted and captured by the drinker.

The impoundment behind the diversion dam and the drinker tank would allow settling of some sediment from stream waters. The disturbed area would be expected to stabilize naturally in a short period of time and would not contribute appreciably to increased sediment transport. No impacts to stream flow or water quality are anticipated.

Groundwater

Minimal impacts are anticipated.

17.11 Visual Resources

Most of the structures associated with the DWU-style water source are underground or at ground level. The 10,000 gallon water tank will be completely buried with only a small vent tube exposed, the 2,500 gallon drinker will be buried and exposed just above ground level, the diversion dam will be constructed with rocks from the immediate vicinity and cement, and any exposed water supply piping will be painted to blend in with the environment. After installation the site is to be reshaped to a natural contour. Vehicle tracks along the access route within the wash are to be

raked out once the project is completed. The S.D. water source itself would not be visible from Amboy Road. A visitor to the Photo 2 (see previous Visual Resources section) location may notice a very low level of change to the landscape characteristics. Overall changes to the characteristic landscape will not attract attention. For these reasons the S.D. water source will meet the VRM Objectives as provided by BLM Policy.

A Geographic Information Systems (GIS) viewshed analysis determined that the proposed project is in the line of sight from 653 acres or approximately .3% of the wilderness.

17.12 Wilderness

Size

The size of the Sheephole Valley Wilderness would not be affected.

Naturalness

The proposed action would impact the naturalness of the Sheephole Valley Wilderness in three ways: 1) the addition of a permanent man-made structure within the wilderness; 2) the additional use of vehicles and motorized equipment within the wilderness, and 3) the addition of an artificial water source to an environment primarily affected by natural processes.

The construction activities would impact naturalness in the immediate vicinity of the project. The impact would be greatest during the construction activities. Once construction has been completed and the post-construction activities implemented as proposed, the installation would be visible from portions of the wilderness but not substantially noticeable.

The proposed action would result in the creation of about 0.5 mile of new vehicular tracks. These tracks, especially the 0.25 mile within the wash, would be clear and deep. However, this would only be during the five days of construction. Law enforcement personnel would be present during construction to ensure no illegal vehicle use occurs. After the construction period the vehicle tracks will be raked out. Overall, illegal vehicle use in the Sheephole Valley Wilderness is not expected to change.

Currently, there are approximately 56 miles of existing vehicle ways within the Sheephole Valley Wilderness. CDFG uses 14 miles of existing vehicle tracks to inspect and maintain artificial waters in the wilderness. The location of the S.D. Site would require the use of 0.5 mile of an existing vehicle way increasing the total number of miles of vehicle ways utilized by CDFG to 14.5. As inspections for this proposed site would be carried out on foot, and maintenance activities are minimal for this design, creation of a well-defined way would not be expected.

The proposed project would be inconsistent with a wilderness being "managed so as to preserve its natural conditions". However, upon project completion, the wilderness area would generally appear "to have been affected primarily by the forces of nature". In addition, the increased probability of survival of the Sheep Hole Mountains bighorn sheep deme would positively affect the wilderness area's values.

Opportunities for solitude or a primitive and unconfined type of recreation

The construction phase would involve a maximum five day period of impact to the opportunity for solitude within the wilderness [1.4% (5÷360x100=1.4%) of the time annually for the first year only]. Personnel monitoring the S.D. artificial water source would hike into the site twice annually. Maintenance would occur on an infrequent basis (once or twice every few years) and may include vehicle access. Impacts to opportunities for solitude due to monitoring and maintenance would therefore be minimal, less than 1% annually.

Use of motorized vehicles, both legal use by CDFG, and illegal use, in this wilderness reduces opportunities for solitude. Currently, motorized vehicles or equipment are used for monitoring and repair of existing artificial waters within this wilderness an estimated 5-10 days per year. Sheep population surveys and other activities using helicopters impact the opportunity for solitude an estimated additional two days per year. Operations to manually fill existing artificial water sources when they are dry have occurred in the past. There have been a total of three helicopter flights to fill existing artificial water sources from 2000 - 2005. Re-filling would be infrequently (maximum three times per decade) needed for this site. Vehicle use of the access route for purposes of maintaining or refilling the artificial water source would not be expected to exceed once a year, on average. It is estimated that there are still at least two unauthorized vehicle incursions per month, or 24 days per year. The current estimate is that there is a total of between 10-15 days each year, or 2-4% of the time annually, when opportunities for solitude are impacted by authorized vehicle use. Impacts on opportunities for solitude by illegal vehicle use are estimated 24 days each year, or 7% of the time annually. The total estimated impacts on opportunities for solitude from vehicle use in wilderness would between 34-39 days or 9-11% of the time annually.

A GIS viewshed analysis (Appendix I) determined that the proposed project site is in the line of sight from 653 acres or approximately .3% (653÷194,847x100=.3%) of the entire Sheephole Valley Wilderness. The 653 acre viewshed, calculated employing ArchGIS software, represents a maximum acreage of the potential line of sight. If impacts on opportunities for solitude by vehicle use in the wilderness is estimated to total 36 days (34+39÷2=36 average days) a year then the estimated likelihood of vehicle use within the project viewshed (and corresponding impacts on opportunities for solitude) is .03% of the time annually or one day a year (.3% of wilderness in viewshed x 10% of time vehicles are within Wilderness).

Special Features

The anticipated affects on bighorn sheep and desert tortoise, which are considered special features of the Sheephole Valley Wilderness, are discussed in the wildlife section.

Wilderness Act, Section 4c Conformance

The California Desert Protection Act of 1994 states that management activities to maintain and restore wildlife populations may be carried out within wilderness areas and shall include use of motorized vehicles by appropriate State agencies (Title 1 Section 103(f)). Delivery of staff, equipment, and supplies to the proposed sites involves using motor vehicles and motorized equipment. An alternate means of installation without use of motor vehicles and motorized equipment was considered. Transportation of equipment using pack animals or via wagon over the sandy access ways was considered infeasible because of the size and weight of project components. This alternative would also require a greater number of workers for a longer amount of time to complete the installation of the water source. The use of motor vehicles and motorized equipment, as described in the proposed action, is the minimum necessary to accomplish the proposed action.

18. ENVIRONMENTAL CONSEQUENCES: No Action Alternative

The Proposed Action would not be undertaken as designed and the existing environment would be unchanged. Existing management and use of the site would continue subject to applicable statutes, regulations, policy and land use plans.

Biology

Sheep populations are closely related to forage availability, but are also affected by habitat quality, the numbers of breeding adults (especially females), and rates of reproduction, recruitment and mortality. The addition of permanent water sources can increase the range, hence forage availability to the sheep, and in turn partially offset the negative effects of low forage quality.

Bighorns would continue to use forage resources as available to them. Thus their use of the range would be based on forage condition (quality and quantity), its proximity to accessible drinking water as dictated by their physiological condition, as well as environmental conditions. During periods of higher winter and summer precipitation across the range, more of the habitat would be available to them and presumably ephemeral drinking water sources. During periods of drought, low rainfall and/or “spot rainfall” less of the range would be available, and bighorn sheep would be more closely associated with the two locations of existing permanent water sources.

During longer periods of good range conditions sheep are likely to be of better health and such vigor would translate into greater reproduction and survival, less mortality and could result in an increase in population. With an increase in population, the probability of deme survival is increased. If population criteria were

met, this population would be considered as a source for sheep for possible relocation.

During periods of low precipitation conditions, sheep would utilize forage that is available in closer proximity to existing water sources. If poor range conditions are related to persisting drought conditions, the likely outcome would be weakened animals, poor or no reproduction, increased mortality and a resultant decrease in population size. The probability of deme persistence and emigrations would likewise decrease which would affect persistence probabilities for the metapopulation as a whole. As noted earlier, this area of the California desert is expected to become warmer and drier over the next twenty years (Epps et al. 2003, Hereford et al. 2004). Under a worse case scenario the population would decline to a level not considered viable and extirpation could result.

The BLM, as per current agreement, would remain responsible (e.g., funding, personnel) to ensure that both existing artificial water sources contain adequate water year round.

The Department's management goals for Sheephole Valley Wilderness to create the opportunity for better utilization of the range, increase the distribution of sheep across the range, and expand the availability of permanent water would not be achieved.

Wilderness

Size

The size of the Sheephole Valley Wilderness would not be affected by adopting this alternative.

Naturalness

The impact on the naturalness of the Sheephole Valley Wilderness would not change in the short term if this alternative is adopted. The long term impacts to naturalness due to a change (reduction or extirpation) in bighorn sheep population are unknown. The reduction or extirpation of bighorn sheep would diminish the wilderness character of the area.

Opportunities for solitude or a primitive and unconfined type of recreation

The impact to opportunities for solitude would not be affected by adopting this alternative. The impacts to primitive types of recreation (wildlife viewing and hunting opportunities) would decrease according to bighorn sheep population declines.

Special Features

The anticipated affects on bighorn sheep, which are considered a special feature of the Sheephole Valley Wilderness, are discussed in the wildlife section.
Under the no action alternative there would be no expected impacts to desert tortoise.

Other Resources

No other resources are anticipated to be impacted by the No Action Alternative.

19. MITIGATION: Proposed Action

19.1 Air Quality

No mitigation measures are required.

19.2 Biological Resources

Desert Tortoise

Activities associated with the proposed action would comply with the following provisions from the Programmatic Biological Opinion on Small Disturbances in Desert Tortoise Habitat (1-8-97-F-17).

In the following measures, a “qualified biologist” is defined as a trained wildlife biologist who is knowledgeable concerning desert tortoise biology, tortoise mitigation techniques, tortoise habitat requirements, identification of tortoise sign, and procedures for surveying for tortoises. Evidence of such knowledge may include one or more of the following: employment as a field biologist working on desert tortoise or successful completion of a contract dealing with desert tortoise fieldwork. Attendance at the training course sponsored by the Desert Tortoise Council would be a supporting qualification.

An “authorized biologist” is defined as a wildlife biologist who has been authorized to handle desert tortoises. An authorized biologist must be approved by the USFWS, the CDFG and the BLM.

a. The project proponent shall designate a field contact representative (FCR) who will be responsible for overseeing compliance with protective stipulations for the desert tortoise and for coordination on compliance with the BLM. The FCR must be on-site during all project activities. The FCR shall have the authority to halt all project activities that are in violation of the stipulations. The FCR shall have a copy of all stipulations when work is being conducted on the site. The FCR may be a crew chief or field supervisor, a project manager, any employee of the project proponent, or a contracted biologist.

b. All employees and/or volunteers of the project proponent who work on-site shall participate in a tortoise education program prior to initiation of field activities. The

project proponent is responsible for ensuring that the education program is developed and presented prior to conducting activities. New employees and/or volunteers shall receive formal, approved training prior to working on-site. The employee education program must be received, reviewed, and approved by the BLM Field Office at least 15 days prior to the presentation of the program. The program may consist of a class presented by a qualified biologist (BLM or contracted) or a video. Wallet-sized cards or a one-page handout with important information for workers to carry are recommended. The program shall cover the following topics at a minimum:

-distribution of the desert tortoise,
-general behavior and ecology of the tortoise,
-sensitivity to human activities,
-legal protection,
-penalties for violations of State or Federal laws,
-reporting requirements, and
-project protective mitigation measures.

c. Only biologists authorized by the USFWS, CDFG, and the BLM shall handle desert tortoises. The BLM or project proponent shall submit the name(s) of proposed authorized biologist(s) to the USFWS for review and approval at least 15 days prior to the onset of activities. No activities shall begin until an authorized biologist is approved. Authorization for handling shall be granted under the auspices of the Section 7 consultation.

d. The area of disturbance shall be confined to the smallest practical area, considering topography, placement of facilities, location of burrows, public health and safety, and other limiting factors. Work area boundaries shall be delineated with flagging or other marking to minimize surface disturbance associated with vehicle straying. Special habitat features, such as burrows, identified by the qualified biologist shall be avoided to the extent possible. To the extent possible, previously disturbed areas within the project site shall be utilized for the stockpiling of excavated materials, storage of equipment, and parking of vehicles. The qualified biologist, in consultation with the project proponent, shall ensure compliance with this measure.

e. No access road shall be bladed to the project site. Access to the project site shall be restricted to designated routes. A qualified biologist shall select and flag the access route to avoid burrows and to minimize disturbance of vegetation. All access routes are to be considered temporary; after project abandonment (or completion, if a short-term activity), the wash route shall be rehabilitated by raking.

Except when absolutely required by the project and as explicitly stated in the project permit, cross-country vehicle use by employees is prohibited during work and non-work hours.

f. Desert tortoises may be handled only by the authorized biologist and only when necessary. In handling desert tortoises, the authorized biologist shall follow the

techniques from handling desert tortoises in “Guidelines for Handling Desert Tortoises during Construction Projects” (Desert Tortoise Council 1996).

g. The authorized biologist shall maintain a record of all desert tortoises handled. This information shall include for each tortoise:

1. the locations (narrative and maps) and dates of observations;
2. general condition and health, including injuries and state of healing and whether animals voided their bladders;
3. location moved from and location moved to;
4. diagnostic markings (i.e., identification numbers or marked lateral scutes);
5. slide photograph of each handled desert tortoise as described in previous measure.

h. No later than 90 days after completion of construction or termination of activities, the FCR and authorized biologist shall prepare a report for the BLM. The report shall document the effectiveness and practicality of the mitigation measures, the number of tortoises excavated from burrows, the number of tortoises moved from the site, the number of tortoises killed or injured, and the specific information for each tortoise as described previously. The report may make recommendations for modifying the stipulations to enhance tortoise protection or to make it more workable. The report shall provide an estimate of the actual acreage disturbed by various aspects of the operation.

i. Upon locating a dead or injured tortoise, the project proponent or agent is to notify the BLM Field Office. The BLM must then notify the appropriate field office (Carlsbad or Ventura) of the USFWS by telephone within three days of the finding. Written notification must be made within five days of the finding, both to the appropriate USFWS field office and to the USFWS Division of Law Enforcement in Torrance. The information provided must include the date and time of the finding or incident (if known), location of the carcass or injured animal, a photograph, cause of death, if known, and other pertinent information.

An injured animal shall be transported to a qualified veterinarian for treatment at the expense of the project proponent. If an injured animal recovers, the appropriate field office of USFWS should be contacted for final disposition of the animal.

The BLM shall endeavor to place the remains of intact tortoise carcasses with educational or research institutions holding the appropriate State and Federal permits per their instructions. If such institutions are not available or the animal’s remains are in poor condition, the information noted above shall be obtained and the carcass left in place. If left in place and sufficient pieces are available, the BLM (or its agent) shall attempt to mark the carcass to ensure that it is not reported again. Arrangements for disposition to a museum shall be made prior to removal of the carcass from the field.

j. Except on county-maintained roads, vehicle speeds shall not exceed 20 miles per hour through desert tortoise habitat.

k. Workers shall inspect for tortoises under a vehicle prior to moving it. If a tortoise is present, the worker shall carefully move the vehicle only when necessary and when the tortoise would not be injured by moving the vehicle or shall wait for the tortoise to move out from under the vehicle.

l. No dogs shall be allowed at a work site in desert tortoise habitat.

m. All trash and food items shall be promptly contained within closed, raven-proof containers. These shall be removed daily from the project site to reduce the attractiveness of the area to ravens and other tortoise predators.

n. Project proponents shall stockpile any vegetation grubbed or bladed from the project site and access road. Following completion of the project, the access road and project site (if a temporary disturbance) shall be recontoured to approximate pre-project condition and the stockpiled vegetation randomly spread across the recontoured area. [Due to the variation in substrate types, additional revegetation measures (e.g., imprinting, reseeding) shall be considered.]

o. During excavation of trenches or holes, earthen ramps will be provided if possible, given Occupational Safety & Health Administration regulations, to facilitate the escape of desert tortoises or other wildlife species that may inadvertently become entrapped. Periodic inspections of trenches and holes will be made to ensure that desert tortoises have not become trapped. If desert tortoises are found within the trench and will not utilize ramps for escape, an authorized biologist will remove the tortoise from the trench by hand, if possible. Final inspections will be made of open trench segments immediately before backfilling. All open pipe segments will be covered when work activity is not occurring at the site.

Bighorn Sheep

a. The artificial water source should be monitored at least two times per year for water level and maintenance needs. A report of each inspection should be submitted to the BLM California Desert District Office and Needles Field Office.

b. Bighorn mortalities should be necropsied when possible and the results submitted to the BLM California Desert District Office and Needles Field Office.

c. If studies show increased mortalities of bighorn sheep along roadways, CDFG will consider additional management actions (i.e. signs, education).

Prairie Falcon

a. A survey for nesting prairie falcons shall be conducted prior to project initiation. Project scheduling should be modified if nests are present within ¼ mile of the project area.

Invasive/Nonnative Species

To avoid the spread of invasive/exotic plants, tools should be cleaned before use at

each site.

To prevent the transport of invasive, non-native plant species to and from the site the following actions should be taken.

- The crew should spray the tires of the vehicle before leaving the site.

- Before leaving the site, all clothing should be checked and any plant material, especially stickers, and burs that may contain invasive non-native plant seeds should be removed.

19.3 Cultural Resources and Native American Religious Values

1) Tent pads and associated areas of the temporary mining camp site in proximity to the proposed use areas should be avoided when accessing the site.

2) At locations where there is rock drywall shoring along the access road, it shall be left intact and undamaged.

19.4 Geology and Soils

No mitigation measures are required.

19.5 Hazardous or Solid Wastes

All costs associated with hazardous materials/waste cleanup (including contaminated soils) should be borne by CDFG.

19.6 Health and Safety

Adherence to the site-specific health and safetyplan, and California Title 8 Regulations is required.

19.7 Land Use

“Dig Alert” should be contacted (1-800-227-2600) prior to project initiation.

19.8 Surface and Ground Water Quality

Surface Water

No mitigation measures are required.

Groundwater:

No mitigation measures are required.

19.9 Wilderness

Availability to the access route utilized during construction should be blocked and signed from all unauthorized vehicles.

20. RESIDUAL IMPACTS

20.1 Air Quality

No residual impacts are anticipated.

20.2 Biological Resources

The proposed action is anticipated to have a positive affect on bighorn sheep populations by assuring that water levels within the developments are maintained. As bighorn continue to disperse and move throughout the Sheep Hole Mountains due to the construction of this water source, the residual effects of increased forage utilization within the area would be minimal. Wehausen and Hansen (1986) found high utilization of forage species by bighorn to be evident only within close proximity of springs preferred by bighorn and insignificant forage utilization only a short distance from the water source.

20.3 Cultural Resources and Native American Religious Values

No residual impacts are anticipated.

20.4 Geology, Minerals, and Soils

No residual impacts are anticipated.

20.5 Hazardous or Solid Wastes

No residual impacts are anticipated.

20.6 Health and Safety

No residual impacts are anticipated.

20.7 Land Use

No residual impacts are anticipated.

20.8 Noise

Displacement of wildlife is expected to be temporary and not expected to last for more than two weeks after completion of the project.

20.9 Surface and Ground Water Quality

Surface Water

No residual impacts are anticipated.

Groundwater

No residual impacts are anticipated.

20.10 Environmental Justice

No residual impacts are anticipated.

20.11 Visual

Due to the design of the DWU-style water source, residual impacts will meet the VRM Objectives as provided by BLM Policy. Visual impacts will be less noticeable over time to the point where the site will not draw the attention of casual visitors.

20.12 Wilderness

Size

Residual impacts will have no effect on the size of the wilderness.

Naturalness

Once construction would be completed and the reclamation measures implemented as proposed, the installation would be noticeable, but not dominant. Once the vegetation in the wash and on the re-created slopes covering the underground tank has recovered, the visibility would be considerably reduced. The rock dam, exposed metal-flex pipes at the dam, the vent pipes for the storage tank, and the concrete steps and aprons in front of the walk-in drinkers would remain visible but would be painted to blend in with the existing environment. Although a GIS viewshed analysis determined that 653 acres of wilderness are in line of site of the artificial water source site, the actual acreage where a visitor could discern impacts would be far less.

The pre-existing vehicle way used to access the artificial water source site will have a residual impact on the naturalness of the wilderness. After installation and reclamation measures are completed vehicular traffic on the access route is expected to occur only once or twice every two to three years. This will, to some limited extent, prevent the route from reverting to a truly natural condition, but it is not expected to substantially change from pre-proposal conditions.

Opportunities for solitude or a primitive and unconfined type of recreation

The construction phase would involve up to a 5-day period of impact to the opportunity for solitude within the wilderness. In the second and subsequent years, the proposed action would add no more than an estimated one day per year (on average) of vehicular use for maintenance.

Re-fill actions are not expected to occur more than once every two to three years. A water pumping truck parked outside the wilderness with a hose-lay extending to the artificial water source would be used if a re-fill is needed. Although expected to occur less frequently, the worst case scenario would require three refills per decade.

After installation the proposed action is not expected to result in more than 1-2 days (less than .5% of the year) when opportunities for solitude are impacted by vehicle use, both authorized and unauthorized, within the wilderness.

Special Features

Residual impacts to desert bighorn sheep are addressed in the Section 22.2; Biological Resources.
There are no expected residual impacts to desert tortoise.

21. CUMULATIVE IMPACTS

Past and Present Activities

In this case, past and presently on-going actions and activities within the Sheephole Valley Wilderness Area include: historic mineral exploration, World War II military training and weapons testing, two large animal artificial waters consisting of above-ground plastic storage tanks with a New Mexico style drinker (Bear Claw and Suds Hole), three small animal artificial waters, vehicle access (14 miles of vehicle ways) by CDFG and volunteers to monitor and maintain the artificial water sources, military over-flights, civilian aircraft over-flights, CDFG helicopter use to conduct population census, capture bighorn sheep for data collection and radio collar installation, and monitoring and maintenance (including refilling) of artificial water sources, dispersed and group recreational use (i.e. camping, hiking, hunting), limited access and use of 6,729 acres of private lands, and BLM aircraft use for wilderness monitoring.

Foreseeable Future Activities

Cumulative impacts are those impacts on the environment which result “from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions.” (40 CFR 1508.7).

The primary cumulative impacts would be on biological resources and on

wilderness values.

Biological

Three artificial water sources accessible only to small animal species were constructed in the Sheep Hole Mountains during the 1950s. See Appendix B for these water locations. These waters are used primarily by quail, dove, passerines, and small mammals. Because of the design of these water sources, larger animals, including bighorn sheep, cannot utilize them.

Two large animal artificial water sources (Bear Claw and Suds Hole) were constructed in the Sheephole Valley Wilderness. Suds Hole was constructed in 1983, and Bear Claw was constructed in 1994. These artificial water sources took, on average, two days to construct with approximately 50 people and involved the use of helicopters and other motorized equipment. The construction impacts (i.e. use of motorized equipment, personnel camping in the area, soil disturbance) of these projects are no longer visible at either site. Both water sources are used extensively by bighorn sheep, as indicated by pellet transects, ground observations, and aerial telemetry, and have also been utilized by other wildlife species in the area. These artificial waters have been instrumental in sustaining bighorn sheep and have encouraged some dispersal of this deme by expanding habitat use.

Differences between these two artificial waters include storage capacity, location, microclimate, and collection ability. Bighorn sheep have at times been concentrated around Suds Hole during periods when Bear Claw had no water.

The five additional artificial waters are anticipated to aid in sheep dispersal and lessen or temper the effects of poor habitat during dry conditions. These waters would also be used by other wildlife species in the Sheep Hole and Calumet Mountains.

Biological degradation due to past construction and the presence of permanent water sources has not been documented in the Sheep Hole Mountains and is therefore not anticipated with the five future projects slated for this area.

Wilderness Impacts

The presence of permanent man-made structures are prohibited unless they are “necessary to meet minimum requirements for the administration of the area” under purposes of the Wilderness Act, 1964. The construction of a total of 11 artificial water sources (two existing large animal artificial water sources and three existing small animal artificial water sources, the S.D. proposal, and five potential future big game sites) would require placing structures in the Sheephole Valley Wilderness Area. The use of the DWU design will place the majority of structures below ground. This design along with the remote location of artificial water source sites will put structures out of sight of most visitors.

Each additional artificial water source would require construction activities and

access similar to that in the proposed action. Each would require regular inspection and maintenance and may require water delivery during extended periods of drought. This would result in increased operation of ground vehicles or aircraft within the wilderness and the establishment of additional intermittently used vehicle ways within the wilderness. Construction equipment may be needed at the sites to repair damage by natural events.

The use of vehicles in wilderness is anticipated to increase over time. Currently, 14 of the 57 miles of existing vehicle ways are used in the inspection and maintenance of artificial waters in this wilderness. The proposed action would add .5 mile of existing vehicle tracks that would be used by vehicles an estimated average of once a year. Construction of the other five anticipated artificial waters would result in use of vehicles on an estimated 30 miles of new or existing vehicle tracks. The cumulative total would be an estimated 44 miles of vehicle tracks being used by motorized vehicles within the wilderness on at least a semi-annual basis. If a total of eleven artificial waters (five existing, the S.D. proposal, and five potential future sites) are established in the Sheephole Valley Wilderness the authorized vehicle use would be expected to more than double to approximately 20-30 trips a year (two monitoring trips per artificial water source, one maintenance trip per artificial water source per year and unexpected number of refill trips during drought years). If eleven water sources are constructed the total number of unauthorized vehicle entries into wilderness is estimated to be 2-4 per month or 24-48 per year.

Past weather patterns and management actions indicate it is likely that there would be future re-fill actions for the artificial water sources. If a total of eleven artificial water sources were ultimately installed, re-fill actions could increase to a level four times greater than at present. Opportunities for solitude are currently compromised for approximately 35-39 days each year. Construction of the other five anticipated artificial water sources would result in additional use of vehicles for 10-15 days per year for inspection and minor maintenance. Activity resulting from additional research or management activities regarding bighorn sheep is estimated to add four days per year. Re-fill actions (expected to be an infrequent activity) for the 11 artificial water sources are anticipated to add 16 to 22 days per year when needed (re-filling 8-11 artificial water sources twice in a season). It is estimated that there would be 2-4 illegal vehicular incursions per month overall or 24-48 days a year. As a result, it is estimated that the cumulative impacts could reduce opportunities for solitude from between 89-128 days, or 24% to 35% of each year. This impact would apply where visitors may encounter evidence of or actual vehicle use within the boundaries of the Sheephole Valley Wilderness. These impacts are limited to specific locations and times and would not impact all visitors.

The potential cumulative impacts to unconfined or a primitive type of recreation are varied. The existence of eleven water sources may detract from the naturalness of specific areas but may increase opportunities for wildlife viewing and hunting. Additional water sources may encourage visitors to explore new areas and increase time spent within the Sheephole Valley Wilderness.

The long term survival of desert bighorn sheep is important for the Sheephole

Valley Wilderness Area. Desert bighorn sheep are a symbol of the desert wilderness for many people both past and present (prehistoric rock art depicts desert bighorn sheep). The loss of desert bighorn sheep would diminish the wilderness character of the area.

22. CONSULTATION AND PUBLIC NOTIFICATION

22.1 Agency Consultation

On April 18, 2002, the BLM submitted to the USFWS, a Biological Evaluation for the proposed S.D. and Upper Surprise BGG projects. Consultation for these projects was initiated by the USFWS on April 26, 2002.

As a result of a BLM, California Desert District Office email of April 03, 2003, from Larry Foreman, Wildlife Biologist, to Judy Hohman and Tim Thomas of the USFWS; and a telephone conference of May 7, 2003, between George Meckfessel and Karen Harville of the Needles Field Office, and Judy Hohman and Robert McMorran of FWS; the Bureau sent a letter on May 18 to USFWS requesting withdrawal from formal consultation that portion of the Proposed Installation/Operation of the S.D. and Upper Surprise Big Game Artificial Water Sources (BGG) Project which proposes the S.D. Big Game Artificial Water Source project, located in the Sheep Hole Mountains.

The BLM is applying the Programmatic Biological Opinion for Small Disturbances of Desert Habitat in the California Desert 1-8-97-F-17 (BO) to the S.D. artificial water source project, which has a disturbance of 1.4 acres, most of which is along a primitive historic roadway and on a rocky slope, which are unsuitable as desert tortoise habitat. Suitable habitat is found along the access route, which traverses 0.25 mile of desert tortoise habitat, before accessing the primitive way. The Small Disturbance BO form and Location Map were mailed to the USFWS on May 20, 2003 from the District Office for a 30 day review. Following their review, no response to the Bureau's application of the BO was received from USFWS. Accordingly, pursuant to the Opinion's section D. Project Reporting, the project may be approved.

22.2 Public Notification

Notification of the proposed action and analysis has been prominently posted in the Needles Field Office public area and on the Field Office web site during the environmental review process. Both the public area posting and the office web site home page note that public participation is the cornerstone of the National Environmental Policy Act process and encourage public involvement in the office's review of uses proposed on public lands. The web site main page provides a link to projects currently under environmental review.
A Notice of Proposed Action (NOPA) CA690-05-0 was mailed to members of the

public and other agencies who have expressed interest in proposals affecting wilderness. The NOPA was mailed on September 2, 2005 and generated seven responses. One response from the California State Lands Commission expressed no comment. One individual commented on the need for more environmental documentation. Support of the proposed project was expressed by the Foundation for North American Wild Sheep and one individual. Two individuals responded with opposition. Another letter of opposition was received from California Wilderness Coalition, Center for Biological Diversity, Defenders of Wildlife, Desert Survivors, Natural Resources Defense Council, The Wilderness Society, and Wilderness Watch.

23. BIBLIOGRAPHY

Andrew, N.G., V.C. Bleich and P.V. August. 1999. Habitat selection by mountain sheep in the Sonoran Desert: Implications for conservation in the United States and Mexico. California Wildlife Conservation Bulletin No. 12. 30 pp.

Andrew, N.G., V.C. Bleich, A.D. Morrison, L.M. Lesicka, and P.J. Cooley. 2001. Wildlife mortalities associated with artificial water sources. Wildlife Society Bulletin 29:275-280.

Ballard, W.B., S.S. Rosenstock, and J.C. deVos. 1998. The effects of artificial water developments on ungulates and large carnivores in the southwest. In Proceedings of A Symposium on Environmental, Economic, and Legal Issues Related to Rangeland Water Developments. Arizona State University, Tempe, AZ.

Berry, K.H. and L.L. Nicholson. 1984. Attributes of populations at twenty-seven sites in California. In Berry, K.H., ed. The status of the desert tortoise (Gopherus agassizii) in the United States. U.S. Department of the Interior, Bureau of Land Management. Riverside, California.

Bleich, V.C., J.D. Wehausen, and S.A. Holl. 1990. Desert-dwelling mountain sheep: conservation implications of a naturally fragmented distribution. Conservation Biology 4:383-390.

Bleich, V.C., J.D. Wehausen, R.R. Ramey II, and J.L. Rechel. 1996. Metapopulation theory and mountain sheep: implications for conservation. Pages 353-374 in D. R. McCullough, editor. Metapopulations and wildlife conservation. Island Press, Covelo.

Bleich, V.C, Andrew, N.G., Martin, M.J., Mulcahy, G.P., Pauli, A.M., and S.S. Rosenstock. In submission. Quality of water available to wildlife: comparisons among anthropogenic and natural sources.

Boyce, W.M., R.R. Ramey II, T.C. Rodwell, E.S. Rubin, and R.S. Singer. 1998. Population subdivision among desert bighorn sheep (*Ovis canadensis*) ewes revealed by mitochondrial DNA analysis. Molecular Ecology 8:99-106.

Clark, R.K., D.A. Jessup, M.D. Koch, and R.A. Weaver. 1985. Survey of desert bighorn sheep in California for exposure to selected infectious diseases. J. Am. Vet. Med. Assoc. 187:1175-1179.

Epps, C.W., V.C. Bleich, J.D. Wehausen, and S.G. Torres. 2003. Status of bighorn sheep in California. Desert Bighorn Council Transactions 47:20-35.

Epps, C.W., D.R. McCullough, J.D. Wehausen, V.C. Bleich, and J.L. Rechel. 2004. Effects of climate change on population persistence of desert-dwelling mountain sheep in California. Conservation Biology 18:102-113.

Epps, C.W., P.J. Palsbell, J.D. Wehausen, G.K. Roderick, R.R. Ramey II, and D.R. McCullough. 2005. Highways block gene flow and cause a rapid decline in genetic diversity of desert bighorn sheep. Ecology Letters 8:1029-1038.

FaunaWest Wildlife Consultants. 1989. "Relative Abundance and distribution of the Common Raven in the Deserts of Southern California and Nevada During Fall and Winter of 1989. Report submitted to the Bureau of Land Management under Contract No. CA950-CT8-56. Available from the California Desert District Office, Moreno Valley, CA.

FaunaWest Wildlife Consultants. 1989. "Relative Abundance and distribution of the Common Raven in the Deserts of Southern California and Nevada During Spring and Summer of 1988-1989. Report submitted to the Bureau of Land Management under Contract No. YA651-CT9-340035. Available from the California Desert District Office, Moreno Valley, CA.

Foreyt, W.J., and D.A. Jessup. 1982. Fatal pneumonia of bighorn sheep following association with domestic sheep. Journal of Wildlife Diseases 18:163-168.

Franklin, I. R. 1980. Evolutionary changes in small populations. Pages 136-150 in M. E. Soule and B. A. Wilcox, editors. Sinauer Associates, Sunderland, Massachusetts.

Geist, V. 1971. Mountain sheep: a study in behavior and evolution. Chicago: University of Chicago Press. 383 pp.

Geist, V. 1975. In Trefethen, James B, ed. The Wild Sheep in Modern North America. 1st ed. Winchester Press, Dumfries, Virginia.

Gutiérrez, R.J., and S. Harrison. 1996. Applying metapopulation theory to spotted owl management: a history and critique. Pages 167-186 in D. R. McCullough, editor. Metapopulations and wildlife conservation. Island Press, Covelo.

Graham, A. and R. Bell. 1989. Investigating observer bias in aerial survey by simultaneous double-counts. Journal of Wildlife Management 53:1009-1016.

Hanski, I. 1991. Single-species metapopulation dynamics: concepts, models, and observations. Biological Journal of the Linnean Society. 42:17-38.

Hanski, I., and M.E. Gilpin. 1997. Metapopulation biology: ecology, genetics, and evolution. Academic Press, San Diego.

Hanski, I., and D. Simberloff. 1997. The metapopulation approach. Pages 5-26 in I. Hanski and M.E. Gilpin, eds. Metapopulation biology: ecology, genetics, and evolution. Academic Press, San Diego, California.

Hanski, I. 1999. Metapopulation ecology. Oxford University Press, New York.

Harrison, S., and J.F. Quinn. 1989. Correlated environments and the persistence of metapopulations. Oikos 56:293-298.

Harrison, S. 1994. Metapopulations and conservation. Pages 111-128 in P. J. Edwards, R. M. May, and N. R. Webb, editors. Large-scale ecology and conservation biology. Blackwell Scientific Publication, London.

Hayes, C.L., E.S. Rubin, M.C. Jorgensen, R.A. Botta, and W.M. Boyce. 2000. Mountain lion predation of bighorn sheep in the peninsular ranges, California. Journal of Wildlife Management. 64: 954-959.

Hereford, R., Webb, R.H., and Longpre, C.I. 2004. Precipitation history of the Mojave Desert Region, 1893-2001: U.S. Geological Survey Fact Sheet 117-03, 4p.

Hoover, F.G. 1995. An investigation of desert tortoise mortality in upland game guzzlers in the deserts of southern California. Proceedings of the Twentieth Annual Symposium Las Vegas, Nevada. Desert Tortoise Council. pp. 36-43.

Jessup, D.A. 1985. Diseases of domestic livestock which threaten bighorn sheep populations. Desert Bighorn Council Transactions 29:29-33.

Krausman, P.R., S.G. Torres, L.L. Ordway, J.J. Hervert, and M. Brown. 1985. Diel Activity of Ewes in the Little Harquahala Mountains, Arizona. Desert Bighorn Council Transactions 29:24-26.

Krausman, P.R. and B.D. Leopold. 1986. Habitat components for desert bighorn sheep in the Harquahala Mountains, Arizona. J. Wildl. Manage. 50:504-508.

Krausman, P.R. 1996. Problems facing bighorn sheep in and near domestic sheep allotments. Pages 59-64 in W. D. Edge and S. L. Olson –Edge, editors. Sustaining rangeland ecosystems. Special Report 953. Oregon State University Extension Service, Corvallis, Oregon.

Krausman, P.R. 1997. Landscape scale on the management of desert bighorn sheep. Pages 349-367 in J. A. Bissonette, editor. Wildlife and landscape ecology: effects of pattern and scale. Springer, New York.

Lesicka, L.M., and J.J. Hervert. 1995. Low maintenance water development for arid environments: Concepts, materials and techniques. Pages 52-57 in D. P. Young, R. Vinzant, and M.D. Strickland, editors. Wildlife water development. Water for wildlife Foundation, Lander, Wyoming.

Leslie, D.M. and C.L. Douglas. 1979. Desert bighorn sheep of the River Mountains, Nevada. Wildlife Society Monograph No. 66.

McCullough, D.R. 1996. Metapopulations and wildlife conservation. Island Press, Covelo.

Monson, G. and L. Sumber, eds. 1990. The Desert Bighorn: Its Life History, Ecology, and Management. The University of Arizona Press Tucson, AZ. 370 pp.

Ralls, K., and J. Ballou. 1983. Extinction: lessons from zoos. Pages 182-204 in C.M. Schonewald-cox, S.M. Chambers, B. MacBryde, and L. Thomas, editors. Genetics and consevation: a reference for managing wild animal and plant populations. Sinauer Associates, Sunderland, Maryland.

Ramey, R.R. II. 1993. Evolutionary genetics and systematics of North American mountain sheep: implications for conservation. Ph.D dissertation, Cornell University, Cornell.

Ramey, R.R. II. 1995. Mitochondrial DNA variation, population structure, and evolution of mountain sheep in the southwestern United States and Mexico. Molecular Ecology 4:429-439.

Rosenstock, S.S., Ballard, W.B., and DeVos, J.C. 1999. Viewpoint: Benefits and impacts of wildlife water developments. Journal of Range Management 52:302-311.

Rosenstock, S.S., O'Brien, C.S., Waddell, R.B., and Rabe, M.J. 2004. Studies of Wildlife Water Developments in Southwestern Arizona: Wildlife Use, Water Quality, Wildlife Diseases, Wildlife Mortalities, and Influences on Native Pollinators. Arizona Fish and Game Department-Research Branch Technical Guidance Bulletin No. 8. 16 pp.

Sawyer, J.O. and T. Keeler-Wolf. 1995. A manual of California vegetation. California Native Plant Society Press. 412p.

Schwartz, O.A., V.C. Bleich, and S.A. Holl. 1986. Genetics and the conservation of mountain sheep Ovis canadensis nelsoni. Biological Conservation 37:179-190.

Torres, S.G., V.C. Bleich, and J.D. Wehausen. 1994. Status of Bighorn Sheep in California, 1993. Desert Bighorn Council Transactions 38:17-28.

U.S. Bureau of Land Management. 1999. The California Desert Conservation Area Plan 1980, as amended. California Desert District. Riverside, California.

U.S. Bureau of Land Management. 2002. Final Environmental Impact Statement. Proposed Northern and Eastern Colorado Desert Coordinated Management Plan. Amendment to the California Desert Conservation Area Plan. California Desert District. Riverside, California.

U.S. Fish and Wildlife Service. 2000. Recovery plan for bighorn sheep in the Peninsular Ranges, California. U.S. Fish and Wildlife Service, Portland, OR. Xv +251 pp.

Weaver, R.A. and J.L. Mensch. 1971. Bighorn sheep in northeastern Riverside County. Wildlife Management, Administrative report 71-1, Sacramento.

Wehausen, J.D. and M.C. Hansen. 1986. Impacts of cattle grazing on bighorn sheep. University of California, White Mountain Research Station, Bishop, CA. Interagency Agreement No. C-913 with California Department of Fish and Game.

Wehausen, J.D. 1999. Rapid extinction of mountain sheep populations revisited. Conservation Biology 13:378-384.

Wright, S. 1969. Evolution and the genetics of populations. Vol. 2, The theory of gene frequencies. University of Chicago Press, Chicago.

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25. APPENDICES

Appendix A: Sheep Hole Mountains Sheep Survey Data 1997-2005

Appendix B: Map of Existing, Proposed and Anticipated Water Sources for Sheep Hole and Calumet Mountains
Appendix C: South Mojave Metapopulation Management Objectives: Sheep Hole-Calumet Mountains Subpopulation
Appendix D: California Environmental Quality Act
Appendix E: Maps of South Mojave Metapopulation Boundary and Sheep Hole-Calumet Deme
Appendix F: The Demise of Mountain Sheep: A Brief History of California's Bighorn Sheep Populations and Department Efforts in the Sheep Hole Mountains
Appendix G: DWU Type Water Source Schematic and Photo; Schematic of Proposed S.D. Water Source
Appendix H: Health and Safety Plan
Appendix I: Viewshed GIS Analysis of Proposed S.D. Water Source