Case No. 84739

IN THE SUPREME COURT OF THE STATE OF NEVADA

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Elizabeth A. Brown
Clerk of Supreme Court

ADAM SULLIVAN, P.E., NEVADA STATE ENGINEER, et al.

Appellants,

vs.

LINCOLN COUNTY WATER DISTRICT, et al.

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Appendix E.
Applicable Laws, Policies, and Regulations

SE ROA 13122

The following tables provide a list of laws and regulations applicable to the proposed activities at the Desert National Wildlife Refuge Complex. Implementation of the Proposed Action would require compliance with these laws and regulations.

Environmental Laws and Regulations

Law (all as amended)	*Record*
American Indian Religious Freedom Act of 1978	42 USC 1996
Americans With Disabilities Act of 1990	42 USC 12101 et seq.
Anadramous Fish Conservation Act of 1974	16 USC 757
Antiquities Act of 1906	16 USC 431 et seq.
Archeological Resources Protection Act of 1974	16 USC 470aa et seq.
Bald Eagle Protection Act of 1940	16 USC 668 et seq.
Clean Air Act, including Conformity requirements	42 USC 7401 et seq.
Clean Water Act of 1974	33 USC 1251 et seq.
Disaster Relief Act of May 22, 1974	88 Stat. 143, 42 USC 5121
Economy Act of June 30, 1932	31 USC 1535
Emergency Wetlands Resources Act of 1986	16 USC 3901 et seq.
Endangered Species Act of 1973	16 USC 1531 et seq.
Farmland Protection Policy Act of 1981	7 USC 4201 et seq.
Federal Fire Prevention and Control Act of October 29, 1974	88 Stat. 1535; 15 USC 2201
Federal Noxious Weed Act of 1990	7 USC 2801 et seq.
Fish and Wildlife Act of 1956	16 USC 742 et seq.
Fish and Wildlife Coordination Act of 1958	16 USC 661 et seq.
Fishery (Magnuson) Conservation and Management Act of 1976	16 USC 1801 et seq.
Migratory Bird Conservation Act of 1929	16 USC 715 et seq.
Migratory Bird Hunting and Conservation Stamp Act of 1934	16 USC 718
Migratory Bird Treaty Act of 1918	16 USC 703 et seq.
National Environmental Policy Act of 1969 (NEPA)	42 USC 4321 et seq.
National Historic Preservation Act of 1966	16 USC 470 et seq.
National Wildlife Refuge System Administration Act of 1966	16 USC 668dd, 668ee
National Wildlife Refuge System Improvement Act of 1997	16 USC 668dd
Native American Graves Protection and Repatriation Act of 1990	25 USC 3001 et seq.
Protection Act of September 20, 1922	42 Stat. 857, USC 594
Reciprocal Fire Protection Act of May 27, 1955	69 Stat. 66, 67; 42 USC 1856, 1856a and b
Refuge Recreation Act of 1962	16 USC 460k et seq.
Water Resources Planning Act of 1965 (sole-source aquifers)	42 USC 1962 et seq.
Wilderness Act of 1964	16 USC 1131 et seq.
Wildlife Suppression Assistance Act of 1989	PL 100-428, as amended by PL 101-11

Executive Orders

Use of Off-Road Vehicles on Public Land	EO 11644
Exotic Organisms	EO 11987
Floodplain Management	EO 11988
Protection of Wetlands	EO 11990
Environmental Justice for Minority Populations	EO 12898
Recreational Fisheries	EO 12962
Management & General Public Use of the National Wildlife Refuge System	EO 12996
Indian Sacred Sites	EO 13007
Consultation and Coordination With Indian Tribal Governments	EO 13175
Responsibilities of Federal Agencies to Protect Migratory Birds	EO 13186

Other Policy and Guidance

Department of the Interior Manual, Part 620 DM, Chapter 1, Wildland Fire Management: General Policy and Procedures	April 10, 1998
Federal Wildland Fire Management Policy	2001
National Policy Issuance #94-10: Native American Policy	June 29, 1994
Secretarial Order 3206: American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act	June 5, 1997
U.S. Fish and Wildlife Service Manual, Part 621, Fire Management	February 7, 2000

Appendix F.
Goals, Objectives, and Strategies for Preferred Alternative

SE ROA 13126

Ash Meadows National Wildlife Refuge

Species Management (Goal 1). Restore and maintain viable populations of all endemic, endangered and threatened species within the Refuge's Mojave Desert oasis ecosystem.

Objective 1.1: Within three years complete baseline population density, presence/absence, abundance and/or cover on all plants, listed endemic invertebrates and nonnative fish. Collect the same baseline data for non-listed endemic invertebrates within ten years.

Rationale: Obtaining baseline information on the distribution and abundance of Refuge plants and wildlife will inform management as well as monitoring and evaluation of restoration efforts.

Strategies

1.1.1	Conduct baseline inventories on vegetation communities, small mammals, and pollinators
1.1.2	Complete a four year baseline inventory and monitoring for endemic fish species and a three year baseline inventory and monitoring for the southwest willow flycatcher
1.1.3	Conduct a two-year refuge-wide reptile survey
1.1.4	Continue and improve inventory of native species diversity and distribution
1.1.5	Continue and improve inventory of non-native species diversity and distribution
1.1.6	Implement monitoring for all non-listed endemic and game species
1.1.7	Characterize faunal associations of plant communities
1.1.8	Characterize historic changes in species and habitat distribution
1.1.9	Work with USGS for determination of crayfish distribution and for monitoring recommendations
1.1.10	Utilize IPM techniques for long-term management of invasive species
1.1.11	Continue current monitoring strategies for special status plants and wildlife
1.1.12	Conduct baseline and periodic monitoring of endangered or threatened bird species
1.1.13	Conduct periodic monitoring of secretive marsh birds and sensitive species of waterfowl

Objective 1.2: Within seven years create, test and implement monitoring protocols for all listed endemic species and non-native species that are negatively impacting endemic species and within 15 years complete the same protocols for all non-listed endemic and game species.

Rationale: Monitoring the distribution and abundance of native and non-native species on the Refuge will allow analysis of trends in distribution and abundance over time. Analysis of trends in distribution and abundance of Refuge species will allow managers to gage the effects of restoration and management actions and to identify species that require additional or intensive management.

Strategies

1.2.1	Utilize independent science review to develop and apply rigorous statistical sampling techniques for all native endemic and non-native species
1.2.2	Work towards the use of key ecosystem health indicator species as a reasonable alternative to comprehensive ecosystem sampling and analysis

Objective 1.3: Within fifteen years restore endemic fish populations to 25-50% of historic range as described in the Recovery Plan for the Endangered and Threatened Species of Ash Meadows Nevada.

Rationale: From the 1990 Recovery Plan for the Endangered and Threatened Species of Ash Meadows Nevada, the pre-1950 estimated amount of occupied aquatic habitat was; Warm Springs pupfish (*Cyprinodon nevadensis pectoralis*) (0.49 acres = net loss of 0.05 acres), Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) (599.90 acres = net loss of 592.81 acres), Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*) (599.11 acres = net loss of 597.95 acres), Devil's Hole pupfish (*Cyprinodon diabolis*) (0.019 acres = no change) (USFWS 1990). Restoration of historic flows and aquatic habitat type should increase native fish populations and decrease non-native fish populations simultaneously (Scoppettone et al. 2005) since native fish species are best adapted to historic flows.

Negative impacts to endemic fish and naucorids have occurred from the introduction of crayfish and other human treatments (i.e.. habitat alteration: leveling land for crops, stripping riparian vegetation and well drilling for irrigation water [Pister 1974]). Restoration of natural flows (21.7cm/sec - 30cm/sec) should favor pupfish and speckled dace over non-native fish (i.e.. sailfin molly and mosquito fish, which prefer flows of <9.0 cm/sec) (Scoppettone et al. 2005).

Strategies

1.3.1	Develop and implement habitat restoration and translocation protocols for target species, including consideration of timing of habitat restoration and genetics
1.3.2	Consider and implement if practical, captive refugia for all sensitive species
1.3.3	Develop life history and habitat conservation models of target species
1.3.4	Monitor success of species post-restoration and correlate with habitat parameters (ex. flow, depth, temperature, etc.)
1.3.5	Update MOU with NDOW, USFWS Ecological Services, and NPS on management responsibilities under the Ash Meadows Recovery Plan
1.3.6	Complete and implement restoration plans for Upper Point of Rocks, Jackrabbit Spring, the Warm Springs Unit (North and South Indian Springs and School Springs), Lower Point of Rocks, Lower Kings Pool, North and South Scruggs, Big, and Fairbanks Springs
1.3.7	Develop a restoration plan for Crystal Spring Unit
1.3.8	Manage and monitor previously restored springs
1.3.9	Develop and implement restoration plans for Tubbs, Bradford, Crystal, Forest, and Marsh Springs
1.3.10	Based on outcome of Carson Slough Restoration Plan, develop and implement restorations plans for Longstreet and Rogers Springs

Objective 1.4: Within 10 years restore Ash Meadow's naucorid (*Ambrysus amargosus*) population to 200% of current population size by doubling the current range to a minimum of 20-40 square meters within the 10 acre watershed that they inhabit.

Rationale: Habitat alteration is the stated cause of Ash Meadows naucorid (*Ambrysus amargosus*) decline from historic levels (USFWS 1990). Currently the Ash Meadows naucorid population is limited to 10-20 square meters, within a 10 acre watershed, with numbers fluctuating from summer highs to winter lows (Goodchild 2006). It may be more practical to focus on acres restored to suitable habitat with Ash Meadows naucorids present instead of an absolute number or Ash Meadows naucorids, but staff should still monitor for the number of Ash Meadows naucorids present. While little is known about the Ash Meadows naucorid habitat needs, similar species feed on aquatic insect larvae as they swim over and through substrate (USFWS 1990). Approximately 10 acres at Point of Rocks Spring are designated critical habitat for this species (USFWS 1990). It will take approximately 10 years to restore Point of Rocks habitat and other springs with tolerable temperature to suitable habitat that can support at least some naucorids.

Strategies

1.4.1	Restore Point of Rocks spring outflow channel habitat to known suitability and monitor parameters (ex. temperature, flow, depth, etc.) to inform adaptive management

Objective 1.5: Maintain or expand current endemic plant population densities and distribution by identifying suitable habitat for range expansion within 10 years and within 15 years begin appropriate out planting.

Rationale: Of the endemic plants found on the Refuge, one plant species is listed as endangered and six are listed as threatened under the Federal Endangered Species Act. The Amargosa niterwort (*Nitrophila mohavensis*) is listed as endangered. The six threatened plant species found on the Refuge are Ash Meadows milk-vetch (*Astragalus phoenix*), Spring-loving centaury (*Centaurium namophilum*), Ash Meadows sunray (*Enceliopsis nudicaulis var. corrugata*), Ash Meadows gumplant (*Grindelia fraxino-pratensis*), Ash Meadows ivesia (*Ivesia kingii* var. *eremica*) and Ash Meadows blazing-star (*Mentzelia leucophylla*). Much of the Refuge's plant habitat has been degraded due to agricultural grading, off road vehicles and trampling by wild horses (USFWS 1990). Limited understanding of plant species life history and uncertainty about the suitability of degraded sites for restoration makes test plots an efficient method for site assessment. Tasks 224 and 225 in the Ash Meadows Species Recovery Plan (USFWS 1990) recommend actions consistent with this objective.

Strategies

1.5.1	Control non-native invasive plants, prioritizing areas with listed plant species and monitor the response of listed plant species with low-impact methods
1.5.2	Perform experimental planting and monitoring on test sites, representative of Refuge habitat
1.5.3	In addition to monitoring plant health, monitor environmental parameters that may be associated with establishment success (ex. % soil moisture, soil bulk density, texture, salt content, etc.)
1.5.4	Based on range of suitable restoration sites, nursery grow endemic species for out planting
1.5.5	Out plant endemic species to habitats with similar parameters to successful test plot sites
1.5.6	Look for sites where listed plants (ex. Niterwort) could occur and try to determine why they are not present

1.5.7	Complete a feasibility study for construction of an on-site greenhouse to supply plants for restoration on the Refuge

Objective 1.6: Within five years establish refugium population of Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*) and complete a feasibility assessment of refugia for other endemic species based on population trends and threats.

Rationale: All four endemic Refuge fish species are currently listed as endangered. Devil's Hole pupfish (*Cyprinodon diabolis*) live in a unique habitat, restricted to a limestone cave situated on the east central border of Ash Meadows (USFWS 1990). Refugium for Devil's Hole pupfish and Warm Springs pupfish will be constructed under the No Action Alternative. The necessary refugia requirements for Devil's Hole pupfish would not be suitable for other species that may require refugia. Ash meadows speckled dace (*Rhinichthys osculus nevadensis*) and Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) historically shared the same habitat (USFWS 1990), but within different thermal niches (Goodchild 2006). The Ash Meadows speckled dace, which inhabit cooler water then Ash Meadows Amargosa pupfish, have not recovered as well after Refuge establishment and should be prioritized for refugia space. Additional research is required to determine if a single refugia could suit all or multiple other endemic species simultaneously.

Strategies

1.6.1	Maintain and monitor the one established pupfish refugium
1.6.2	Conduct quarterly fish counts and periodic water quality measurements
1.6.3	Within five years of CCP approval assess the feasibility and necessity of a refugium for the Ash Meadows speckled dace and implement if funding is available
1.6.4	Within five years, complete a feasibility assessment of on-site and off-site refugia for all other Ash Meadows NWR endemic species
1.6.5	Investigate feasibility and funding for captive populations of all sensitive species (ex. naucorids, aquatic snails, plants, etc.)
1.6.6	Investigate the use of private aquaria as refugia

Objective 1.7: Within two years complete evaluation of the Recovery Plan for the Endangered and Threatened Species of Ash Meadows Nevada progress and create contingency strategies for Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*) and Warm Springs pupfish (*Cyprinodon nevadensis pectoralis*) protection.

Rationale: Tasks 253, 2531 and 2532, of the Recovery Plan for Ash Meadows species, recommend actions to monitor and assess factors controlling population size of Warm Springs pupfish (*Cyprinodon nevadensis pectoralis*), Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) and Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*) (USFWS 1990). While species monitoring has been ongoing, in the sixteen years since approval of the Recovery Plan for Ash Meadows species (USFWS 1990) no comprehensive evaluation of plan progress has been completed. Evaluating Recovery Plan progress and species status is essential to focus future recovery activities where they are most needed. Establishing a formal process to review and approve scientific protocols will allow valuable input from interdisciplinary scientists yet allow research and monitoring to proceed when uncertainty exists. Developing contingency strategies for endangered fish species, under advisement of the Recovery Team, can hedge against unforeseen events that could imperil a single, isolated population.

Data from past and current refugia such as: refugia at Hoover Dam; Ash Meadows pupfish station; and Point of Rocks Spring should provide valuable information on the habitat requirements of particular species. Preliminary review of information indicates that School Springs could be a favorable site for a multiple aquatic species refugia.

Strategies

1.7.1	Work with Recovery Team to assess progress on Recovery Plan
1.7.2	Work with Recovery Team to develop a contingency plan for Ash Meadows speckled dace and Warm Springs pupfish protection
1.7.3	Establish scientific review process and protocols
1.7.4	Same as 1.3.5

Habitat (Goal 2). Restore and maintain the ecological integrity of natural communities within the Ash Meadows National Wildlife Refuge.

Objective 2.1: Improve Refuge wide vegetation map through ground surveys and updating of GIS layers and initiate long-term, annual vegetation monitoring.

Rationale: Vegetation mapping is essential to plan for desired future conditions, to monitor vegetation recovery after restoration, for adaptive management and to plan for and monitor success of invasive species eradication.

Strategies

2.1.1	Obtain normal color aerial photography on a decadal scale or more frequently if necessary
2.1.2	Supplement and improve on 2006 Geomorphic and Biological Assessment
2.1.3	Improve Refuge-wide vegetation map through ground surveys and updating of GIS layers and initiate long-term, annual vegetation monitoring by establishing permanent, long-term vegetation monitoring plots/transects
2.1.4	Obtain funding for and hire: 1 IPM Coordinator/Botanist, biological technician and 1 GIS specialist (part-time)
2.1.5	Obtain 1-2 foot contour data for Refuge to aid in restoration and planning activities

Objective 2.2: Maintain natural average and range of variability in spring discharge (annual discharge of 17,000 acre/feet per year from 30 known springs), flood frequency, water quality, historic spring temperature range between springs of 18-34 ˚C (64-93 ˚F), and water table elevation on Refuge.

Rationale: Ash Meadows endemic fish species have evolved and adapted to the historic natural conditions for flow, flooding and water elevation. Endemic aquatic community health is likely dependent on habitat characteristics including discharge, flood frequency and groundwater elevation. Studies have shown that restoration of natural channel configuration, temperature and flow favors native Ash Meadows endemic fishes and may reduce non-native fish populations (Scoppettone et al. 2005). Temperatures were probably historically very stable within particular springs, but variable between springs. According to the AMNWR Water Monitoring Plan, the discharge from approximately 30 springs is 17,000 acre-feet annually of which the Service has water rights for 16,360 acre-feet. Water temperatures vary between springs from 64 to 93° F (e.g., Cold Spring = 65° F, Bradford = 68-70° F, Tubbs = 70° F, North Scruggs = 93° F; all of the Warm Springs Complex is above 90° F) (Baldino 2006). Importantly, Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) require relatively warmer temperatures for reproduction, and Ash Meadows Speckled dace (*Rhinichthys osculus nevadensis*) require relatively cooler temperatures. According to Scoppettone et al. (2005) Ash Meadows Speckled dace reproduce in temperatures ranging from 17.5 to 24° C (64 to 75° F). On the Refuge, Bradford Springs with a temperature of 69°F currently holds the largest population of Ash Meadows Speckled dace. The Ash Meadows Amargosa pupfish population has been found in relatively warmer springs ranging in temperature from 21.2-33.1 °C (70-92 °F) (Brown and Feldmeth 1971). Obtaining baseline information on habitat parameters and monitoring for changes should, over time, clarify the relationship between variable parameters and aquatic community health. In addition, alteration of natural conditions can favor non-native species and disrupt habitat features essential for survival and reproduction of endemic species. Tasks 114, 211, 212 and 213 of the Ash Meadows Species Recovery Plan recommend actions to restore historic spring conditions (USFWS 1990).

Strategies

2.2.1	Convene hydrologists to analyze existing spring discharge and groundwater elevation data
2.2.2	Maintain appropriate water temperature through techniques including restoration of historic stream channels, alternation of channel depth/width, increasing channel length, and re-establishing historic overstory plant communities
2.2.3	Protect spring discharge and groundwater elevation in both valley-fill and carbonate by working with partners to monitor spring discharge rates and other techniques similar to strategy 2.2.2
2.2.4	Within 10 years obtain baseline data on spring discharge, flood frequency, and groundwater elevation for seventeen springs identified in the Refuge Geomorphic and Biological Assessment
2.2.5	Evaluate nutrient input to streams from roads
2.2.6	Work with local land owners to develop more efficient water transport systems to manage water flow
2.2.7	Continue to monitor and assess water flows, levels, and temperatures at springs and wells identified in the current Water Monitoring Plan
2.2.8	Analyze water quality and quantity biannually, and implement measures in coordination with the State Engineer to defend water rights and mitigate substantial changes in temperature or flow
2.2.9	Maintain the existing spring outflow structures and stream channels at monitoring sites
2.2.10	Pursue funding for and implement the Ash Meadows embedded model within the Death Valley Regional Flow Model

<u>Objective 2.3</u>: Manage and monitor previously restored springs (Point of Rocks and Kings spring) and continue restoration of at least 17,400 linear feet of four spring systems and outflow channels (Jackrabbit Spring, Warm Springs, Fairbanks Spring and Big Spring and others if possible) to a series of riffles and runs, with open channels free of emergent vegetation and surrounding riparian plant communities with approximately 75% deciduous multiple story channel canopy cover including: 50% native tree cover of mesquite (*Prosopis spp.*) and leather-leaf ash (*Fraxinus velutina*); 75% shrub

cover of willow (*Salix spp*.), Emory baccharis (*Baccharis emoryi*) and associated species; and 20% bare soil or alkali sacaton (*Sporobolus airoides*).

Rationale: Ash Meadows aquatic and terrestrial habitat was altered from historic conditions as development occurred in the late 1960s and 1970s. At least through 1972 significant habitat destruction was ongoing in Ash Meadows including; leveling land with heavy equipment, stripping streams of riparian vegetation, installing irrigation structures and well drilling (Pister 1974). The major impact was occurring from a lowering of the water table and decreased spring flows (Pister 1974). The Recovery Plan for Ash Meadows Species states that the greatest threats to endemic species are non-native introduced aquatic animals and exotic terrestrial plants. The Recovery Plan also emphasizes the importance of protecting spring outflows and restoring historic channels to enable free movement of listed fish between springs (USFWS 1990).

To allow native species to thrive it is necessary to restore habitats to approximate conditions that existed prior to significant human disturbance. A critical part of any restoration effort is the maintenance of water table levels similar to historic levels. Restoration of hydrologic conditions will increase the residence time of waters throughout the Refuge (Otis Bay 2006). Increasing this residence time should improve access to water resources by resident plant and animal communities as well as migratory birds.

The Refuge is recognized as an Important Bird Area (IBA) by Bird Life International, highlighting its importance to restricted range, migratory bird species and the use of habitat by Federal endangered species. The yellow-breasted chat (*Icteria virens*), a Nevada Partners in Flight focal species that is confined to the use of riparian and shrubby areas in the arid southwest and would benefit from riparian restoration. Habitat associated with spring outflows is also important for the endangered southwestern willow flycatcher (*Empidonax traillii extimus*), which would also benefit from riparian restoration.

Tasks 21 and 211 of the Ash Meadows Species Recovery Plan recommend actions to restore spring flows to historic channels (USFWS 1990). There are: 1,200 ft. of Fairbanks spring channel: Jackrabbit spring to the service road is 6,625 ft of channel; there are 2,346 feet of channel at Warm springs (North and South Indian springs and the associated marsh); and 7,300 feet of channel at Big Spring.

In 1997 Kings Pool water was routed into an excavated channel simulating the historic outflow stream. After the conversion of Kings Pool outflow to approximate historic conditions there was a shift in species composition from 23% to 91% native fish (Scoppettone et al. 2005), suggesting that restoration of habitat may be an effective recovery strategy for endangered fish on other parts of the Refuge. Removal of Ash Meadows Road is recommended to restore the historic outflow channels of Point of Rocks, Kings and Forest Springs and to reconnect ash and mesquite forest patches (Otis Bay 2006).

Strategies

2.3.1	Conduct an assessment of berms, ditches, dams, impoundments, and reservoir basins
2.3.2	After assessment initiate removal of berms, ditches, dams, impoundments, and unnecessary roads within the Warm Springs, Jackrabbit/Big Springs, Upper Carson Slough, and Crystal Springs units to restore natural hydrology on a landscape scale
2.3.3	Minimize and control impacts of cattail on aquatic habitat as detailed in the Refuge IPM plan (USFWS 2006), including removal from outflow channels at Kings, Point of Rocks, and Crystal springs

2.3.4	Restore natural average and range of variability, flood frequency, water quality and water table elevation for open water at Peterson Reservoir and Horseshoe Reservoir
2.3.5	Restore Crystal Spring outflow to historic channel, through the administrative area, when the office/visitor center is relocated
2.3.6	Incorporate the hydrologic and geomorphic restoration recommendations from the Geomorphic and Biological Assessment (Otis Bay 2006) into restoration and management activities
2.3.7	Identify and develop partnerships with providers of restoration nursery stock
2.3.8	Design control structure to allow water management and invasive species management as needed for restored springs
2.3.9	Evaluate nutrient input to streams from roads
2.3.10	Implement the plan for the modification or removal of Crystal Reservoir that minimizes adverse environmental impacts
2.3.11	Same as 1.5.7
2.3.12	Install temporary fish barriers until bass eradication is complete at Big and Jackrabbit springs
2.3.13	Inventory, assess, and mitigate landscape disturbances including graded lands, mines, fences and other disturbances

Objective 2.4: Within 10 years, reduce salt cedar (*Tamarix spp.*) and Russian knapweed (*Acroptilon repens*) distribution by 50 to 95% of the 2006, baseline distribution on 4,000 acres of Refuge land and work with the Bureau of Land Management (BLM) to control Russian knapweed and salt cedar on the adjacent BLM Area of Critical Environmental Concern.

Rationale: While many non-native species may impact native species and ecosystem function, salt cedar (*Tamarix spp.*) and Russian knapweed (*Acroptilon repens*) have been identified, by Refuge staff, as the most invasive, noxious weeds on the Refuge. Salt cedar is a Category C (currently established and widespread) noxious weed in Nevada and Russian knapweed is a Category B (established in scattered populations in State) noxious weed in Nevada (NDOA 2006). Both species degrade Refuge habitat and controlling Russian knapweed is a necessary partnership with Nevada resource agencies, to prevent its further spread. The Refuge has received funding, from the Southern Nevada Public Land Management Act, to implement an integrated pest management (IPM) plan to control salt cedar, knapweed and other invasive plant species on the Refuge. Currently the NDOW recommends that goats not be used for invasive plant control, due to possible transmission of diseases carried by goats and domestic sheep to wild, big horn sheep (*Ovis canadensis nelsoni*) populations. The relative risks and benefits of various invasive species control methods have been analyzed in the course of finalizing the Refuge IPM Plan.

Strategies

2.4.1	Implement non-native plant species control as outlined in the IPM plan for all habitat types
2.4.2	Within ten years, reduce salt cedar and Russian knapweed distribution by 75 to 95% of the 2006 distribution on 4,000 acres of Refuge land and work with BLM to control salt cedar and Russian knapweed on adjacent BLM land
2.4.3	Same as 1.5.1
2.4.4	Coordinate with the Service's Private Lands Program to assist private landowners with the removal of salt cedar and planting native species within the Refuge boundary

Objective 2.5: Reduce or contain crayfish populations, Refuge wide, such that current distributions are not exceeded.

Rationale: Crayfish directly prey on native endemic species, such as fish, invertebrates and aquatic vegetation, directly impacting those species. Crayfish may also indirectly impact native invertebrate species through competition. Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*), which typically occur near the bottom of spring systems are thought to be particularly vulnerable to predation by crayfish (Williams and Sada 1985). Crayfish have also been observed feeding on Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) (Williams and Sada 1985). Removal of crayfish is necessary to sustain healthy populations of native endemic species. Task 2322 of the Ash Meadows Species Recovery Plan recommends actions consistent with this objective (USFWS 1990). On the Refuge crayfish are known to occur in all aquatic systems except for a few Warm Springs areas and a few seeps (Goodchild 2006).

Strategies

2.5.1	Regularly trap and remove crayfish from spring habitats by implementing crayfish control strategies identified during development of the Refuge IPM plan. Focus on 10 most infested and important aquatic systems (Marsh, N & S Indian, N & S Scruggs, Jackrabbit, Kings, Point of Rocks, Big, Crystal springs, and Bradford Spring) and expand program as necessary
2.5.2	Evaluate alternative crayfish control strategies (sterilization, biological control) in cooperation with other agencies

Objective 2.6: Manage 7,850 acres and within fifteen years restore 650 acres of alkaline meadow/wet meadow habitat for native plant communities dominated by alkali sacaton (*Sporobolus airoides*) and salt grass (*Distichlis spicata*) with other native vegetation cover ranging from 10-90% cover including Hall's meadow hawksbeard (*Crepis runcinata*), alkali cordgrass (*Spartina gracilis*), Baltic rush (*Juncus balticus*), foxtail barley (*Hordeum jubatum*), *Atriplex spp*. and associated native plant species.

Rationale: Several endemic species are predominately found in alkaline wet meadow habitat including the threatened spring loving century (*Centaurium namophilum*) and Ash Meadows Ivesia (*Ivesia kingii var. eremica*) (Otis Bay 2006). Increasing the wet meadow to alkaline meadow ratio will more closely approximate historic conditions and mitigate historic human impacts to select areas. Restoring historic conditions should also minimize distribution of non-native plant species and favor native, endemic terrestrial and aquatic species. Restoration of native grassland conditions will increase suitable habitat for Ash Meadows montane voles (*Microtus montanus nevadensis*) a Species of Conservation Priority, which use this habitat type for foraging and nesting (NDOW 2005). In the Mojave Desert, alkali meadows are restricted to areas where the water table is 1-3 meters deep, making groundwater maintenance essential to the sustenance of this habitat type (Otis Bay 2006) and the resulting contribution to the biological integrity, diversity and environmental health of the Refuge ecosystem. Seasonally inundated wet meadows produce large quantities of insects that are a rich food source for bats and insectivorous birds (NDOW 2005). Lowland wet meadows also provide valuable habitat for amphibians which use the habitat as late-summer refugia and winter hibernacula (NDOW 2005).

In coordination with the FHA and Nye County a transportation plan is being developed that, in part, will address the impact of roads, on-road vehicles and off-road vehicles on habitat maintenance and restoration. Wet meadows are highly susceptible to damage by motorized recreation. Rutting from off road vehicles and soil compaction can alter the natural hydrology or the meadows reducing their value for wildlife (NDOW 2005). Poor road placement has also led to degradation of wet meadow habitat through erosion, changes in hydrology and other direct impacts (NDOW 2005).

Strategies

2.6.1	Restore and maintain historic hydrology
2.6.2	Actively revegetate where appropriate with salt grass and alkali sacaton
2.6.3	Monitor changes over time as restoration is implemented
2.6.4	Same as 1.5.1
2.6.5	Develop restoration plan for entire Carson Slough
2.6.6	Remove and revegetate roads deemed unnecessary
2.6.7	Inventory, assess, mitigate, and initiate restoration of roads
2.6.8	Evaluate current land uses such as utility corridors and ensure regulatory compliance
2.6.9	Maintain Spring Meadows Road and allow non-commercial through traffic
2.6.10	Maintain existing boundary fence as a wild horse exclosure
2.6.11	Repair post and cable barriers and install other barriers where needed to protect resources
2.6.12	Replace or add gates on service or fire roads and sign them
2.6.13	Maintain closure of nonessential roads
2.6.14	Increase law enforcement to prevent off highway vehicles, fires, collecting of species, and other inappropriate activities
2.6.15	Add 11 to 15 road gates to prevent unauthorized use of roads and resource damage
2.6.16	Same as 1.5.7
2.6.17	Same as 2.4.1
2.6.18	Complete the Refuge Transportation Plan

<u>Objective 2.7</u>: Within fifteen years restore 550 acres of lowland riparian habitat with native plant communities including an overstory of leather-leaf Ash (*Fraxinus velutina*), narrow-leaved willow (*Salix exigua*), Goodding's willow (*Salix gooddingii*), Fremont cottonwood (*Populus fremontii*), quailbrush (Atriplex lentiformis), arrow weed (*Pluchea sericea*), Emory baccharis (*Baccharis emoryi*) and other associated native plant species.

Rationale: Lowland riparian habitat is important for many Federal endangered species act listed or species of concern including the endangered southwest willow flycatcher (*Empidonax traillii extimus*), American peregrine falcon (*Falco peregrinus*), vermillion flycatcher (*Pyrocephalus rubinus*), Phainopepla (*Phainopepla nitens*), long-eared myotis (*Myotis evotis*) as well as many other migratory birds and resident animals (Recon 2000). The Final Recovery Plan for Southwest Willow Flycatchers requires the establishment of 25 southwest willow flycatcher territories in the Amargosa management unit (an increase of 22 territories, from 2002 levels) to meet the recovery objectives (SWFRTTS 2002). The Refuge is listed as one of five river reaches, within the Amargosa unit, where southwest willow flycatcher habitat restoration efforts should be focused (SWFRTTS 2002). Riparian habitat is also critical to migratory species such as the yellow-breasted chat, a Partners in Flight focal species.

Restoring 550 acres of lowland riparian habitat on the Refuge would support the Nevada Steering Committee Intermountain West Joint Venture (NSCIWJV) Priority A objective for lowland riparian habitat to "Permanently protect and/or restore 300 linear miles of lowland riparian habitat in Nevada" (NSCIWJV 2005). Lowland riparian habitat is quite limited in the region and restoring lowland riparian habitat will contribute to the biological integrity, diversity and environmental health of the surrounding region and the National Wildlife Refuge System as a whole. The BLM plans to manage public lands, adjacent to the Refuge, to complement spring and aquatic habitat for special status species (Recon 2000). Restoring lowland riparian habitat to natural dynamic, heterogeneous conditions will simultaneously benefit many imperiled species (USFWS 2002c).

Strategies

2.7.1	Same as 2.4.1
2.7.2	Revegetate with native Ash, willows, cottonwood, etc.
2.7.3	Restore historic hydrologic conditions
2.7.4	Obtain historic plant distribution through pollen analysis and refine restoration acreage targets
2.7.5	Same as 2.6.7
2.7.6	Same as 2.3.10
2.7.7	Same as 1.5.7

Objective 2.8: Manage 2,000 acres of mesquite bosque for native habitat with a complex overstory of predominantly honey mesquite (*Prosopis glandulosa torreyana*), screw bean mesquite (*Prosopis pubescens*), narrow-leaved willow (*Salix exigua*), Goodding's willow (*Salix gooddingii*), Emory baccharis (*Baccharis emoryi*) and understory plants including saltbush (*Atriplex spp.*), bushy bluestem grass (*Andropogon glomeratus*), ryegrass (*Elymus cinereus*), foxtail barley (*Hordeum jubatum*), pine blue grass (*Poa scabrella*), salt grass (*Distichlis spicata*), aster (*Aster spp.*) and other associated native plant species.

Rationale: In many areas mesquite bosques are being lost to urban and suburban development, woodcutting, sand and gravel mining, human-caused wildfires and have been significantly invaded by non-native plants including salt cedar (*Tamarix spp.*) (NDOW 2005). Mesquite bosques are found in areas with deep soil and shallow water tables, such as riparian areas and the edges of dry lake beds and were historically dominated by honey mesquite (*Prosopis glandulosa*) (NDOW 2005). Mesquite bosques support a disproportionately greater number of wildlife species than the surrounding desert scrub (BLM 1999) and are especially critical in the summer and during drought years because often they retain the only green vegetation left in the Mojave landscape (NDOW 2005). Mesquite bosques are known to provide valuable habitat for many migratory bird species, as well as resident species native to the Mojave ecosystem. At least 65 species of birds have been observed using mesquite bosques as migratory stopover sites, breeding sites or wintering areas (BLM 1999) including species of concern such as Phainopepla (*Phainopepla nitens*), Lucy's warbler (*Vermivora luciae*) (NDOW 2005) and priority birds like the loggerhead shrike (*Lanius ludovicianus*) (NSCIWJV 2005). Lucy's warbler is also on the Partners in Flight watch list of Species of Continental Importance for the U.S. and Canada (Rich et al. 2004). Bats such as the California Leaf-nosed bat (*Macrotus californicus*), a species of concern, spend the majority of forage time in desert washes within bosques and other bat species use ephemeral water sources in washes seasonally (Altenbach et al. 2005). In addition, another species of concern, the Ash Meadows montane vole uses mesquite bosque habitat for burrowing and foraging (NDOW 2005).

An objective of the State of Nevada Comprehensive Wildlife Conservation Strategy is to: "Expand protected status for mesquite bosque and desert wash ecological systems through 2015 with stands in stable or increasing condition trend" (NDOW 2005). Managing mesquite bosque habitat on the Refuge supports a Priority A goal of the Coordinated Implementation Plan for Bird Conservation in Nevada to "Minimize the loss of mesquite and catclaw habitats whenever possible" (NSCIWJV 2005).

Strategies

2.8.1	Same as 2.4.1
2.8.2	Restore historic hydrology and revegetate mesquite bosques and dunes along spring channels and in former agricultural fields
2.8.3	Same as 2.6.7
2.8.4	Maintain policy of no mesquite wood collection on the Refuge through law enforcement as well as educational outreach to visitors
2.8.5	Use prescribed fire where appropriate to create, improve or maintain desired plant and animal communities, as well as to treat hazardous fuels
2.8.6	Manage wildland fires on the refuge using the fitting Appropriate Management Response which considers resource values at risk and potential negative impacts of various fire suppression measures (firefighter and public safety will be the highest priority on every incident)
2.8.7	Rehabilitate 30-45% of old agricultural fields by controlling invasive species and installing native plants

Objective 2.9: Manage 11,000 to 11,500 acres for a range of native upland desert plant communities including gradations between: warm desert scrub communities including creosote bush (*Cryptantha angustifolia*), white bursage (*Ambrosia dumosa*), white bursage four winged salt bush (*Atriplex canescens*), desert holly (*Atriplex hymenelytra*), beaver tail cactus (*Opuntia basilaris*), indigo bush (*Psorothamnus fremontii*), Mojave aster (*Xylorhiza tortifolia*) and desert chikory (*Rafinesquia neomexicana*); dry ridgetop plant communities of predominately cotton top (*Echinocactus polycephalus*), bevertail cactus (*Opuntia basilaris*), cholla (*Opuntia spp.*) and associated native plant species; shrub/scrub habitat including arrow saltbush (*Atriplex phyllostegia*), desert saltbush (*Atriplex polycarpa*), alkali rabbitbrush (*Chrysothamnus albidus*), box-thorn (*Lycium shockleyi*), greasewood (*Sarcobatus vermiculatus*) and other associated native plant species.

Rationale: Over 12,400 acres of the Refuge is currently passively managed as desert upland habitat (Otis Bay 2006). Two species of concern, chuckwalla (*Sauromalus ater*) and burrowing owl (*Athene cunicularia hypugea*) respectively use creosote dominated upland habitat for protection from predators and burrowing sites (NDOW 2005). After fencing to exclude wild horses and burrows, major threats to this habitat type on the Refuge include soil compaction and damage to shrubs by off-highway vehicles and invasive understory species (NDOW 2005).

Strategies

2.9.1	Same as 2.4.1
2.9.2	Same as 2.6.14
2.9.3	Develop and implement plan to remove dikes in uplands

2.9.4	Same as 2.6.7
2.9.5	Same as 2.6.10
2.9.6	Same as 1.5.7

<u>Objective 2.10</u>: Within fifteen years restore 150 acres of emergent marsh, as outlined in the 2006 Biological Assessment, through removal of barriers between stream channels and manage for plant communities dominated by bulrushes (*Scirpus spp*.), saw-grass (*Cladium californicum*) and rushes (*Juncus spp*.) with only minimal, sporadic patches of southern cattail (*Typha domingensis*).

Rationale: Refuge marshes provides rich habitat for native endemic fish, migratory birds, resident amphibians and resident aquatic invertebrates (NDOW 2005). Marsh habitat that is inundated year round, with spring water sources, is of particular importance for resident amphibians and endemic fish species of conservation priority including the Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) (NDOW 2005). Breeding populations of the endangered Yuma clapper rail (*Rallus longirostris yumanensis*) and species of concern such as the black tern (*Chlidonias niger*) require marsh habitat for nesting and feeding (NDOW 2005). In addition, the threatened bald eagle (*Haliaeetus leucocephalus*) is known to find prey in marsh habitat (NDOW 2005), but have only inconsistently been reported at Ash Meadows (Baldino 2006).

Early successional stage cattail marsh is considered essential to maintain and expand breeding populations of Yuma clapper rail (USFWS 1983). Native, cattail species were not historically abundant in Ash Meadow's marshes. Historically Ash Meadows marshes were dominated by bulrushes (*Scirpus spp.*), saw-grass (*Cladium californicum*) and rushes (*Juncus spp.*), but changes in hydrology and nutrient dynamics have led to marshes dominated by native cattail (*Typha domingensis*). According to Dr. Frank Coville, a botanist with the Death Valley Expedition of 1891, cattail occurred "...sparingly at several points...". Returning marshes to historic states will require replicating historic conditions such as open water, low nutrient input and short-term control of cattail until historic plant communities can become established.

Restoring Refuge marsh wetlands supports the statewide Priority A wetlands objective of the Coordinated Implementation Plan for Bird Conservation in Nevada to "Permanently protect and/or restore 25,000 acres of high-quality wetlands and associated habitats in Nevada" (NSCIWJV 2005). An objective of the State of Nevada Comprehensive Wildlife Conservation Strategy is: "(an) Increase in wetland management potential through purchase of water rights and wetland improvement projects by 2015" (NDOW 2005).

Strategies

2.10.1	Restore spring systems as described in the 2006 Geomorphic and Biological Assessment
2.10.2	Design marsh habitat restoration with emphasis on bird and bat forage
2.10.3	Same as 2.5.1
2.10.4	Same as 2.4.1
2.10.5	Same as 2.6.7

<u>Objective 2.11</u>: By 2011, develop a step-down plan for the modification and/or removal of Crystal Reservoir and implement the plan if funding is available.

Rationale: Carson Slough and the associated riparian area was severely degraded due to late twentieth century agriculture, peat mining and construction of a dam which resulted in the creation of

Crystal Reservoir. The artificial habitat formed by the impounded Crystal Reservoir is a site infested by predacious, non-native fish, which are identified within the Ash Meadows Recovery Plan for removal. The inadequately engineered Crystal dam shows signs of failing and poses a serious liability issue for the Refuge and a number of safety issues for Refuge visitors.

The Crystal Reservoir dam has the potential for catastrophic failure, and there is a need to remove the structure. Failure of this dam would scour habitat below the reservoir, which would likely destroy the largest population of the endangered Amargosa niterwort within Nevada. Other listed plants, including the Ash Meadows ivesia, spring-loving centaury and the Ash Meadows gumplant, also occur downstream of the dam and are in danger, as is a large population of the endangered Ash Meadows Amargosa pupfish. The unique alkaline soils below the reservoir also support a unique ecosystem, which would be lost if Crystal dam failed. Riparian areas on the Refuge provide valuable habitat for migratory and resident bird species. Any restoration of riparian habitat, including Crystal Spring restoration, will increase the acreage of habitats used by migratory and resident birds.

Crystal Reservoir has also tended to attract uses that are unrelated to or that directly conflict with Refuge purposes. Ongoing public safety issues at Crystal Reservoir have included swimmers itch (dermatitis caused by parasite infection), large uncontrolled public fires, waste generated by large public barbeque events, stolen car disposal, waste dumping and illegal firearms discharge. Activities at this area are a potential liability risk for the Refuge and consume resources that would more appropriately be used for management activities related to Refuge purpose.

Strategies

2.11.1	Obtain biological and geomorphic data to inform demolition and restoration plan for Crystal Reservoir
2.11.2	Develop methods to remove Crystal Reservoir that minimize environmental impacts, including impacts to threatened and endangered species
2.11.3	Consult independent science advisory team for review and improvement of the ecosystem approach to Refuge management
2.11.4	Refuge Manager will direct changes in management after consideration of science advisor team recommendations

Objective 2.12: Continue ongoing efforts to acquire remaining lands within the authorized Refuge boundary from willing sellers.

Rationale: The Service currently owns 13,827 acres within the approved refuge boundary. Another 9,460 acres are managed under cooperative agreement with the BLM. Approximately 40 acres of Refuge lands are managed by the NPS. The pending land and mineral withdrawal would transfer these lands to the Service. Another approximately 680 acres of land within the approved refuge boundary remain under private ownership. Completing acquisition of contiguous land within the Refuge boundary will optimize the Service's ability to manage the Refuge for its intended purposes.

Strategies

2.12.1	Continue coordination with private landowners to protect Refuge resources
2.12.2	Establish conservation agreements or acquire in-holdings from willing sellers
2.12.3	Complete the pending land and mineral withdrawal with the BLM
2.12.4	Continue ongoing efforts to acquire remaining lands within the approved Refuge boundary from willing sellers

Research (Goal 3). Encourage and provide opportunities for research which supports Refuge and Service objectives.

Objective 3.1: Monitor the impacts of non-native aquatic animals including red-rim melania (*Melanoides tuberculata*), bullfrog (*Rana catesbeiana*), crayfish (*Procambarus clarkii*) and non-native fish on Refuge native aquatic species through laboratory/field experiments and adaptively develop/test eradication technologies in all Refuge aquatic environments.

Rationale: Loss of endemic, aquatic species is likely to occur due to non-native invasive aquatic animal predation on and competition with native species. Non-native fish that have been documented on the Refuge include; sailfin mollies (*Poecilia latipinna*), mosquito fish (*Gambusia affinis*), largemouth bass (*Micropterus salmoides*) and arawana (*Osteoglossum bicirrhosum*) (Williams and Sada 1985). By 1990 the arawana were not detectable, but the other exotic fish remained (USFWS 1990). Convict cichlids (*Archocentrus nigrofasciatus*, surviving), green sunfish (*Lepomis cyanellus*, surviving), koi (*Cyprinus carpio* ,may not survive, but reported), goldfish (*Carassius auratus*, surviving) have been reported in Refuge reservoirs or have been detected in spring systems. Crayfish are not native to the Refuge or surrounding area, but have been introduced and have established breeding populations. By the early 1980s red swamp crayfish (*Procambarus clarkii*) were established in larger spring systems on the Refuge (Williams and Sada 1985). Crayfish have been observed feeding on endangered Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*). Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*) are thought to be particularly vulnerable to crayfish predation due to the dace's benthic habit (Williams and Sada 1985). Presently crayfish are known to be present in at least 10 spring systems on the Refuge (Otis Bay 2006). The bullfrog (*Rana catesbeiana*) is not native to the Refuge or surrounding area and bullfrogs prey on, compete with and displace native species. The red-rim melania snail (*Melanoides tuberculata*) is not native to the Refuge or surrounding area and can compete with and displace native species. The red-rim melania is also a transmission vector for parasites that can impact resident species (GSMFC 2006).

Information obtained during adaptively managed control of invasive aquatic animals could also be applicable to numerous other Refuges and other locations throughout Nevada and the western US. The State of Nevada's Comprehensive Wildlife Conservation Strategy (2005) emphasizes preventing the spread of crayfish to new locations and eradicating introduced crayfish where they threaten other aquatic species. Tasks 232 and 2321 of the Ash Meadows Species Recovery Plan (USFWS 1990) recommend removal of non-native aquatic species and conducting research if necessary to determine the best removal methods while minimizing any impacts to listed and candidate species.

Strategies

3.1.1	Conduct a literature review of aquatic invasive species ecology, trophic interactions and eradication treatments, for species identified as detrimental to native Refuge species
3.1.2	Conduct experiments on Refuge habitat and species impacts and trophic interactions due to aquatic invasive species
3.1.3	Develop funding partnerships for aquatic invasive species eradication studies
3.1.4	Conduct a study of crayfish ecology on Refuge
3.1.5	Conduct laboratory and field experiments on eradication/control techniques

3.1.6	Study exclusion methods to restrict movement of non-native fish (ex. large mouth bass, green sunfish, etc.) into native fish habitat
3.1.7	Use study results to inform an IPM plan for aquatic invasive species
3.1.8	Continue working with USGS, USFWS Endangered Species program, NDOW and other partners

Objective 3.2: Experiment with a variety of control methods for each invasive plant species on Refuge and monitor effectiveness of treatment.

Rationale: Invasive plants displace native and endemic plant species and alter fire regime, plant community composition and wildlife diversity. More precise and effective means of control are necessary in order to minimize impacts to desirable native species and maximize efficient use of Refuge resources while controlling or eradicating invasive plant species. Salt cedar (*Tamarix spp.*), an invasive tree species, dominates significant portions of habitat on the Refuge (Otis Bay 2006). Although southern cattail (*Typha domingensis*) is a native species, alteration of hydrologic and nutrient dynamics on the Refuge has caused cattail to form dense monocultural stands, degrading marsh habitat. Until restoration of the Refuge is complete, cattail will require management to reduce stands and to maintain cattail in an early successional state that is considered essential for breeding populations of endangered Yuma clapper rail (*Rallus longirostris yumanensis*) (USFWS 1983). According to Otis Bay (2006), many of the native plants on the Refuge may be fire sensitive and slow to recover from prescribed burning. By contrast non-native plant species such as salt cedar and annual grasses can regenerate and spread quickly after fires (Otis Bay 2006). It is likely that general use of prescribed burning would favor established non-native plant species such as salt cedar and annual grasses. For these reasons it will be necessary to carefully apply prescribed burning with full consideration of integrated pest management strategies for non-native plant species. Task 2221 of the AM Species Recovery Plan (USFWS 1990) recommends consultation with the agency most experienced with removal of salt cedar and Russian olive (*Elaeagnus angustifolia*) for advice and conducting supplemental research as needed.

Strategies

3.2.1	Establish invasive plant control monitoring plots
3.2.2	Evaluate salt cedar control methods
3.2.3	Evaluate cattail control methods
3.2.4	Evaluate knapweed control methods
3.2.5	Evaluate control methods for other invasive plant species
3.2.6	Same as 2.8.5
3.2.7	Same as 2.8.6

Objective 3.3: Conduct an ongoing study of Refuge ecosystem dynamics, energetics, taxonomy and ecology focusing on alkali meadow/springs habitat.

Rationale: Increased scientific knowledge of alkali meadow/springs habitat may support the legal protection of groundwater resources. Most Refuge endemic plant species occur in alkali meadow habitat and enhancing understanding of alkali meadow ecosystem dynamics will contribute to optimal management of this important habitat type.

Strategies

3.3.1	Work to obtain funding for trophic level studies
3.3.2	Complete studies and analysis of historic data to link uplands, alkali meadows, and springs habitats
3.3.3	Conduct studies to obtain basic life history information for endemic and listed plant species
3.3.4	Conduct taxonomic studies of Refuge plant species
3.3.5	Conduct monthly monitoring of groundwater (ex. wells and flumes)
3.3.6	Conduct monthly monitoring of discharge from springs

Objective 3.4: Obtain baseline data on local climate within the three major Refuge drainage basins. Model climate change impact scenarios and develop adaptation strategies.

Rationale: Obtaining reliable and accurate climate data can support species recovery efforts, provide legal protection of water resources and can inform the evaluation of dams and impoundments. Currently Refuge staff have inadequate data on local climate trends to adequately support management decisions, necessitating the need for more accurate and reliable local climate data information.

Strategies

3.4.1	Install a weather station within each of the three major drainage basins
3.4.2	Obtain core samples from old spring mounds, Carson Slough, etc.
3.4.3	Conduct tree ring studies on local species to determine growth patterns over long periods of time, to infer past climate conditions, climate change over time and to inform fire management by determining past, natural fire regimes
3.4.4	Conduct studies of past pollen and spore distribution (palynology studies) to infer past climate conditions and climate change over time
3.4.5	Maintain a GIS based weather database
3.4.6	Model climate change impact scenarios and develop adaptation strategies

Objective 3.5: Refine understanding of terrestrial habitat use by mammals, herpetofauna, birds and invertebrates through ongoing faunal inventory.

Rationale: To fulfill the Refuge purpose, the Service needs reliable data on Refuge habitat use by threatened and endangered species. Accurate data on habitat use by Federal endangered species act listed species, bats, reptiles, amphibians and other native species is currently lacking. Little is known about the distribution and abundance of terrestrial fauna, making species management difficult or impossible. Of particular importance is an assessment of the population status of the Ash Meadows montane vole (*Microtus montanus nevadensis*), a species of conservation priority (NDOW 2005). The Ash Meadows montane vole may already be extinct, but was known to live on the Refuge property historically. Task 6512 of the Ash Meadows Species Recovery Plan recommends conducting surveys to determine the location, extent and size of existing terrestrial species populations (USFWS 1990).

Strategies

3.5.1	Develop funding sources and partnerships
3.5.2	Conduct comprehensive Refuge terrestrial species inventory

3.5.3	Conduct bat studies
3.5.4	Obtain baseline information on reptiles and amphibians
3.5.5	Conduct a one-year assessment on the relationship between coarse woody debris and terrestrial invertebrates and continue annual monitoring if feasible
3.5.6	Assess contribution of invertebrates associated with coarse woody debris to terrestrial macrofauna diet

Objective 3.6: Conduct a two year study of impacts of road-generated dust on each listed plant.

Rationale: Roads often lead to direct wildlife mortality, through vehicle collisions as well as indirect impacts through habitat fragmentation. Refuge roads cross known areas of endemic plant species critical habitat, likely having a negative impact on that critical habitat.

Strategies

3.6.1	Develop funding sources and partnerships
3.6.2	Evaluate dust impacts to listed plants through two-year studies (lab and field work) and generate recommendations to inform road management

Objective 3.7: Conduct a study to assess the composition, distribution, fire regimes, drought patterns and flood regimes of Refuge vegetation communities prior to circa 1850.

Rationale: Increasing scientific understanding of vegetation community change through time will inform Refuge staff and improve the efficiency of restoration and recovery efforts. Given the range of disciplines necessary for the successful completion of a complex study of historic vegetation patterns, it will likely be necessary to partner with others to achieve this objective. Tasks 221, 2211 and 2212 of the Ash Meadows Species Recovery Plan recommend actions consistent with this objective (USFWS 1990).

Strategies

3.7.1	Same as 3.6.1
3.7.2	As funds become available establish a cooperative agreement with a university program to complete studies leading to a final report
3.7.3	Use disciplines such as paleontology, and archeology to research historic conditions
3.7.4	Same as 3.4.3
3.7.5	Same as 3.4.4
3.7.6	Attempt to determine the historic fire regime for Ash Meadows prior to broad establishment of invasive species

Objective 3.8: Develop and implement an information management system at the Refuge, in part through GIS database creation and management.

Rationale: Significant progress has been made on a GIS database in the course of completing the Refuge Geomorphic and Biological Assessment (Otis Bay 2006). Allowing access to as much relevant data as possible in a single location on the Refuge will allow Refuge staff and partners access to the information necessary for applied research and monitoring of Refuge resources. Increasing the accessibility of information such as vegetation monitoring data, wildlife monitoring data and water resource data at a single location on Refuge will facilitate the best possible management of Refuge resources.

Strategies

3.8.1	Develop funding sources and partnerships
3.8.2	Develop a data management plan and adopt relevant data standards
3.8.3	Identify and archive existing datasets, including hard copy only data (ex. maps, photos, diaries, etc.)
3.8.4	Partner with NPS, BLM and State

Objective 3.9: By 2010, complete a feasibility study to clarify the need for construction of an on-site research facility.

Rationale: Lack of facilities at the remote Refuge site has limited the ability of scientists to conduct research that would enhance Refuge management. Given that wetlands on the Refuge are recognized as of international importance, by the Ramsar convention on wetlands treaty, it is likely that providing facilities and access to independent scientists would result in an increase in applied research on resident species. Providing adequate facilities for visiting researchers, on the remote Refuge, should increase understanding of resident Refuge species and communities. Ongoing and planned restoration activities will provide a wealth of opportunities to monitor the response of managed species and their habitats and additional monitoring by independent researchers would likely yield useful information for adaptive management.

Strategies

3.9.1	Secure funding for a feasibility study for an on-site research facility
3.9.2	Contract a feasibility study for location and design of an on-site research facility

Visitor Services (Goal 4). Provide visitors with wildlife-dependent recreation, interpretation, and environmental education opportunities that are compatible with, and foster an appreciation and understanding of Ash Meadows National Wildlife Refuge's wildlife and plant communities.

Objective 4.1: Develop and begin implementing an Environmental Education Plan by 2011.

Rationale: Environmental education is a priority public uses identified in the NWRS Improvement Act of 1997 and is an important component of resource protection, conservation and wildlife-dependent recreational opportunities available at the Refuge. Development of an Environmental Education Plan will provide a management tool for Refuge staff to evaluate opportunities for education on and off the Refuge. Providing scientifically based, age-appropriate education to the public on the unique species and habitats present on the Refuge should enhance understanding and increase appreciation of Refuge resources. Providing environmental education at local community events would continue to inform the public about recreational opportunities on the Refuge and could increase the number of visitors to the Refuge. The development, implementation and ongoing improvement of a program for education, interpretation, and outreach will require additional resources, as well as coordination with local schools, other resource agencies as well as conservation and user groups.

Strategies

4.1.1	Incorporate volunteers in habitat restoration and maintenance efforts, such as litter removal
4.1.2	Provide visitor information on endangered species protection measures at the visitor contact station and entrance kiosk
4.1.3	Assess visitor education needs and opportunities
4.1.4	Incorporate environmental education goals of Ash Meadows Recovery Plan, Clark County Multiple Species Habitat Conservation Plan and Ramsar Convention on Wetlands
4.1.5	Contact local schools and provide at least three to five on-site programs a year
4.1.6	Work with possible public, NGO, and private partners to develop off-site refugium for pupfish to promote awareness of the endangered pupfish and other endemic species at the Refuge
4.1.7	Develop cooperative agreements with public, non-government entities and private partners to provide off-Refuge educational outreach to the local public on the value of the Refuge for wildlife and the public
4.1.8	Have staff provide off-Refuge educational outreach to the local public on the value for wildlife and the public of Ash Meadows NWR by participating in two to three local community events annually
4.1.9	Create and maintain a list of local community events
4.1.10	Contact event organizers to arrange for not for profit booth/table space or other opportunities for participation
4.1.11	Handout Refuge related educational materials and/or make presentations at local events
4.1.12	Develop an outreach Plan to support the Carson Slough Restoration Plan
4.1.13	Develop a an educational video on the endemic fish and other wildlife of Ash Meadows NWR
4.1.14	Obtain funding for and hire: 1 interpretive staff

Objective 4.2: Begin implementation of the Ash Meadows NWR Interpretation Plan.

Rationale: Interpretation is a priority public use identified in the NWRS Improvement Act of 1997 and is an important component of visitor recreational opportunities available at the Refuge. Providing both user-directed and staff facilitated high quality interpretation of the unique species, habitats and other resources present on the Refuge will enhance the visitor's passive and active experience. Development of an Interpretation Plan will provide a structure for the Refuge staff to evaluate opportunities for visitor experiences while engaging in interpretation related recreation on the Refuge. The implementation and ongoing improvements of an Interpretive Plan will require additional resources, as well as coordination with other resource agencies, tribes and user groups.

Strategies

4.2.1	Design and construct boardwalks to follow Kings Pool Stream from parking lot to Kings Pool, with a pool overlook
4.2.2	Design and construct interpretative displays for new boardwalks to be installed at Point of Rocks

4.2.3	Design and construct boardwalk to the Longstreet Cabin and an overlook for the Longstreet Spring pool
4.2.4	Maintain designated roads and visitor use areas
4.2.5	Improve Point of Rocks and Longstreet Cabin parking areas
4.2.6	Maintain current visitor services for wildlife-dependent recreational activities in accordance with existing Public Use Management Plan
4.2.7	Conduct a study of Refuge visitation to determine the number and purpose of visits
4.2.8	Improve signs on Refuge boundary
4.2.9	Include sensitive plant and pupfish life history information in Refuge brochures, fact sheets, and maps
4.2.10	Coordinate with Death Valley National Park staff to provide Devils Hole pupfish interpretive materials
4.2.11	Develop multi-lingual interpretative materials and construct new interpretive facilities at Point of Rocks, Longstreet, and Crystal Springs and entrances to Refuge.
4.2.12	Design and construct other interpretive facilities identified in the Interpretive Plan
4.2.13	Staff visitor contact station five days per week
4.2.14	Improve existing roadways and parking areas to good condition as described in the Ash Meadows Refuge Roads Inventory (2004), based on Geomorphic and Biological Assessment

Objective 4.3: Develop and begin implementing a Refuge Visitor Services Plan by 2012.

Rationale: Visitation of the Refuge has been increasing over time despite minimal Refuge outreach actions. An increase in the regional population and ongoing efforts to inform the public about recreational opportunities have resulted in increasing numbers of visitors to the Refuge. Increasing visitation creates the need for an effective method to evaluate and manage compatible public uses and to assess visitor impacts to the fragile ecosystems on the Refuge. Visitor use facilities need to be designed to accommodate increasing visitation and to promote appropriate wildlife-dependent activities on the Refuge. A Visitor Services Plan will evaluate and prescribe strategies to develop and manage compatible wildlife-dependent recreational opportunities, related infrastructure, and associated staffing and funding needs on the Refuge. A Visitor Services Plan will be useful to engage, educate and coordinate with private property owners, local governments and user groups, and other agencies with jurisdictional responsibilities for Refuge resources.

Strategies

4.3.1	Same as 4.2.7
4.3.2	Same as 4.2.15
4.3.3	Identify and develop funding sources and partnerships
4.3.4	Design and implement visitor services that enhance visitor satisfaction and optimize protection of Refuge resources
4.3.5	Same as 2.6.15
4.3.6	Same as 4.2.8
4.3.7	Same as 4.2.1

4.3.8 Same as 4.2.3

<u>Objective 4.4</u>: Coordinate with Death Valley National Park to provide a consistent message regarding Refuge and Park resources, focusing on Devils Hole pupfish and influences upon its unique environment.

Rationale: The National Park Service manages 40 acres on the Refuge and has staff with responsibility for interpretation and environmental education regarding Devil's Hole pupfish (*Cyprinodon diabolis*) and their environment. As a globally significant natural feature located within the Refuge and far from Death Valley National Park (Park) proper, the protection and conservation of the fragile Devil's hole ecosystem can be improved through increased coordination between the Refuge and the Park. While Devils hole pupfish can not be viewed by the public in their protected environment, visitors to the Refuge can view related pupfish such as the Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) in restored Refuge environments. By allowing visitors to view related pupfish, the Refuge offers a unique opportunity to teach visitors about the Devil's hole pupfish and about threatened and endangered pupfish in general. A Cooperative Management Agreement between the Refuge and the Park can optimize protection of the Devil's Hole ecosystem by defining partnership roles and responsibilities, decreasing counter productive and duplicative efforts, standardizing research methods and enhancing conservation and environmental education strategies.

Strategies

4.4.1	Meet with Park staff to discuss challenges and opportunities for optimizing interpretation of Devil's Hole resources
4.4.2	Create and distribute interpretative materials about threatened and endangered pupfish

<u>Objective 4.5</u>: Obtain baseline hunting information and within three years create a hunting step-down plan.

Rationale: Development of a step-down hunt plan is necessary to balance stakeholder requests for hunting access with Refuge purposes and other visitor services. Hunting is a priority public use identified in the NWRS Improvement Act of 1997, but hunting must be managed to assure human safety and compatibility with Refuge purposes. Several Refuge areas used by interpretative programs physically overlap with areas of existing hunting use. For safety, other uses should be separated from hunting and an appropriate buffer zone between any interpretative program area and hunting area should be maintained. Little baseline information exists on hunting, so it will likely require in excess of two years to obtain baseline information, analyze the information and create a realistic step down hunting management plan. To protect public safety it will also be necessary to assure an adequate buffer is maintained between Refuge hunting areas and private lands.

Hunting was a public use on some private land at Ash Meadows before the Refuge was established, in 1984. In 1986, an interim Hunt Plan was approved. The interim Hunt Plan authorized hunting until a master plan could be written in 1989. Although the Hunt Plan did not specify where hunting was to occur, it did allow small game, upland game and waterfowl to be hunted. The plan also prohibited off-highway vehicle (OHV) use, swimming in springs and streams, and dispersed camping. In 1994, a revised Compatibility Determination for migratory bird, upland game and waterfowl hunting at Ash Meadows was approved. It was anticipated in the stipulations section of the Compatibility Determination that hunting areas would be restricted to the northern portion of the Refuge to also allow for Refuge use by environmental educators, photographers, hikers, the general public as well as hunters during the hunt season.

Strategies

4.5.1	Continue hunt program under the Interim Hunt Plan until a revised Hunt Plan is completed
4.5.2	Obtain baseline information on Refuge hunting and within 3 years create a hunting step-down plan that addresses waterfowl and upland game hunting
4.5.3	Obtain funding for and hire: 2 law enforcement officers and 1/2 wildlife biologist
4.5.4	Have Complex law enforcement officer monitor hunting occurring on refuge

Objective 4.6: Within five years, complete design and construction of a new Refuge Headquarters/Visitor Contact Station building.

Rationale: Increasing staffing levels will require additional office and storage space and increasing public visitation will require additional facilities to provide visitor services. The historic drainage of the Crystal spring outflow passed through the current office location. To maintain consistency with Refuge purposes, any new facility should be designed with consideration of the historic Crystal Spring drainage and the likely benefits of restoring the historic drainage.

Strategies

4.6.1	Contract for a feasibility study for location and design of new building
4.6.2	Contract for construction of the new facility

Cultural and Historic Resources (Goal 5). Manage cultural resources for their educational, scientific, and traditional cultural values for the benefit of present and future generations of refuge users, communities, and culturally affiliated tribes.

Objective 5.1: Create and implement a basic Cultural Resources Management capability at the Refuge to respond to the basic compliance requirements of federal cultural resources legislation.

Rationale: Cultural resources are a non-renewable resource and need to be protected and preserved on the Refuge. Relatively little is known about cultural resources that may be present on the Refuge. Cultural resources discovery, planning, protection and interpretative are generally the result of a habitat- or visitor use-related project effort, but efforts to improve conservation and interpretation of cultural resources should be a priority. The Refuge will require additional resources to conduct the develop of a Cultural Resources Management Plan with appropriate site and project prioritization, surveys, documentation, and conservation, restoration and interpretation strategies. The story of the Refuge and its historic role in the region and the nation are important and exciting elements to be shared with visitors both on- and off-Refuge.

Strategies

5.1.1	Notify the Regional Office Archaeologist when site-specific projects are initiated so that appropriate resource assessments and coordination with Nevada State Historic Preservation Office (SHPO) and culturally affiliated tribes are conducted
5.1.2	Update Refuge brochures and interpretive signage, as staffing and funding allow, with appropriate cultural resources information

5.1.3	Solicit funding for site-specific project efforts from non-Refuge sources, such as Federal Highway Administration, Southern Nevada Public Lands Management Plan, Nevada SHPO, etc.
5.1.4	Incorporate cultural resource values, issues, and requirements into design and implementation of the other habitat, wildlife, and public use activities and strategies conducted by the Desert NWR Complex
5.1.5	Compile all existing baseline data on cultural resources sites, surveys, and reports within, and near, the Ash Meadows NWR and create secure digital, GIS, and hard copy databases, maps, and a library. Share data with the Nevada SHPO as developed.

Objective 5.2: Create and implement a proactive historic preservation program in compliance with Section 110 of the National Historic Preservation Act.

Rationale: The National Historic Preservation Act requires the inventory and evaluation of cultural resources on Ash Meadows NWR for planning, scientific, educational, and preservation purposes, and mitigation of adverse impacts caused by erosion and deterioration at significant cultural resources. Creating a proactive cultural resources preservation program is the most effective way to assure compliance with Section 110 of the National Historic Preservation Act. Fulfilling this objective will require incorporation of expertise in cultural resource interpretation and archaeology, beyond current Refuge staff.

Strategies

5.2.1	Prepare evaluation criteria and conduct a cultural resource inventory at all public use facilities and areas that would be affected by Refuge projects
5.2.2	Inventory, evaluate, and nominate to the National Register Traditional Cultural Properties and sacred sites in consultation with culturally affiliated tribes
5.2.3	Inventory, evaluate, and mitigate adverse effects and stabilize samples of cultural resources on Ash Meadows NWR using a research design prepared in consultation with culturally affiliated tribes and the scientific community
5.2.4	Conduct a study of ethnobotany and traditional plant use locations on Ash Meadows NWR in consultation with culturally affiliated tribes
5.2.5	Create a cultural resource layer in the Complex's GIS that aids in the identification, planning, monitoring and interpretation of cultural sites
5.2.6	Secure Refuge System and non-Refuge System funding to develop and implement mitigation, stabilization, or research projects

Objective 5.3: Manage cultural resources and cultural resource information for research, education and interpretation in consultation with appropriate tribes and the public.

Rationale: Many sites on the Refuge may be considered sensitive due to cultural significance for Tribes and the public or susceptibility to damage from visitation. Cultural sites selected for interpretation should be the least sensitive as determined through best professional judgment of the Refuge manager after consultation with a Service archaeologist, relevant tribes and the public. The majority of Ash Meadows NWR was Southern Paiute Aboriginal land, prior to European settlement (SWCA 2004). A small portion of the northern section of the refuge was Western Shoshone Aboriginal land, prior to European settlement (SWCA 2004). Both Tribes should be consulted to assure cultural sensitivity of management activities and to enhance the cultural perspective of interpretation. Accomplishing this objective will require hiring an interpretative specialist.

Strategies

5.3.1	Identify and evaluate cultural resources that can educate Refuge visitors on how humans have interacted with wildlife and habitats in the past
5.3.2	Consult with culturally affiliated tribes, the SHPO, and other stakeholders on ways to use these resources to achieve educational, scientific, and traditional cultural needs
5.3.3	Forge partnerships with culturally affiliated tribes and cultural interest organizations
5.3.4	Cultivate the Consolidated Group of Tribal Organizations to assist in the development of educational, scientific, and traditional cultural needs for cultural resources management
5.3.5	Work with culturally affiliated tribes on projects to restore habitats of important native plants and to harvest (for traditional non-commercial purposes) native plant foods
5.3.6	Coordinate with the Complex's recreation and education planners and programs to incorporate cultural resources information into education and interpretive programs and media
5.3.7	Consult with culturally affiliated tribes and other stakeholders to design and implement educational materials, programs and activities that would address traditional or sacred resources, and to increase awareness on- and off-Refuge about the sensitivity of cultural resources to visitor impacts and the penalties for vandalism
5.3.8	Update Refuge brochures and interpretive signs with appropriate cultural resources information
5.3.9	Implement projects to restore habitats associated with important native plants and to harvest (for traditional, non-commercial purposes) native plant foods in coordination with culturally affiliated tribes
5.3.10	Conduct a study of ethnobotany and traditional plant use on Ash Meadows NWR in consultation with culturally affiliated tribes
5.3.11	Coordinate with existing site stewardship volunteer programs to assist in site monitoring, educational and interpretive programs, and to promote cultural resources conservation in neighboring communities

<u>Objective 5.4</u>: Protect cultural resources by decreasing or preventing looting, vandalism, and deterioration.

Rationale: Protecting Refuge cultural sites will benefit the current and future public by providing them with information on historic human uses of Refuge lands and the importance of preserving the Refuge land and its unique cultural resources. All of the cultural resource sites on the Refuge are currently susceptible to vandalism because of inadequate Refuge staff and funding. Vandalism is likely to increase as Refuge visitation increases with the growing regional and local population and will likely result in damage or destruction of non-renewable cultural resources, preventing those resources from being enjoyed by future generations of Americans. Once the Refuge has been surveyed for cultural resources in the course of developing the Cultural Resources Management Plan, Refuge staff should evaluate the known resources and select a sub-set of cultural resources for both on and off Refuge interpretation. Additional resources would be necessary to develop the interpretive materials, the sites themselves and to monitor the selected sites for visitor use-related impacts.

Strategies

5.4.1	Identify and evaluate cultural resources subject to looting/vandalism, erosion, or deterioration and implement steps, including barriers and signs to reduce these threats and preserve the resources
5.4.2	Coordinate with the Nevada SHPO, tribes, special interest groups, and neighboring land management agencies to support cultural resources monitoring and enforcement activities and to decrease impacts to cultural resources
5.4.3	Coordinate future research, management, and planning on cultural resources with culturally affiliated tribes, the Consolidated Group of Tribal Organizations, the Nevada SHPO, neighboring land management agencies, and other special interest groups

Desert National Wildlife Refuge

Bighorn Sheep (Goal 1). Maintain and, where necessary, restore healthy population levels of bighorn sheep on Desert National Wildlife Refuge within each of the six major mountain ranges.

Objective 1.1: Increase the bighorn sheep (*Ovis canadensis nelsoni*) populations in the Sheep Range up to 1,000 individuals, increase the East Desert Range up to 100 individuals, increase the Desert and Pintwater Range subpopulations up to 250 and 300 individuals each and maintain the remaining subpopulations at or near their current levels over the next 15 years.

Rationale: Desert National Wildlife Refuge was established to protect, enhance, and maintain wildlife resources, including bighorn sheep (*Ovis canadensis nelsoni*). The Service and the Nevada Department of Wildlife (NDOW) have conducted annual comprehensive helicopter surveys of the Desert Refuge since 1974. The refuge-wide desert bighorn sheep population objective, as listed in the Refuge Management Plan, Part II (1987) and draft Sheep Management Plan (1990), is 2,000. Based on helicopter survey data gathered between 1974 and 1988, the refuge-wide desert bighorn population was typically at or very near the population objective. During the last fifteen years, 1989-2003, the refuge-wide desert bighorn population was approximately 1,000 individuals below the objective level. Therefore, a 100% increase, from the current baseline, is required to reach the objective level.

Most of the shortfall is accounted for by declines in the Sheep Mountains sub-population and the smaller, more transitory sub-population of the adjunct East Desert Mountains. Highly variable environmental factors play the major role in determining bighorn sheep population levels. Additionally, sheep regularly shift from one range on the refuge to another as natural conditions change from year to year. Due to this natural habitat variation, specific range population goals for bighorn sheep are difficult to achieve.

Appendix J contains a detailed review of desert bighorn sheep population status and management on Desert NWR, including factors potentially affecting distribution and abundance on the Refuge.

Strategies

1.1.1	Maintain all existing water sources (springs and rainwater catchments)
1.1.2	Protect bighorn habitat which encompasses upper alluvial fans, canyon bottoms and ridge tops as well as the precipitous mountain flanks from unauthorized uses, including off-road vehicle use, by installing signs, barricading/fencing and patrols by Law Enforcement Officers.
1.1.3	Minimize the potential for disease transmission to the bighorn sheep by continuing to prohibit domestic stock grazing on the Desert Refuge, particularly sheep and goats.
1.1.4	Continue current –NDOW-managed hunt program based on annual population surveys
1.1.5	Conduct a minimum of one annual fall helicopter survey to estimate the adult sex ratio, ram age structure, lamb survival/recruitment and populations size with NDOW.
1.1.6	Continue to allow bighorn sheep research on the refuge through special use permits.
1.1.7	Conduct yearly spring helicopter survey to identify lambing and recruitment sites.
1.1.8	Monitor vegetation response to burns in the Sheep Refuge.

1.1.9	Determine connectivity between sub-populations and their habitats on- and off-Refuge using historical records, random sightings, and radio-tracking data. Identify those corridors where exclusion removal of obstacles is most important to maximize connectivity and coordinate with appropriate partners to develop an approach to improve connectivity between subpopulations.
1.1.10	Document monitoring protocols so that they are consistently implemented when personnel changes occur in the Desert Refuge staff and/or in the NDOW staff.
1.1.11	Remove vegetation around catchments as needed to protect from wildfires and limit cover for bighorn sheep predators
1.1.12	Evaluate and adjust as necessary the current population monitoring methodology to determine adequacy for trend analyses.
1.1.13	Construct additional rainwater catchments if existing sources are determined to be inadequate.
1.1.14	Translocate bighorn sheep to the Refuge and outside of the Refuge to maintain desert bighorn sheep sub-populations and provide genetic diversity, as necessary based on the best information available, in coordination with NDOW; all sheep should receive health assessments, as time and funding allow.
1.1.15	Conduct a radio telemetry study to assess bighorn sheep mortality factors, particularly mountain lion predation, home ranges and habitat utilization/abandonment, and other research priorities. Coordinate radio telemetry with Air Force so that an appropriate band can be assigned to prevent transmission problems or equipment failure.
1.1.16	Collect blood and fecal samples to determine general health of herd, diet composition and nutrient uptake, and genetic diversity.
1.1.17	Monitor mountain lion populations on the Refuge
1.1.18	Develop and implement a Sheep Management Plan in cooperation with NDOW. The Plan would be flexible and address a number of issues such as management of water developments, herd health, predator management, habitat management (prescribed fire) and population management (translocations).
1,1,19	Develop formal agreement with NDOW covering management of desert bighorn sheep on the Refuge
1.1.20	Continue monitoring well water use and spring discharge at Corn Creek
1.1.21	Work with the State Engineer to defend water rights and mitigate substantial changes in temperature or flow
1.1.22	Regularly monitor flow rates for springs throughout the Refuge

Wildlife Diversity (Goal 2). Maintain the existing natural diversity of native wildlife and plants, including special-status species, at Desert National Wildlife Refuge.

Objective 2.1: Within five years of the plan's approval, conduct baseline presence-absence surveys of federally listed, proposed, candidate and species of concern on the refuge and develop and implement monitoring plans for these species. Within the same period, conduct baseline inventories of Refuge plant communities to determine plant and wildlife species composition and abundance. Repeat inventories every five years to track long term trends in community composition.

Rationale: Situated at the transition between the Mojave and Great Basin Deserts, with over 9,000 feet of elevation range, the Desert National Wildlife Refuge is a rich reservoir of biodiversity. A total of 702 plant species representing 80 different families have been documented on the refuge. However, despite being protected for over 70 years, little is known about the natural communities or listed and candidate species use of the Refuge. Desert is an important expanse of Mojave Desert lowland and montane habitat. In order to properly manage the Desert Refuge, Refuge staff need to obtain presence and population data on wildlife and plant species and their habitats. The existing baseline information for species in the Desert Refuge is rather limited, but includes birds (Audubon Society cooperative surveys, Great Basin Bird Observatory) and bighorn sheep (*Ovis canadensis nelsoni*) (NDOW cooperative surveys). This data does not provide adequate information on the wide diversity of species that are likely present on the Refuge.

Long term monitoring on the Refuge will be critical to understanding trends in plant and animal communities and informing adaptive management. Monitoring data will also be important to understanding the effects of global climate change on refuge resources. For example, hotter, drier weather could increase the frequency and intensity of wildfires, threatening Refuge plant communities. Climate changes could also alter the distribution of forest and woodlands (EPA) and increase the vulnerability of desert bighorn sheep populations inhabiting lower and drier mountain ranges to extinction (Epps et al 2004).

Strategies

2.1.1	Continue current partnerships with federal and state agencies, academic institutions, and public and private interest groups to assist in the survey and assessment efforts.
2.1.2	Continue to monitor the health of Pahrump poolfish (*Empetrichthys latos*) in refugium.
2.1.3	Conduct regular bird surveys at Corn Creek and maintain a record of raptors observed during helicopter surveys for bighorn sheep.
2.1.4	Develop survey and mapping data using GIS tools and following the standards provided in the USFWS WH8 Promises Team report regarding biotic and abiotic data layers.
2.1.5	Develop and implement an inventory and monitoring plan in coordination with FWS Endangered Species Program, NDOW, DOD and academic institutions.
2.1.6	Establish permanent, representative sample plots in each major plant community on the Refuge. At each site, conduct baseline inventory of plant and animal species composition and abundance. Repeat inventories every five years.
2.1.7	Model climate change impact scenarios and develop adaptation strategies

Objective 2.2: Within 2 years of the plan's approval, eliminate 75 percent of the illegal recreational activities occurring along the southern boundary and prevent them from occurring along the eastern boundary to protect plant communities and wildlife, including the threatened desert tortoise (*Gopherus agassizii*). Within 15 years after plan approval, develop and implement a plan to rehabilitate areas along the southern and eastern boundaries that have damaged by these illegal activities (such as off-road vehicle use).

Rationale: Non-compatible recreational uses on the Refuge, such as off-road vehicles, degrade or functionally destroy habitat and adversely affect wildlife and plant species. Refuge System policy and the National Wildlife Refuge Improvement Act of 1997 also provide that "…the biological integrity, diversity, and environmental health of the System (Refuge) are maintained for the benefit of present and future generations." A variety of non-compatible recreational uses are currently occurring on the Desert Refuge; however, the limited resources available to monitor these activities prevent prohibitions of these activities from being enforced. Enhanced law enforcement and improvements to signs along designated roads are critical to the initial stage of protecting species and habitats on the

Desert. Installing adequate fencing along the Refuge boundaries or where new, un-designated roads have been formed by off-road vehicles would additionally aid in protecting the Refuge resources.

Strategies

2.2.1	Maintain designated roads and visitor use areas as staffing and funding allow.
2.2.2	Maintain and replace regulatory signs along boundaries and designated roadways.
2.2.3	Continue utilization of volunteers for habitat restoration and maintenance efforts.
2.2.4	Promote awareness of and solicit support to combat trespassing and ESA violations along the boundaries in cooperation with Law Enforcement staff, various SNPLMA conservation initiative teams, FWS-ES, Clark County MSHCP and Clark County Metropolitan Police.
2.2.5	Use aerial photography, satellite imagery, and/or GPS to monitor damage caused by off-road vehicle trespass on refuge lands.
2.2.6	Install boundary signs at regular intervals along the entire southern, eastern, and northern boundary. Include regulatory, direction and interpretive elements as appropriate.
2.2.7	Expand litter removal efforts with increases in staffing and volunteer recruitment.
2.2.8	Increase law enforcement presence and patrols on the Refuge with an emphasis on the southern boundary.
2.2.9	Construct and maintain a steel post and cable fence along the southern boundary, with consideration for desert tortoise movement between suitable habitat.
2.2.10	Designate one or two points of entry on the southeast boundary of the Refuge and enforce it as the only access routes.
2.2.11	Coordinate with local jurisdictions to ensure development adjacent to boundary is compatible (ex. green belt, walled residential).
2.2.12	Where necessary, fence and maintain the eastern boundary using a steel post and cable construction method. Ensure that fence design does not act as wildlife barrier, especially for sheep.
2.2.13	Increase law enforcement patrols throughout the Refuge with an emphasis on the eastern boundary.
2.2.14	Develop and implement plan to close illegal trails and rehabilitate damaged habitat along the southern boundary in coordination with NDOW and adjacent land owner(s).
2.2.15	Track citations issued by law enforcement to estimate changes in trends of illegal activities on the Refuge.

<u>Objective 2.3</u>: Within 3 years of plan approval, begin restoration of vegetation characteristics including cover, composition, and structure characteristic of a natural fire regime within appropriate plant communities on the refuge.

Rationale: Typically, ponderosa pine communities are favorably affected by fire. Exclusion of fire has been shown to allow encroachment of shade tolerant species such as various fir and oak species which often act as ladder fuels during a fire. These ladder fuels change the characteristics of a fire from one of low to moderate intensity with positive overall effects to one of high intensity with negative overall effects.

Studies need to be conducted in the ponderosa pine communities to determine the historic fire return interval, and what impacts a lack of fire has had (if any) on species composition and density. Based on these studies, a plan to use fire (prescribed or natural) may be developed that will maintain or improve the health of the ponderosa pine systems on the refuge.

Strategies

2.3.1	Manage wildland fires on the refuge using an Appropriate Management Response which considers resource values and Service and Air Force assets at risk and potential negative impacts of various fire suppression measures. Response may range from monitoring high elevation fires to full suppression Firefighter and public safety will be the highest priority on every incident, regardless of other resources at risk
2.3.2	Use prescribed fire and naturally ignited fires to restore vegetation characteristics representative of a natural fire regime
2.3.3	Work with partners to fill data gaps in fire ecology of Desert NWR plant communities
2.3.4	Consider habitat needs of Gilbert's skink (*Eumeces gilberti*), an NDOW species of conservation priority as well as Partners in Flight Priority Birds such as pinon jay (*Gymnorhinus cyanocephalus*) and gray vireo (*Vireo vicinior*) when doing prescribed burns in pinon-juniper habitat.
2.3.5	Prepare Integrated Pest Management Plan and associated NEPA compliance

Specially-designated Areas (Goal 3). Manage specially-designated areas such that they augment the purposes of the Desert Refuge.

<u>Objective 3.1</u>: Renegotiate the Memorandum of Understanding (MOU) with the U.S. Air Force by 2012.

Rationale: The U.S. Air Force effectively co-manages a portion of the Desert Range and a Memorandum of Understanding is in place that provides both agencies with specific directives for managing the resources on their respective portions of the Desert Range. The MOU enables a more effective and coordinated management of the unique wildlife and plant species and the wilderness character of the Desert Range. Public Law 106-65 requires the Service and the Air Force ". . . to extend the memorandum of understanding for a period that coincides with the duration of the withdrawal of the lands constituting Nellis Air Force Range . . .". Amendments to the memorandum of understanding " . . .take effect 90 days after the date on which the Secretary of the Interior submits notice of such amendments to the Committees on Environment and Public Works, Energy and Natural Resources, and Armed Services of the Senate and the Committees on Resources and Armed Services of the House of Representatives.".

Strategies

3.1.1	Work with the Air Force to update the MOU as required by Public Law 106-65.
3.1.2	Offer opportunities for the DOD staff and Refuge staff to cooperate more effectively through shared management, biological efforts, and site visits.
3.1.3	Maintain access restrictions on DOD-withdrawn lands.

Objective 3.2: Within three years of plan completion develop a research and management program to utilize the existing Research Natural Areas (RNAs) per Refuge System policy as test plots for research on habitat health and community succession.

Rationale: The five RNAs designated on the Desert Refuge have not been fully utilized as Refuge System policy prescribes. The purpose of RNAs is to allow natural processes to predominate without human intervention. Depending on the specific RNA, compatible recreation opportunities may be allowed within the RNA. To satisfy their purpose, the RNAs on the Desert Range could be employed as test plots for prescribed burn methodologies, as baseline experimental controls for fire management, and as baseline data plots for habitat restoration and habitat health research efforts. Additional resources will be needed to develop appropriate research protocols for these areas.

Strategies

3.2.1	Survey and rectify the RNA boundaries with accurate legal descriptions and ground markers.
3.2.2	Conduct photographic reconnaissance and documentation of all RNAs.
3.2.3	Use the RNAs as experimental control habitat/vegetation communities baseline data plots to assist in development and testing of habitat restoration methodologies.
3.2.4	Encourage academic and agency scientists to conduct non-manipulative research in the RNAs to support Refuge management.
3.2.5	Submit a request to the FWS Director to de-designate Papoose Lake RNA.

Objective 3.3: Protect and maintain the wilderness character of the proposed 1.37 million-acre Desert Wilderness Area. Within five years of plan completion, initiate discussions with the Air Force regarding a revised wilderness proposal which includes technical corrections such as: correcting overlaps with the bombing range; allowing repair or relocation of hazardous sections of road; and allowing the use of helicopters to repair and maintain water developments and access remote areas for wildlife surveys.

Rationale: In 1974, the President Nixon submitted a wilderness proposal to Congress recommending 1.4 million acres of the Desert Refuge be designated wilderness. Congress has never acted on the proposal. Since then, Refuge staff have been managing the areas to protect its wilderness values. Clarification of the status of the Desert Range area will allow long-term planning for the Refuge to proceed with more certainty.

Strategies

3.3.1	Prohibit all public motorized activities within the proposed wilderness unless authorized by stipulations in 1974 proposal or an approved minimum tool analysis, until Congress acts on the wilderness proposal.
3.3.2	Prepare a revised wilderness proposal which includes technical corrections such as: correcting overlaps with the bombing range; allowing repair or relocation of hazardous sections of road; and allowing the use of helicopters to repair and maintain water developments and access remote areas for wildlife surveys.

Visitor Services (Goal 4). Provide visitors with opportunities to understand, appreciate, and enjoy the fragile Mojave/Great Basin Desert ecosystem.

Objective 4.1: By 2010, provide quality environmental education and interpretive opportunities for the public accommodate up to 200,000 visits per year.

Rationale: The Refuge Improvement Act of 1997 identifies six priority public uses of the Refuge System (hunting, fishing, wildlife observation, photography, environmental education, and interpretation) and encourages refuge managers to facilitate these uses when compatible with refuge purposes. Providing environmental education opportunities on and off the Desert Refuge is key to helping traditional and nontraditional user groups understand the importance of the Desert Refuge and its resources and can engender appreciation for all of the refuges in southern Nevada. A Refuge volunteer program is an effective way for Refuge staff to engage the public. Additional resources will be necessary to manage and monitor the compatible wildlife-dependent visitor activities accurately and effectively.

Strategies

4.1.1	Continue to coordinate promotion of the Refuge and operation of the Visitor Contact Station with the Southern Nevada Conservancy (SNC).
4.1.2	Utilize volunteers, as available, to provide interpretation and guidance to visitors at the visitor contact station in coordination with the Desert Complex outdoor recreation coordinator.
4.1.3	Continue to utilize SNIA volunteers to provide interpretation and environmental education programs for refuge visitors.
4.1.4	Create environmental education program using Southern Nevada Public Land Management Act (SNPLMA) funds.
4.1.5	Expand volunteer program on refuge with a target of staffing visitor contact station full time during peak use and 4 hours/day during other seasons.
4.1.6	Establish seasonal volunteer resident campground host/docent at Mormon Wells picnic area.
4.1.7	Develop cultural resources interpretive and environmental education materials in coordination with the Native American tribes.
4.1.8	Develop live “sheep cam” at water development and stream video through website and to visitor contact station/center. Apply for SNPLMA funds, or other appropriate sources to develop the webcam.
4.1.9	Develop and install interpretive panels and signs at designated entry point(s) (ex. the importance of Corn Creek as a migratory bird stop over site).
4.1.10	Complete planning, design, and construction of a visitor center and office space at Corn Creek.

Objective 4.2: Increase public awareness and appreciation of the Desert Refuge by participating in at least three local community events annually.

Rationale: Public outreach provides a way for the community to learn about the natural and cultural resources on the Desert Refuge and to encourage them to participate in recreational opportunities on the Refuge. Increasing participation in the number of local community events would allow Refuge staff to interact with the public and promote the Refuge.

Strategies

4.2.1	Develop and install a permanent environmental education/interpretive display at a prominent public venue such as McCarran International Airport
4.2.2	Conduct an annual public open house.
4.2.3	Develop and distribute a Desert Refuge video in the community.
4.2.4	Prepare and distribute an annual Congressional briefing summary.
4.2.5	Develop a quarterly Refuge newsletter.
4.2.6	Conduct annual surveys to measure program effectiveness.
4.2.7	Coordinate outreach activities with the Air Force, as appropriate

Objective 4.3: By 2011, provide opportunities, including adequate facilities, for up to 200,000 visitors per year visitors to view, photograph, and enjoy the Refuge's unique natural communities and wildlife during all seasons.

Rationale: The Refuge Improvement Act of 1997 identifies six priority public uses of the Refuge System (hunting, fishing, wildlife observation, photography, environmental education, and interpretation) and encourages refuge managers to facilitate these uses when compatible with refuge purposes. According to the Refuge Recreation Act of 1962 as amended, recreational uses on refuges must be compatible with the purpose(s) for which the refuge was established. Providing compatible wildlife-dependent recreational opportunities on the Desert Refuge is important to management of the resources because it aids in educating the public about the importance of preserving the natural environment.

Strategies

4.3.1	Maintain visitor facilities (Mormon Well and Alamo Roads, parking areas, camping areas, and picnic areas) in current condition and as staff and funding allow.
4.3.2	Maintain and replace regulatory, directional, and interpretive signs as needed and as staff and funding allow.
4.3.3	Evaluate potential sites and construct blinds for wildlife observation and photography.
4.3.4	Improve and maintain Mormon Well and Alamo Roads to fair condition based on the 2002 Refuge Road Inventory.
4.3.5	Map existing trials using GPS. Manage trails to ensure impacts to bighorn sheep and other wildlife are minimized.
4.3.6	Use post and cable fencing to designate specific parking turnouts along Alamo, Mormon Well and Gass Peak Roads.
4.3.7	Construct an entrance sign and information kiosk at the east end of Mormon Well Road.
4.3.8	Evaluate the impacts on staff and the management benefits resulting from implementation of a recreation-fee program.

Objective 4.4: In partnership with NDOW and the Air Force, provide safe opportunities for hunting bighorn sheep (*Ovis canadensis nelsoni*) on the Refuge.

Rationale: Hunting, one of the six priority public uses identified in the Refuge Improvement Act, has occurred on Desert Refuge since it was established in 1936. Sustainable hunting programs can promote understanding and appreciation of natural resources and their management on lands and waters in the Refuge System.

The hunt program on Desert Refuge is administered by NDOW. The majority of the refuge is contained within six hunt units (280, 281, 282, 283, 284, and 286). During the 14 year period between 1992 and 2005, a total of 182 tags were issued for these units with an average of 13 per year. The average success over the same period was 61 percent. The tags issued on the Desert NWR hunt units represent about 10 percent of the 128 on average issued State-wide each year. In this objective, *safe* means that there are no hunting-related safety incidents.

Strategies

4.4.1	Maintain current hunting program.
4.4.2	Conduct annual surveys and reporting of game species population numbers and the number of hunters, and species harvested in coordination with NDOW.
4.4.3	Provide Refuge-specific and NDOW hunting guidelines and regulations material to the public at the Refuge Headquarters.
4.4.4	Post and maintain designated hunting area signs on Refuge and provide hunting information to the public through brochures, fact sheets, and maps.

Cultural and Historic Resources (Goal 5). Manage cultural resources for their educational, scientific, and traditional cultural values for the benefit of present and future generations of refuge users, communities, and culturally affiliated tribes.

Objective 5.1: Create and implement a basic Cultural Resources Management capability at Desert NWR Complex to respond to the basic compliance requirements of federal cultural resources legislation

Rationale: Cultural resources are a non-renewable resource and need to be protected and preserved on the Refuge. The extent of valuable cultural resources present on the Desert Refuge is relatively unknown but likely to be considerable given the vastness of the Refuge lands, the presence of springs and some riparian habitat and the diversity of desert vegetation communities that could have supported prehistoric and historic peoples. Little is known about cultural resources on the Desert Refuge; therefore, Refuge staff need to obtain additional resources to conduct the necessary surveys. Once these resources are evaluated, some of them may be included in the interpretation and education of the Desert Refuge to explain their importance to the public.

Strategies

5.1.1	Incorporate cultural resource values, issues, and requirements into design and implementation of the other habitat, wildlife, and public use activities and strategies conducted by the Desert NWR Complex.
5.1.2	Compile all existing baseline data on cultural resources sites, surveys, and reports within, and near Desert NWR and create secure digital, GIS, and hard copy databases, maps, and library.
5.1.7	Communicate and consult with culturally affiliated Tribes, academic institutions, advocacy organizations, Agencies, and the Nevada SHPO for basic informational, compliance, research, and "government-to-government" purposes.

Objective 5.2: Create and implement a proactive historic preservation program in compliance with Section 110 of the National Historic Preservation Act (NHPA) on Desert NWR. This requires; inventory and evaluation of cultural resources on the Desert NWR for planning, scientific, educational, and preservation purposes, and mitigation of adverse impacts caused by erosion and deterioration at significant cultural resources.

Rationale: The cultural sites on the Refuge may currently be impacted by both vandalism and degradation from exposure to the natural elements. Additional resources are necessary to clean-up the littered and vandalized sites, stabilize eroded and deteriorated cultural features, and to monitor sites on a regular basis. The establishment of partnership and volunteer opportunities to assist in site restorations, stabilizations, and interpretation efforts would engender a sense of resource stewardship and increase compatible and productive types of interactions both on the Refuge and with the Refuge staff.

Strategies

5.2.1	Prepare evaluation criteria and conduct a cultural resource inventory at all public use facilities and Areas that would be affected by Refuge projects.
5.2.2	Inventory, evaluate, and nominate Traditional Cultural Properties and sacred sites to the National Register, in consultation with culturally affiliated Tribes and the Nevada SHPO.
5.2.3	Inventory, evaluate and mitigate adverse effects and stabilize samples of cultural resources on Desert NWR using a research design prepared in consultation with culturally affiliated Tribes and the scientific community.
5.2.4	Conduct a study of ethnobotany and traditional plant use at locations on Desert NWR in consultation with culturally affiliated Tribes.
5.2.5	Create a cultural resource layer in a NWR complex GIS database that aids in the identification, planning, monitoring, and interpretation of cultural sites.
5.2.6	Secure Refuge System and non-Refuge System funding to develop and implement a mitigation, stabilization, or research project.

Objective 5.3: Manage cultural resources and cultural resource information for research, education, and interpretation in consultation with culturally affiliated Tribes and the public.

Rationale: Many sites on the Refuge may be considered sensitive due to cultural significance for Tribes and the public or susceptibility to damage from visitation. Cultural sites selected for interpretation should be the least sensitive as determined through best professional judgment of the Refuge manager after consultation with a Service archaeologist, culturally affiliated Tribes and the public. There are 451 recorded prehistoric sites on the Refuge; many of these are on lands administered by the U.S. Air Force. These include sites from virtually all categories and time periods, including campsites, lithic scatters, rock shelters, rock art, quarries, special activity sites, and multi-component sites (Fergusson and DuBarton 2003). The Refuge also contains two National Register Archeological Districts, the 620,000 acre Sheep Mountain District and the 1,000 acre Corn Creek Campsite District.

Strategies

5.3.1	Identify and evaluate cultural resources that can educate refuge users on how humans have interacted with wildlife and habitats in the past. Consult with culturally affiliated Tribes and other stakeholders on ways to use these resources to achieve educational, scientific, and traditional cultural needs.
5.3.2	Form partnerships with culturally affiliated Tribes and cultural interest organizations. Cultivate the Consolidated Group of Tribal Organizations to assist in the development of educational, scientific, and traditional cultural Refuge needs for cultural resource management.
5.3.3	Coordinate with the Consolidated Group of Tribal Organizations and the Nevada SHPO to identify potential critical/priority cultural sites on the non-military overlay of the Desert Refuge. Develop a cooperative program to survey and record these sites.
5.3.4	Work with culturally affiliated Tribes on projects to restore habitats of important native plants and to harvest (for traditional non-commercial purposes) native plant foods.
5.3.5	Coordinate with the Complex and Refuge recreation and education planners and programs to incorporate cultural resource information into education and interpretive programs and media.
5.3.6	Consult with culturally affiliated Tribes, the Nevada SHPO, and other stakeholders to design and implement educational materials, programs and activities that would be used to address traditional or sacred resources, and to increase awareness on- and off-Refuge about the sensitivity of cultural resources to visitor impacts and the penalties for vandalism.

Objective 5.4: Protect cultural resources by decreasing or preventing looting, vandalism, and deterioration.

Rationale: Protecting Refuge cultural sites will benefit the public by providing them with information on historic human uses of Refuge lands and the importance of preserving the Refuge land and its unique cultural resources. All of the cultural resource sites on the Refuge are currently susceptible to vandalism. Vandalism is likely to increase as Refuge visitation increases with the growing regional and local population. This would result in damage or destruction of non-renewable cultural resources, preventing those resources from being enjoyed by future generations of Americans. Additionally, the establishment of partnership and volunteer opportunities to assist in site restorations, stabilizations, and interpretation efforts would engender a sense of resource stewardship and increase compatible and productive types of interactions both on the Refuge and with the Refuge staff. This objective assumes that Objective 5.1 is adopted.

Strategies

5.4.1	Identify and evaluate cultural resources subject to looting/vandalism, erosion, or deterioration and implement steps, including barriers and signs to reduce these threats and preserve the resources
5.4.2	Coordinate with the Regional Office, the Nevada State Historic Preservation Office, the DOD, culturally affiliated tribes, special interest groups, and neighboring land management agencies to support cultural resources monitoring and enforcement activities and to decrease impacts to cultural resources.
5.4.3	Coordinate future research, management, and planning on cultural resources with culturally affiliated tribes, the Consolidated Group of Tribal Organizations, the Nevada State Historic Preservation Office, neighboring land management agencies, and other special interest groups.

5.4.4 Coordinate with existing site stewardship volunteer program to assist in site monitoring, delivery of educational and interpretive literature and programs, and to promote cultural resources conservation in the region.

Moapa Valley National Wildlife Refuge

Endemic and Special Status Species (Goal 1). Protect and restore, when possible, healthy populations of endemic and special status species, such as the endangered Moapa dace, within the Muddy River headwaters.

<u>Objective 1.1</u>: Complete the restoration of the springheads and outflow channels on the the Pedersen Unit by 2009 and on the Apcar Unit by 2015 where: water temperatures are maintained at 30-32 °C (86-89.6 °F), flows range from 0.3-1.0 m/s, native plant communities include herbaceous plants [e.g. *Chara* and other algae, waternymph (*Najas sp.*), watercress (*Nasturtium sp.*), spikerush (*Eleocharis sp.*), sedges (*Carex sp.*) and grasses] in and surrounding spring sources, and herbaceous and woody communities [e.g. velvet ash (*Fraxinus velutina*), Cottonwood (*Populus sp.*), willow (*Salix spp.*), screwbean mesquite (*Prosopis pubescens*) and understory sedges (*Carex sp.*)] near larger channels and other water parameters are within acceptable levels for Moapa dace (3.4-8.4 mg/L dissolved oxygen, 606-867 mg/L total dissolved solids and pH of 7.1-7.9).

Rationale: The endangered Moapa dace (*Moapa coriacea*) depends on the health and integrity of the local hydrologic system to survive. Suitable Moapa dace habitat consists of: consistent springhead and outflow channel water temperature in the range of 30-32°C (86-89.6 °F), water velocity of 0.3-1.0 m/s, dissolved oxygen of 3.4-8.4 mg/L, total dissolved solids of 606-867 mg/L and pH of 7.1-7.9 (USFWS 1995). Suitable native plant communities vary from areas surrounding spring source and small outflow areas including *Chara spp.* and other algae, waternymph (*Najas sp.*), watercress (*Nasturtium sp.*), spikerush (*Eleocharis sp.*), sedges (*Carex sp.*) and grasses to communities lining larger channels including velvet ash (*Fraxinus velutina*), willow (*Salix spp.*), screwbean mesquite (*Prosopis pubescens*) and understory sedges (*Carex sp.*) (USFWS 1981). Non-native plants, in particular non-native palm trees such as *Washingtonia filifera* and *Phoenix dactylifera*, have largely replaced native plant communities surrounding spring heads and outflow channels, degrading aquatic habitat and crowding out desirable native plant species (SWCA 2004). Restoration of historic hydrology and native plant communities should not only favor Moapa dace and other native species (Moapa White River springfish, Moapa pebblesnail, grated tryponia, Moapa warm spring riffle beetle, Amargosa naucorid, and Moapa naucorid), but should also discourage non-native fish species such as Tilapia (*Oreochromis aureus*) which energetically favor lower flow, lentic systems (Scoppettone 2006). Non-native mosquito fish (*Gambusia affinis*) will likely continue to co-exist in springhead and outflow channels even after habitat restoration and will require additional effort for control or eradication. Coordinated planning and implementation of Moapa dace habitat improvement strategies will benefit other resident and migratory bird species that also rely on the Refuge springs and streams.

Lowland riparian habitat is important for many ESA listed or species of concern that occur on the Refuge including the southwest willow flycatcher (*Empidonax traillii extimus*), vermillion flycatcher (*Pyrocephalus rubinus*), Phainopepla (*Phainopepla nitens*), long-eared myotis (*Myotis evotis*) as well as many other migratory birds and resident animals (Recon 2000). Completing restoration of the lowland riparian habitat on the Plummer, Pedersen and Apcar units will support the Nevada Steering Committee Intermountain West Joint Venture (NSCIWJV) Priority A objective for lowland riparian habitat to "*Permanently protect and/or restore 300 linear miles of lowland riparian habitat in Nevada*" (NSCIWJV 2005). Lowland riparian habitat is quite limited in the region and restoring this important lowland riparian habitat will contribute to the biological integrity, diversity and environmental health of the surrounding region and the National Wildlife Refuge System as a whole. Restoring spring systems as outlined in this objective is consistent with the first recovery action recommended by the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem (USFWS 1996). Additional resources are vital to achieve the objectives defined in the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem (USFWS 1996).

Strategies

1.1.1	Continue channel restoration on the Pedersen Unit by planting native species.
1.1.2	Complete restoration of the spring heads and channels on Apcar Unit.
1.1.3	Restore native overstory, mid-level and understory vegetation (using local seed and/or seedlings) to riparian corridors, transitional upland sites and any disturbed or newly exposed areas.
1.1.4	Consider habitat needs of other special status fish and invertebrates when designing and implementing restoration projects (Moapa White River springfish, Moapa pebblesnail, grated tryponia, Moapa warm spring riffle beetle, Amargosa naucorid, and Moapa naucorid)
1.1.5	Monitor streams before and after rehabilitation, to determine benefits or detriments to endemic fish and invertebrate populations.
1.1.6	Continue to solicit and utilize volunteers to assist with habitat restoration projects.
1.1.7	Coordinate with BLM for local seed collection and National Park Service for germination/production of native species.
1.1.8	Develop strategies to remove non-native fish species, including mollies and mosquito fish, from Refuge streams in coordination with the USFWS Endangered Species program and NDOW.
1.1.9	Maintain restored habitat after restoration activities are completed

Objective 1.2: Continue to conduct annual surveys and monitoring of Moapa dace (*Moapa coriacea*) and annual surveys of Moapa White River springfish (*Crenichthys baileyi moapae*).

Rationale: Critical monitoring of Moapa dace (*Moapa coriacea*) and snorkel surveys of Moapa White River springfish (*Crenichthys baileyi moapae*) have been conducted annually although uncertainty exists about long-term staff levels. Collecting regular monitoring data on Moapa dace and their habitats within the Refuge is vital to achieve the Refuge purposes, for staff to properly conserve and manage Refuge resources and to develop visitor use opportunities in the future. Annual monitoring of Moapa dace is recommended as recovery action number two in the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem (USFWS 1996). Moapa White River springfish is a species of concern that requires monitoring on the Refuge to assess long-term population trends.

Strategies

1.2.1	Coordinate with USFWS Endangered Species program and NDOW for technical and financial assistance with inventories and monitoring of listed fish species and fish species of concern.
1.2.2	Inventory Refuge habitat consistent with the Moapa Dace Recovery Plan
1.2.3	Develop a GIS-enabled species inventory program, beginning with Moapa dace inventory data.
1.2.4	Develop and implement an inventory and monitoring plan for listed fish species and fish species of concern.
1.2.5	Model climate change impact scenarios and develop adaptation strategies

Objective 1.3: Collect monthly monitoring data for water flow and temperature of Pedersen and Pedersen East springs and Warm Springs West flume and collect monthly monitoring data for water quality parameters including temperature, flow, dissolved oxygen, pH and total dissolved solids at other Refuge springs as needed by 2009.

Rationale: The springs and outflow channels provide habitat for resident birds, reptiles, amphibians, mammals and migratory bird species. Many factors have historically affected water levels and water quality, including on and off Refuge human impacts from resource developments as well as natural climatic conditions. Water resource impacts will be ongoing considerations during planning and management of finite water resources. Preventing deleterious changes in the condition of water resources is critical to fulfilling the Refuge purposes, thus they require constant and increasing monitoring efforts. Increasing and diversifying monitoring efforts will provide timely direction and guidance to Refuge staff as they continue habitat enhancement and restoration and investigate the potential for visitor use opportunities. Water quality characteristics suitable for Moapa dace (*Moapa coriacea*): springhead and outflow channel temperatures of 30-32 °C (86-89.6 °F), flows of 0.3-1.0 m/s, dissolved oxygen of 3.4-8.4 mg/L, total dissolved solids of 606-867 mg/L and pH of 7.1-7.9 (USFWS 1995) are a target for suitable habitat and a baseline for assessing significant changes from suitability that may require mitigation.

Strategies

1.3.1	Participate in local and regional water resource management efforts to assess impacts and to protect water resources on the Refuge.
1.3.2	Participate in the Muddy River Regional water monitoring planning process.
1.3.3	Coordinate with Regional Office hydrology staff, USFWS Endangered Species program, USGS, Moapa Valley Water District, and other entities as appropriate to share monitoring data and maintain monitoring equipment and sites.
1.3.4	Collect monthly monitoring data for water flow and temperature of Pedersen and Pedersen East springs and Warm Springs West flume and collect monthly monitoring data for water quality parameters including temperature, flow, dissolved oxygen, pH and total dissolved solids at other Refuge springs as needed.
1.3.5	Develop a long-term water resources management plan for the Refuge by 2011.
1.3.6	Obtain basic water quality data collected by other agencies; share data with other agencies
1.3.7	Purchase and install equipment.
1.3.8	Continue monitoring water quality parameters if other agencies stop.
1.3.9	Determine appropriate equipment needs and monitoring site locations within each spring area.
1.3.10	Determine appropriate water quality parameters to be measured in coordination with Regional Office hydrology staff and Moapa dace fish biologists.

Objective 1.4: Protect and maintain historic natural habitat including water quality and quantity in the Refuge springs and channels suitable for Moapa dace (*Moapa coriacea*) survival, reproduction and recruitment: springhead and outflow channel temperatures of 30-32°C (86-89.6 °F), flows of 0.3-1.0 m/s, dissolved oxygen of 3.4-8.4 mg/L, total dissolved solids of 606-867 mg/L and pH of 7.1-7.9.

Rationale: Protection of existing, enhanced, and restored/created Moapa dace (*Moapa coriacea*) habitat is a fundamental component of the recovery and conservation of this species (USFWS 1983). Threats to Moapa dace and their habitat occur on and off Refuge and include fire, floods, recreational/commercial/agricultural developments, water resources development, invasive species encroachment, vandalism and visitor activities. Suitable water quality required for Moapa dace includes: consistent springhead and outflow channel water temperature in the range of 30-32°C (86-89.6 °F), water velocity of 0.3-1.0 m/s, dissolved oxygen of 3.4-8.4 mg/L, total dissolved solids of 606-867 mg/L and pH of 7.1-7.9 (USFWS 1995). Maintaining adequate water quality will also require ongoing control of non-native invasive plants within corridors surrounding springheads and outflow channels (SWCA 2004). In order to achieve this objective, efforts will need to be comprehensive and range from increasing public knowledge of the fragility and uniqueness of the Refuge ecosystem to improving signs, developing visitor access infrastructure and dismantling over 40 years of pre-Refuge resort-related infrastructure.

Strategies

1.4.1	Maintain existing boundary fencing and gates, and replace as needed.
1.4.2	Maintain regulatory signs on the Refuge in good condition and replace as needed.
1.4.3	Remove dead fan palm fronds and thin the underbrush and overgrowth as needed to reduce risk of fire
1.4.4	Extinguished unwanted fires as fast as safely possible in order to minimize potential negative impacts to Moapa dace.
1.4.5	Continue periodic removal of nonnative aquatic species
1.4.6	Develop and implement an Integrated Pest Management Plan to control and eradicate invasive species encroachment.
1.4.7	Use prescribed fire where appropriate to reduce hazardous fuels and treat unwanted vegetation.
1.4.8	Participate in community based fire safe planning both on and off the Refuge. Explore other options for protecting the Refuge from fire.
1.4.9	Develop regulatory, directional, interpretative signs and materials, such as brochures and fact sheets, to guide and enhance the visitor experience.
1.4.10	Monitor habitat changes, maintain and continue improvements for restoration efforts and other landscape improvements, and provide adequate level of monitoring and maintenance for invasive species control and fire management.
1.4.11	Work with the State Engineer to defend water rights and mitigate substantial changes in temperature or flow
1.4.12	Continue to participate in the Muddy River Recovery Implementation Program and the Biological Advisory Committee

<u>Objective 1.5</u>: Within five years of the CCP's approval, conduct baseline inventories of federally listed, proposed, candidate and species of concern on the refuge; conduct baseline inventories of aquatic habitat for invertebrates and amphibians to determine species composition and abundance; and inventory existing upland habitat for migratory birds, mammals, and reptiles.

Rationale: Collecting data on the species and their habitats within the Refuge is vital to achieve the Refuge purposes, for staff to properly conserve and manage Refuge resources and to develop visitor use opportunities in the future. A comprehensive understanding of the diversity, presence and habitat needs of wildlife species is currently lacking. To date, species inventories on the Refuge have been limited by limited staff availability. Inventories have only been conducted on a project-by-project basis. Additional resources will be needed to fulfill this objective.

Strategies

1.5.1	Conduct baseline inventories of federally listed, proposed, candidate and species of concern on the refuge; conduct baseline inventories of aquatic habitat for invertebrates and amphibians to determine species composition and abundance; and inventory existing upland habitat for migratory birds, mammals, and reptiles.
1.5.2	Coordinate with USFWS Endangered Species program and NDOW for technical and financial assistance with species inventories and monitoring.
1.5.3	Repeat inventories every 5 years to track long term trends in community composition.
1.5.4	Develop a GIS-enabled species inventory program.
1.5.5	Develop a long-term inventory and monitoring plan for federally listed, proposed, candidate and species of concern on the Refuge
1.5.6	Coordinate with NDOW to conduct surveys for the presence and use of fan palm habitat by migratory and resident bat species.

Objective 1.6: Work with partners to protect 1,765 acres of habitat within the Muddy River Headwaters area for the Moapa dace and other special status species.

Rationale: Protection of the lands considered would fulfill the habitat criterion of the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem (Recovery Plan) (USFWS 1995). The proposed expansion area includes about 1,665 acres of spring, riverine, riparian, wetland, and mesquite bosque habitats land adjacent to the Refuge that are occupied by species listed as threatened or endangered under the Endangered Species Act of 1973, The proposed expansion area also contains other species of concern including yellow-billed cuckoo, and southwestern willow flycatcher. The proposed project provides opportunities for Federal, Tribal, State, and local government partnerships with private property owners. These partnerships are the basis for achieving mutual conservation goals while maintaining the rural lifestyle and economic vitality of the Moapa Valley.

Strategies

1.6.1	Expand the Refuge Acquisition Boundary by 1,765 acres and work with partners to protect habitat within the expanded boundary through purchase, transfer, and/or agreement (see Land Protection Plan, Appendix L)
1.6.	Prepare step down habitat management plan for lands acquired within the expansion area.

Visitor Services (Goal 2). Provide opportunities for local communities and others enjoy and learn about the resources of Moapa Valley NWR and participate in its restoration.

Objective 2.1: Open the refuge to the general public every day for interpretive self-guided or Refuge staff guided tours with a capacity of up to 1,000 visits annually and continue providing opportunities for volunteers to assist in habitat restoration projects with oversight from Refuge staff.

Rationale: The sensitivity of the natural resources on the Refuge to visitor impacts is an issue that must be evaluated prior to opening the Refuge to the general public and monitored after any additional visitation policy changes. Appropriate interpretive and educational materials should be developed and provided to the local communities and area schools to increase people's awareness and minimize impacts to fragile Refuge habitats and restoration efforts. The Refuge grounds are currently unsafe for the general public due to the deteriorating condition of pre-Refuge, resort related structures, the lack of visitor use facilities such as potable water and shade structures and the lack of staff to plan for, coordinate and supervise wildlife-dependent recreation activities. Opening the Refuge to the public will increase their understanding and appreciation of the unique endemic wildlife species and other resident and migratory species found in the Warm Springs area. Guided tours along designated trail routes would allow visitors to enjoy the Refuge resources while limiting disturbance to riparian habitat. Visitors would also benefit from interactions with knowledgeable staff. Providing public information and education is recommended as recovery action number four in the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem (USFWS 1996). Additional resources will be required to achieve this objective.

Strategies

2.1.1	Complete volunteer needs assessment, create position descriptions, and coordinate with outdoor recreation planner to recruit, hire, and train volunteers
2.1.2	Continue participation in local community events (e.g., Clark County Fair, Moapa Day Celebration, Earth Day) as staff and funding allow.
2.1.4	Organize local school contacts to generate enthusiasm for the Refuge and its endemic species.
2.1.5	Develop one environmental education program at the Refuge by 2009.
2.1.6	Develop interpretive and environmental education materials.
2.1.7	Work with NDOT to erect signs on Interstate-15 and US-93 promoting the Refuge and directing the public to the Refuge.
2.1.8	Erect a Refuge entrance sign near Warm Springs Road.
2.1.9	Plan and construct a self-guided trail system along the spring head, pools and riparian corridor on the Plummer and Pedersen Units
2.1.10	Conduct an annual public open house to encourage interactions and foster relationships between Refuge staff and the local community.
2.1.11	Coordinate with Desert Complex Outdoor Recreation Coordinator to recruit docents to staff the Refuge and to facilitate visitor interpretative tours.
2.1.12	Monitor the number of refuge visitors.
2.1.13	Seek opportunities for community based outreach, such as participation in off Refuge activities.

2.1.14	Develop regionally focused cultural resources environmental education and interpretation materials for self guided tours.
2.1.16	Confer with the Moapa Band of Paiutes to incorporate their history and native plant and animal species knowledge as part of the interpretive program at the Refuge.
2.1.17	Coordinate the installation of a permanent environmental education display at the Moapa Valley Community Center or other suitable public venue
2.1.18	Construct an overlook trail with interpretive panels and shade structure on top of the hill on the Plummer unit for viewing the Refuge and the Moapa Valley.
2.1.19	Design and install new interpretive panels.

Pahranagat National Wildlife Refuge

Wetland Habitat (Goal 1). Restore and maintain wetland habitat for waterfowl and other migratory birds with an emphasis on spring and fall migration feeding and resting habitat requirements.

Objective 1.1: By 2012, complete and implement a habitat restoration and management plan for Pahranagat NWR.

Rationale: The Pahranagat Valley, originally inhabited by Native Americans, began to be farmed in the 1850's when pioneers arrived in the area. The past 150 years of human activity have dramatically altered ecological and hydrological functioning of the valley. On the Refuge, most of the remaining dams, levees, dikes and irrigation ditches currently in use were constructed over 50 years ago when the area was an active farm.

Where the Refuge now sits, the wetlands are degraded and no longer support a diverse aquatic community including the Federally endangered Pahranagat roundtail chub (*Gila robusta jordani*) that once inhabited the lakes, streams and springs on the Refuge. With fewer than 6 individuals of this fish species surviving in the wild and approximately 2,000 in a refugium on the State of Nevada's Key Pittman Wildlife Management Area (Nevada Department of Wildlife 2006), establishing a second refugium population on the Refuge is an important step towards saving the species from extinction. Additionally, much of the habitat for migratory waterfowl and the Federally endangered southwestern willow flycatcher (*Empidonas traillii extimus*) are showing signs of senescence and have an increased risk of fire (Maxwell pers. obsrv.).

Active long-term management is needed to bring the lakes and wetlands on the Refuge to a healthy state that can support diverse aquatic and terrestrial communities. Today, the North Marsh and Upper Lake are contaminated with pesticides and heavy metals from agricultural runoff entering upstream. A population of non-native common carp (*Cyprinus carpio*) limits the development of emergent wetland vegetation keeping the lake ecosystem in a continuous, disturbed, early successional state characterized by high turbidity.

In 1995 the U.S. Fish and Wildlife Service initiated a study to describe and quantify contaminants that might be impacting endangered species, species of concern, migratory birds and Service Lands. Results from the study suggest that water quality may be a limiting factor for endemic fishes and that elevated selenium, arsenic and boron in aquatic vegetation and in aquatic invertebrates may represent a concern for aquatic birds (Tuttle et al. 1999).

Currently there is a need to revaluate Refuge operations and develop resource management strategies to restore and provide for long-term ecosystem health. In 2006, the Service received approval for a Pre-Proposal Planning request under the Southern Nevada Public Land Management Act to develop a comprehensive management vision for the Refuge using wetlands hydrology and biology to guide planning and management decisions. This plan, which was initiated in 2008, will integrate many different aspects of Refuge operations and encompass resource conservation and protection, recreation, environmental education and public safety.

Strategies

1.1.1	Inventory biological and hydrological resources to inform the planning and design of the wetlands restoration
1.1.2	Acquire and process satellite imagery and elevation modeling to prepare engineering plans for the wetlands restoration;
1.1.3	Plan and design wetlands restoration at the Refuge that will improve existing water quality, water control and conveyance structures and ensure water use is compatible with public safety, Refuge purposes and biological resource management goals
1.1.4	Prepare a long-term integrated wetlands management plan that provides an overall management framework for resource conservation, recreation and public safety. This plan will outline specific maintenance tasks and a schedule that spans a 20 year period
1.1.5	Plan and design a refugium and public viewing chamber for the endangered Pahranagat roundtail chub
1.1.6	Hire a term project manager and a term project biologist to oversee and coordinate all project activities
1.1.7	Inventory biological and hydrological resources to inform the planning and design of the wetlands restoration
1.1.8	Model climate change impact scenarios and develop adaptation strategies

Objective 1.1: Until the restoration and management plan is completed and implemented, manage the 640 acres of open water in North Marsh/Upper Pahranagat Lake to optimize the growth of submerged aquatic vegetation as foraging habitat for waterfowl while using the water primarily to manage habitats downstream.

Rationale: Several species of waterfowl require open water for resting and foraging during their annual migrations. Because of the importance of open water for insects, many species of birds and bats forage over open water. Open water habitats are also particularly important to nesting and staging grebes, and as foraging sites for fish-eating waterbirds (Ivey and Herziger 2005).

Currently, the quality of waterfowl habitat in Upper Lake and North Marsh is limited due to the lack of submerged aquatic vegetation. Non-native carp (*Cyprinus carpio*) uproot aquatic vegetation when spawning and feeding and suspend benthic sediments resulting in limited light for plant growth. Upper Pahranagat Lake draw downs in spring and summer would promote the growth of submerged aquatic vegetation, by warming soils and increasing available sunlight. In addition, draw downs during peak spring migration would benefit migrating shorebirds and other migratory birds. Since no inflow is currently available during the summer, water is stored in Upper Pahranagat Lake at a level of between 4 feet in October and 11 feet in April to maintain the sport bass fishery and water is released into areas south of Upper Pahranagat Lake including Middle Marsh and Lower Pahranagat Lake to provide waterfowl habitat during spring and fall migrations. Draw downs are likely to reduce warm water sport fisheries in Upper Pahranagat Lake. A comprehensive Refuge water budget and an evaluation of different habitat management strategies is planned to formulate options for improving open water habitat for waterfowl, waterbirds, shorebirds and other migratory birds and to develop alternative management strategies for relatively wet and dry years. In addition the two levees that maintain water levels in Upper Pahranagat Lake may pose a threat to human safety, as they are compromised by vegetation and leaks due to the exclusive use of gravels and rock to maintain the levees.

Pahranagat NWR is a Focal Area for the lake and reservoir ecological systems in Nevada's Comprehensive Wildlife Conservation Strategy (CWCS). This CCP objective directly addresses the CWCS objective to "Manage lakes and reservoirs to benefit associated fish and wildlife, and meet population objectives established in regional plans" (NDOW 2006). Scattered patches of cottonwoods (*Populus fremontii*) on the Refuge provide some of the last remaining habitat where the yellow-billed cuckoo (*Coccyzus americanus*), a species of conservation priority, can be found (NDOW 2006). While the yellow-billed cuckoo was thought likely to be present, its presence on the Refuge was not documented until July, 2006 (Maxwell per. comm. 2006). Many other bird species that are endangered, threatened or of concern also regularly utilize habitat on the Refuge. The rarity and isolation of lakes in the Mojave Desert makes the lakes on the Refuge of great importance for wildlife (NDOW 2006).

Strategies

1.1.2	Discharge water into Middle Marsh and Lower Pahranagat Lake to provide migratory waterfowl habitat during spring and fall.
1.1.3	Initiate annual clearing of irrigation ditches by all available methods.
1.1.4	Draw down water levels in Upper Lake in summer to control carp and encourage growth of submerged aquatic vegetation.
1.1.5	Manage carp populations
1.1.6	Collect surface water data from the Upper Pahranagat Lake flume if additional staff becomes available.
1.1.7	Continue current maintenance, repair, and improvement efforts on North Marsh and Upper Pahranagat Lake appurtenances.
1.1.8	Encourage the routine reduction of carp populations on private and state-managed lands through coordination with upstream water resources management entities and users.
1.1.9	Implement a geotechnical engineering study of Upper Pahranagat Lake to evaluate levee integrity and water loss through the lake bottom.
1.1.10	Continue regular monitoring and reporting for structural integrity of the North Marsh levee and Upper Pahranagat Lake dam.
1.1.11	Develop a rainfall-runoff analysis for Upper Pahranagat Lake to support management decisions on lake capacity and species and habitat enhancements.
1.1.12	Monitor carp populations and submerged aquatic plant species health using GIS tools,. with the assistance of NDOW.
1.1.13	Develop and implement a habitat management plan to improve quality of existing open water habitat for waterfowl, waterbirds, shorebirds and other migratory birds.
1.1.14	Every three years, conduct surveys of nesting colonial waterbirds (great blue heron, black-crowned night heron, western grebe) (from Ivey and Herziger 2005).

Objective 1.2: Maintain seasonal flooding in marshes fringing Middle Marsh and North Marsh with a target ratio of 60 percent open water and 40 percent emergent vegetation, including hard-stemmed bulrush (*Scirpus acutus*), cattail (*Typha domingensis*) and other vegetation to support waterfowl.

Rationale: Marshes are some of the most diverse and productive wildlife habitats in Nevada. They are critical to both breeding and migratory resting and forage needs of many species of birds. Seven bat species of concern may occur in and around marsh habitat on the Refuge (see Appendix G). The Pahranagat Refuge protects about 10 percent of this relatively rare habitat in the Mojave Desert portion of Nevada. Dabbling ducks prefer to feed in shallow water, between 2 to 10 inches deep, with an equal ratio of open water and emergent vegetation (Fredrickson and Reid 1988). Deeper water habitats provide foraging sites for diving ducks. This range of wetland and aquatic habitat, equally interspersed with tall emergent vegetation such as cattail and hardstem bulrush, provides excellent cover and loafing habitat for a variety of waterfowl. A variety of strategies are available to reduce decadent vegetation and increase open water habitat for migratory birds, while simultaneously providing sufficient foraging and nesting habitat around the edges of open water. Pahranagat Refuge is listed as a Focal Area for the marsh habitat type in Nevada's Comprehensive Wildlife Conservation Strategy (NDOW 2005). Implementation of this objective and its supporting strategies help meet CWCS and Intermountain West Joint Venture objectives for wetland management and protection (NDOW 2005, Ivey and Herziger 2005).

Strategies

1.2.1	Use prescribed fire, mechanical, and chemical methods to control vegetation as needed.
1.2.2	Supplement flows into Middle Marsh with pumped well water to help maintain water levels.
1.2.3	Every three years, coordinate surveys of birds and bats

Objective 1.3: Until the restoration and management plan is completed and implemented, maintain approximately 700 acres of wet meadow habitat north of the Middle Marsh; including Baltic rush (*Juncus balticus*), saltgrass (*Distichlis spicata*) and yerba mansa (*Anemopsis californica* and grassland habitat in a diversity of successional stages to provide foraging and nesting habitat for migratory waterfowl such as Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos*), gadwall (*Anas strepera*), pintail (*Anas acuta*), teal (*Anas spp.)* and greater sandhill crane (*Grus canadensis tabida*).

Rationale: The Refuge meadow and grassland habitats support a variety of waterfowl, and other birds during fall and spring migrations. There is also some use of the wet meadow habitat for nesting and by mallards, gadwall, and cinnamon teal (*Anas cyanoptera*). The Pahranagat Valley montane vole (*Microtus montanus fucosus*) is a BLM Nevada State Sensitive species and a Nevada Species of Conservation Priority (NDOW 2005) endemic to the Pahranagat Valley which also occurs in wet meadow, alkaline and grassland plant communities. The vole occupies shallow burrows and surface runways and eats grasses, sedges, and a wide variety of forbs (NDOW 2005). Providing a variety of successional stages in these communities greatly increases the variety of birds that can use them. For example, short grass habitat in recently burned areas provides forage for sandhill cranes and geese while areas with tall grasses provide nesting habitat for waterfowl. Implementation of this objective will help meet the Nevada CWCS goal for wet meadow habitat and conservation priority species, to achieve: "Thriving self-sustaining wildlife populations in healthy plant communities on saturated soils maintained by high water tables; residual plant cover maintained to meet the life history needs of species dependent on this habitat type." (NDOW 2005).

Strategies

1.3.1	Use prescribed fire and mowing as needed to maintain productivity
1.3.2	Investigate methods to increase efficiency of water delivery from Upper Lake.

1.3.3	Conduct spring waterfowl surveys using volunteers and refuge staff.
1.3.4	Continue to coordinate with NDOW for fall and winter waterfowl surveys, to support ongoing monitoring and research.
1.3.5	Obtain waterfowl data collected by other agencies on a seasonal basis.
1.3.6	Continue limited IPM efforts in existing 112-acre grassland habitat to contain spread by knapweed and reduce its extent.
1.3.7	Continue project to determine population status, distribution and demography of Pahranagat Valley montane vole
1.3.8	Add spring and fall surveys and breeding pair and brood counts to current fall and winter surveys
1.3.9	Monitor avian species abundance during fall and spring migration for response to habitat manipulation

Objective 1.4 Until the restoration and management plan is completed and implemented, maintain approximately 350 acres of alkali flat habitat including saltgrass (*Distichlis spicata*) and alkali sacaton (*Sporobolus airoides*) dominated plant communities, flooded from for 0 to 1.5 feet for breeding and migrating waterfowl, waterbirds and shorebirds including: avocet (*Recurvirostra americana*), black necked stilt (*Himantopus mexicanus*), grebe (*Aechmophorus spp., Podiceps spp.*), mallard (*Anas platyrhynchos*), green-wing teal (*Anas crecca*), gadwall (*Anas strepera*) and redhead (*Aythya americana*).

Rationale: About a million shorebirds breed in the Intermountain West and millions more migrate through the area each year (Oring et. al. 2000). Lower Pahranagat Lake provides important habitat for shorebirds, dabbling ducks, grebes and other waterbirds. During wet years, when water persists on the alkali flats through early summer, Avocet, black necked stilt and green-wing teal have been observed using the habitat for breeding. Nevada's marshes have astonishing capability to produce prolific populations of macro invertebrates that provide food resources for migratory birds, resident fish, shorebirds and small water birds. Hundreds of thousands of shorebirds migrate north and south through Nevada annually and are dependent on the availability of these high quality invertebrate stocks to enhance fat reserves critical to reaching their breeding and wintering destinations.

Strategies

1.4.1	Control salt cedar and other invasive species near Lower Pahranagat Lake and the Pahranagat Wash/Lower Lake area and restore Lower Pahranagat Lake edge with native plant species.
1.4.3	Develop and implement a species inventory and monitoring plan to identify species composition, relative abundance, seasonality, health and distribution of waterfowl, waterbirds and shorebirds as staff and funding become available.

Objective 1.5: By 2020, protect and maintain existing water supplies, pursue additional water rights, and maintain and improve management and use of surface and groundwater by repairing, or removing infrastructure to restore and improve the water delivery and storage system. Update and implement the Water Resources Management Plan for the Refuge by 2009.

Rationale: Pahranagat Refuge encompasses one of the most significant wetland habitats in southern Nevada and is an important resting site for waterfowl, waterbirds, shorebirds and other migratory birds along the Pacific Flyway. Additionally, the Refuge purpose and past management plans mandate the conservation and enhancement of these wetlands for migratory waterfowl and other birds. To fulfill the Refuge purpose, water resources should be managed to restore native habitats for waterfowl, waterbirds, shorebirds and other migratory birds. To date, staffing and other resources have been inadequately allocated to fully realize this mandate. Refuge surface and groundwater resources must be inventoried and opportunities for obtaining additional water must be assessed. Furthermore, the staffing and funding necessary to fulfill these goals must be secured. Additional water supplies and/or the restoration of water diversion systems from seasonal to year-round would improve waterfowl breeding habitat and fisheries during the dry summer months, create opportunities for managing aquatic vegetation through manipulation of water levels, support irrigation of grasslands and grain crops that provide forage for migratory waterfowl and upland birds such as sandhill cranes, and help to restore riparian habitats crucial to the survival of the endangered Southwestern willow flycatcher and other riparian dependant breeding and migrant song birds.

Strategies

1.5.1	Monitor water inflow at Upper Pahranagat Lake to support water rights.
1.5.2	Pursue 1996 application to the Nevada Division of Water Resources (DWR) for year-round water discharges.
1.5.3	Survey existing groundwater wells and repair or cap as appropriate.
1.5.4	Install a new pump in Well No. 3 and monitor for flow to document beneficial use of allocation and support the water right.
1.5.5	Install a flume or weir at the outflow of Lower Pahranagat Lake to assist in development of the water budget.
1.5.6	Install and monitor flow meters and data loggers on each of the three groundwater wells located on the Refuge.
1.5.7	Complete a Refuge-wide water budget
1.5.8	Install gages and data logging equipment at springs adjacent to Middle Marsh.
1.5.9	Maintain water rights through annual reporting of beneficial use of allocation to the Nevada State Engineer.
1.5.10	Repair existing water infrastructure as staffing and funding allow.
1.5.11	Determine the status of groundwater wells of record, and repair and/or abandon as appropriate, and apply for change(s) in point of use with Nevada Division of Water Resources.
1.5.12	Determine the appropriate water restoration delivery system changes, prioritize restoration and develop an implementation strategy
1.5.13	Work with the State Engineer to defend water rights and mitigate substantial changes in temperature or flow
1.5.14	Acquire additional water rights from willing sellers.

Objective 1.6: By 2012, assess the needs of sandhill crane use between Upper Pahranagat Lake and Middle Marsh to determine the foraging and roosting habitat needs for migrating sandhill cranes (*Grus canadensis*).

Rationale: Pahranagat NWR is one of two known migration staging areas for the Lower Colorado River Valley (LCRV) population of greater sandhill cranes (*Grus canadensis tabida*). Anecdotal reports suggest that in 2003 and 2004 migrating sandhill cranes remained on the Refuge for less than 24 hours but in 2006 sandhill cranes remained in the Middle Marsh area for approximately 30 days (Maxwell per. comm.). During the 1990's, almost 25 percent of the Lower Colorado River population used the Refuge. The longer stopover may be related to the availability of grain crops in previous years that are no longer being provided on the Refuge. Native grasslands on the Refuge could provide better foraging and resting habitat for migrating cranes and thus contribute to their overall survival. In addition, upland game hunting must be accessed during fall migration in order to understand the possible disturbance effects on sandhill cranes.

Strategies

1.6.1	Implement recommendations of habitat restoration and management plan
1.6.2	Informally monitor sandhill crane usage of the refuge.

Objective 1.7: Complete and implement a Refuge Integrated Pest Management (IPM) Plan by 2012.

Rationale: Several different invasive plant species have been documented on the Refuge. Some of these species possess the potential to detrimentally impact sensitive, endemic and/or listed species, while others have gained a foothold in various vegetation communities and are out-competing native plant species. The primary invasive weeds found on the Refuge include salt cedar, Russian olive (*Elaeagnus angustifolia*), Scotch thistle (*Onopordum acanthium*), and Russian knapweed (*Acroptilon repens*). Salt cedar (*Tamarix spp.*) and Russian olive can invade riparian areas and out-compete native cottonwoods (*Populus fremontii*) and willows (*Salix spp.*); Scotch thistle invades wet meadow habitat; and Russian knapweed can dominate grassland habitat and outcompete native grasses. An integrated pest management plan is necessary to guide Refuge staff in efficiently and effectively combating invasive species and restoring the habitat to historical plant species composition and diversity. Refuge staff should confer with the Regional IPM Coordinator to develop the IPM Plan, which should include appropriate, integrated methods to control or eradicate plant species (mechanical, cultural, chemical, etc.) and establish adaptive management strategies for monitoring native habitat succession as invasive species control or eradication proceeds. Additional resources will be necessary to complete the IPM Plan and implement its strategies.

Strategies

1.7.1	Continue to control salt cedar, Russian olive, Russian knapweed, Scotch thistle, and other invasive species using appropriate methods (mechanical, chemical, cultural, biological, etc.).
1.7.2	Continue to coordinate invasive plant surveys and mapping efforts with county, state, and Federal agencies
1.7.3	Apply for SNPLMA and other funding to support development and implementation IPM plan
1.7.4	Complete and implement an IPM Plan.
1.7.5	Coordinate IPM Plan projects with upstream property owners.

Wildlife Diversity (Goal 2). Restore and maintain the ecological integrity of natural communities within Pahranagat Refuge and contribute to the recovery of listed and other special status species.

Objective 2.1: Maintain 100 acres of existing riparian habitats; including cottonwood (*Populus fremontii*), coyote willow (*Salix exigua*) and Gooding's willow (*Salix gooddingii*) around the North Marsh and Upper Pahranagat Lake to provide breeding habitat for southwestern willow flycatcher (*Empidonax traillii extimus*) and other migratory birds. **By 2012** complete habitat restoration and management plan and begin implementation of recommendations for willow flycatcher habitat.
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Rationale: The Pahranagat River drainage is one of only five Southwestern willow flycatcher breeding sites in Nevada. The southwestern willow flycatcher is listed as endangered, and the primary cause of its decline has been loss and modification of habitat (USFWS 2002c). In the Pahranagat valley, habitat has been lost primarily to water diversions and land conversion to agricultural uses. The southwestern willow flycatcher usually breeds in patchy to dense riparian or wetland habitat with common native plant species such as willows *(Salix spp.)*, mulefat (*Baccharis spp.*) and cottonwood (*Populus fremontii*) as well as non-native species such as salt cedar (*Tamarix spp.*) and Russian Olive (*Eleagnus angustifolia*) (USFWS 2002c). Nest sites typically have dense foliage to 4 meters in height, but the dense foliage may only be at the at the shrub level or as a low dense canopy (USFWS 2002c).

The Refuge currently supports about 100 acres of cottonwood/willow riparian habitat (Fremont's cottonwood, coyote and Gooding's willows). Riparian habitat in around the North Marsh and Upper Pahranagat Lake provides nesting, breeding and foraging habitat for neotropical migrants including the Southwestern Willow Flycatcher. An additional 430 acres could be restored to native willow habitat potentially suitable for the flycatcher and other species. In 2004, 29 Southwestern willow flycatchers were recorded at the Refuge nesting in a total of 14 territories (with one non-breeding adult). Thirteen of the nests were found in coyote or Goodings willow and one was found in a cottonwood; no nesting was observed in salt cedar or Russian olive thickets. The dense salt cedar thickets dominating Lower Pahranagat Lake, that are slated for restoration, were surveyed and no willow flycatcher nests were found though flycatchers have been known to nest in salt cedar when other habitat is unavailable.

Recovery criterion for the southwestern willow flycatcher focus on include increasing populations and nesting territories in geographically distributed locations throughout the West (USFWS 2002c). As of 2001 there were 34 nesting territories in the Pahranagat Valley. The Recovery Plan sets a target of 50 nesting territories, in the Pahranagat Valley, as part of the overall criteria to down-list the southwestern willow flycatcher to threatened status (USFWS 2002c). Expanding native willow riparian habitat on the Refuge would provide more potential nesting habitat for the flycatcher and help support the recovery of this endangered species. In addition, management strategies designed to benefit the Southwestern Willow Flycatcher would also benefit blue grosbeak (*Passerina caerulea*), yellow warbler (*Dendroica petechia*), yellow-breasted chat (*Icteria virens*), and Bell's vireo (*Vireo bellii*) – all species considered for prioritization by Nevada Partners in Flight (Neel 1999).

Strategies

2.1.1	Complete and implement habitat restoration plan recommendations for willow flycatcher habitat
2.1.2	Continue to cooperate with USBR on limited presence-absence surveys for the southwestern willow flycatcher.
2.1.3	Continue to cooperate with the U.S. Bureau of Reclamation on surveys for the southwestern willow flycatcher
2.1.4	Conduct riparian vegetation surveys that include percent cover, density, age, and structure.

2.1.5	Continue to coordinate with USFWS Endangered Species Program (USFWS-ES) for technical and financial assistance with plant species and/or habitat inventories and monitoring.
2.1.6	Monitor impacts of fishing on bird habitat use and adopt seasonal closures of sensitive areas as necessary
2.1.7	Monitor the response of migratory birds, the southwestern willow flycatcher in particular, to restoration efforts.

<u>Objective 2.2:</u> By 2012 complete and begin implementation of restoration and management plan recommendations for the degraded springs on the Refuge.

Rational: The spring habitats on Pahranagat Refuge are important elements of the Refuge's biodiversity. In surveys conducted during 1986, a unique form of the endemic Pahranagat speckled dace was found in Cottonwood Spring North and Lone Tree Spring (Tuttle et. al. 1990). The current status of these populations is not known. Elsewhere in Nevada, similar spring and spring outflows support important populations of endemic gastropods and other aquatic invertebrates. Three of the spring outflows; Cottonwood Spring, Cottonwood Spring North and Lone Tree Spring have been dredged or trenched to varying degrees. The Pahranagat Valley is a focal area for spring and springbrook habitat type in the Nevada CWCS (NDOW 2005). Implementation of this objective will help achieve the CWCS objectives for spring/springbrook function and spring/springbrook dependant species of conservation priority.

Strategies

2.2.1	Apply for SNPLMA and other funding to support the development and implementation of a restoration plan for springs.
2.2.2	Conduct fish, invertebrate, bird, mammal and plant inventories of each spring head.
2.2.3	Investigate historic photos and other records to determine pre-development characteristics of springs.
2.2.4	Complete and begin implementation of restoration and management plan recommendations for each spring in coordination with NDOW and USFWS Endangered Species Program.

<u>Objective 2.3:</u> Protect or restore the existing 1,000 acres of Mojave mixed scrub and creosote-bursage habitat throughout the Refuge for resident and migratory species.

Rationale: A variety of migratory birds such as Gambel's quail (*Callipepla gambelii*) and roadrunner (*Geococcyx californianus*) utilize the larger shrubs, cacti, and yucca for nesting and foraging, and some raptors use the habitat to hunt. The threatened desert tortoise (*Gopherus agassizii*) may also occur in the upland areas at low densities. Two species of concern, chuckwalla (Sauromalus ater) and burrowing owls (Athene cunicularia hypugea) respectively use creosote dominated upland habitat for protection from predators and burrowing sites (NDOW 2005). Upland habitat should be protected from degradation due to unauthorized off-road and other vehicle use and encroachment by cattle grazing primarily on adjacent lands. Ungrazed desert/scrub vegetation adjacent to grasslands and wetlands is not well represented in the Pahranagat Valley and can contribute significantly to native biodiversity.

Strategies

2.3.1	Continue enforcing prohibitions for off-road vehicle traffic.
2.3.2	Continue maintaining Refuge fence to reduce encroachment from cattle on adjacent BLM lands.

2.3.3	Close unused roads, as necessary.
2.3.4	Install physical barriers to prevent vehicle traffic in closed areas.
2.3.5	Inventory and monitor upland habitat on a regular basis.
2.3.6	Coordinate road closures with BLM
2.3.7	Prepare wilderness study report and NEPA document which evaluates options for preserving wilderness values of three wilderness study areas along the western boundary
2.3.8	Manage wildland fires on the refuge using the Appropriate Management Response which considers resource values at risk and potential negative impacts of various fire suppression measures; firefighter and public safety will be the highest priority on every incident
2.3.9	Restore native upland habitat adjacent to Lower Pahranagat Lake, Black Canyon, and other areas as appropriate..

Objective 2.4: Establish a self-sustaining population of the endangered Pahranagat roundtail chub (*Gila robusta jordani*) and associated native fish such as the Pahranagat speckled dace (*Rhinichthys osculus velifer*) by planning a refugium on the Refuge by 2012.

Rationale: The endangered Pahranagat roundtail chub and the associated species of concern, the Pahranagat speckled dace, are not currently found on the Refuge. However, historical records indicate that the roundtail chub's range once encompassed all major waters of the Pahranagat Valley (USFWS 1998). The most important factor currently limiting adult Pahranagat roundtail chub is thought to be a lack of relatively cool, shaded, summer water. Spawning of Paharanagat roundtail chub peaks in mid-February and occurs in pools with gravel substrate, at depths of 0.58 to 1.04 meters (1.9 to 3.4 feet), water velocity ranging from 0.08 to 0.54 meter per second (0.25 to 1.2 feet per second), with temperature in the range of 17.0 to 24.5 °C (63 to 76 °F) and dissolved oxygen concentrations from 5.2 to 6.3 milligrams per liter (parts per million) (USFWS 1998). One study of adult Pahranagat roundtail chub in the Ash Springs outflow found that they varied seasonally in habitat preference between a total depth of 0.82 to 0.73 meters and a mean stream velocity of 0.25 to 0.36 meters per second with adults occupying significantly deeper and slower water in summer then in spring and winter (Tuttle et al. 1990). The two major threats to the Pahranagat roundtail chub are the introduction of non-native aquatic species and riparian habitat degradation, primarily the partial conversion of Pahranagat Creek to irrigation ditches.

Strategies

2.4.1	Plan and design a refugium on the Refuge in coordination with NDOW and FWS-ES
2.4.2	Construct a refugium for the roundtail chub on the refuge

Visitor Services (Goal 3). Provide visitors with compatible wildlife-dependent recreation, interpretation, and environmental education opportunities that foster an appreciation and understanding of Pahranagat NWR's wildlife and plant communities.

Objective 3.1: The Refuge will provide safe opportunities for hunting upland game species such as mourning dove (*Zenaida macroura*) and Gambel's quail (*Callipepla gambelii*), waterfowl and rabbits (*Lepus sp.*) on approximately 2,000 acres, where hunters will have a reasonable chance of success in uncrowded conditions.

Rationale: Hunting, one of the six priority public uses identified in the Refuge Improvement Act, has occurred on Pahranagat Refuge since it was established in 1963. Hunting programs can promote understanding and appreciation of natural resources and their management on lands and waters in the Refuge System. In this objective, *safe* means that there are no hunting-related safety incidents. *Reasonable chance of success* means that the average harvest per hunter visit would be greater than or equal to the State average. *Uncrowded* means that there would be no more than one hunter per 20 acres.

Strategies

3.1.1	Provide Refuge-specific and NDOW hunting guidelines and regulations material to the public at the Refuge Headquarters.
3.1.2	Post and maintain designated hunting area signs on Refuge and provide hunting information to the public through brochures, fact sheets and maps.
3.1.3	Monitor the number of hunters using the Refuge each day by establishing a registration box at multiple Refuge entry points along US Hwy 93 for visitors engaging in hunting activities.

<u>Objective 3.2</u>: By 2015, update and begin implementation of the Fisheries Management Plan for the Refuge.

Rationale: Fishing, one of the six priority public uses identified in the Refuge Improvement Act, has been permitted on the Refuge since the early 1970s. In general fishing programs promote understanding and appreciation of natural resources and their management on all lands and waters in the Refuge System.

After attempting to eradicate carp (*Cyprinus carpio*) from the refuge in 1969, Florida strain largemouth bass (*Micropterus salmoides floridanus*) were introduced to the refuge during 1971. Despite several stocking attempts, fluctuating water levels and large carp populations kept bass populations low during the 1970s. After a draw down (1976-1978) and rotenone treatment during 1978, white crappie (*Pomoxis annularis*) and black bullhead (*Ictalurus melas*) were stocked during 1979 and redear sunfish (*Lepomis microlophus*) during 1980. Although bass were not restocked by NDOW at this time, they either remained in the system after drawdown and rotenone treatment or were reintroduced into the system. During the 1980s the Service requested the assistance of NDOW in maintaining the fishery on the refuge. The 1989 Fisheries Management Plan indicated that "Water manipulation needed to maintain feed and habitat for migrating waterfowl can affect the water levels on the refuge creating a negative impact on the fishery, especially during drought years." As a result, a compromise was reached and a cooperative agreement developed during 1990 with NDOW to maintain a minimum depth, of 4.0 ft. on the outlet structure gauge, to maintain water levels for fish.

Currently, the Refuge supports a bass fishery that is relatively well known in the region. Though stocking was allowed on the refuge in the past, current Refuge System policy prohibits the stocking of exotic species on a refuge (7 RM 10, 7 RM 12, and 601 FW 3) and requires that refuges be managed to "…ensure that the biological integrity, diversity, and environmental health of the System are maintained…". The Fisheries Management Plan needs to be updated to reflect current Refuge policies and to address the likely impact that proposed draw downs, of Upper Pahranagat Lake to enhance bird habitat, will have on warm water fisheries in Upper Pahranagat Lake.

Strategies

3.2.1	Continue to allow sport fish in Upper Pahranagat Lake and Middle Marsh

3.2.2	Update the Fisheries Management Plan for the Refuge in coordination with NDOW
3.2.3	Conduct carp and other invasive fish control and eradication efforts in Upper Pahranagat Lake
3.2.4	Coordinate with NDOW to implement state fishing regulations
3.2.5	Develop strategy to reinstall fish screens for upstream control of fish passage.
3.2.6	Continue to maintain visitor facilities and structures at Upper Pahranagat Lake.
3.2.7	Maintain swimming prohibitions at all open water locations and maintain regulatory signs at those locations.
3.2.8	Monitor impacts of fishing on bird use of riparian and wetland habitats and adopt seasonal closure of sensitive areas if necessary.
3.2.9	Improve and maintain existing restroom facilities for visitor use at Upper Pahranagat Lake.
3.2.10	Assess the effects of increased water withdrawals from Upper Pahranagat Lake and North Marsh for wetlands management in Middle Marsh and Lower Pahranagat Lake on sport fisheries
3.2.11	Close the existing campground and convert to a day use area
3.2.12	Close boat ramps and designate an alternative car-top boat launch site

Objective 3.3: The Service will provide wildlife dependant recreational opportunities, including maintenance and management of current and anticipated new Headquarters facilities, sufficient to accommodate from 30,000 to 60,000 visitors per year to view, photograph, learn about, appreciate and enjoy the Refuge's unique natural communities and wildlife during all seasons.

Rationale: The Refuge is well known, by the public, for the diversity of migratory bird species that stop at the Refuge to rest, feed and breed. Wildlife observation and photography are priority public uses identified in the National Wildlife Refuge System Improvement Act. Visitor participation in wildlife observation and photography can instill an appreciation for the value of and need for fish and wildlife habitat conservation. Pahranagat Refuge can enhance visitor opportunities to view wildlife in their natural habitat by providing observation trails, platforms, viewing equipment and brochures.

Strategies

3.3.1	Maintain existing visitor facilities and anticipated addition to Headquarters building.
3.3.2	Monitor the number of visitors using the Refuge each day.
3.3.3	Design and construct a wildlife viewing trail system possibly along historic farming and ranching roads and trails.
3.3.4	Construct photography and observation blinds along the trail route.
3.3.5	Maintain the observation deck, on the south levee of Upper Pahranagat Lake, and trail throughout the Refuge to accommodate visitors.
3.3.6	Continue to offer wildlife lists at the Refuge headquarters.

Objective 3.4: The Refuge will encourage educators from the southern Nevada region to use Pahranagat Refuge's unique natural communities as an outdoor environmental education and interpretation classroom, with a target of 25 school groups annually within five years.

Rationale: Environmental education and interpretation are priority public uses of refuges identified in the National Wildlife Refuge System Improvement Act. Environmental education is a process designed to teach citizens and visitors the history and importance of conservation and the biological and the scientific knowledge of our Nation's natural resources. Through environmental education, we can help develop a citizenry that has the awareness, knowledge, attitudes, skills, motivation, and commitment to work cooperatively towards the conservation of our Nation's environmental resources. Interpretive programs include activities, talks, publications, audio-visual media, signs, and exhibits that convey key natural and cultural resource messages to visitors. By providing opportunities to connect to the Refuge resources, interpretation provokes participation in resource stewardship. It helps refuge visitors understand their relationships to, and impacts on, Refuge resources.

Strategies

3.4.1	Monitor the number of visitors using the Refuge each day and the number of people participating in Refuge-related off-site activities.
3.4.2	Develop and implement an interpretive plan for the Refuge by working with partners.
3.4.3	Develop Refuge-specific environmental education materials.
3.4.4	Develop signs, such as "least-wanted" posters, for invasive plant species.
3.4.5	Construct office space to accommodate additional staff.
3.4.6	Coordinate with Nevada Department of Transportation (NDOT) to install directional signage for US Hwy 15 and US Hwy 93 to promote Refuge visitation, prevent accidents, improve circulation, and decrease inappropriate visitor uses.
3.4.7	Construct a new visitor contact station and office space at refuge headquarters unit or other appropriate location
3.4.8	Construct interpretive walking trail that connects Upper Pahranagat Lake with the Headquarters Unit
3.4.9	Coordinate with NDOT to create turn lanes so visitors can safely exit highway to visit the Refuge

<u>Objective 3.5</u>: Within three years, the Refuge will offer a minimum of 6 outreach activities each year.

Rationale: Offering additional outreach events on the Refuge is one method to increase community awareness of the Refuge and its unique resources, especially among nontraditional user groups. While offering additional outreach and outreach events can not guarantee additional Refuge visitors, over time it is likely to.

Strategies

3.5.1	Coordinate with NDOT to install directional signage for US Hwy 15 and US Hwy 93 to promote Refuge visitation, prevent accidents, improve circulation, and decrease inappropriate visitor uses.
3.5.2	Focus outreach effort on six major Refuge System events: International Migratory Bird Day, the Junior Duck Stamp Program, and the National Wildlife Refuge Week, Public Lands Day, Earth Day, National Fishing Day

Cultural Resources (Goal 4). Manage cultural resources for their educational, Scientific, and traditional cultural values for the benefit of present and future generations of Refuge users, communities, and culturally affiliated tribes.

Objective 4.1: Create and implement a basic Cultural Resources Management capability at Pahranagat NWR Complex to respond to the basic compliance requirements of federal cultural resources legislation.

Rationale: Cultural resources are a non-renewable resource and are protected under federal law and Service/refuge policy. The full extent of cultural resources on Pahranagat Refuge is relatively unknown but likely to be considerable given the location of the Refuge lands, the abundance of springs and riparian habitat and the diversity of desert vegetation communities that could have supported prehistoric and historic peoples. A cultural resources inventory and evaluation is necessary to characterize and manage these non-renewable resources and improve our understanding of past human use of this area. Once Refuge cultural resources are evaluated, some of them may be included in the interpretation and education of the Refuge to explain their importance to the public.

Strategies

4.1.1	Incorporate cultural resource values, issues, and requirements into design and implementation of the other habitat, wildlife, and public use activities and strategies conducted by the Desert NWR Complex.
4.1.2	Compile all existing baseline data on cultural resources sites, surveys, and reports within, and near, Pahranagat NWR and create secure digital, GIS, and hard copy databases, maps, and library.
4.1.3	Communicate and consult with culturally affiliated Tribes, academic institutions, advocacy organizations, Agencies, and the Nevada SHPO for basic informational, compliance, research, and “government-to-government” purposes.

Objective 4.2: Create and implement a proactive historic preservation program in compliance with Section 110 of the National Historic Preservation Act (NHPA). Inventory and evaluate of cultural resources on the Pahranagat NWR for planning, scientific, educational, and preservation purposes, and mitigation of adverse impacts caused by erosion and deterioration at significant cultural resources.

Rationale: The cultural sites on the Pahranagat Refuge may currently be impacted by vandalism and degradation from exposure to the natural elements. Additional resources are necessary to clean-up the littered and vandalized sites, stabilize eroded and deteriorated cultural features, and monitor them on a regular basis. Additionally, the establishment of partnership and volunteer opportunities to assist in site restorations, stabilizations, and interpretation efforts would engender a sense of resource stewardship and increase compatible and productive types of interactions both on the Refuge and with the Refuge staff.

Strategies

4.2.1	Prepare evaluation criteria and conduct a cultural resource inventory at all public use facilities and Areas that would be affected by Refuge projects.
4.2.2	Inventory, evaluate, and nominate Traditional Cultural Properties and sacred sites to the National Register, in consultation with culturally affiliated Tribes and the Nevada SHPO.
4.2.3	Inventory, evaluate, mitigate adverse effects on and stabilize samples of cultural resources on Pahranagat NWR using a research design prepared in consultation with culturally affiliated Tribes, the Nevada SHPO, and the scientific community.
4.2.4	Conduct a study of ethnobotany and traditional plants use locations on Pahranagat NWR in consultation with culturally affiliated Tribes.
4.2.5	Create a cultural resource layer in the NWR complex GIS that aids in the identification, planning and monitoring, and interpretation of cultural sites.

4.2.6 Secure Refuge System and non-Refuge System funding to develop and implement a mitigation, stabilization, or research project.

Objective 4.3: Manage cultural resources and cultural resource information for research, education, and interpretation in consultation with culturally affiliated Tribes and the public.

Rationale: Many sites on the Refuge may be considered sensitive due to cultural significance for Tribes and the public or susceptibility to damage from visitation. Cultural sites selected for interpretation should be the least sensitive as determined through best professional judgment of the Refuge manager after consultation with a Service archaeologist, culturally affiliated Tribes and the public. Twenty-five pre-historic archeological sites have been documented on the Refuge including several lithic debris (stone tool) sites, campsites and the Black Canyon Petroglyphs, a National Register of Historic Places listed rock art site (SWCA 2004). At least one historic house still exists on the Refuge and other historic sites could provide researchers with information related to mining, the development of ranching and the relationship between Native Americans and Euro-Americans during the Protohistoric Period (SWCA 2004).

Strategies

4.3.1	Identify and evaluate cultural resources that can educate refuge users on how humans have interacted with wildlife and habitats in the past. Consult with culturally affiliated Tribes, the Nevada SHPO, and other stakeholders on ways to use these resources to achieve educational, scientific, and traditional cultural needs.
4.3.2	Forge partnerships with culturally affiliated Tribes and cultural interest organizations. Cultivate the Consolidated Group of Tribal Organizations to assist in the development of educational, scientific, and traditional cultural needs for the cultural resources management.
4.3.3	Work with culturally affiliated Tribes on projects to restore habitats of important native plants and to harvest (for traditional non-commercial purposes) native plant foods.
4.3.4	Coordinate with the Complex and Refuge recreation and education planners and programs to incorporate cultural resources information into education and interpretive programs and media.
4.3.5	Consult with culturally affiliated Tribes, the Nevada SHPO, and other stakeholders to design and implement educational materials, programs and activities that would address traditional or sacred resources, and to increase awareness on- and off-Refuge about the sensitivity of cultural resources to visitor impacts and the penalties for vandalism.

Objective 4.4: Protect cultural resources by decreasing or preventing looting, vandalism, and deterioration.

Rationale: Protecting Refuge cultural sites will benefit the current and future public by providing them with information on historic human uses of Refuge lands and the importance of preserving the Refuge land and its unique cultural resources. All of the cultural resource sites on the Refuge are currently susceptible to vandalism. Vandalism is likely to be ongoing and will likely result in damage or destruction of non-renewable cultural resources, preventing those resources from being enjoyed by future generations of Americans. Once the Refuge has been surveyed for cultural resources Refuge staff should work with stewardship volunteers to assist in site monitoring and the delivery of interpretative programs.

Strategies

4.4.1	Identify and evaluate cultural resources subject to looting/vandalism, erosion, or deterioration

	and implement steps, including barriers and signs to reduce these threats and preserve the resources.
4.4.2	Coordinate with the Nevada SHPO, culturally affiliated Tribes, special interest groups, and neighboring land management agencies to support cultural resources monitoring and enforcement activities and to decrease impacts to cultural resources.
4.4.3	Coordinate future research, management, and planning on cultural resources with culturally affiliated Tribes, the Consolidated Group of Tribal Organizations, the Nevada SHPO, neighboring land management agencies, and other special interest groups.
4.4.4	Coordinate with existing site stewardship volunteer program to assist in site monitoring, delivery of educational and interpretive literature and programs, and to promote cultural resources conservation in neighboring communities.

Appendix G.
Compatibility Determinations for Existing and Proposed Uses

Appropriate Use Policy

This policy describes the initial decision process the refuge manager follows when first considering whether or not to allow a proposed use on a refuge. The refuge manager must find a use appropriate before undertaking a compatibility review of the use. An appropriate use, as defined by the Appropriate Use Policy (603 FW 1 of the Service Manual), is a proposed or existing use on a refuge that meets at least one of the following four conditions:

- The use is a wildlife-dependant recreational use as identified in the Improvement Act.
- The use contributes to the fulfilling of the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the Improvement Act was signed into law.
- The use involves the take of fish and wildlife under State regulations.
- The use has been found to be appropriate as specified in section 1.11 (603 FW 1 of the Service Manual).

If an existing use is not appropriate, the refuge manager will eliminate or modify the use as expeditiously as practicable. If a new use is not appropriate, the refuge manager will deny the use without determining compatibility. If a use is determined to be an appropriate refuge use, the refuge manager will then determine if the use is compatible (see Compatibility section below). Although a use may be both appropriate and compatible, the refuge manager retains the authority to not allow the use or modify the use. Uses that have been administratively determined to be appropriate are the six wildlife-dependent recreational uses (hunting, fishing, wildlife observation and photography, environmental education, and interpretation) and take of fish and wildlife under State regulations. Table 1 summarizes the appropriateness findings for existing and proposed uses on each refuge.

Compatibility Policy

Lands within the NWRS are different from other multiple use public lands in that they are closed to all public uses unless specifically and legally opened. The Improvement Act states ". . . the Secretary shall not initiate or permit a new use of a Refuge or expand, renew, or extend an existing use of a Refuge, unless the Secretary has determined that the use is a compatible use and that the use is not inconsistent with public safety." The Improvement Act also states that ". . . compatible wildlife-dependent recreational uses [hunting, fishing, wildlife observation and photography, or environmental education and interpretation] are the priority general public uses of the System and shall receive priority consideration in Refuge planning and management."

In accordance with the Improvement Act, the Service has adopted a Compatibility Policy (603 FW 2) that includes guidelines for determining if a use proposed on a National Wildlife Refuge is compatible with the purposes for which the refuge was established. A compatible use is defined in the policy as a proposed or existing wildlife-dependent recreational use or any other use of a National Wildlife Refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the NWRS mission or the purposes of the Refuge. The Policy also includes procedures for documentation and periodic review of existing refuge uses.

When a determination is made as to whether a proposed use is compatible or not, this determination is provided in writing and is referred to as a compatibility determination. An opportunity for public review and comment is required for all compatibility determinations. For compatibility determinations prepared concurrently with a CCP or step-down management plan, the opportunity for public review and comment is provided during the public review period for the draft plan and associated NEPA document. Table 1 summarizes the compatibility findings for each refuge. Draft compatibility determinations for the existing and proposed uses on each refuge follow Table 1.

Table 1. Summary of Appropriateness and Compatibility Findings, Desert NWR Complex

Existing/Proposed Use	*Use Appropriate?*	*Use Compatible?*[1]
Ash Meadows NWR		
Wildlife Observation & Photography	yes	yes
Environmental Education & Interpretation	yes	yes
Hunting; Waterfowl, Upland	yes	yes
Frog Gigging	yes	yes
Boating	no	
Research	yes	yes
Virtual Geocacheing	yes	yes
Geocacheing	no	
Swimming	no	
Horseback riding	no	
Off-Road Vehicle Use	no	
Camping	no	
Use of incendiary devices	no	
Desert NWR		
Wildlife Observation & Photography	yes	yes
Environmental Education & Interpretation	yes	yes
Hunting; Sheep	yes	yes
Research	yes	yes
Geocacheing	no	
Pine Nut Gathering	yes	yes
Camping; Dispersed and at Mormon Wells	yes	yes
Hiking and Backpacking	yes	yes
Rock Climbing	no	
Horseback Riding	yes	yes
Fun Run	no	
Robotics Automotive Testing	no	
Dog Burials	no	
Group Camping/Festival	no	
Large Group Picnics	no	
Off-Road Vehicle Use	no	
Moapa NWR		
Wildlife Observation & Photography	yes	yes
Environmental Education & Interpretation	yes	yes
Research	yes	yes

[1] Compatibility determinations are not prepared for uses found not appropriate.

Pahranagat NWR		
Wildlife Observation & Photography	yes	yes
Environmental Education & Interpretation	yes	yes
Hunting; Waterfowl, Upland	yes	yes
Fishing	yes	yes
Boating	yes	yes
Motorized Boating	no	
Research	yes	yes
Camping	no	
Swimming	no	
Horseback Riding	no	
Weddings	no	

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COMPATIBILITY DETERMINATION

Use: Wildlife Observation and Photography

Refuge Name: Ash Meadows National Wildlife Refuge, located in Nye County, Nevada.

Establishing and Acquisition Authority(ies): Ash Meadows National Wildlife Refuge (Refuge) was established on June 18, 1984 under authority of the Endangered Species Act of 1973.

Refuge Purpose(s): The purpose of Ash Meadows comes from the Endangered Species Act of 1973:

> *"...to conserve (A) fish or wildlife which are listed as endangered species or threatened species...or (B) plants..."* (16 USC Sec. 1534).

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: The National Wildlife Refuge System Improvement Act of 1997 identifies wildlife observation and photography as well as hunting, fishing, interpretation, and environmental education as wildlife dependent public uses for NWR's. As two of the six priority public uses of the Refuge System, these uses are to be encouraged when compatible with the purposes of the Refuge. Wildlife observation and photography are considered simultaneously in this compatibility determination. Many elements of wildlife observation and photography program are also similar to opportunities provided in the environmental education and interpretation programs.

Ash Meadows Refuge is open to the public for wildlife observation and photography daily from sunrise to sunset. Currently, there are nearly 65,000 visits annually to the Refuge. Typical use is by individuals, family groups, school groups, and large groups during Refuge-sponsored special events. Year round hiking is permitted along designated roads and trails. Crystal Springs Interpretive Boardwalk (1/3 mile long) provides an up-close view of the springs, fish and plants of the Refuge without disturbing the fragile habitat.

All motorized vehicles must be properly licensed and restricted to designated roads and all off-highway vehicles are prohibited. Watercrafts are not allowed for use in Refuge waters.

Wildlife observation and photography are considered together in this compatibility determination because both are considered to be wildlife-dependent, non-consumptive uses and many elements of these programs are similar. Both of these public uses are dependent upon establishing access within the Refuge. An estimated 65,000 annual visitors participate in various wildlife-dependent activities on the Refuge.

Future access within the Refuge will be increased through the careful planning and construction of interpretive boardwalks and back country trails, photography/hunting blinds, and observation decks. These access points will be planning to potentially improve visitors' wildlife observation and photography opportunities. Interpretive panels will be designed for each of these access points so as to assist those unfamiliar with the area in determining what they may be able to observe and photograph there. Written materials will also be developed with wildlife checklists.

Availability of Resources:
The Refuge receives approximately 65,000 visitors each year. Most of those visitors are hoping to observe the unique set of wildlife found only at Ash Meadows NWR. Fewer attempt to capture Refuge inhabitants on film or in digital form but that sector seems to be growing. Once the infrastructure is in place, some of which will be completed (POR and Longstreet interpretive boardwalks) before the end of 2008, the maintenance of that infrastructure and the program should be easily managed.

The following funding/annual costs (based on FY 2009 costs) would be required to administer and manage the activities as described above:

	One-time Costs	**Annual Costs**
Managing Current Use		
Administration		$2,500
Interpretation/Education Materials Production	$10,000	$1,000
Law enforcement		$120,000
Improving/Enhancing Use		
Construction of two interpretive boardwalks with panels, parking, restrooms, and habitat restoration	$1,200,000	
Maintenance of two boardwalks, etc.		$4,200
Construction of back country trail system with interpretive panels	$1,000,000	
Maintenance of back country trail system		$5,000
Construction of at least three photography/hunting blinds	$8,000	
Maintenance of photography/hunting blinds		$2,000
Construction of an observation deck at Peterson Reservoir area with interpretive panels	$50,000	
Maintenance of observation deck		$2,000
Improve refuge roads and construct/improve eight parking areas	$1,600,000	
Maintenance refuge roads and parking areas		$66,000
TOTAL	**$3,868,000**	**$202,700**

Refuge operational funds are currently available through the Service budget process to administer these uses. The majority of the one-time costs for these projects has been obtained or will be proposed for through the Southern Nevada Public Lands Management Act.

Anticipated Impacts of Use: Once considered “non-consumptive”, it is now recognized that wildlife observation and wildlife photography can negatively impact wildlife by altering wildlife behavior, reproduction, distribution, and habitat (Purdy et al. 1987, Knight and Cole 1995).

Purdy et al. (1987) and Pomerantz et al. (1988) described six categories of impacts to wildlife as a result of visitor activities. They are:

1) Direct mortality: immediate, on-site death of an animal;
2) Indirect mortality: eventual, premature death of an animal caused by an event or agent that predisposed the animal to death;
3) Lowered productivity: reduced fecundity rate, nesting success, or reduced survival rate of young before dispersal from nest or birth site;
4) Reduced use of refuge: wildlife not using the refuge as frequently or in the manner they normally would in the absence of visitor activity;
5) Reduced use of preferred habitat on the refuge: wildlife use is relegated to less suitable habitat on the refuge due to visitor activity; and

6) Aberrant behavior/stress: wildlife demonstrating unusual behavior or signs of stress that are likely to result in reduced reproductive or survival rates.

Individual animals may be disturbed by human contact to varying degrees. Human activities on trails can result in direct effects on wildlife through harassment, a form of disturbance that can cause physiological effects, behavioral modifications, or death (Smith and Hunt 1995). Many studies have shown that birds can be impacted from human activities on trails when they are disturbed and flushed from feeding, resting, or nesting areas. Flushing, especially repetitive flushing, can strongly impact habitat use patterns of many bird species. Flushing from an area can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Migratory birds are observed to be more sensitive than resident species to disturbance (Klein 1989).

Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976), colonial nesting species (Buckley and Buckley 1976), and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people. In addition, for many passerine species, primary song occurrence and consistency can be impacted by a single visitor (Gutzwiller et al. 1994). In areas where primary song was affected by disturbance, birds appeared to be reluctant to establish nesting territories (Reijnen and Foppen 1994).

Depending on the species (especially migrants vs. residents), some birds may habituate to some types of recreation disturbance and either are not disturbed or will immediately return after the initial disturbance (Hockin et al. 1992; Burger et al. 1995; Knight & Temple 1995; Madsen 1995; Fox & Madsen 1997). Rodgers & Smith (1997) calculated buffer distances that minimize disturbance to foraging and loafing birds based on experimental flushing distances for 16 species of waders and shorebirds. They recommended 100 meters as an adequate buffer against pedestrian traffic, however, they suggest this distance may be reduced if physical barriers (e.g., vegetation screening) are provided, noise levels are reduced, and traffic is directed tangentially rather than directly toward birds. Screening may not effectively buffer noise impacts, thus visitors should be educated on the effects of noise and noise restrictions should be enforced (Burger 1981, 1986; Klein 1993; Bowles 1995; Burger & Gochfeld 1998). Seasonally restricting or prohibiting recreation activity may be necessary during spring and fall migration to alleviate disturbance to migratory birds (Burger 1981, 1986; Boyle & Samson 1985; Klein et al. 1995; Hill et al. 1997).

Of the wildlife observation techniques, wildlife photographers tend to have the largest disturbance impacts (Klein 1993, Morton 1995, Dobb 1998). While wildlife observers frequently stop to view species, wildlife photographers are more likely to approach wildlife (Klein 1993). Even slow approach by wildlife photographers tends to have behavioral consequences to wildlife species (Klein 1993). Other impacts include the potential for photographers to remain close to wildlife for extended periods of time, in an attempt to habituate the wildlife subject to their presence (Dobb 1998) and the tendency of casual photographers, with low-power lenses, to get much closer to their subjects than other activities would require (Morton 1995), including wandering off trails. This usually results in increased disturbance to wildlife and habitat, including trampling of plants. Klein (1993) recommended that refuges provide observation and photography blinds to reduce disturbance of waterbirds when approached by visitors.

Education is critical for making visitors aware that their actions can have negative impacts on birds, and will increase the likelihood that visitors will abide by restrictions on their actions. For example, Klein (1993) demonstrated that visitors who spoke with refuge staff or volunteers were less likely to disturb birds. Increased surveillance and imposed fines may help reduce visitor caused disturbance (Knight & Gutzwiller 1995). Monitoring is recommended to adjust management techniques over time, particularly because it is often difficult to generalize about the impacts of specific types of recreation in different environments. Local and site -specific knowledge is necessary to determine effects on birds and to develop effective management strategies (Hockin et al. 1992; Klein et al. 1995; Hill et al. 1997).

The construction and maintenance of trails, photography blinds, and parking lots will have minor impacts on soils and vegetation around the trails. This could include an increased potential for erosion, soil compaction (Liddle 1975), reduced seed emergence (Cole and Landres 1995), alteration of vegetative structure and composition, and sediment loading (Cole and Marion 1988). However, by concentrating foot traffic onto the trails other habitats on the Refuge will remain undisturbed.

Disturbance of wildlife is the primary concern regarding these uses. Disturbance to wildlife, such as the flushing of feeding, resting, or nesting birds, is inherent to these activities. There is some temporary disturbance to wildlife due to human activities on trails (hiking, bird watching) however, the disturbance is generally localized and will not adversely impact overall populations. Increased facilities and visitation would cause some displacement of habitat and increase some disturbance to wildlife, although this is expected to be minor given the size of the Refuge and by avoiding or minimizing intrusion into important wildlife habitat.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination: This program as described is determined to be compatible. Potential impacts of research activities on Refuge resources will be minimized because sufficient stipulations and safeguards will be included in this Compatibility Determination and the required Special Use Permit and because research activities will be monitored by Refuge staff. The refuge manager and biologist would ensure that proposed monitoring and research investigations would contribute to the enhancement, protection, conservation, and management of native Refuge wildlife populations and their habitats thereby helping the Refuge fulfill the purposes for which it was established, the mission of the National Wildlife Refuge System, and the need to maintain ecological integrity, diversity, and environmental health.

_______Use is Not Compatible

___X___Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Regulations and wildlife friendly behavior (e.g., requirements to stay on designated trails, dogs must be kept on a leash, etc.) will be described in brochures and posted at the Visitor Center.
- Regulatory and directional signs will clearly mark areas closed to the public and designated routes of travel.
- Maps and public use information will be available at the visitor contact station and kiosks.
- Refuge staff will conduct regular surveys of public activities on the refuge. The data will be analyzed and used by the refuge manager to develop future modifications if necessary to ensure compatibility of the wildlife observation and photography programs.
- Use will be directed to public use facilities which are not in or near sensitive areas.
- Interpretive presentations and products will continue to include messages on minimizing disturbance to wildlife.
- Commercial photography would require a Special Use Permit.

Justification: These wildlife-dependent uses are priority public uses of the National Wildlife Refuge System. Providing opportunities for wildlife observation and photography would contribute toward fulfilling provisions of the National Wildlife Refuge System Administration Act, as amended in 1997, and one of the goals of the Ash Meadows Refuge (Goal 4, Appendix F, CCP/EIS). Wildlife observation and photography would provide an excellent forum for allowing public access and increasing understanding of Refuge resources. The stipulations outlined above should minimize potential impacts relative to wildlife/human interactions. Based upon impacts described in the Draft Comprehensive Conservation Plan and Environmental Impact Statement (USFWS 2008), it is determined that wildlife observation and photography within the Ash Meadows National Wildlife Refuge, as described herein, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System. In our opinion, these wildlife dependent uses will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Re-Evaluation Date:

____X___ Mandatory 15-year Re-Evaluation (for priority public uses)

________ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X_ Environmental Impact Statement and Record of Decision

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Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional Director - Refuges: ______________________________ ________________
(Signature) (Date

COMPATIBILITY DETERMINATION

Use: Environmental Education and Interpretation

Refuge Name: Ash Meadows National Wildlife Refuge, located in Nye County, Nevada.

Establishing and Acquisition Authority(ies): Ash Meadows National Wildlife Refuge (Refuge) was established on June 18, 1984 under authority of the Endangered Species Act of 1973.

Refuge Purpose(s): The purpose of Ash Meadows comes from the Endangered Species Act of 1973:

> *"...to conserve (A) fish or wildlife which are listed as endangered species or threatened species...or (B) plants..."* (16 USC Sec. 1534).

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: The National Wildlife Refuge System Improvement Act of 1997 identifies environmental education and interpretation, as well as hunting, fishing, wildlife observation and photography as priority public uses for refuges, where compatible with the Refuge purposes. Environmental education is defined as a process designed to teach citizens and visitors the history and importance of conservation and the biological and the scientific knowledge of our Nation's natural resources (605 FW 6). Interpretation is defined as a communication process that forges emotional and intellectual connections between the audience and the resource (605 FW 7).

Ash Meadows Refuge is open to the public for environmental education as scheduled and provides interpretive materials throughout the Refuge, with interpretive programs being offered as scheduled. Currently, there are approximately 65,000 visits annually to the Refuge. Typical use is by individuals, family groups, school groups, and large groups during Refuge-sponsored special events. Crystal Springs Interpretive Boardwalk (1/3 mile long) provides an up-close view of one of the springs, and native fish and plants of the Refuge without disturbing the fragile habitat.

The Refuge is in the process of developing an Environmental Education Plan, Interpretation Plan, and programming for each. The Environmental Education Plan will assess visitor education needs and opportunities and incorporate the environmental education goals of Ash Meadows Recovery Plan, Clark County Multiple Species Habitat Conservation Plan, the RAMSAR Convention, and the state's education standards for grade levels on which focus will be given. An objective of the Recovery Plan is to minimize human disturbance. This objective will be met by focusing on public education in concert with rare species protection. The Service will work with the public, non-government entities, and private partners to develop an offsite refugium for pupfish, in order to promote awareness of the endangered pupfish and other endemic species at the refuge. The Service will also contact local schools and provide on-site programs for school children.

The Interpretation Plan will assess interpretation needs and opportunities. The Service will develop multi-lingual interpretative materials and construct new interpretive facilities at Longstreet Springs and Point of Rocks. Interpretive displays at Devils Hole will be improved with assistance of Death Valley National Park staff, and educational materials will be developed. A volunteer program is being developed to staff the visitor contact station on a year-round basis and provide other services. The Service would also prepare plans to identify additional locations for interpretive facilities and identify locations for new signs and replace existing signs.

The Point of Rocks area, including proposed boardwalk, is an outstanding location for an outdoor classroom. Students can see first-hand examples of many environmental concepts including: endangered species, endemic species, wetlands, riparian corridors, habitat restoration, water issues in the west, Native American history, cultural resources, geology, and a diversity of wildlife.

The Service will also participate in annual events, which may include the Nye County Fair, Pahrump Fall Festival, and Earth Day and speak at monthly community events, as invited.

The Refuge will develop a comprehensive Visitor Services Management Plan to describe compatible recreation opportunities for the public and evaluate improvements to visitor services on the Refuge. The plan would discuss additional sites for environmental education and interpretation, compatibility of non-wildlife dependent public uses, implementation of a recreation-fee program, and identify public uses that are not allowed on the Refuge. A Sign Management Plan will also develop a consistent and comprehensive message for signs, waysides, visitor road use and parking on the Refuge.

Environmental education and interpretation are considered together in this compatibility determination because both are considered to be wildlife-dependent, non-consumptive uses and many elements of these programs are similar. Both of these public uses are dependent upon establishing trail systems and vehicle parking areas in the Refuge. Though the Refuge currently hosts 65,000 visitors annually, that number is expected to increase, especially due to the movement of Nevada and California metropolis dwellers outward, closer to the Refuge.

Availability of Resources: Refuge operational funds are currently available through the Service budget process to administer these uses. The majority of the one-time costs for these projects has been obtained through the Southern Nevada Public Lands Management Act.

Anticipated Impacts of Use: The Refuge provides habitat consisting of spring-fed wetlands and alkaline desert uplands for at least 24 plants and animals found nowhere else in the world. The Ash Meadows NWR has a greater concentration of endemic life than any other area in the United States and the second greatest concentration in all of North America.

Disturbance of wildlife is the primary concern regarding these uses. Disturbance to wildlife, such as the flushing of feeding, resting, or nesting birds, is inherent to these activities. There is some temporary disturbance to wildlife due to human activities on trails (hiking, bird watching) however, the disturbance is generally localized and will not adversely impact overall populations. Visitors participating in education or interpretive programming are asked to respect the environment they are visiting. Increased facilities and visitation would cause some displacement of habitat and increase some disturbance to wildlife, although this is expected to be minor given the size of the Refuge and by avoiding or minimizing intrusion into important wildlife habitat.

Individual animals may be disturbed by human contact to varying degrees. Human activities on trails can result in direct effects on wildlife through harassment, a form of disturbance that can cause physiological effects, behavioral modifications, or death (Smith and Hunt 1995). Many studies have shown that birds can be impacted from human activities on trails when they are disturbed and flushed from feeding, resting, or nesting areas. Flushing, especially repetitive flushing, can strongly impact habitat use patterns of many bird species. Flushing from an area can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Migratory birds are observed to be more sensitive than resident species to disturbance (Klein 1989).

Herons and shorebirds were observed to be the most easily disturbed (when compared to gulls, terns and ducks) by human activity and flushed to distant areas away from people (Burger 1981). A reduced number of shorebirds were found near people who were walking or jogging, and about 50 percent of flushed birds flew elsewhere (Burger 1981). In addition, the foraging time of sanderlings decreased and avoidance (e.g., running, flushing) increased as the number of humans within 100 meters increased (Burger and Gochfeld 1991). Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976), colonial nesting species (Buckley and Buckley 1976), and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people. In addition, for many passerine species, primary song occurrence and consistency can be impacted by a single visitor (Gutzwiller et al. 1994). In areas where primary song was affected by disturbance, birds appeared to be reluctant to establish nesting territories (Reijnen and Foppen 1994).

Depending on the species (especially migrants vs. residents), some birds may habituate to some types of recreation disturbance and either are not disturbed or will immediately return after the initial disturbance (Hockin et al. 1992; Burger et al. 1995; Knight & Temple 1995; Madsen 1995; Fox & Madsen 1997). Rodgers & Smith (1997) calculated buffer distances that minimize disturbance to foraging and loafing birds based on experimental flushing distances for 16 species of waders and shorebirds. They recommended 100 meters as an adequate buffer against pedestrian traffic, however, they suggest this distance may be reduced if physical barriers (e.g., vegetation screening) are provided, noise levels are reduced, and traffic is directed tangentially rather than directly toward birds. Screening may not effectively buffer noise impacts, thus visitors should be educated on the effects of noise and noise restrictions should be enforced (Burger 1981, 1986; Klein 1993; Bowles 1995; Burger & Gochfeld 1998). Seasonally restricting or prohibiting recreation activity may be necessary during spring and fall migration to alleviate disturbance to migratory birds (Burger 1981, 1986; Boyle & Samson 1985; Klein et al. 1995; Hill et al. 1997).

Education is critical for making visitors aware that their actions can have impacts on wildlife, and will increase the likelihood that visitors will abide by restrictions on their actions. For example, Klein (1993) demonstrated that visitors who spoke with refuge staff or volunteers were less likely to disturb birds. Increased surveillance and imposed fines may help reduce visitor caused disturbance (Knight & Gutzwiller 1995). Monitoring is recommended to adjust management techniques over time, particularly because it is often difficult to generalize about the impacts of specific types of recreation in different environments. Local and site -specific knowledge is necessary to determine effects on birds and to develop effective management strategies (Hockin et al. 1992; Klein et al. 1995; Hill et al. 1997). Informed management decisions coupled with sufficient public education could do much to mitigate disturbance effects of wildlife-dependent recreations (Purdy et al 1987).

Environmental education and interpretation activities generally support Refuge purposes and impacts can largely be minimized (Goff et al. 1988). The minor resource impacts attributed to these activities are generally outweighed by the benefits gained by educating present and future generations about refuge resources. Environmental education is a public use management tool used to develop a resource protection ethic within society. While it is associated with school-age children, it is not limited to this group. This tool allows us to educate refuge visitors about endangered and threatened species management, wildlife management and ecological principles and communities. A secondary benefit of environmental education is that it instills an ‘ownership’ or ‘stewardship’ ethic in visitors which could reduce vandalism, littering and poaching; it also strengthens service visibility in the local community.

The disturbance by environmental education activities is considered to be of minimal impact because: (1) the total number of students permitted through the reservation system will be limited to 100 per day; (2) students and teachers will be instructed in trail etiquette and the best ways to view wildlife with minimal disturbance; (3) education groups will be required to have a sufficient number of adults to supervise the group; (4) trail design will provide adequate cover for wildlife; and (5) observation areas and scopes are provided to view wildlife at a distance which reduces disturbance.

Education staff will coordinate with biologists regarding activities associated with restoration or monitoring projects to ensure that impacts to both wildlife and habitat are minimal. As with any restoration and monitoring activities conducted by Refuge personnel, these activities conducted by students would be at a time and place where the least amount of disturbance would occur.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Participants in the Refuge's environmental education program will be restricted to established trails, the visitor contact station, and other designated sites.
- All groups using the Refuge for environmental education will be encouraged to make reservations in advance through the Refuge office. This process, which takes the place of a Special Use Permit (SUP), allows refuge staff to manage the number and location of visitors for each unit. There is a current refuge policy that educational groups are not charged a fee or required to have a SUP. A daily limit of 100 students participating in the education program at any one site will be maintained through this reservation system. Efforts will be made to spread out use by large groups while reservations are made, reducing disturbance to wildlife and over-crowding of Refuge facilities during times of peak demand.
- Trail etiquette, including ways to reduce wildlife disturbance, will be discussed with teachers during orientation workshops and with students upon arrival during their welcome session. On the Refuge, the teacher(s) is(are) responsible for ensuring that students follow required trail etiquette.
- Refuge biologists and public use specialists will conduct regular surveys of public activities on the refuge. The data will be analyzed and used by the refuge manager to develop future modifications if necessary to ensure compatibility of environmental education programs.
- Educational groups are required to have a sufficient number of adults to supervise their groups, a minimum of 1 adult per 8 students.

Justification: These wildlife-dependent uses are priority public uses of the National Wildlife Refuge System. Providing opportunities for environmental education and interpretation, would contribute toward fulfilling provisions of the National Wildlife Refuge System Administration Act, as amended in 1997, and one of the goals of the Ash Meadows Refuge (Goal 3, Chapter 3, CCP). Environmental education and interpretation would provide an excellent forum for allowing public access and increasing understanding of Refuge resources. The stipulations outlined above should minimize potential impacts relative to wildlife/human interactions. Based upon impacts described in the Draft Comprehensive Conservation Plan and Environmental Impact Statement (USFWS 2008), it is determined that environmental education and interpretation within the Ash Meadows National Wildlife Refuge, as described herein, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System. These wildlife dependent uses will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

<u>Mandatory Re-Evaluation Date</u>:

__X___ Mandatory 15-year Re-Evaluation (for priority public uses)

_______ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X__ Environmental Impact Statement and Record of Decision

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USFWS. 2008. Desert National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Impact Statement. U.S. Fish and Wildlife Service, Region 8.

Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader
Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional
Director - Refuges: ______________________________ ________________
(Signature) (Date

COMPATIBILITY DETERMINATION

Use: Hunting

Refuge Name: Ash Meadows National Wildlife Refuge, located in Nye County, Nevada.

Establishing and Acquisition Authority(ies): Ash Meadows National Wildlife Refuge (Refuge) was established on June 18, 1984 under authority of the Endangered Species Act of 1973.

Refuge Purpose(s): The purpose of Ash Meadows comes from the Endangered Species Act of 1973:

> *"...to conserve (A) fish or wildlife which are listed as endangered species or threatened species...or (B) plants..."* (16 USC Sec. 1534).

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: Hunting is identified in the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-ee) as a priority use for refuges when it is compatible with the refuge purposes and mission of the Refuge System. An Interim Hunting Plan was published for Ash Meadows NWR in 1986 in order to address the tradition of hunting during the establishment of the Refuge. That document allowed for the continuation of "small game, upland game, and waterfowl hunting as in the past on the Ash Meadows National Wildlife Refuge, Nye County, Nevada for a period of approximately three (3) years or until a master plan is completed."

With the writing of the CCP, Ash Meadows NWR has re-evaluated the hunt opportunities on the Refuge. As a result, Ash Meadows NWR is proposing to allow duck, coot, snipe, dove, and quail hunting on approximately 7,000 acres of land owned in fee-title by the USFWS or, 51% of the Refuge owned in fee-title by the USFWS. Maps and descriptions of the hunt units are included in the Ash Meadows Hunt Management Plan. The hunting program will provide high quality, safe hunting opportunities, and will be carried out consistently with State regulations and Refuge-specific regulations found in 50 CFR 32.47.

The guiding principles of the Refuge System's hunting programs (Service Manual 605 FW 2.4) are to:

- Manage wildlife populations consistent with Refuge System-specific management plans approved after 1997 and, to the extent practicable, State fish and wildlife conservation plans;
- Promote visitor understanding of and increase visitor appreciation for America's natural resources;
- Provide opportunities for quality recreational and educational experiences consistent with criteria describing quality found in 605 FW 1.6;
- Encourage responsible participation in this tradition deeply rooted in America's natural heritage and conservation history; and
- Minimize conflicts with visitors participating in other compatible wildlife-dependent recreational activities.

Though the Refuge does not manage for any of the hunted species specifically, their ability to utilize the Refuge resources is important. The Refuge must ensure that practices within the Refuge boundary do not put populations outside of the Refuge at risk. Therefore, management of the hunt program will be based on good science and the ability to maintain a quality hunt program which, according to the Service Manual 605 FW 1.6:

- Promotes safety of participants, other visitors, and facilities;
- Promotes compliance with applicable laws and regulations and responsible behavior;
- Minimizes or eliminates conflict with fish and wildlife population or habitat goals or objectives in an approved plan;
- Minimizes or eliminates conflicts with other compatible wildlife-dependent recreation;
- Minimizes conflicts with neighboring landowners;
- Promotes accessibility and availability to a broad spectrum of the American people;
- Promotes resource stewardship and conservation;
- Promotes public understanding and increases public appreciation of America's natural resources and our role in managing and conserving these resources;
- Provides reliable/reasonable opportunities to experience wildlife;
- Uses facilities that are accessible to people and blend into natural setting; and
- Uses visitor satisfaction to help define and evaluate programs.

The Refuge has approximately 3,100 annual hunting visits. Hunting success has been harder to determine as few hunters have participated in voluntary reporting of harvests, which has been requested the past two years.

Contact with staff is encouraged, as the Refuge visitor center/office is generally open seven days per week. Although a check station is not a feasible means of maintaining contact with area hunters, they are invited to stop by the visitor center/office for information, to report the success of/displeasure with their hunt experience, and to report illegal activity on the Refuge. Refuge staff also make contact with hunters in parking areas or on the way to hunt areas, when possible.

Attention has been given to where a majority of Refuge hunters go for the various types of allowed hunting. These observations were used in determining which parts of the Refuge are best for hunting, with the least amount of conflicts, allowing for the creation of hunt units. Areas not included in the hunt units either contain sub-prime habitat for hunted species, are in close proximity to private in-holdings with residents, or are high-use areas for non-hunting visitors during the same time periods as hunt seasons. Because endangered plants are managed for by the Refuge, attention had to be given to population distribution of endangered and threatened plant species. In addition, the Refuge is surrounded by Bureau of Land Management lands, all of which are open to hunting, according to State regulations.

Weapons allowed for these hunts include shotguns and non-toxic shot only. The number of hunters per hunt day will not be limited unless, through future evaluation, a carrying capacity has been documented and met. Hunters may use trained retrieving dogs, which must be under the hunter's voice control at all times. Watercraft may not be used in Refuge waters. With the threat of invasive aquatic species, watercraft are no longer allowed for use in Refuge waters.

Availability of Resources: Annual costs are currently maintainable through funding and staff resources available to the Refuge.

The following funding/annual costs (based on FY 2009 costs) would be required to administer and manage hunting activities as described above:

	One-Time Costs	Annual Costs
Printing (brochures, signs, posters, etc)		$5,000
Law Enforcement (permit compliance, access control, protection. Approx. 600 hours.)		$30,000

Monitoring (bird pop. surveys)		$4,400
Maintenance (parking lot, trash cleanup, toilet. Approx. 150 hours.)		$5,100
Road Maintenance (grading)		$7,000
Administrative Services		$3,600
TOTAL		**$55,100**

Anticipated Impacts of Use: Direct effects of hunting include mortality, wounding, and disturbance (De Long 2002). Hunting can alter behavior (i.e. foraging time), population structure, and distribution patterns of wildlife (Owens 1977, Raveling 1979, White-Robinson 1982, Thomas 1983, Bartelt 1987, Madsen 1985, and Cole and Knight 1990). There also appears to be an inverse relationship between the numbers of birds using an area and hunting intensity (DeLong 2002). In Connecticut, lesser scaup were observed to forage less in areas that were heavily hunted (Cronan 1957). In California, the numbers of northern pintails on Sacramento Refuge non-hunt areas increased after the first week of hunting and remained high until the season was over in early January (Heitmeyer and Raveling 1988). Following the close of hunting season, ducks generally increased their use of the hunt area; however, use was lower than before the hunting season began. Human disturbance associated with hunting includes loud noises and rapid movements, such as those produced by shotguns and boats powered by outboard motors. This disturbance, especially when repeated over a period of time, compels waterfowl to change food habits, feed only at night, lose weight, or desert feeding areas (Madsen 1995, Wolder 1993).

These impacts can be reduced by the presence of adjacent sanctuary areas where hunting does not occur, and birds can feed and rest relatively undisturbed. Sanctuaries or non-hunt areas have been identified as the most common solution to disturbance problems caused from hunting (Havera et. al 1992). Prolonged and extensive disturbances may cause large numbers of waterfowl to leave disturbed areas and migrate elsewhere (Madsen 1995, Paulus 1984). In Denmark, hunting disturbance effects were experimentally tested by establishing two sanctuaries (Madsen 1995). Over a 5-year period, these sanctuaries became two of the most important staging areas for coastal waterfowl. Numbers of dabbling ducks and geese increased 4 to 20 fold within the sanctuary (Madsen 1995). Thus, sanctuary and non-hunt areas are very important to minimize disturbance to waterfowl populations to ensure their continued use of the Refuges.

Intermittent hunting can be a means of minimizing disturbance, especially if rest periods in between hunting events are weeks rather than days (Fox and Madsen 1997). It is common for Refuges to manage hunt programs with non-hunt days. At Sacramento National Wildlife Refuge, 3-16 percent of pintails were located on hunted units during non-hunt days, but were almost entirely absent in those same units on hunt days (Wolder 1993). In addition, northern pintails, American wigeon, and northern shovelers decreased time spent feeding on days when hunting occurred on public shooting areas, as compared to non-hunt days (Heitmeyer and Raveling 1988). The intermittent hunting program of three hunt days per week at Sacramento Refuge results in lower pintail densities on hunt areas during non-hunt days than non-hunt areas (Wolder 1993). However, intermittent hunting alone may not always significantly reduce hunting impacts.

Hunting is a highly regulated activity, and generally takes place at specific times and seasons (fall and winter) when the game animals are less vulnerable, reducing the magnitude of disturbance to refuge wildlife. Managed and regulated hunting will not reduce species populations to levels where other wildlife-dependent uses will be affected.

The use of trained retrieving dogs would be permitted and encouraged in all areas open to bird hunting as a means of reducing waste. These dogs would be required to be under voice or physical control at all times. Any hunter who allows his/her dog to disturb wildlife is not well received by other hunters who do not want waterfowl disturbed on the ponds that they are hunting.

Hunting is an appropriate wildlife management tool that can be used to manage wildlife populations. Some wildlife disturbance will occur during the hunting seasons. Proper zoning, regulations, and Refuge seasons will be designated to minimize any negative impacts to wildlife populations using the Refuges. Harvesting hunted species will not result in a substantial decrease in biological diversity on the Refuge.

Conflicts between hunting and other public uses will be minimized by the following:

- Physically separating non-hunting and hunting acres to spatially divide the activities.
- Limiting hunting to certain days of the week, based on input from Refuge Biologists, to allow for resting periods, season openers, and law enforcement availability. Generally, though, at least three (3) days per seven-day period will be available for hunting on the Refuge.
- Posting boundary and hunting areas and maintaining that signage to clearly define the designated hunting areas.
- Allowing vehicle traffic only on designated roads and parking areas. Only pedestrian access will be allowed beyond designated parking areas within a hunt unit.
- Regular field checks by refuge law enforcement officers in order to maintain compliance with regulations.
- Providing information about the refuge hunting program through staff in the visitor center/office, signs, and flyers.

Wildlife populations on the Refuge are able to sustain hunting and support other wildlife-dependent priority uses. To manage the populations to support hunting, the Refuge adopts harvest regulations set by the State within Federal framework guidelines. Regular surveys of hunted species will be maintained and harvest records kept, as possible, to determine if further restrictions on harvest limits need to be made.

By its very nature, hunting has very few positive effects on the target species while the activity is occurring. If hunt programs are managed properly, though, the populations of the target species can benefit overall. Also, hunting can give people a deeper appreciation of wildlife and a better understanding of the importance of conserving wildlife habitat, which ultimately contributes to fulfilling the Refuge System mission.

Though hunting may not have a direct impact on the endangered and threatened fish, wildlife, and plant species on the Refuge, consideration was given to indirect impacts, such as the introduction of exotic and invasive species due to the regular presence of hunters. It has not been determined that hunting significantly impacts these populations, although direct study has not been done on the Refuge.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Bag limits will be based on those set by Nevada Department of Wildlife unless statistically sound surveys indicate a significant drop in target species populations, at which point, at the discretion of the Refuge Manager, more restrictive bag limits will be set, evaluated on an annual basis.

- Hunters are allowed onto the Refuge one (1) hour before sunrise and may stay until one (1) hour after sunset. Actual legal hunt hours are as determined by Nevada Department of Wildlife.
- Weapons must be unloaded and either dismantled or cased while traveling on/through the Refuge in a vehicle.
- Hunters requiring special assistance must contact the Refuge two business days before hunting to obtain any necessary permits or information.
- Hunting over spring pools is not allowed. Hunters must stay 100 feet off outer edge of a spring pool and cannot shoot across it.
- Hunters are not allowed to hunt across boundary lines of the Refuge or its hunt units. Hunters should keep their shots 100 feet inward from boundaries so as to not endanger private residents in or around the Refuge boundaries and to keep from having wounded birds outside of huntable areas.
- Longstreet Spring and Cabin is a popular jumping off point for hunters and a point of interest for non-hunting visitors. Access to hunting areas is encouraged from the Longstreet parking area but, hunters must stay beyond the signage indicating the area closed to hunting immediately around the spring and historic cabin, which are set aside for non-hunting visitors.
- All or any part of the Refuge may be closed to hunting by the Refuge Manager whenever necessary to protect the resources of the area or in the event of an emergency endangering life or property.

Justification: Allowing the continuation of hunting on the Refuge does not materially interfere with or detract from fulfilling the Refuge purpose of protecting endangered and threatened fish, wildlife, or plants nor does it interfere with or detract from fulfilling the Refuge System mission. The interim hunt program has been evaluated and subsequent changes made to reflect the management goals of the Refuge, the availability of resources, and impacts of use on an endangered species refuge.

Mandatory Reevaluation Date:

X___ Mandatory 15-Year Reevaluation (for priority public uses)

_____ Mandatory 10-Year Reevaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

______Categorical Exclusion without Environmental Action Statement

______Categorical Exclusion and Environmental Action Statement

______Environmental Assessment and Finding of No Significant Impact

__X__Environmental Impact Statement and Record of Decision

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Refuge Determination

Refuge Manager: ________________________________ __________________
(Signature) (Date)

Project Leader
Approval: ________________________________ __________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ________________________________ __________________
(Signature) (Date)

Assistant Regional
Director - Refuges: ________________________________ __________________
(Signature) (Date

COMPATIBILITY DETERMINATION

Use: Frog Gigging

Refuge Name: Ash Meadows National Wildlife Refuge, located in Nye County, Nevada.

Establishing and Acquisition Authority(ies): Ash Meadows National Wildlife Refuge (Refuge) was established on June 18, 1984 under authority of the Endangered Species Act of 1973.

Refuge Purpose(s): The purpose of Ash Meadows comes from the Endangered Species Act of 1973:

> *"...to conserve (A) fish or wildlife which are listed as endangered species or threatened species...or (B) plants..."* (16 USC Sec. 1534).

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: The taking of non-native bullfrogs (*Rana catesbeiana*) is usually done by gigging. The State of Nevada addresses the harvest of bullfrogs under their sport fishing regulations, which must be followed for harvesting on the Refuge. General fishing for game fish has never been officially opened on the Refuge; however, game fishing has occurred on the Refuge, at Crystal Reservoir (a.k.a. Amargosa Lake) for many years, until 2001. Although some introduced game fish still exist on the refuge, habitat enhancement and restoration efforts are expected to reduce or eliminate these non-native, predatory fish from Refuge waters. Part of that habitat enhancement includes the removal of aquatic exotic species from the Refuge waters. As a result, the Refuge will continue to be closed to all other forms of fishing.

Availability of Resources:
As the number of visitors expected to perform this activity is relatively small, gigging for bullfrogs should not pose a problem and can be handled with existing Refuge staff. The U.S. Fish and Wildlife Service Law Enforcement Officer stationed at the Refuge patrols and enforces state and federal laws and regulations.

Anticipated Impacts of the Use(s): Shoreline activities, such as human noise, could cause some birds to flush and go elsewhere. Disturbance and destruction of riparian vegetation, bank stability, and water quality may result from high levels of frog gigging activities. Due to the limited number of people attempting this activity, these negative impacts are anticipated to be insignificant when compared to the positive impacts of exotic predator reduction.

These impacts will be minimized further by the following:
- Requiring anyone who wants to gig for bullfrog to obtain a Special Use Permit, and any licensing required by the State of Nevada.
- Providing information about exotics and their impacts on the native resources to permittees.
- Monitor gigging activities to ensure facilities are adequate and wildlife disturbance is minimal.
- Law enforcement patrols will be conducted by refuge officers to enforce state and federal regulations.
- Limit gigging activities during the Migratory Bird Treaty Act critical period (March 15 – August 15) if nesting activity is recorded by Refuge staff. Nesting activity should be monitored at the beginning of this period by Refuge staff annually.

- Provide information about the Refuge gigging program by installing informational signs/kiosks, creating and distributing brochures, and utilizing the Refuge's website.
- Install public use ethics panel, including the importance of not littering and displaying the "pack it in and pack it out" message at appropriate access points.

The Refuge believes that there will be minimal conflicts between bullfrog giggers and the other wildlife-dependent recreational users.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

<u>Determination:</u>

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Refuge staff will submit for Refuge Specific Regulations: Recreational Fishing. We allow recreational fishing for bullfrogs by gigging only in Refuge waters in accordance with State regulations subject to the following conditions:
  - All fishers must obtain a Special Use Permit from the Refuge staff prior to any fishing activity on the Refuge.
- Refuge staff will monitor gigging for bullfrog to ensure that facilities are adequate and disturbance to wildlife continues to be minimal.
- Users will park in signed parking areas, stay on designated roads, and recreate in a manner that prevents erosion or habitat damage.
- Refuge staff will provide information about gigging for bullfrog closures to each permitted user.
- Refuge staff will work to ensure proper signing and to distribute regulations in order to better inform the visiting public.
- Refuge Law Enforcement Officers will patrol regularly to enforce state and federal regulations.

Justification: Harvesting bullfrogs is an appropriate wildlife-dependent recreational activity for this Refuge. Based upon impacts described in the Comprehensive Conservation Plan, it is determined that harvesting bullfrogs within the Ash Meadows National Wildlife Refuge, as described herein, will not materially interfere with or detract from the purposes for which the Refuge was established or mission of the National Wildlife Refuge System.

Fishing is a priority public use listed in the Improvement Act of 1997. Although regular sport fishing is not appropriate on this endangered species Refuge, by facilitating fishing for bullfrogs on the Refuge, the visitors' knowledge and appreciation of fish and wildlife is likely to increase. Harvesting bullfrogs is a form of public stewardship of wildlife and their habitats on the Refuge. Increased public stewardship supports and complements the Service's actions in achieving the Refuge's purposes and the mission of the National Wildlife Refuge System.

The harvesting bullfrogs is a component of the Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada (1990), under recovery action #232 that states "remove non-native competitive/predatory aquatic species." Additionally, a goal of Refuge management is to provide opportunities for wildlife-dependent recreation "that are compatible with, and foster an appreciation and understanding of, Ash Meadows NWR's wildlife and plant communities."

Mandatory Re-Evaluation Date:

__X____ Mandatory 15-year Re-Evaluation (for priority public uses)

_______ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

____ Environmental Assessment and Finding of No Significant Impact

__X___ Environmental Impact Statement and Record of Decision

References Cited

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Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader
Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional
Director - Refuges: ______________________________ ________________
(Signature) (Date

COMPATIBILITY DETERMINATION

Use: Research

Refuge Name: Ash Meadows National Wildlife Refuge, located in Nye County, Nevada.

Establishing and Acquisition Authority(ies): Ash Meadows National Wildlife Refuge (Refuge) was established on June 18, 1984 under authority of the Endangered Species Act of 1973.

Refuge Purpose(s): The purpose of Ash Meadows comes from the Endangered Species Act of 1973:

> *"...to conserve (A) fish or wildlife which are listed as endangered species or threatened species...or (B) plants..."* (16 USC Sec. 1534).

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: There is much that can be learned from field research within the Refuge. Baseline information in the biological, geophysical, hydrological and other fields is still in need of being collected. There are many opportunities for consultants, colleges and universities, and other agencies to obtain permission to conduct critical and noteworthy research on the Refuge.

Two provisions of the National Wildlife Refuge Improvement Act are to "maintain biological integrity, diversity and environmental health" and to conduct "inventory and monitoring." Monitoring and research are an integral part of National Wildlife Refuge management. Plans and actions based on thorough research and consistent monitoring provide an informed approach to management affects on wildlife and habitat.

Currently, research applicants are required to submit a proposal that outlines: (1) objectives of the study; (2) justification for the study; (3) detailed methodology and schedule; (4) potential impacts on Refuge wildlife or habitat, including disturbance (short and long term), injury, or mortality (this includes a description of measures the researcher will take to reduce disturbance or impacts); (5) research personnel required; (6) costs to Refuge, if any; and (7) progress reports and end products (i.e., reports, thesis, dissertations, publications). Research proposals are reviewed by Refuge staff and conservation partners, as appropriate, for approval.

Evaluation criteria currently includes, but is not limited to, the following:

- Research that will contribute to specific Refuge management issues will be given higher priority over other research requests.
- Research that will conflict with other ongoing research, monitoring, or management programs will not be granted.
- Research projects that can be accomplished off-Refuge are less likely to be approved.
- Research which causes undue disturbance or is intrusive will likely not be granted. Level and type of disturbance will be carefully evaluated when considering a request.
- Refuge evaluation will determine if any effort has been made to minimize disturbance through study design, including considering adjusting location, timing, scope, number of permittees, study methods, number of study sites, etc.
- If staffing or logistics make it impossible for the Refuge to monitor researcher activity in a

sensitive area, the research request may be denied, depending on the specific circumstances.
- The length of the project will be considered and agreed upon before approval. Projects will be reviewed annually.

These criteria will also apply to any properties acquired in the future within the approved boundary of the Refuge.

Availability of Resources:
The Refuge receives approximately 10-12 research requests per year. Some permit requests require 4-8 hours to process, others may take as long as 20 hours, depending on the complexity and whether pre-research surveys are required. Refuge operational funds are currently available through the Service budget process to administer this program.

Anticipated Impacts of Use: Use of the Refuge to conduct research will benefit Refuge fish, wildlife, plant populations, and their habitats. Monitoring and research investigations are an important component of adaptive management. Research investigations would be used, in part, to evaluate habitat restoration projects and ecosystem health. Specific restoration and habitat management questions could be addressed in most research investigations to improve habitat and benefit wildlife populations. Standardized monitoring would be used to insure data compatibility for comparisons from across the landscape so that natural resource bottleneck areas could be identified for habitat enhancement and restoration (Elzinga et al. 1998; Ralph et al. 1993).

An expected short-term effect of monitoring and research investigations is that Refuge management activities would be modified to improve habitat and wildlife populations, as a result of new information. Expected long-term and cumulative effects include a growing body of science-based data and knowledge as new and continued monitoring and new research compliments and expands upon previous investigations, as well as an expanded science-based body of data and information from which to draw upon to implement the best Refuge management practices possible. Natural resources inventory, monitoring and research are not only provisions of the Refuge Improvement Act, but they are necessary tools to maintain biological integrity and diversity and environmental health, which are also key provisions of the act.

Some direct and indirect effects would occur through disturbance which is expected with some research activities, especially where researchers are entering sanctuaries. Researcher disturbance could include altering wildlife behavior, going off designated trails, collecting soil and plant samples or trapping and handling wildlife. Most of these effects would be short-term because only the minimum of samples (e.g., water, soils, vegetative litter, plants, macro-invertebrates) are required for identification and/or experimentation Statistical analysis will be encouraged and and captured and marked wildlife will be released. Long-term effects would be eliminated/ reduced because refuge evaluation of research proposals would insure only proposals with adequate safeguards to avoid/minimize impacts would be accepted. Potential impacts associated with research activities would be minimized because sufficient restrictions would be included as part of the study design and researcher activities would be monitored by Refuge staff. Refuge staff would ensure research projects contribute to the enhancement, protection, preservation, and management of native Refuge wildlife populations and their habitats thereby helping the Refuge fulfill the purposes for which it was established, the mission of the National Wildlife Refuge System, and the need to maintain ecological integrity. Additionally, the special use permit would include conditions to further ensure that impacts to wildlife and habitats are avoided and minimized.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination: This program as described is determined to be compatible. Potential impacts of research activities on Refuge resources will be minimized because sufficient stipulations and safeguards will be included in this Compatibility Determination and the required Special Use Permit and because research activities will be monitored by Refuge staff. The refuge manager and biologist would ensure that proposed monitoring and research investigations would contribute to the enhancement, protection, conservation, and management of native Refuge wildlife populations and their habitats thereby helping the Refuge fulfill the purposes for which it was established, the mission of the National Wildlife Refuge System, and the need to maintain ecological integrity, diversity, and environmental health.

_______Use is Not Compatible

___X___Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility: The criteria for evaluating a research proposal, outlined in the Description of Use section above, will be used when determining whether a proposed study will be approved on the Refuge. If proposed research methods are evaluated and determined to have potential adverse impacts on refuge wildlife or habitat, then the refuge would determine the utility and need of such research to conservation and management of refuge wildlife and habitat. If the need was demonstrated by the research permittee and accepted by the refuge, then measures to minimize potential impacts (e.g., reduce the numbers of researchers entering an area, restrict research in specified areas) would be developed and included as part of the study design and on the SUP. SUPs will contain specific terms and conditions that the researcher(s) must follow relative to activity, location, duration, seasonality, etc. to ensure continued compatibility. All Refuge rules and regulations must be followed unless alternatives are otherwise accepted in writing by Refuge management.

All information, reports, data, collections, or documented sightings and observations, that are obtained as a result of this permit are the property of the Service and can be accessed by the Service at any time from the permittee at no cost, unless specific written arrangements are made to the contrary. The Refuge also requires the submission of annual or final reports and any/all publications associated with the work done on the Refuge. Each SUP may have additional criteria. Each SUP will also be evaluated individually to determine if a fee will be charged and for the length of the permit.

Extremely sensitive wildlife habitat areas would be avoided unless sufficient protection from research activities (i.e., disturbance, collection, capture and handling) is implemented to limit the area and/or wildlife potentially impacted by the proposed research. Where appropriate, some areas may be temporarily/seasonally closed so that research would be permitted when impacts to wildlife and habitat are less of a concern. Research activities will be modified to avoid harm to sensitive wildlife and habitat when unforeseen impacts arise.

Refuge staff will monitor researcher activities for potential impacts to the refuge and for compliance with conditions on the SUP. The refuge manager may determine that previously approved research and special use permits be terminated due to observed impacts. The refuge manager will also have the ability to cancel a SUP if the researcher is out of compliance with the stated conditions.

Justification: This program as described is determined to be compatible. Based upon impacts described in the Comprehensive Conservation Plan and Environmental Impact Statement (USFWS 2008), it is determined that research within the Refuge, as described herein, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System. Refuge monitoring and research will directly benefit and support refuge goals, objectives and management plans and activities. Fish, wildlife, plants and their habitat will improve through the application of knowledge gained from monitoring and research. Biological integrity, diversity and environmental health would benefit from scientific research conducted on natural resources at the refuge. The wildlife-dependent, priority public uses (wildlife viewing and photography, environmental education and interpretation, fishing and hunting) would also benefit as a result of increased biodiversity and wildlife and native plant populations from improved restoration and management plans and activities associated with monitoring and research investigations which address specific restoration and management questions.

Mandatory Re-Evaluation Date:

____X___ Mandatory 15-year Re-Evaluation (for priority public uses)

________ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X_ Environmental Impact Statement and Record of Decision

References Cited

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Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional Director - Refuges: ______________________________ ________________
(Signature) (Date

COMPATIBILITY DETERMINATION

Use: Geocaching (Virtual Only)

Refuge Name: Ash Meadows National Wildlife Refuge, located in Nye County, Nevada.

Establishing and Acquisition Authority(ies): Ash Meadows National Wildlife Refuge (Refuge) was established on June 18, 1984 under authority of the Endangered Species Act of 1973.

Refuge Purpose(s): The purpose of Ash Meadows comes from the Endangered Species Act of 1973:

> *"...to conserve (A) fish or wildlife which are listed as endangered species or threatened species...or (B) plants..."* (16 USC Sec. 1534).

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: Geocaching is a game of adventure using handheld Geographic Positioning System (GPS) devices. The handhelds are used to locate caches of "prizes", which are found using coordinates points only. Often a cache is a container of some sort filled with treasures and a log, among other things. The idea is that "cachers" obtain coordinates to a cache, use their GPS handheld to make their way to the cache, record their adventure, take a prize and leave a prize. The placement of these caches, depending on the location, can require digging into the ground, moving rocks or vegetation, or other alterations to the area in order to somewhat hide the cache. This is an aspect of the caching that gives federal land managers pause. An ideal alternative to the physical cache is a virtual cache, or waypoint cache.

A waypoint cache uses existing landmarks and the "cache" is held at a manned site. The "cachers" have to visit a starting landmark (determined by given coordinates). Then, the site manager can have the "cachers" follow somewhat of a scavenger hunt, going from landmark to landmark, using clues or additional coordinate points until a final clue is given, leading the "cachers" to the manned site (an office, or the like). "Cachers" can then pick up their prize from the manned site, leave a prize, if they like, and write in the virtual cache log. The challenge of using the GPS handheld can be just as great as, if not more than, that of looking for a physical cache and without the impact on areas outside of the normal public use areas.

Availability of Resources:
The Refuge does not receive many requests for geocaching, physical or virtual ones. Setting up a waypoint geocache may take 2-3 hours. Law enforcement may require some time to ensure waypoint geocaches are not followed up with physical ones. Refuge operational funds are currently available through the Service budget process to administer this program.

Anticipated Impacts of Use: Use of the Refuge for virtual geocaching will benefit Refuge fish, wildlife, plant populations, and their habitats because it will introduce a different audience to the National Wildlife Refuge System and its purpose.

Geocachers, as a community, are warned against establishing caches, physical or virtual, on federal public lands without permission of the land manager. That being said, there have been cases where physical caches have been found on National Wildlife Refuges that were not authorized. The same could be true for waypoint caches but, the impact of that would be less so on the Refuge. Law enforcement would likely concentrate on unauthorized physical sites.

In general, impacts from virtual geocaching would be similar to those described in the wildlife observation and photography compatibility determination. There could be an increased impact to the public use landmarks used in a waypoint cache. Damage could occur that would not otherwise be realized for a much longer period of time with regular use. This impact may be minimized with regular maintenance of the area. A regular presence of staff on the Refuge may minimize vandalism of landmark sites, as well.

The greatest impact of allowing a waypoint cache would be the staff time required to set up the landmark route and the cache.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination: This program as described is determined to be compatible. Virtual geocaching would contribute to the enhancement, protection, conservation, and management of native Refuge wildlife populations and their habitats thereby helping the Refuge fulfill the purposes for which it was established, the mission of the National Wildlife Refuge System, and the need to maintain ecological integrity, diversity, and environmental health.

_______Use is Not Compatible

___X___Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Only virtual or waypoint geocaches will be authorized by use of a Special Use Permit or established by Refuge Staff.
- Physical geocaches will not be authorized under any circumstance and violators may be fined, at the discretion of the Refuge Law Enforcement Officer.
- Virtual or waypoint geocaches must be established in partnership with Refuge staff to ensure landmarks used are acceptable public use sites.
- The final cache should be maintained at the Refuge headquarters and information about the Refuge will accompany all cache prizes taken by participants.
- No other collecting from the Refuge will be authorized.

Justification: Waypoint geocaching will indirectly benefit and potentially create support for refuge goals, objectives, management plans and activities. It will offer added opportunities to introduce visitors to the Refuge, its purposes, and its mission. Waypoint geocaching will likely open resource-dependent connections between geocachers and Refuges. The impact on the resource and staff will be minimal with measurable returns. Virtual geocaching may also be used as an education tool, introducing local students to GPS technologies in a real-world environment while broadening their knowledge of the Refuge and their relation to it.

Mandatory Re-Evaluation Date:

_______ Mandatory 15-year Re-Evaluation (for priority public uses)

___X___ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X_ Environmental Impact Statement and Record of Decision

Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader
Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional
Director - Refuges: ______________________________ ________________
(Signature) (Date)

COMPATIBILITY DETERMINATION

Use: Wildlife Observation and Photography

Refuge Name: Desert National Wildlife Refuge (Refuge), located in Clark and Lincoln counties, Nevada.

Establishing and Acquisition Authority(ies): Desert National Wildlife Range was established by Executive Order Number 7373 of President Franklin D. Roosevelt on May 20, 1936. Originally named the Desert Game Range and under the joint administration of the Fish and Wildlife Service and the Bureau of Land Management, it contained a total of 2,250,000 acres, including lands both north and south of U.S. Highway 95. Public Land Order 4079, issued on August 26, 1966 and corrected on September 23, 1966, revoked Executive Order 7373, changed the name to Desert National Wildlife Range, reduced its size to 1,588,000 acres, and transferred sole administration to the Fish and Wildlife Service. Between 1935 and 1989, an additional 760 acres in the vicinity of Corn Creek were acquired under various authorities, including the Migratory Bird Conservation Act, Endangered Species Act, and Refuge Recreation Act. The Military Lands Withdrawal Act of 1999 (Public Law 106-65) transferred primary jurisdiction of 110,000 acres of bombing impact areas on the Refuge from the Service to Department of Defense. In 2002, the Clark County Conservation of Public Land and Natural Resources Act (Public Law 107-282) transferred 26,433 acres of BLM land adjacent to Desert NWR's east boundary to the Service. In 2004, the Lincoln County Conservation, Recreation, and Development Act (Public Law 108-424) transferred approximately 8,382 acres the eastern boundary of Desert NWR to the BLM for use as a utility corridor. In addition, 8,503 acres of BLM-administered land adjacent to the northeast corner of the Refuge were transferred to the Service.

Refuge Purpose(s):

- For lands acquired under Public Land Order 4079, dated August 31, 1966, the purpose is ". . . *for the protection, enhancement, and maintenance of wildlife resources, including bighorn sheep.*"
- For lands acquired under 16 USC 715d (Migratory Bird Conservation Act): "*…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…*".
- For lands acquired under 16 U.S.C. § 1534 (Endangered Species Act of 1973) the purpose is ". . . *to conserve (a) fish or wildlife which are listed as endangered species or threatened species . . . or (b) plants.*"
- For lands acquired under 16 U.S.C. § 460k-460l (Refuge Recreation Act) the purpose is ". . . *suitable for - (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species . . .* "

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: The National Wildlife Refuge System Improvement Act of 1997 identifies wildlife observation and photography as well as hunting, fishing, interpretation, and environmental education as wildlife dependent public uses for NWR's. As two of the six priority public uses of the Refuge system, these uses are to be encouraged when compatible with the purposes of the Refuge.
Desert Refuge is open to the public year-round for wildlife observation and photography. Currently, there are nearly 70,000 visits to the Refuge annually. Typical use is by individuals, family groups, school groups, and large groups during Refuge-sponsored special events. The majority of this use

occurs at Corn Creek. Current facilities include a wildlife observation/interpretive trail and the Pahrump poolfish refugium viewing area.

Wildlife observation also occurs throughout the eastern portion of the Refuge, often in association with other uses, including: backpacking and hiking; camping; recreational use of pack and saddle stock; hunting; and pine nut gathering. See the compatibility determinations for these uses for more information.

All public access to the western portion of the Desert Refuge is prohibited by federal law. This area, part of the U.S. Air Force's Nevada Test and Training Range, is used as a bombing, gunnery and aerial warfare training facility.

Under alternative C of the CCP/EIS (the preferred alternative), the Service would continue to maintain visitor facilities that facilitate wildlife observation and photography, including roads, trails, and parking, camping, and picnic areas. In addition, the Service proposes to make several facility improvements to enhance opportunities for wildlife observation and photography, improve public safety, and minimize impacts on the Refuge's resources.

At Corn Creek, the Service proposes to construct an additional wheel-chair accessible interpretive trail which will tie in to the existing trail system and the new visitor's center and offices. A photography blind and new interpretive signs are also planned for this area. The Service also proposes to develop bighorn sheep web cam which will stream images to the new visitor center.

In addition, the Service proposes to improve Alamo, Mormon Well, and Gass Peak Roads to ensure the public has continued assess to the Refuge. Post and cable fencing would be installed at designated parking turnouts along these three roads to prevent resource damage. In addition, the Service would map existing trails on Gass Peak and the Sheep Range with GPS and develop and distribute a trail guide for the public.

With these improvements, the construction of the visitor center and population growth in the Las Vegas Area, visitation to the Refuge is expected to increase but not dramatically.

Availability of Resources: The following funding/annual costs (based on FY 2009 costs) would be required to administer and manage the activities as described above:

	One-time Costs	Annual Costs
Managing current use		
Administration		500
Maintain visitor facilities		2,000
Maintain and replace regulatory, directional, and interpretive signs		1,000
Maintain roads		2,000
Improving/Enhancing Use		
Improve Mormon Well and Gass Peak Roads to "fair" condition	10,000,000	
Repair Alamo Road		
Plan and construct photography blinds		3,000
TOTAL	**10,000,000**	**8,500**

Anticipated Impacts of Use: Once considered "non-consumptive", it is now recognized that wildlife observation and wildlife photography can negatively impact wildlife by altering wildlife behavior, reproduction, distribution, and habitat (Purdy et al. 1987, Knight and Cole 1995).

Purdy et al. (1987) and Pomerantz et al. (1988) described six categories of impacts to wildlife as a result of visitor activities. They are:

1) Direct mortality: immediate, on-site death of an animal;
2) Indirect mortality: eventual, premature death of an animal caused by an event or agent that predisposed the animal to death;
3) Lowered productivity: reduced fecundity rate, nesting success, or reduced survival rate of young before dispersal from nest or birth site;
4) Reduced use of refuge: wildlife not using the refuge as frequently or in the manner they normally would in the absence of visitor activity;
5) Reduced use of preferred habitat on the refuge: wildlife use is relegated to less suitable habitat on the refuge due to visitor activity; and
6) Aberrant behavior/stress: wildlife demonstrating unusual behavior or signs of stress that are likely to result in reduced reproductive or survival rates.

Individual animals may be disturbed by human contact to varying degrees. Human activities on trails can result in direct effects on wildlife through harassment, a form of disturbance that can cause physiological effects, behavioral modifications, or death (Smith and Hunt 1995). Many studies have shown that birds can be impacted from human activities on trails when they are disturbed and flushed from feeding, resting, or nesting areas. Flushing, especially repetitive flushing, can strongly impact habitat use patterns of many bird species. Flushing from an area can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Migratory birds are observed to be more sensitive than resident species to disturbance (Klein 1989).

Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976), colonial nesting species (Buckley and Buckley 1976), and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people. In addition, for many passerine species, primary song occurrence and consistency can be impacted by a single visitor (Gutzwiller et al. 1994). In areas where primary song was affected by disturbance, birds appeared to be reluctant to establish nesting territories (Reijnen and Foppen 1994).

Depending on the species (especially migrants vs. residents), some birds may habituate to some types of recreation disturbance and either are not disturbed or will immediately return after the initial disturbance (Hockin et al. 1992; Burger et al. 1995; Knight & Temple 1995; Madsen 1995; Fox & Madsen 1997). Rodgers & Smith (1997) calculated buffer distances that minimize disturbance to foraging and loafing birds based on experimental flushing distances for 16 species of waders and shorebirds. They recommended 100 meters as an adequate buffer against pedestrian traffic, however, they suggest this distance may be reduced if physical barriers (e.g., vegetation screening) are provided, noise levels are reduced, and traffic is directed tangentially rather than directly toward birds. Screening may not effectively buffer noise impacts, thus visitors should be educated on the effects of noise and noise restrictions should be enforced (Burger 1981, 1986; Klein 1993; Bowles 1995; Burger & Gochfeld 1998). Seasonally restricting or prohibiting recreation activity may be necessary during spring and fall migration to alleviate disturbance to migratory birds (Burger 1981, 1986; Boyle & Samson 1985; Klein et al. 1995; Hill et al. 1997).

Of the wildlife observation techniques, wildlife photographers tend to have the largest disturbance impacts (Klein 1993, Morton 1995, Dobb 1998). While wildlife observers frequently stop to view species, wildlife photographers are more likely to approach wildlife (Klein 1993). Even slow approach by wildlife photographers tends to have behavioral consequences to wildlife species (Klein 1993). Other impacts include the potential for photographers to remain close to wildlife for extended periods of time, in an attempt to habituate the wildlife subject to their presence (Dobb 1998) and the tendency of casual photographers, with low-power lenses, to get much closer to their subjects than other activities would require (Morton 1995), including wandering off trails. This usually results in increased disturbance to wildlife and habitat, including trampling of plants. Klein (1993) recommended that refuges provide observation and photography blinds to reduce disturbance of waterbirds when approached by visitors.

Education is critical for making visitors aware that their actions can have negative impacts on birds, and will increase the likelihood that visitors will abide by restrictions on their actions. For example, Klein (1993) demonstrated that visitors who spoke with refuge staff or volunteers were less likely to disturb birds. Increased surveillance and imposed fines may help reduce visitor caused disturbance (Knight & Gutzwiller 1995). Monitoring is recommended to adjust management techniques over time, particularly because it is often difficult to generalize about the impacts of specific types of recreation in different environments. Local and site -specific knowledge is necessary to determine effects on birds and to develop effective management strategies (Hockin et al. 1992; Klein et al. 1995; Hill et al. 1997).

The construction and maintenance of trails, photography blinds, and parking lots will have minor impacts on soils and vegetation around the trails. This could include an increased potential for erosion, soil compaction (Liddle 1975), reduced seed emergence (Cole and Landres 1995), alteration of vegetative structure and composition, and sediment loading (Cole and Marion 1988). However, by concentrating foot traffic onto the trails other habitats on the Refuge will remain undisturbed.

Disturbance of wildlife is the primary concern regarding these uses. Disturbance to wildlife, such as the flushing of feeding, resting, or nesting birds, is inherent to these activities. There is some temporary disturbance to wildlife due to human activities on trails (hiking, bird watching) however, the disturbance is generally localized and will not adversely impact overall populations. Increased facilities and visitation would cause some displacement of habitat and increase some disturbance to wildlife, although this is expected to be minor given the size of the Refuge and by avoiding or minimizing intrusion into important wildlife habitat.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Regulations and wildlife friendly behavior (e.g., requirements to stay on designated trails, dogs must be kept on a leash, etc.) will be described in brochures and posted at the Visitor Center.
- Regulatory and directional signs will clearly mark areas closed to the public and designated routes of travel.
- Maps and public use information will be available at the visitor contact station and kiosks.
- Refuge staff will conduct regular surveys of public activities on the refuge. The data will be analyzed and used by the refuge manager to develop future modifications if necessary to ensure compatibility of the wildlife observation and photography programs.
- Use will be directed to public use facilities which are not in or near sensitive areas.
- Interpretive presentations and products will continue to include messages on minimizing disturbance to wildlife.
- Commercial photography would require a Special Use Permit.

Justification: These wildlife-dependent uses are priority public uses of the National Wildlife Refuge System. Providing opportunities for wildlife observation and photography would contribute toward fulfilling provisions of the National Wildlife Refuge System Administration Act, as amended in 1997, and one of the goals of the Desert Refuge (Goal 4, Appendix F, CCP/EIS). Wildlife observation and photography would provide an excellent forum for allowing public access and increasing understanding of Refuge resources. The stipulations outlined above should minimize potential impacts relative to wildlife/human interactions. Based upon impacts described in the Draft Comprehensive Conservation Plan and Environmental Impact Statement (USFWS 2008), it is determined that wildlife observation and photography within the Desert National Wildlife Refuge, as described herein, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System. In our opinion, these wildlife dependent uses will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Re-Evaluation Date:

__X__ Mandatory 15-year Re-Evaluation (for priority public uses)

_____ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X__ Environmental Impact Statement and Record of Decision

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Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional Director - Refuges: ______________________________ ________________
(Signature) (Date)

COMPATIBILITY DETERMINATION

Use: Environmental Education and Interpretation

Refuge Name: Desert National Wildlife Refuge (Refuge), located in Clark and Lincoln counties, Nevada.

Establishing and Acquisition Authority(ies): Desert National Wildlife Range was established by Executive Order Number 7373 of President Franklin D. Roosevelt on May 20, 1936. Originally named the Desert Game Range and under the joint administration of the Fish and Wildlife Service and the Bureau of Land Management, it contained a total of 2,250,000 acres, including lands both north and south of U.S. Highway 95. Public Land Order 4079, issued on August 26, 1966 and corrected on September 23, 1966, revoked Executive Order 7373, changed the name to Desert National Wildlife Range, reduced its size to 1,588,000 acres, and transferred sole administration to the Fish and Wildlife Service. Between 1935 and 1989, an additional 760 acres in the vicinity of Corn Creek were acquired under various authorities, including the Migratory Bird Conservation Act, Endangered Species Act, and Refuge Recreation Act. The Military Lands Withdrawal Act of 1999 (Public Law 106-65) transferred primary jurisdiction of 110,000 acres of bombing impact areas on the Refuge from the Service to Department of Defense. In 2002, the Clark County Conservation of Public Land and Natural Resources Act (Public Law 107-282) transferred 26,433 acres of BLM land adjacent to Desert NWR's east boundary to the Service. In 2004, the Lincoln County Conservation, Recreation, and Development Act (Public Law 108-424) transferred approximately 8,382 acres the eastern boundary of Desert NWR to the BLM for use as a utility corridor. In addition, 8,503 acres of BLM-administered land adjacent to the northeast corner of the Refuge were transferred to the Service.

Refuge Purpose(s): Desert National Wildlife Refuge purposes include:

- For lands acquired under Public Land Order 4079, dated August 31, 1966, the purpose is ". . . *for the protection, enhancement, and maintenance of wildlife resources, including bighorn sheep.*"
- For lands acquired under 16 USC 715d (Migratory Bird Conservation Act): "*…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…*".
- For lands acquired under 16 U.S.C. § 1534 (Endangered Species Act of 1973) the purpose is ". . . *to conserve (a) fish or wildlife which are listed as endangered species or threatened species . . . or (b) plants.*"
- For lands acquired under 16 U.S.C. § 460k-460l (Refuge Recreation Act) the purpose is ". . . *suitable for - (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species . . .* "

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: The National Wildlife Refuge System Improvement Act of 1997 identifies wildlife observation and photography as well as hunting, fishing, interpretation, and environmental education as wildlife dependent public uses for NWRs. As two of the six priority public uses of the Refuge system, these uses are to be encouraged when compatible with the purposes of the Refuge. The public and communities desire more opportunities for these uses. Environmental education and interpretation are considered together in this compatibility determination because they both are wildlife-dependent, non-consumptive uses and many elements of these programs are similar.

The Service allows the year-round access to designated open areas for environmental education and interpretation. Desert Refuge is open to the public for environmental education and interpretation daily from sunrise to sunset. Currently, there are nearly 70,000 visits to the Refuge annually. Most of these visits are to Corn Creek Field Station. Typical use is by individuals, family groups, school groups, and large groups during Refuge-sponsored special events.

Under alternative C of the CCP (the preferred alternative), the Refuge would continue to maintain visitor facilities, including parking, camping, and picnic areas, and they would replace regulatory, directional, and interpretive signs along designated roads and trails and at the refugium, as needed. Volunteers, including Southern Nevada Interpretive Association members, would continue to be utilized at the visitor contact station to provide interpretation and guidance for visitors.

In addition, the Service would expand and improve the refuge environmental education program. A new visitor center with interpretive and educational displays would be constructed at Corn Creek. Interpretive panels and signs would be replaced along trails and at the refugium and installed at the designated entry points. The Service would expand the volunteer program on the Refuge with a target of staffing the visitor center full-time during peak use periods and for 4 hours per day during lower-use periods.

Interpretation efforts would be expanded through the development of cultural resources materials in coordination with local Native American tribes. The Service would also develop a live “sheep cam” at water sources to educate the public on the bighorn sheep. The video would be streamed through the web site and at the visitor contact station for viewing by the public.

Both of these public uses are dependent upon establishing boardwalks and vehicle parking areas in the Refuge. An estimated 70,000 annual visits will be to participate in these activities. These uses are identified and discussed in detail in Chapter 3 of the CCP (USFWS 2008) and are incorporated by reference.

Availability of Resources: The following funding/annual costs (based on FY 2009 costs) would be required to administer and manage the activities as described above:

	One-time Costs	Annual Costs
Administration		1,200
Maintain visitor center		83,000
Develop environmental education and interpretive materials		2,000
TOTAL		**86,200**

Anticipated Impacts of Use: Once considered “non-consumptive”, it is now recognized that activities such as environmental education and interpretation can negatively impact wildlife by altering wildlife behavior, reproduction, distribution, and habitat (Purdy et al. 1987, Knight and Cole 1995).

Purdy et al. (1987) and Pomerantz et al. (1988) described six categories of impacts to wildlife as a result of visitor activities. They are:

1) Direct mortality: immediate, on-site death of an animal;
2) Indirect mortality: eventual, premature death of an animal caused by an event or agent that predisposed the animal to death;
3) Lowered productivity: reduced fecundity rate, nesting success, or reduced survival rate of young before dispersal from nest or birth site;
4) Reduced use of refuge: wildlife not using the refuge as frequently or in the manner they normally would in the absence of visitor activity;

5) Reduced use of preferred habitat on the refuge: wildlife use is relegated to less suitable habitat on the refuge due to visitor activity; and
6) Aberrant behavior/stress: wildlife demonstrating unusual behavior or signs of stress that are likely to result in reduced reproductive or survival rates.

Individual animals may be disturbed by human contact to varying degrees. Human activities on trails can result in direct effects on wildlife through harassment, a form of disturbance that can cause physiological effects, behavioral modifications, or death (Smith and Hunt 1995). Many studies have shown that birds can be impacted from human activities on trails when they are disturbed and flushed from feeding, resting, or nesting areas. Flushing, especially repetitive flushing, can strongly impact habitat use patterns of many bird species. Flushing from an area can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Migratory birds are observed to be more sensitive than resident species to disturbance (Klein 1989).

Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976) and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people. In addition, for many passerine species, primary song occurrence and consistency can be impacted by a single visitor (Gutzwiller et al. 1994). In areas where primary song was affected by disturbance, birds appeared to be reluctant to establish nesting territories (Reijnen and Foppen 1994).

Depending on the species (especially migrants vs. residents), some birds may habituate to some types of recreation disturbance and either are not disturbed or will immediately return after the initial disturbance (Hockin et al. 1992; Burger et al. 1995; Knight & Temple 1995; Madsen 1995; Fox & Madsen 1997). Rodgers & Smith (1997) calculated buffer distances that minimize disturbance to foraging and loafing birds based on experimental flushing distances for 16 species of waders and shorebirds. They recommended 100 meters as an adequate buffer against pedestrian traffic, however, they suggest this distance may be reduced if physical barriers (e.g., vegetation screening) are provided, noise levels are reduced, and traffic is directed tangentially rather than directly toward birds. Screening may not effectively buffer noise impacts, thus visitors should be educated on the effects of noise and noise restrictions should be enforced (Burger 1981, 1986; Klein 1993; Bowles 1995; Burger & Gochfeld 1998). Seasonally restricting or prohibiting recreation activity may be necessary during spring and fall migration to alleviate disturbance to migratory birds (Burger 1981, 1986; Boyle & Samson 1985; Klein et al. 1995; Hill et al. 1997).

Education is critical for making visitors aware that their actions can have negative impacts on birds, and will increase the likelihood that visitors will abide by restrictions on their actions. For example, Klein (1993) demonstrated that visitors who spoke with refuge staff or volunteers were less likely to disturb birds. Increased surveillance and imposed fines may help reduce visitor caused disturbance (Knight & Gutzwiller 1995). Monitoring is recommended to adjust management techniques over time, particularly because it is often difficult to generalize about the impacts of specific types of recreation in different environments. Local and site -specific knowledge is necessary to determine effects on birds and to develop effective management strategies (Hockin et al. 1992; Klein et al. 1995; Hill et al. 1997). Informed management decisions coupled with sufficient public education could do much to mitigate disturbance effects of wildlife-dependent recreations (Purdy et al 1987).

The disturbance by environmental education activities is considered to be of minimal impact because: (1) the total number of students permitted through the reservation system is limited to 100 per day; (2) students and teachers will be instructed in trail etiquette and the best ways to view wildlife with minimal disturbance; (3) education groups will be required to have a sufficient number of adults to supervise the group; (4) trail design will provide adequate cover for wildlife; and (5) observation areas and scopes are provided to view wildlife at a distance which reduces disturbance.

Education staff will coordinate with biologists regarding activities associated with restoration or monitoring projects to ensure that impacts to both wildlife and habitat are minimal. As with any restoration and monitoring activities conducted by Refuge personnel, these activities conducted by students would be at a time and place where the least amount of disturbance would occur.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Participants in the Refuge's environmental education program will be restricted to established trails, the visitor contact station, and other designated sites.
- All groups using the Refuge for environmental education will be required to make reservations in advance through the Refuge office. This process, which takes the place of a Special Use Permit (SUP), allows refuge staff to manage the number and location of visitors for each unit. There is a current refuge policy that educational groups are not charged a fee or required to have a SUP. A daily limit of 100 students participating in the education program will be maintained through this reservation system. Efforts will be made to spread out use by large groups while reservations are made, reducing disturbance to wildlife and over-crowding of Refuge facilities during times of peak demand.
- Trail etiquette including ways to reduce wildlife disturbance will be discussed with teachers during orientation workshops and with students upon arrival during their welcome session. On the Refuge, the teacher(s) is responsible for ensuring that students follow required trail etiquette.
- Refuge biologists and public use specialists will conduct regular surveys of public activities on the refuge. The data will be analyzed and used by the refuge manager to develop future modifications if necessary to ensure compatibility of environmental education programs.
- Educational groups are required to have a sufficient number of adults to supervise their groups, a minimum of 1 adult per 12 students.

Justification: These wildlife-dependent uses are priority public uses of the National Wildlife Refuge System. Providing opportunities for environmental education and interpretation would contribute toward fulfilling provisions of the National Wildlife Refuge System Administration Act, as amended in 1997, and one of the goals of the Desert Refuge (Goal 4, Chapter 3, CCP). Environmental education and interpretation would provide an excellent forum for allowing public access and increasing understanding of Refuge resources. Environmental education and interpretation activities generally support Refuge purposes and impacts can largely be minimized (Goff et al. 1988). The minor resource impacts attributed to these activities are generally outweighed by the benefits gained by educating present and future generations about refuge resources. Environmental education is a public use management tool used to develop a resource protection ethic within society. While it targets school age children, it is not limited to this group. This tool allows us to educate refuge visitors about endangered and threatened species management, wildlife management and ecological principles and communities. A secondary benefit of environmental education is that it instills an 'ownership' or 'stewardship' ethic in visitors and most likely reduces vandalism, littering and poaching; it also strengthens service visibility in the local community.

The stipulations outlined above should minimize potential impacts relative to wildlife/human interactions. Based upon impacts described in the Comprehensive Conservation Plan and Environmental Impact Statement (USFWS 2008), it is determined that environmental education and interpretation within the Desert National Wildlife Refuge, as described herein, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System. In our opinion, these wildlife dependent uses will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Re-Evaluation Date :

__X___ Mandatory 15-year Re-Evaluation, Date will be provided in Final EIS/CCP (for priority public uses)

_______ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X__ Environmental Impact Statement and Record of Decision

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Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional Director - Refuges: ______________________________ ________________
(Signature) (Date)

COMPATIBILITY DETERMINATION

Use: Hunting (desert bighorn sheep)

Refuge Name: Desert National Wildlife Refuge (Refuge), located in Clark and Lincoln counties, Nevada.

Establishing and Acquisition Authority(ies): Desert National Wildlife Range was established by Executive Order Number 7373 of President Franklin D. Roosevelt on May 20, 1936. Originally named the Desert Game Range and under the joint administration of the Fish and Wildlife Service and the Bureau of Land Management, it contained a total of 2,250,000 acres, including lands both north and south of U.S. Highway 95. Public Land Order 4079, issued on August 26, 1966 and corrected on September 23, 1966, revoked Executive Order 7373, changed the name to Desert National Wildlife Range, reduced its size to 1,588,000 acres, and transferred sole administration to the Fish and Wildlife Service. Between 1935 and 1989, an additional 760 acres in the vicinity of Corn Creek were acquired under various authorities, including the Migratory Bird Conservation Act, Endangered Species Act, and Refuge Recreation Act. The Military Lands Withdrawal Act of 1999 (Public Law 106-65) transferred primary jurisdiction of 110,000 acres of bombing impact areas on the Refuge from the Service to Department of Defense. In 2002, the Clark County Conservation of Public Land and Natural Resources Act (Public Law 107-282) transferred 26,433 acres of BLM land adjacent to Desert NWR's east boundary to the Service. In 2004, the Lincoln County Conservation, Recreation, and Development Act (Public Law 108-424) transferred approximately 8,382 acres the eastern boundary of Desert NWR to the BLM for use as a utility corridor. In addition, 8,503 acres of BLM-administered land adjacent to the northeast corner of the Refuge were transferred to the Service.

Refuge Purpose(s):

- For lands acquired under Public Land Order 4079, dated August 31, 1966, the purpose is ". . . *for the protection, enhancement, and maintenance of wildlife resources, including bighorn sheep.*"
- For lands acquired under 16 USC 715d (Migratory Bird Conservation Act): "*…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…*".
- For lands acquired under 16 U.S.C. § 1534 (Endangered Species Act of 1973) the purpose is ". . . *to conserve (a) fish or wildlife which are listed as endangered species or threatened species . . . or (b) plants.*"
- For lands acquired under 16 U.S.C. § 460k-460l (Refuge Recreation Act) the purpose is ". . . *suitable for - (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species . . .*"

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: Hunting is identified in the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-ee) as a priority use for refuges when it is compatible with the refuge purposes and mission of the Refuge System. As a result, the Service is proposing to continue desert bighorn sheep hunting on approximately 1.37 million acres of Desert Refuge. Camping often occurs in association with hunting. See the compatibility determinations for camping for more information.

The hunting program will provide high quality, safe, and cost-effective hunting opportunities, and will be carried out consistent with State regulations. The guiding principles of the Refuge System's hunting programs (Service Manual 605 FW 2) are to:

- Manage wildlife populations consistent with Refuge System-specific management plans approved after 1997 and, to the extent practicable, State fish and wildlife conservation plans;
- Promote visitor understanding of and increase visitor appreciation for America's natural resources;
- Provide opportunities for quality recreational and educational experiences consistent with criteria describing quality found in 605 FW 1.6;
- Encourage participation in this tradition deeply rooted in America's natural heritage and conservation history; and
- Minimize conflicts with visitors participating in other compatible wildlife-dependent recreational activities.

The Refuge's hunting program will comply with the Code of Federal Regulations Title 50, 32.1 and be managed in accordance with Service Manual 605 FW2, Hunting and applicable State regulations.

The sheep hunt program on Desert NWR began in 1954 and has continued each season except one (1955). The hunt program is currently administered by Nevada Department of Wildlife (NDOW). Six hunting units comprising portions of six mountain ranges have been established by NDOW, within Desert NWR (Figure 1). A specific number if permits are issued each season based on the size and composition of the sheep population and the age structure of the ram segment in each unit. Two separate hunts are conducted each year on Desert NWR with the first starting mid-November and ending mid-December. This coincides with the annual state-wide desert bighorn sheep hunt. This hunt occurs in units 283, 284, and 286. The second hunt starts mid December and continues to the first of January within units 280, 281, and 282. These units lie within the Nevada Test and Training Range and as regulated by the Memorandum of Understanding between the Air Force and the Service; military use is suspended for the duration of the hunting period. Table 1 shows the opening and closing dates and quotas for each unit during the 2007 season.

Table 1. 2007 desert bighorn sheep hunt season dates and quotas.

Hunt Unit	2007 Season Dates	2007 Quotas
280	Dec 15 - Jan 1	3
281	Dec 15 - Jan 1	4
282	Dec 15 - Jan 1	2
283, 284	Nov 10 - Dec 10	4
286	Nov 10 - Dec 10	2

The number of permits issued each season for each hunt is equal to 8% of the ram population estimate. After coordination with the Service, Nevada Department of Wildlife issues the permits through random computer drawing and NDOW retains the fees derived from the permits to cover costs. All hunters who draw a bighorn sheep tag in Nevada are required to attend an NDOW indoctrination class prior to receiving their sheep tag. This course is designed to teach hunters ram recognition and aging techniques as well as some life history data and general hunting procedures. Both lecture and outdoor session are roughly four hours long with the outdoor portion used to instruct and test sheep aging techniques using a 15 power spotting scope, which is a mandatory item to carry into the field. Hunters

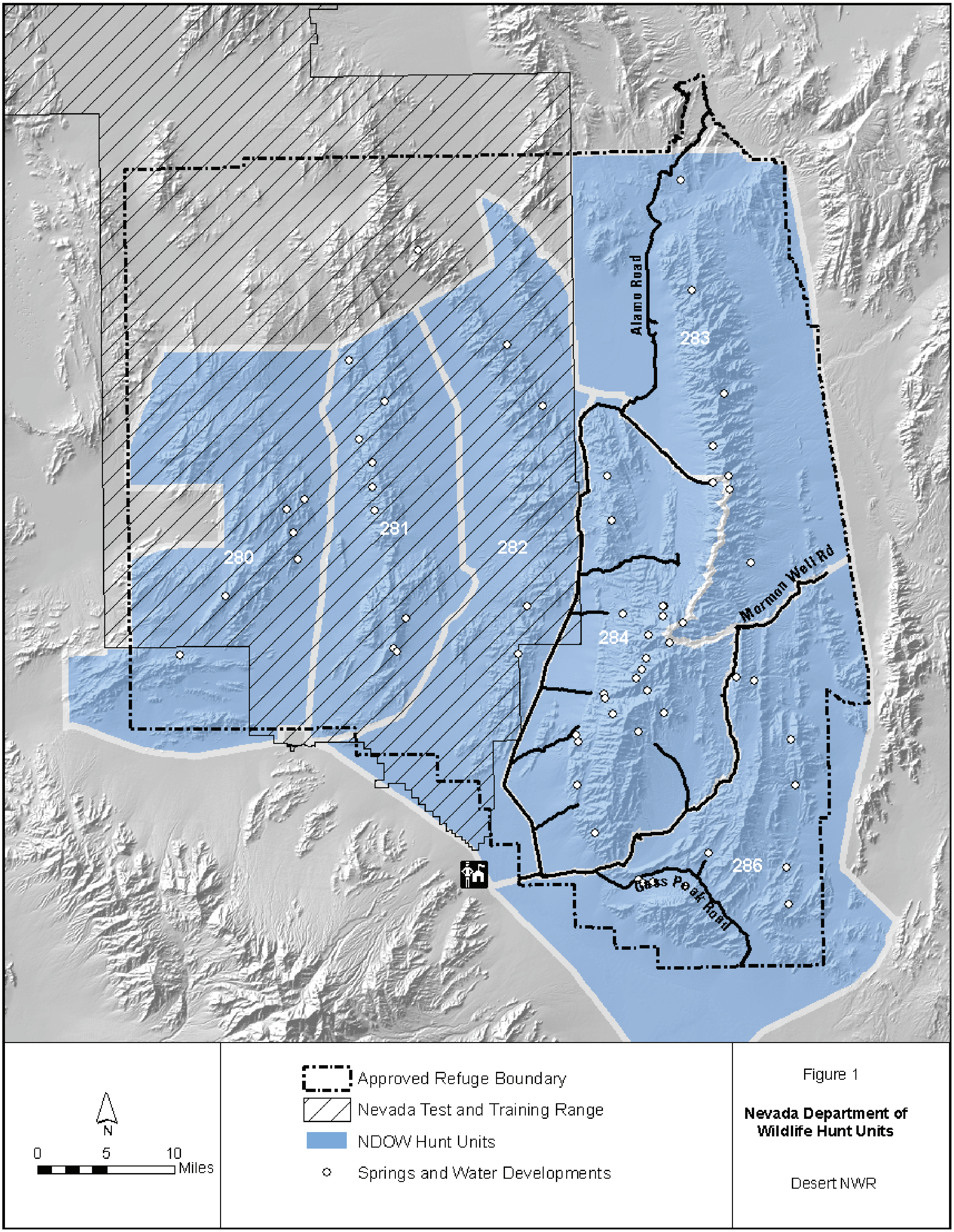

Figure 1

Nevada Department of Wildlife Hunt Units

Desert NWR

are instructed that bighorn sheep managers are interested in removing only older rams even though young lambs are legal to kill. Both State and Federal laws and regulations relating to sheep hunting and governing the use of Desert NWR are explained. Hunters within the portion of DNWR overlain by the Nevada Test and Training Range (units 280, 281, 282) are also required to attend a Department of Defense safety briefing and pass a background check prior to hunting.

Federal and State laws and regulations are enforced by Desert NWRC law enforcement personnel and NDOW game wardens, respectively..

In general, hunters travel in vehicles on established roads to the unit which they have drawn a tag for and then they travel on foot. However, hunters occasionally travel via horseback to their desired destination (C. McDermott pers. com.). Camping is allowed anywhere within the eastern portion of Desert NWR outside the NTTR (units 283, 284, and 286), except within ¼ mile of any water development. However, within the NTTR (Units 280, 281, and 282), hunters must camp at designated sites.

During the 15 year period between 1992 and 2006, a total of 196 tags were issued for the six Desert NWR units with an average of 13 per year. The average success over the same period was 59 percent. The tags issued on the Desert NWR hunt units represent about 11 percent of the 120 on average issued State-wide each year. Each tag holder spent an average of 8.5 days hunting within the Desert Refuge units. Table 2 summarizes the results by hunt unit from 1992 - 2006.

Table 2. Desert NWR Bighorn Sheep Hunt Results Summary: 1992 - 2006

Unit Group	# Tags Issued	Percent Success	Sheep Taken	Average Days Hunted	Average Age of Ram	Average B&C Score	Maximum B&C Score
280	7	57%	4	7	7.5	157 7/8	161 7/8
281	59	39%	23	8.6	6.8	153 3/8	177 3/8
282	33	58%	19	7.5	6.4	147 1/8	162 6/8
283, 284	55	60%	33	10.2	5.6	148 4/8	163 2/8
286	42	79%	33	9.1	5.8	151 7/8	171 6/8
SUM	196		112	42.4			
Average	13.1	57%	7.5	8.48	6.1		
State Average	120	83%		6.7	6.2	149 5/8	183 2/8

Source: NDOW 2007

Availability of Resources: The following funding/annual costs (based on FY 2008 costs) would be required to administer and manage the activities as described above:

	One-time Costs	Annual Costs
General Administration		$500
Law Enforcement personnel		$1,500
Annual aerial sheep surveys - personnel		$1,500
-flight time		$15,000
Sheep harvest data collection and analysis and interpretation		$20,000
TOTAL		**$38,500**

Anticipated Impacts of Use:
Possible impacts of sheep hunting include: the direct take of bighorn sheep rams and its indirect effects on the remaining population; disturbance to sheep and other wildlife; and habitat modification. All these impacts are expected to be relatively minor and localized due to the low levels of use on the refuge.

Direct and Indirect Effects of Trophy Hunting
During the last 15 years (1992 to 2006), an average of 7.5 rams total were taken each year on Desert Refuge. The average age of the rams was 6.1 years (NDOW 2007

Hunters tend to target the oldest rams with the biggest horns in a given population. This can have a variety of indirect effects on the remaining sheep population. In a life history study on Desert NWR reviewing 20 years of data, Bradley and Baker (1967) found that mortality for hunting was not an important factor relative to the sex ratio of the Refuge bighorn sheep population. Singer and Zeigenfuss (2002) found that that young rams in trophy-hunted populations of mountain sheep were more involved in breeding activities and harassed ewes more frequently. However, the same study found no compelling evidence for any deleterious effects on ewe energetics or ewe reproductive success. Singer and Zeigenfuss (2002) also found that trophy hunting decreased competition between rams for obtaining copulations because rut groups in hunted populations had fewer rams than groups in unhunted populations. They also found compelling evidence for depressed survivorship of young rams in heavily hunted populations, but not in lightly trophy-hunted populations (<3 percent of the total population or <10 percent of standing ram population). By this standard, Desert NWR's sheep population would be considered lightly hunted since the number of tags issued is based on 8 percent of the ram population and about 60 percent of tags on average result in a successful hunt each year.

Disturbance-Related Impacts on Wildlife:
Immediate responses by wildlife to recreational activity can range from behavioral changes including nest abandonment or change in food habits, physiological changes such as elevated heart rates due to flight, or even death (Knight and Cole 1995). The long term effects are more difficult to assess but may include altered behavior, vigor, productivity or death of individuals; altered population abundance, distribution, or demographics; and altered community species composition and interactions.

According to Knight and Cole (1991), there are three wildlife responses to human disturbance: 1) avoidance; 2) habituation; and 3) attraction. The magnitude of the avoidance response may depend on a number of factors including the type, distance, movement pattern, speed, and duration of the disturbance, as well as the time of day, time of year, weather; and the animal's access to food and cover, energy demands, and reproductive status (Knight and Cole 1991; Gabrielsen and Smith 1995).

In otherwise suitable habitat, sheep have been observed to abandon an area, either temporarily or permanently, when their tolerance to disturbance is exceeded (Welles and Welles 1961, Light 1971, Wehausen 1980, Papouchis et al. 2001, Thompson et al. 2007). If the resulting loss of habitat is significant, the population's carrying capacity could be reduced (Light and Weaver 1973). Furthermore, when disturbance elicits a flight response in sheep, resulting energetic losses and loss of foraging time could negatively affect the physiology of individuals, potentially reduce their survival and reproductive success (MacArthur et al. 1979). Papouchis et al. (2001) found that response of female bighorn sheep to disturbance was greater during the spring lambing period and the response of male sheep was greatest during the fall rut.

In some circumstances, sheep may habituate to predictable human activity (Wehausen et al. 1977, Kovach 1979), including highway traffic (Horesji 1976), hiking (Hicks and Elder 1979, Hamilton et al. 1982, Holl and Bleich 1987), and aircraft (Krausman et al. 1998). Habituation is defined as a form of learning in which individuals stop responding to stimuli that carry no reinforcing consequences for the individuals that are exposed to them (Alcock 1993). A key factor for predicting how wildlife would respond to disturbance is predictability. Gabrielsen and Smith (1995) suggest that most animals seem to have a greater defense response to humans moving unpredictably in the terrain than to humans following a distinct path.

Wildlife may also be attracted to human presence. For example, wildlife may be converted to "beggars" lured by handouts (Knight and Temple 1995), and scavengers are attracted to road kills (Rosen and Lowe 1994).

Impacts on Habitat:
Hunters can also have adverse impacts on vegetation and soil conditions. Hiking or walking can alter habitats by trampling vegetation, compacting soil, and increasing the potential of erosion (Liddle 1975; Hendee *et al*. 1990). Soil compaction makes root penetration more difficult, making it difficult for seedlings to become established (Cole and Landres 1995). In moderate cases of soil compaction, plant cover and biomass is decreased. In highly compacted soils, plant species abundance and diversity is reduced in the long-term as only the most resistant species survive (Liddle 1975). Impacts from vegetation trampling can lower species richness, decrease ground cover and plant species density, increase weedy annuals, and induce changes in species composition (Grabherr 1983).

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Aerial surveys of each unit will be conducted each fall to develop population estimates and ram/ewe/lamb/ratios.
- The number of bighorn sheep tags issues each year will not exceed 8 percent of the current ram population estimate for each unit.
- Hunts will be scheduled in accordance with the NDOW in mid-November through December, which is after the breeding season when all animals are scattered and are not dependant on a water supply and yearling lambs are able to care for themselves if separated from the ewes.
- Hunters will be required to attend an NDOW indoctrination class prior to hunting which covers specific Federal and State wildlife regulations.
- Hunters within the portion of DNWR overlain by the Nevada Test and Training Range (units 280, 281, 282) are also required to attend a Department of Defense safety briefing prior to hunting.
- Bighorn sheep guides are required to obtain a Special Use Permit prior to taking clients onto the Refuge.
- Natural bighorn sheep mortality (pickup heads) found on the Refuge are government property and possession or removal of them from the Refuge is not permitted.
- Desert NWR law enforcement personnel will conduct random patrols throughout the hunt season.
- No camping is allowed within ¼ mile of springs and water developments.
- Each sheep taken on Desert NWR must be checked out by Refuge personnel at Corn Creek Field Station

Justification: Hunting is a priority public use of the National Wildlife Refuge System. Providing opportunities for desert bighorn sheep hunting would contribute toward fulfilling provisions of the National Wildlife Refuge System Administration Act, as amended in 1997, and one of the goals of the

Desert Refuge (Goal 4, Chapter 3, CCP/EIS). The stipulations outlined above should minimize potential direct and indirect impacts of the hunt. Based upon impacts described here and in the Comprehensive Conservation Plan/Environmental Impact Statement (USFWS 2008), it is determined that hunting of desert bighorn sheep within the Desert National Wildlife Refuge, as described herein, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System.

Mandatory Re-Evaluation Date:

__X___ Mandatory 15-year Re-Evaluation (for priority public uses)

_______ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X__ Environmental Impact Statement and Record of Decision

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Welles, R.E. and F.B. Welles. 1961. The bighorn of Death Valley. U.S. Govt. Printing Office, Washington D.C. Fauna Series No. 6. 242 pp.

Refuge Determination

Refuge Manager:	______________________________ (Signature)	________________ (Date)
Project Leader Approval:	______________________________ (Signature)	________________ (Date)

Concurrence

Refuge Supervisor:	______________________________ (Signature)	________________ (Date)
Assistant Regional Director - Refuges:	______________________________ (Signature)	________________ (Date)

COMPATIBILITY DETERMINATION

Use: Research

Refuge Name: Desert National Wildlife Refuge, located in Clark and Lincoln Counties, Nevada.

Establishing and Acquisition Authority(ies): Desert National Wildlife Range was established by Executive Order Number 7373 of President Franklin D. Roosevelt on May 20, 1936. Originally named the Desert Game Range and under the joint administration of the Fish and Wildlife Service and the Bureau of Land Management, it contained a total of 2,250,000 acres, including lands both north and south of U.S. Highway 95. Public Land Order 4079, issued on August 26, 1966 and corrected on September 23, 1966, revoked Executive Order 7373, changed the name to Desert National Wildlife Range, reduced its size to 1,588,000 acres, and transferred sole administration to the Fish and Wildlife Service. Between 1935 and 1989, an additional 760 acres in the vicinity of Corn Creek were acquired under various authorities, including the Migratory Bird Conservation Act, Endangered Species Act, and Refuge Recreation Act. The Military Lands Withdrawal Act of 1999 (Public Law 106-65) transferred primary jurisdiction of 110,000 acres of bombing impact areas on the Refuge from the Service to Department of Defense. In 2002, the Clark County Conservation of Public Land and Natural Resources Act (Public Law 107-282) transferred 26,433 acres of BLM land adjacent to Desert NWR's east boundary to the Service. In 2004, the Lincoln County Conservation, Recreation, and Development Act (Public Law 108-424) transferred approximately 8,382 acres the eastern boundary of Desert NWR to the BLM for use as a utility corridor. In addition, 8,503 acres of BLM-administered land adjacent to the northeast corner of the Refuge were transferred to the Service.

Refuge Purpose(s):

- For lands acquired under Public Land Order 4079, dated August 31, 1966, the purpose is ". . . *for the protection, enhancement, and maintenance of wildlife resources, including bighorn sheep."*
- For lands acquired under 16 USC 715d (Migratory Bird Conservation Act): "…*for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…"*.
- For lands acquired under 16 U.S.C. § 1534 (Endangered Species Act of 1973) the purpose is ". . . *to conserve (a) fish or wildlife which are listed as endangered species or threatened species . . . or (b) plants."*
- For lands acquired under 16 U.S.C. § 460k-460l (Refuge Recreation Act) the purpose is ". . . *suitable for - (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species . . . "*

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: Two provisions of the National Wildlife Refuge Improvement Act are to "maintain biological integrity, diversity and environmental health" and to conduct "inventory and monitoring." Monitoring and research are an integral part of National Wildlife Refuge management. Plans and actions based on research and monitoring provide an informed approach, which analyzes the management affects on refuge wildlife.

When the Refuge receives requests to conduct scientific research at the Refuge, Special Use Permits (SUPs) are required to be issued for research and monitoring. SUPs are only issued for monitoring and investigations which contribute to the enhancement, protection, preservation, and management of native Refuge plant and wildlife populations and their habitats. Research applicants are required to submit a proposal that outlines: (1) objectives of the study; (2) justification for the study; (3) detailed methodology and schedule; (4) potential impacts on Refuge wildlife or habitat, including disturbance (short and long term), injury, or mortality (this includes a description of measures the researcher will take to reduce disturbance or impacts); (5) research personnel required; (6) costs to Refuge, if any; and (7) progress reports and end products (i.e., reports, thesis, dissertations, publications). Research proposals are reviewed by Refuge staff and conservation partners, as appropriate. SUPs are issued by the refuge manager, if the proposal is approved.

Evaluation criteria will include, but not be limited to, the following:

- Research that will contribute to specific Refuge management issues will be given higher priority over other research requests.
- Research that will conflict with other ongoing research, monitoring, or management programs will not be granted.
- Research projects that can be accomplished off-Refuge are less likely to be approved.
- Research which causes undue disturbance or is intrusive will likely not be granted. Level and type of disturbance will be carefully evaluated when considering a request.
- Refuge evaluation will determine if any effort has been made to minimize disturbance through study design, including considering adjusting location, timing, scope, number of permittees, study methods, number of study sites, etc.
- If staffing or logistics make it impossible for the Refuge to monitor researcher activity in a sensitive area, the research request may be denied, depending on the specific circumstances.
- The length of the project will be considered and agreed upon before approval. Projects will be reviewed annually.

These criteria will also apply to any properties acquired in the future within the approved boundary of the Refuge.

Availability of Resources:
The Refuge receives approximately 5 - 7 research requests per year. Some permit requests require up to one hour to process, others could take longer, depending on the complexity of the research request. On average, the program costs approximately $500.00/year. Refuge operational funds are currently available through the Service budget process to administer this program.

	One-time Costs	Annual Costs
General Administration		$500
TOTAL		$500

Anticipated Impacts of Use: Possible impacts of research include disturbance to wildlife and habitat modification. Potential impacts associated with research activities would be mitigated/minimized because sufficient restrictions would be included as part of the study design and researcher activities would be monitored by Refuge staff. Due to the small number of researchers that use the Refuge, the impacts on sheep and other wildlife and their habitat are expected to be relatively minor and localized. These potential impacts are described below.

Impacts on Wildlife:
According to Knight and Cole (1991), there are three categories of wildlife responses to human disturbance: 1) avoidance; 2) habituation; and 3) attraction. The magnitude of the avoidance response may depend on a number of factors including the type, distance, movement pattern, speed, and duration of the disturbance, as well as the time of day, time of year, weather; and the animal's access to food and cover, energy demands, and reproductive status (Knight and Cole 1991; Gabrielsen and Smith 1995).

In otherwise suitable habitat, sheep have been observed to abandon an area, either temporarily or permanently, when their tolerance to disturbance is exceeded (Welles and Welles 1961, Light 1971, Wehausen 1980, Papouchis *et al*. 2001, Thompson *et al*. 2007). If the resulting loss of habitat is significant, the population's carrying capacity could be reduced (Light and Weaver 1973). Furthermore, when disturbance elicits a flight response in sheep, resulting energetic losses and loss of foraging time could negatively affect the physiology of individuals, potentially reduce their survival and reproductive success (MacArthur et al. 1979). Papouchis *et al*. (2001) found that response of female bighorn sheep to disturbance was greater during the spring lambing period and the response of male sheep was greatest during the fall rut.

In some circumstances, sheep may habituate to predictable human activity (Wehausen et al. 1977, Kovach 1979), including highway traffic (Horesji 1976), hiking (Hicks and Elder 1979, Hamilton et al. 1982, Holl and Bleich 1987), and aircraft (Krausman et al. 1998). Habituation is defined as a form of learning in which individuals stop responding to stimuli that carry no reinforcing consequences for the individuals that are exposed to them (Alcock 1993). A key factor for predicting how wildlife would respond to disturbance is predictability. Gabrielsen and Smith (1995) suggest that most animals seem to have a greater defense response to humans moving unpredictably in the terrain than to humans following a distinct path.

Wildlife may also be attracted to human presence. For example, wildlife may be converted to "beggars" lured by handouts (Knight and Temple 1995), and scavengers are attracted to road kills (Rosen and Lowe 1994).

Impacts on Habitat:
Research activities could also have adverse impacts on vegetation and soil conditions. However, most of these effects would be short-term because only the minimum of samples (e.g., water, soils, vegetative litter, plants, ect.) required for identification and/or experimentation and statistical analysis would be permitted. Off trail walking by researchers could have similar effects as hikers in general who can alter habitats by trampling vegetation, compacting soil, and increasing the potential of erosion (Liddle 1975; Hendee *et al*. 1990). Soil compaction makes root penetration more difficult, making it difficult for seedlings to become established (Cole and Landres 1995). In moderate cases of soil compaction, plant cover and biomass is decreased. In highly compacted soils, plant species abundance and diversity is reduced in the long-term as only the most resistant species survive (Liddle 1975). Impacts from vegetation trampling can lower species richness, decrease ground cover and plant species density, increase weedy annuals, and induce changes in species composition (Grabherr 1983).

Public Review and Comment: Public review and comments will be solicited in conjunction with distribution of the Draft CCP/EIS for the Desert National Wildlife Refuge Complex. Comments received (including those regarding research) will be addressed in the Response to Comments.

Determination:

_______Use is Not Compatible

___X___Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility: The criteria for evaluating a research proposal, outlined in the Description of Use section above, will be used when determining whether a proposed study will be approved on the Refuge. If proposed research methods are evaluated and determined to have potential adverse impacts on refuge wildlife or habitat, then the refuge would determine the utility and need of such research to conservation and management of refuge wildlife and habitat. If the need was demonstrated by the research permittee and accepted by the refuge, then measures to minimize potential impacts (e.g., reduce the numbers of researchers entering an area, restrict research in specified areas) would be developed and included as part of the study design and on the SUP. SUPs will contain specific terms and conditions that the researcher(s) must follow relative to activity, location, duration, seasonality, etc. to ensure continued compatibility. All Refuge rules and regulations must be followed unless otherwise accepted in writing by Refuge management.

All information, reports, data, collections, or documented sightings and observations, that are obtained as a result of this permit are the property of the Service and can be accessed by the Service at any time from the permittee at no cost. The Refuge also requires the submission of annual or final reports and any/all publications associated with the work done on the Refuge. Each SUP may have additional criteria. Each SUP will also be evaluated individually to determine if a fee will be charged and for the length of the permit.

Extremely sensitive wildlife habitat areas would be avoided unless sufficient protection from research activities (i.e., disturbance, collection, capture and handling) is implemented to limit the area and/or wildlife potentially impacted by the proposed research. Where appropriate, some areas may be temporarily/seasonally closed so that research would be permitted when impacts to wildlife and habitat are no longer a concern. Research activities will be modified to avoid harm to sensitive wildlife and habitat when unforeseen impacts arise.

Refuge staff will monitor researcher activities for potential impacts to the refuge and for compliance with conditions on the SUP. The refuge manager may determine that previously approved research and SUPs be terminated due to observed impacts. The refuge manager will also have the ability to cancel a SUP if the researcher is out of compliance with the conditions of the SUP.

Justification: Refuge monitoring and research will directly benefit and support refuge goals, objectives and management plans and activities. Fish, wildlife, plants and their habitat will improve through the application of knowledge gained from monitoring and research. Biological integrity, diversity and environmental health would benefit from scientific research conducted on natural resources at the refuge. The wildlife-dependent, priority public uses (wildlife viewing and photography, environmental education and interpretation, fishing and hunting) would also benefit as a result of increased biodiversity and wildlife and native plant populations from improved restoration and management plans and activities associated with monitoring and research investigations which address specific restoration and management questions.

Mandatory Re-Evaluation Date:

________ Mandatory 15-year Re-Evaluation (for priority public uses)

____X___ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X_ Environmental Impact Statement and Record of Decision

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Papouchis, C. M., F. J. Singer and W. B. Sloan. 2001. Responses of desert bighorn sheep to increased human recreation. Journal of Wildlife Management 65:573-582.

Rosen, P. C. and C. H. Lowe. 1994. Highway mortality of snakes in the Sonoran Desert of southern Arizona. Biol. Conserv. 68:143-148.

Thompson, D. K. Longshore, and C. Lowrey. 2007. The impact of human disturbance on desert bighorn sheep (*Ovis canadensis nelsoni*) in the Wonderland of Rocks / Queen Mountain region of Joshua Tree National Park, California: A final report prepared for Joshua Tree National Park, CA.

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Welles, R.E. and F.B. Welles. 1961. The bighorn of Death Valley. U.S. Govt. Printing Office, Washington D.C. Fauna Series No. 6. 242 pp.

Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional Director - Refuges: ______________________________ ________________
(Signature) (Date)

COMPATIBILITY DETERMINATION

Use: Pine Nut Gathering

Refuge Name: Desert National Wildlife Range, located in Clark and Lincoln Counties, Nevada.

Establishing and Acquisition Authority(ies): Desert National Wildlife Range was established by Executive Order Number 7373 of President Franklin D. Roosevelt on May 20, 1936. Originally named the Desert Game Range and under the joint administration of the Fish and Wildlife Service and the Bureau of Land Management, it contained a total of 2,250,000 acres, including lands both north and south of U.S. Highway 95. Public Land Order 4079, issued on August 26, 1966 and corrected on September 23, 1966, revoked Executive Order 7373, changed the name to Desert National Wildlife Range, reduced its size to 1,588,000 acres, and transferred sole administration to the Fish and Wildlife Service. Between 1935 and 1989, an additional 760 acres in the vicinity of Corn Creek were acquired under various authorities, including the Migratory Bird Conservation Act, Endangered Species Act, and Refuge Recreation Act. The Military Lands Withdrawal Act of 1999 (Public Law 106-65) transferred primary jurisdiction of 110,000 acres of bombing impact areas on the Refuge from the Service to Department of Defense. In 2002, the Clark County Conservation of Public Land and Natural Resources Act (Public Law 107-282) transferred 26,433 acres of BLM land adjacent to Desert NWR's east boundary to the Service. In 2004, the Lincoln County Conservation, Recreation, and Development Act (Public Law 108-424) transferred approximately 8,382 acres the eastern boundary of Desert NWR to the BLM for use as a utility corridor. In addition, 8,503 acres of BLM-administered land adjacent to the northeast corner of the Refuge were transferred to the Service.

Refuge Purpose(s):

- For lands acquired under Public Land Order 4079, dated August 31, 1966, the purpose is ". . . *for the protection, enhancement, and maintenance of wildlife resources, including bighorn sheep."*
- For lands acquired under 16 USC 715d (Migratory Bird Conservation Act): "*…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…*" .
- For lands acquired under 16 U.S.C. § 1534 (Endangered Species Act of 1973) the purpose is ". . . *to conserve (a) fish or wildlife which are listed as endangered species or threatened species . . . or (b) plants."*
- For lands acquired under 16 U.S.C. § 460k-460l (Refuge Recreation Act) the purpose is ". . . *suitable for - (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species . . . "*

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: Pine nut gathering is a tradition passed down in Native American and pioneer families. The gathering of pine nuts in and around Desert National Wildlife Refuge (Refuge) by Native Americans occurred historically and continues to be an ongoing use today. The amount of pine nuts being harvested is traditionally low and is not expected to increase. The use of refuge lands as a gathering site is considered to be of vital importance to the Southern Pauites and other tribes.
This use does not occur on an annual basis because pinyon tree production is linked to moisture cycles. The refuge contains approximately 185,000 acres of pinyon-juniper woodlands. The only trees accessible by car are those located along the upper reaches of Mormon Well Road and at the end of

Pine Nut Road. The infrequent removal of pine cones and nuts in these areas has had no noticeable effect on the overall status of this vegetative type. Pinyon-juniper woodlands lack a well-developed understory because of the closed canopy, so trampling of vegetation is not expected to be significant.

As proposed, compatible wild food gathering would be allowed on those areas of the Refuge already open for other forms of public use. Based upon historical use, it is estimated that less than 100 users per year would directly pursue this activity. Other users may passively pursue this activity while visiting the refuge for another purpose.

Gathering of wild foods is not one of the 6 legislated uses of the National Wildlife Refuge System. However, the use of refuge lands as a gathering site is considered to be of vital importance to Native American cultural groups. Given the small number of users are not expected to significantly impact the amount of food available for wildlife, the Refuge proposes to allow pine nut gathering to continue by Special Use Permit. If the number of users increases, or adverse impacts to habitat or wildlife begin to occur, the Refuge will re-evaluate this use.

Availability of Resources: No additional resources will be needed to support this use

Anticipated Impacts of Use: Anticipated impacts from this use are minor damage to vegetation, littering, and disturbance to wildlife. No long-term or cumulative impacts are expected on wildlife or habitat.

Possible impacts pine nut gathering could have include disturbance to wildlife, and habitat modification. Wildlife can be affected by the sight and sound of recreationists (Boyle and Sampson 1985). Habitat can be affected through vegetation trampling, soil compaction, and erosion (Cole 1983, 1990). Due to the small number of pine nut gatherers that use the Refuge, the impacts on sheep and other wildlife and their habitat are expected to be relatively minor and localized. These potential impacts are described below.

Impacts on Wildlife:
Immediate responses by wildlife to recreational activity can range from behavioral changes including nest abandonment or change in food habits, physiological changes such as elevated heart rates due to flight, or even death (Knight and Cole 1995). The long term effects are more difficult to assess but may include altered behavior, vigor, productivity or death of individuals; altered population abundance, distribution, or demographics; and altered community species composition and interactions.

According to Knight and Cole (1991), there are three categories of wildlife responses to human disturbance: 1) avoidance; 2) habituation; and 3) attraction. The magnitude of the avoidance response may depend on a number of factors including the type, distance, movement pattern, speed, and duration of the disturbance, as well as the time of day, time of year, weather; and the animal's access to food and cover, energy demands, and reproductive status (Knight and Cole 1991; Gabrielsen and Smith 1995).

Though bighorn sheep do not consume pine nuts, they do utilize the grasses, shrubs, and forbs in the pinyon-juniper understory and will use the woodlands for thermoregulation (Zeller 2003). In otherwise suitable habitat, sheep have been observed to abandon an area, either temporarily or permanently, when their tolerance to disturbance is exceeded (Welles and Welles 1961, Light 1971, Wehausen 1980, Papouchis *et al.* 2001, Thompson *et al.* 2007). If the resulting loss of habitat is significant, the population's carrying capacity could be reduced (Light and Weaver 1973). Furthermore, when disturbance elicits a flight response in sheep, resulting energetic losses and loss of foraging time could negatively affect the physiology of individuals, potentially reduce their survival and reproductive success (MacArthur et al. 1979). Papouchis *et al.* (2001) found that response of female bighorn sheep to disturbance was greater during the spring lambing period and the response of male sheep was greatest during the fall rut.

Other species, like the pinyon jay and pinyon mouse, that rely on pine nuts as a food source, or bird species that utilize the pinyon-juniper overstory (Scott's oriole, gray vireo, ash-throated flycatcher and ferruginous hawk) (NDOW 2005) could be more directly affected by pine nut gathering. However, the use has been, and will continue to be, confined to areas adjacent to access roads leaving the majority of the habitat relatively undisturbed. Though wildlife will certainly be disturbed when pine nut gathering is occurring, the use is expected to be very limited, less than 100 users per season, and thus the overall impact is considered to be low. The amount of plant material being harvested is small enough not to constitute any measurable impact on habitat or food sources. Since gathering activities are limited, disturbance to wildlife and impact on wild food supply is also expected to be limited.

In some circumstances, sheep may habituate to predictable human activity (Wehausen et al. 1977, Kovach 1979), including highway traffic (Horesji 1976), hiking (Hicks and Elder 1979, Hamilton et al. 1982, Holl and Bleich 1987), and aircraft (Krausman et al. 1998). Habituation is defined as a form of learning in which individuals stop responding to stimuli that carry no reinforcing consequences for the individuals that are exposed to them (Alcock 1993). A key factor for predicting how wildlife would respond to disturbance is predictability. Gabrielsen and Smith (1995) suggest that most animals seem to have a greater defense response to humans moving unpredictably in the terrain than to humans following a distinct path.

Wildlife may also be attracted to human presence. For example, wildlife may be converted to "beggars" lured by handouts (Knight and Temple 1995), and scavengers are attracted to road kills (Rosen and Lowe 1994).

Impacts on Habitat:
Pine nut gathering can also have adverse impacts on vegetation and soil conditions. Pine nut gatherers can alter habitats by trampling vegetation, compacting soil, and increasing the potential of erosion (Liddle 1975; Hendee *et al*. 1990). Soil compaction makes root penetration more difficult, making it difficult for seedlings to become established (Cole and Landres 1995). In moderate cases of soil compaction, plant cover and biomass is decreased. In highly compacted soils, plant species abundance and diversity is reduced in the long-term as only the most resistant species survive (Liddle 1975). Impacts from vegetation trampling can lower species richness, decrease ground cover and plant species density, increase weedy annuals, and induce changes in species composition (Grabherr 1983).

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_______Use is Not Compatible

___X___Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility: In order to allow public access to the Refuge for pine nut gathering, the following measurers will be taken.

- Pine nut gathering activities will be reviewed at the annual meeting with tribal representatives. If impacts from gathering increase so that the activity is adversely affecting wildlife habitat or if disturbance to wildlife is occurring, then tribal representatives will be asked to adjust pine nut gathering activities to reduce impacts. Adjustments may include reductions in harvest, changes in timing of gathering to reduce wildlife or management conflicts, or reductions in numbers of visitors or frequency of visitors.

- Refuge staff will monitor the impact of the number of users and re-evaluate the compatibility of this use as necessary.
- Commercial gathering of wild foods is prohibited.
- Pine nuts will only be gathered from the ground.
- Vehicles will stay on designated roads.

Justification: As proposed, wild food gathering would allow the small number of interested individuals to enjoy the refuge with little or no additional cost to the refuge. The goals of the National Wildlife Refuge System (System) include **p**roviding an understanding and appreciation of fish and wildlife ecology, wildlife habitat, and the human role in the environment. The Service strives to provide priority public uses when compatible with the purpose and goals of the Refuge and the mission of the System. The National Wildlife Refuge System Improvement Act of 1997 identifies environmental education and interpretation as priority public uses for National Wildlife Refuges, along with hunting, fishing, wildlife observation and photography. This use, while not wildlife dependent, is a traditional use that contributes to environmental education and awareness. An understanding of plant ecology and annual moisture cycles is essential to successful pine nut harvesting, thus this activity helps to educate participants about Desert Refuge habitats, while sustaining cultural practices.

Mandatory Re-Evaluation Date:

________ Mandatory 15-year Re-Evaluation (for priority public uses)

___X___ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X_ Environmental Impact Statement and Record of Decision

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Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional Director - Refuges: ______________________________ ________________
(Signature) (Date)

COMPATIBILITY DETERMINATION

Use: Camping

Refuge Name: Desert National Wildlife Refuge (Refuge), located in Clark and Lincoln counties, Nevada.

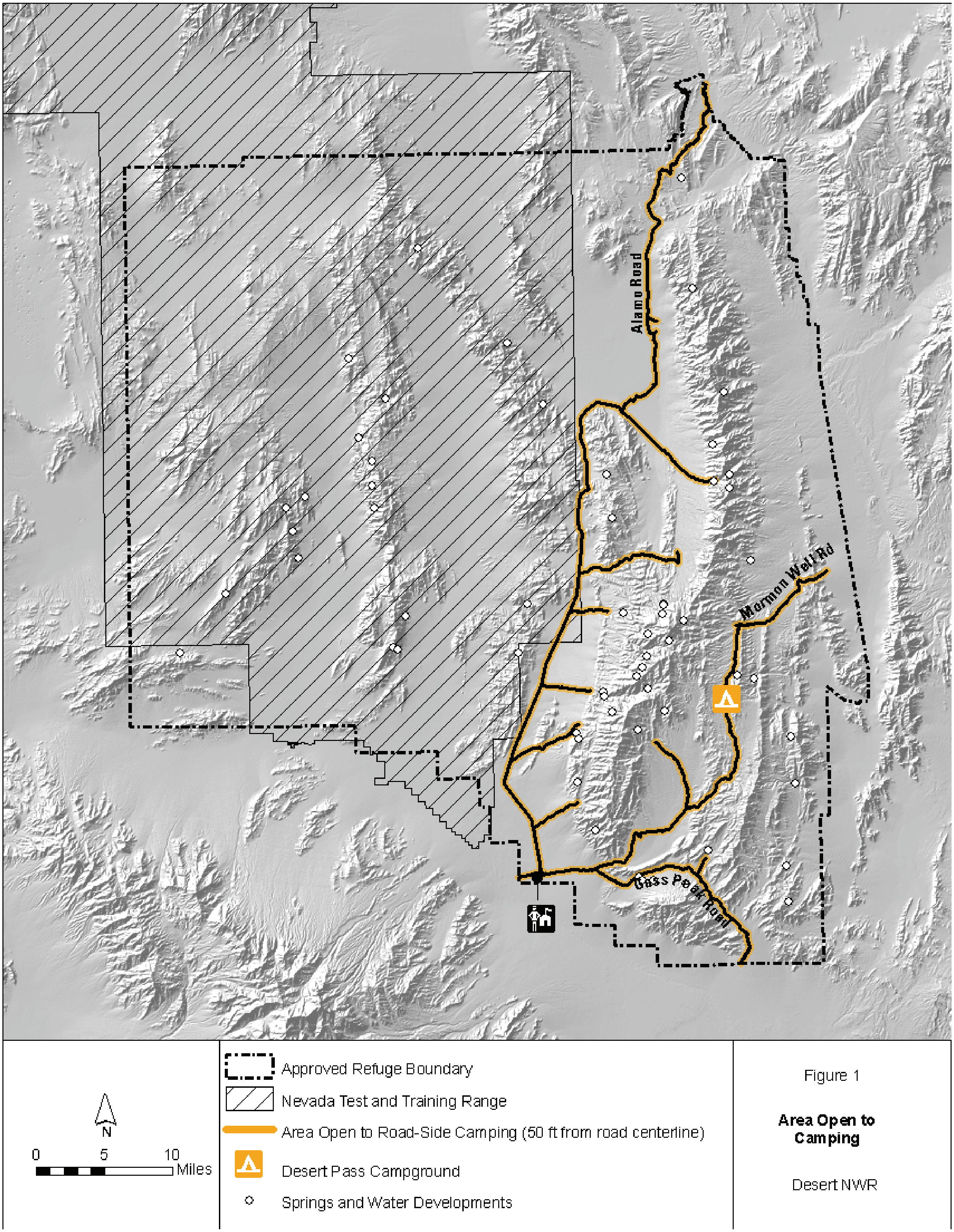
Establishing and Acquisition Authority(ies): Desert National Wildlife Range was established by Executive Order Number 7373 of President Franklin D. Roosevelt on May 20, 1936. Originally named the Desert Game Range and under the joint administration of the Fish and Wildlife Service and the Bureau of Land Management, it contained a total of 2,250,000 acres, including lands both north and south of U.S. Highway 95. Public Land Order 4079, issued on August 26, 1966 and corrected on September 23, 1966, revoked Executive Order 7373, changed the name to Desert National Wildlife Range, reduced its size to 1,588,000 acres, and transferred sole administration to the Fish and Wildlife Service. Between 1935 and 1989, an additional 760 acres in the vicinity of Corn Creek were acquired under various authorities, including the Migratory Bird Conservation Act, Endangered Species Act, and Refuge Recreation Act. The Military Lands Withdrawal Act of 1999 (Public Law 106-65) transferred primary jurisdiction of 110,000 acres of bombing impact areas on the Refuge from the Service to Department of Defense. In 2002, the Clark County Conservation of Public Land and Natural Resources Act (Public Law 107-282) transferred 26,433 acres of BLM land adjacent to Desert NWR's east boundary to the Service. In 2004, the Lincoln County Conservation, Recreation, and Development Act (Public Law 108-424) transferred approximately 8,382 acres the eastern boundary of Desert NWR to the BLM for use as a utility corridor. In addition, 8,503 acres of BLM-administered land adjacent to the northeast corner of the Refuge were transferred to the Service.

Refuge Purpose(s):

- For lands acquired under Public Land Order 4079, dated August 31, 1966, the purpose is ". . . *for the protection, enhancement, and maintenance of wildlife resources, including bighorn sheep.*"
- For lands acquired under 16 USC 715d (Migratory Bird Conservation Act): "*…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…*".
- For lands acquired under 16 U.S.C. § 1534 (Endangered Species Act of 1973) the purpose is ". . . *to conserve (a) fish or wildlife which are listed as endangered species or threatened species . . . or (b) plants.*"
- For lands acquired under 16 U.S.C. § 460k-460l (Refuge Recreation Act) the purpose is ". . . *suitable for - (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species . . .* "

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: Currently, car camping is permitted year-round, within 50 feet of designated roads or existing pull-outs and parking areas, on the portion of Desert NWR outside the Nevada Test and Training Range (Figure 1). Back country camping is permitted virtually anywhere on the Refuge primarily east of the Alamo Road. The Refuge currently has over 180 miles of designated roads. Camping is also allowed at Desert Pass Campground (formerly Mormon Well Campground). This



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campground is located on the west side of Mormon Well Road in ponderosa pine woodland. It has eight designated sites with tables, fire rings, and vault toilets. Water is not available at the campground.

Camping is limited to 14 consecutive days. Campfires are permitted unless fire restrictions are in place. However, campers must bring their own wood and must use existing fire rings. Water is scarce and critical to wildlife, so campers must carry their own water. We propose to continuation of camping on Desert Refuge at or near current levels.

In general, use of Desert Pass Campground is heaviest on Memorial Day, Labor Day and holiday weekends. All eight sites are usually filled on these weekends (C. McDermott pers. com.). Use during other times of year is sporadic, with more use on weekends and less on weekdays and during winter.

Under the proposed action (Alternative C), the Service would recruit a seasonal volunteer resident host/docent at the Desert Pass Campground. Under the Alternative C, the Service would also use post and cable fencing to designate parking turnouts along Alamo, Mormon Well, and Gass Peak Roads. These improvements would help minimize impacts to desert habitat from car camping by limiting the tendency of pullouts to expand over time do to vehicular use.

Availability of Resources: The following funding/annual costs (based on FY 2008 costs) would be required to administer and manage the activities as described above:

	One-time Costs	Annual Costs
Administration and management	$500	$500
Maintenance (road grading for access to pullouts, etc)	$1,000	$1000
Post and cable fencing to define pull outs.	$5,000	$1,000
TOTAL	**$6,500**	**$2,000**

Anticipated Impacts of Use: Anticipated Impacts of the Use

Possible impacts of camping include disturbance to wildlife and habitat modification. Wildlife can be affected by the sight and sound of recreationists (Boyle and Sampson 1985). Habitat can be affected through vegetation trampling, soil compaction, and erosion (Cole 1983, 1990). Due to the small number of campers that use the Refuge, the impacts on sheep and other wildlife and their habitat are expected to be relatively minor and localized. These potential impacts are described below.

Impacts on Wildlife:
Immediate responses by wildlife to recreational activity can range from behavioral changes including nest abandonment or change in food habits, physiological changes such as elevated heart rates due to flight, or even death (Knight and Cole 1995). The long term effects are more difficult to assess but may include altered behavior, vigor, productivity or death of individuals; altered population abundance, distribution, or demographics; and altered community species composition and interactions.

According to Knight and Cole (1991), there are three categories of wildlife responses to human disturbance: 1) avoidance; 2) habituation; and 3) attraction. The magnitude of the avoidance response may depend on a number of factors including the type, distance, movement pattern, speed, and duration of the disturbance, as well as the time of day, time of year, weather; and the animal's access to food and cover, energy demands, and reproductive status (Knight and Cole 1991; Gabrielsen and Smith 1995).

In otherwise suitable habitat, sheep have been observed to temporarily or permanently abandon an area when their tolerance to disturbance is exceeded (Welles and Welles 1961, Light 1971, Wehausen 1980, Papouchis *et al.* 2001, Thompson *et al.* 2007). If the resulting loss of habitat is substantial, the population's carrying capacity could be reduced (Light and Weaver 1973). Furthermore, when disturbance elicits a flight response in sheep, resulting energetic losses and loss of foraging time could negatively affect the physiology of individuals, potentially reduce their survival and reproductive success (MacArthur et al. 1979). Papouchis *et al.* (2001) found that response of female bighorn sheep to disturbance was greater during the spring lambing period and the response of male sheep was greatest during the fall rut.

In some circumstances, sheep may habituate to predictable human activity (Wehausen et al. 1977, Kovach 1979), including highway traffic (Horesji 1976), hiking (Hicks and Elder 1979, Hamilton et al. 1982, Holl and Bleich 1987), and aircraft (Krausman et al. 1998). Habituation is defined as a form of learning in which individuals stop responding to stimuli that carry no reinforcing consequences for the individuals that are exposed to them (Alcock 1993). A key factor for predicting how wildlife would respond to disturbance is predictability. Gabrielsen and Smith (1995) suggest that most animals seem to have a greater defense response to humans moving unpredictably in the terrain than to humans following a distinct path.

Wildlife may also be attracted to human presence. For example, wildlife may be converted to "beggars" lured by handouts (Knight and Temple 1995), and scavengers are attracted to road kills (Rosen and Lowe 1994).

Impacts on Habitat:
Campers can also have adverse impacts on vegetation and soil conditions. Hiking or walking can alter habitats by trampling vegetation, compacting soil, and increasing the potential of erosion (Liddle 1975; Hendee *et al*. 1990). Soil compaction makes root penetration more difficult, making it difficult for seedlings to become established (Cole and Landres 1995). In moderate cases of soil compaction, plant cover and biomass is decreased. In highly compacted soils, plant species abundance and diversity is reduced in the long-term as only the most resistant species survive (Liddle 1975). Impacts from vegetation trampling can lower species richness, decrease ground cover and plant species density, increase weedy annuals, and induce changes in species composition (Grabherr 1983).

Campers often spend more time at their campsite than anywhere else during their visit, which can potentially result in a source of pollution (Hendee *et al*. 1990). Bacterial contamination is a concern in wilderness settings and can be estimated by evaluating the densities of fecal coliforms (indicators of fecal contamination) and fecal streptococci (found in warm-blooded organisms, including humans).

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Pets are allowed, but they must be on a leash and under camper's physical control at all times.
- Vehicle travel is only permitted on designated roads. All motor vehicles, including off-road vehicles, must be licensed and insured for highway use (i.e., street legal). All vehicle operators must have a valid operator's license in their possession.
- Back country camping is not permitted within 1/4 mile or within sight of any water development or spring.

- Car camping is only permitted within 50 feet of designated roads, and preferably within existing pull outs and parking areas.
- Restroom and other facilities at Desert Pass Campground will be maintained to minimize impacts on surrounding habitat.
- All campers are limited to a 14-consequetive day stay limit.
- All educational and interpretive materials for campers will emphasize Leave-No-Trace principles (www.lnt.org).
- Existing turnouts will be designated with post and cable fencing or other perimeter delineators, to prevent enlargement.
- Seasonal fire restrictions will be strictly enforced.
- Limitations on the number and size of groups may be implemented at more heavily used

Justification: While not one of the six priority wildlife dependent public uses listed or identified in the National Wildlife Refuge System Administration Act as amended (1997), camping is believed to be a compatible public use under the stipulations outlined in this compatibility determination. The primary reasons for this determination include:
1. Camping can facilitate priority public uses such as hunting, wildlife observation, and photography.
2. Due to its large size and remote nature, much of the refuge is very difficult to access. Camping facilitate this access.
2. Campers are a target audience not reached through other opportunities; they are potential partners and a potential source of support for the Refuges.
3. Impacts associated camping would be minimized through implementation of the stipulations noted above.
4. Camping impacts will be monitored and the use modified if necessary.

Based upon the information presented here and in the Draft Comprehensive Conservation Plan and Environmental Impact Statement (USFWS 2008), it is determined that hiking and backpacking within the Desert National Wildlife Refuge, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System.

Mandatory Re-Evaluation Date :

_____ Mandatory 15-year Re-Evaluation (for priority public uses)

__X__ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X__ Environmental Impact Statement and Record of Decision

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<u>Refuge Determination</u>

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader
Approval: ______________________________ ________________
(Signature) (Date)

<u>Concurrence</u>

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional
Director - Refuges: ______________________________ ________________
(Signature) (Date)

COMPATIBILITY DETERMINATION

Use: Hiking and Backpacking

Refuge Name: Desert National Wildlife Refuge (Refuge), located in Clark and Lincoln counties, Nevada.

Establishing and Acquisition Authority(ies): Desert National Wildlife Range was established by Executive Order Number 7373 of President Franklin D. Roosevelt on May 20, 1936. Originally named the Desert Game Range and under the joint administration of the Fish and Wildlife Service and the Bureau of Land Management, it contained a total of 2,250,000 acres, including lands both north and south of U.S. Highway 95. Public Land Order 4079, issued on August 26, 1966 and corrected on September 23, 1966, revoked Executive Order 7373, changed the name to Desert National Wildlife Range, reduced its size to 1,588,000 acres, and transferred sole administration to the Fish and Wildlife Service. Between 1935 and 1989, an additional 760 acres in the vicinity of Corn Creek were acquired under various authorities, including the Migratory Bird Conservation Act, Endangered Species Act, and Refuge Recreation Act. The Military Lands Withdrawal Act of 1999 (Public Law 106-65) transferred primary jurisdiction of 110,000 acres of bombing impact areas on the Refuge from the Service to Department of Defense. In 2002, the Clark County Conservation of Public Land and Natural Resources Act (Public Law 107-282) transferred 26,433 acres of BLM land adjacent to Desert NWR's east boundary to the Service. In 2004, the Lincoln County Conservation, Recreation, and Development Act (Public Law 108-424) transferred approximately 8,382 acres the eastern boundary of Desert NWR to the BLM for use as a utility corridor. In addition, 8,503 acres of BLM-administered land adjacent to the northeast corner of the Refuge were transferred to the Service.

Refuge Purpose(s):

- For lands acquired under Public Land Order 4079, dated August 31, 1966, the purpose is ". . . *for the protection, enhancement, and maintenance of wildlife resources, including bighorn sheep.*"
- For lands acquired under 16 USC 715d (Migratory Bird Conservation Act): "*…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…*".
- For lands acquired under 16 U.S.C. § 1534 (Endangered Species Act of 1973) the purpose is ". . . *to conserve (a) fish or wildlife which are listed as endangered species or threatened species . . . or (b) plants.*"
- For lands acquired under 16 U.S.C. § 460k-460l (Refuge Recreation Act) the purpose is ". . . *suitable for - (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species . . .* "

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: Currently, hiking and backpacking are permitted year round on 747,000 acres of Desert NWR outside the Nevada Test and Training Range (Figure 1). Most of these lands are located on the eastern part of the Refuge generally east of Alamo Road. The area includes three mountain ranges (Las Vegas, Sheep, and East Desert Ranges). We propose the continuation of hiking and backpacking at the current levels on the Refuge.

The most popular backpacking area on the Refuge is Hidden Forest Canyon. Several groups use this area each weekend for most of the year (C. McDermott per. com). The 5.7-mile trail follows an old road through desert scrub and ponderosa pine forest to an old cabin. Most groups camp near the cabin. Wiregrass Spring is 0.15 miles past the cabin.

Other hiking/backpacking destinations on the Refuge include and Sawmill Canyon, Blackgate Canyon, Gass Peak, Hayford Peak, Joe May Canyon, Long Valley, Quartzite Mountain, and Yucca Peak. Some hikes follow abandoned roads and established trails. Others require strenuous off-trail hiking over steep, rugged terrain.

Camping associated with backpacking is permitted throughout this area except within 1/4 mile or within sight of any water development or spring. Backpackers must bring their own water. Spring water can be consumed, but should be treated first by filtration

Under the proposed action (Alternative C), the Service would map existing trails on Gass Peak and the Sheep Range using GPS and develop a trail guide for visitors. Trails would be managed to minimize impacts to sheep.

Availability of Resources: The following funding/annual costs (based on FY 2008 costs) would be required to administer and manage the activities as described above:

	One-time Costs	Annual Costs
Managing current use		
Administration and management	1,500	$500
Improving/Enhancing Use		
Map trails / develop trail guide	1,000	
TOTAL	**$2,500**	**$500**

Anticipated Impacts of Use: Anticipated Impacts of the Use

Possible impacts of hiking and backpacking include disturbance to wildlife and habitat modification. Wildlife can be affected by the sight and sound of recreationists (Boyle and Samson 1985). Habitat can be affected through vegetation trampling, soil compaction, and erosion (Cole 1983, 1990). Due to the small number of hikers and backpackers that use the Refuge, the impacts on sheep and other wildlife and their habitat are expected to be relatively minor and localized. These potential impacts are described below.

Impacts on Wildlife:
Immediate responses by wildlife to recreational activity can range from behavioral changes including nest abandonment or change in food habits, physiological changes such as elevated heart rates due to flight, or even death (Knight and Cole 1995). The long term effects are more difficult to assess but may include altered behavior, vigor, productivity or death of individuals; altered population abundance, distribution, or demographics; and altered community species composition and interactions.

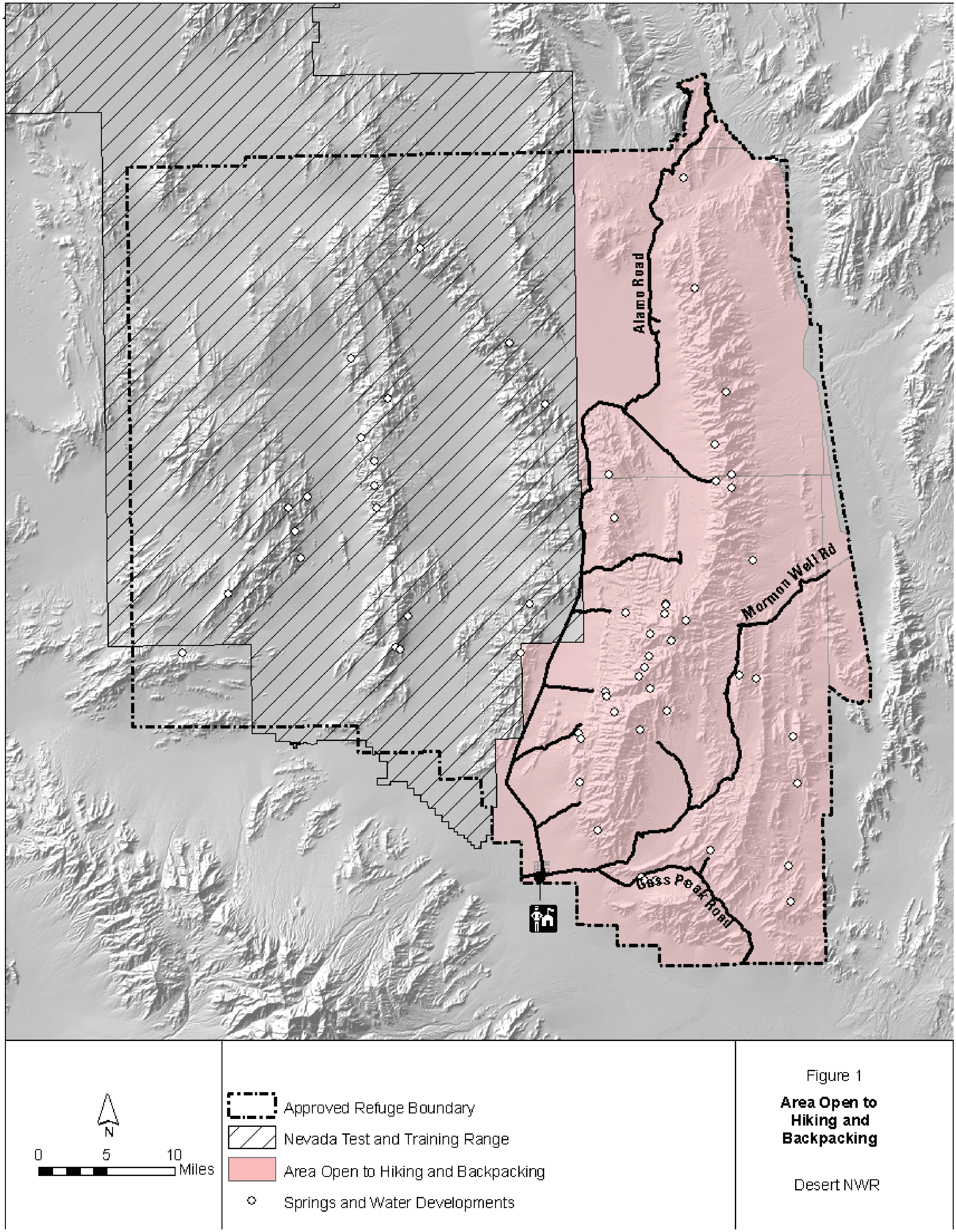

Figure 1

Area Open to Hiking and Backpacking

Desert NWR

According to Knight and Cole (1991), there are three categories of wildlife responses to human disturbance: 1) avoidance; 2) habituation; and 3) attraction. The magnitude of the avoidance response may depend on a number of factors including the type, distance, movement pattern, speed, and duration of the disturbance, as well as the time of day, time of year, weather; and the animal's access to food and cover, energy demands, and reproductive status (Knight and Cole 1991; Gabrielsen and Smith 1995).

In otherwise suitable habitat, sheep have been observed to abandon an area, either temporarily or permanently, when their tolerance to disturbance is exceeded (Welles and Welles 1961, Light 1971, Wehausen 1980, Papouchis *et al*. 2001, Thompson *et al*. 2007). If the resulting loss of habitat is significant, the population's carrying capacity could be reduced (Light and Weaver 1973). Furthermore, when disturbance elicits a flight response in sheep, resulting energetic losses and loss of foraging time could negatively affect the physiology of individuals, potentially reduce their survival and reproductive success (MacArthur et al. 1979). Papouchis *et al*. (2001) found that response of female bighorn sheep to disturbance was greater during the spring lambing period and the response of male sheep was greatest during the fall rut.

In some circumstances, sheep may habituate to predictable human activity (Wehausen et al. 1977, Kovach 1979), including highway traffic (Horesji 1976), hiking (Hicks and Elder 1979, Hamilton et al. 1982, Holl and Bleich 1987), and aircraft (Krausman et al. 1998). Habituation is defined as a form of learning in which individuals stop responding to stimuli that carry no reinforcing consequences for the individuals that are exposed to them (Alcock 1993). A key factor for predicting how wildlife would respond to disturbance is predictability. Gabrielsen and Smith (1995) suggest that most animals seem to have a greater defense response to humans moving unpredictably in the terrain than to humans following a distinct path.

Wildlife may also be attracted to human presence. For example, wildlife may be converted to "beggars" lured by handouts (Knight and Temple 1995), and scavengers are attracted to road kills (Rosen and Lowe 1994).

Impacts on Habitat:
Hiking and backpacking can also have adverse impacts on vegetation and soil conditions. Hiking or walking can alter habitats by trampling vegetation, compacting soil, and increasing the potential of erosion (Liddle 1975; Hendee *et al*. 1990). Soil compaction makes root penetration more difficult, making it difficult for seedlings to become established (Cole and Landres 1995). In moderate cases of soil compaction, plant cover and biomass is decreased. In highly compacted soils, plant species abundance and diversity is reduced in the long-term as only the most resistant species survive (Liddle 1975). Impacts from vegetation trampling can lower species richness, decrease ground cover and plant species density, increase weedy annuals, and induce changes in species composition (Grabherr 1983).

Backpackers often spend more time at their campsite than anywhere else during their visit, which can potentially result in a source of pollution (Hendee *et al*. 1990). Bacterial contamination is a concern in wilderness settings and can be estimated by evaluating the densities of fecal coliforms (indicators of fecal contamination) and fecal streptococci (found in warm-blooded organisms, including humans).

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Pets are allowed, but they must be on a leash and under hiker/backpacker's physical control at all times.
- Vehicle travel is only permitted on designated roads. All motor vehicles, including off-road vehicles, must be licensed and insured for highway use (i.e., street legal). All vehicle operators must have a valid operator's license in their possession.
- Camping associated with backpacking is permitted throughout this area except within 1/4 mile or within sight of any water development or spring.
- Access to certain portions of the Refuge may be restricted during bighorn sheep lambing season and fall rut
- All educational and interpretive materials for hikers/backpackers will emphasize Leave-No-Trace principles (www.lnt.org).
- Seasonal fire restrictions will be strictly enforced.
- Open fires will not be permitted

Justification: While not one of the six priority wildlife dependent public uses listed or identified in the National Wildlife Refuge System Administration Act as amended (1997), hiking and backpacking is believed to be a compatible public use under the stipulations outlined in this compatibility determination. The primary reasons for this determination include:
1. Hiking and backpacking can facilitate priority public uses such as hunting, wildlife observation, and photography.
2. Due to its large size and remote nature, much of the refuge is very difficult to access. Hiking and backpacking help facilitate this access.
2. Hikers and backpackers are a target audience not reached through other opportunities; they are potential partners and a potential source of support for the Refuges.
3. Impacts associated with hiking and backpacking would be minimized through implementation of the stipulations noted above.
4. Hiking and backpacking impacts will be monitored and the use modified if necessary.

Based upon the information presented here and in the Draft Comprehensive Conservation Plan and Environmental Impact Statement (USFWS 2008), it is determined that hiking and backpacking within the Desert National Wildlife Refuge, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System.

Mandatory Re-Evaluation Date:

_____ Mandatory 15-year Re-Evaluation (for priority public uses)

__X__ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X__ Environmental Impact Statement and Record of Decision

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Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader
Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional
Director - Refuges: ______________________________ ________________
(Signature) (Date)

COMPATIBILITY DETERMINATION

Use: Recreational Use of Pack and Saddle Stock

Refuge Name: Desert National Wildlife Refuge (Refuge), located in Clark and Lincoln counties, Nevada.

Establishing and Acquisition Authority(ies): Desert National Wildlife Range was established by Executive Order Number 7373 of President Franklin D. Roosevelt on May 20, 1936. Originally named the Desert Game Range and under the joint administration of the Fish and Wildlife Service and the Bureau of Land Management, it contained a total of 2,250,000 acres, including lands both north and south of U.S. Highway 95. Public Land Order 4079, issued on August 26, 1966 and corrected on September 23, 1966, revoked Executive Order 7373, changed the name to Desert National Wildlife Range, reduced its size to 1,588,000 acres, and transferred sole administration to the Fish and Wildlife Service. Between 1935 and 1989, an additional 760 acres in the vicinity of Corn Creek were acquired under various authorities, including the Migratory Bird Conservation Act, Endangered Species Act, and Refuge Recreation Act. The Military Lands Withdrawal Act of 1999 (Public Law 106-65) transferred primary jurisdiction of 110,000 acres of bombing impact areas on the Refuge from the Service to Department of Defense. In 2002, the Clark County Conservation of Public Land and Natural Resources Act (Public Law 107-282) transferred 26,433 acres of BLM land adjacent to Desert NWR's east boundary to the Service. In 2004, the Lincoln County Conservation, Recreation, and Development Act (Public Law 108-424) transferred approximately 8,382 acres the eastern boundary of Desert NWR to the BLM for use as a utility corridor. In addition, 8,503 acres of BLM-administered land adjacent to the northeast corner of the Refuge were transferred to the Service.

Refuge Purpose(s): Desert National Wildlife Refuge purposes include:

- For lands acquired under Public Land Order 4079, dated August 31, 1966, the purpose is ". . . *for the protection, enhancement, and maintenance of wildlife resources, including bighorn sheep.*"
- For lands acquired under 16 USC 715d (Migratory Bird Conservation Act): "*…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…*".
- For lands acquired under 16 U.S.C. § 1534 (Endangered Species Act of 1973) the purpose is ". . . *to conserve (a) fish or wildlife which are listed as endangered species or threatened species . . . or (b) plants.*"
- For lands acquired under 16 U.S.C. § 460k-460l (Refuge Recreation Act) the purpose is ". . . *suitable for - (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species . . .*"

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: Currently, the recreational use of pack and saddle stock is permitted on the eastern 747,000 acres of Desert NWR outside the Nevada Test and Training Range (Figure 1). These lands are located primarily east of Alamo Road, and include three mountain ranges (Las Vegas, Sheep, and East Desert Ranges).

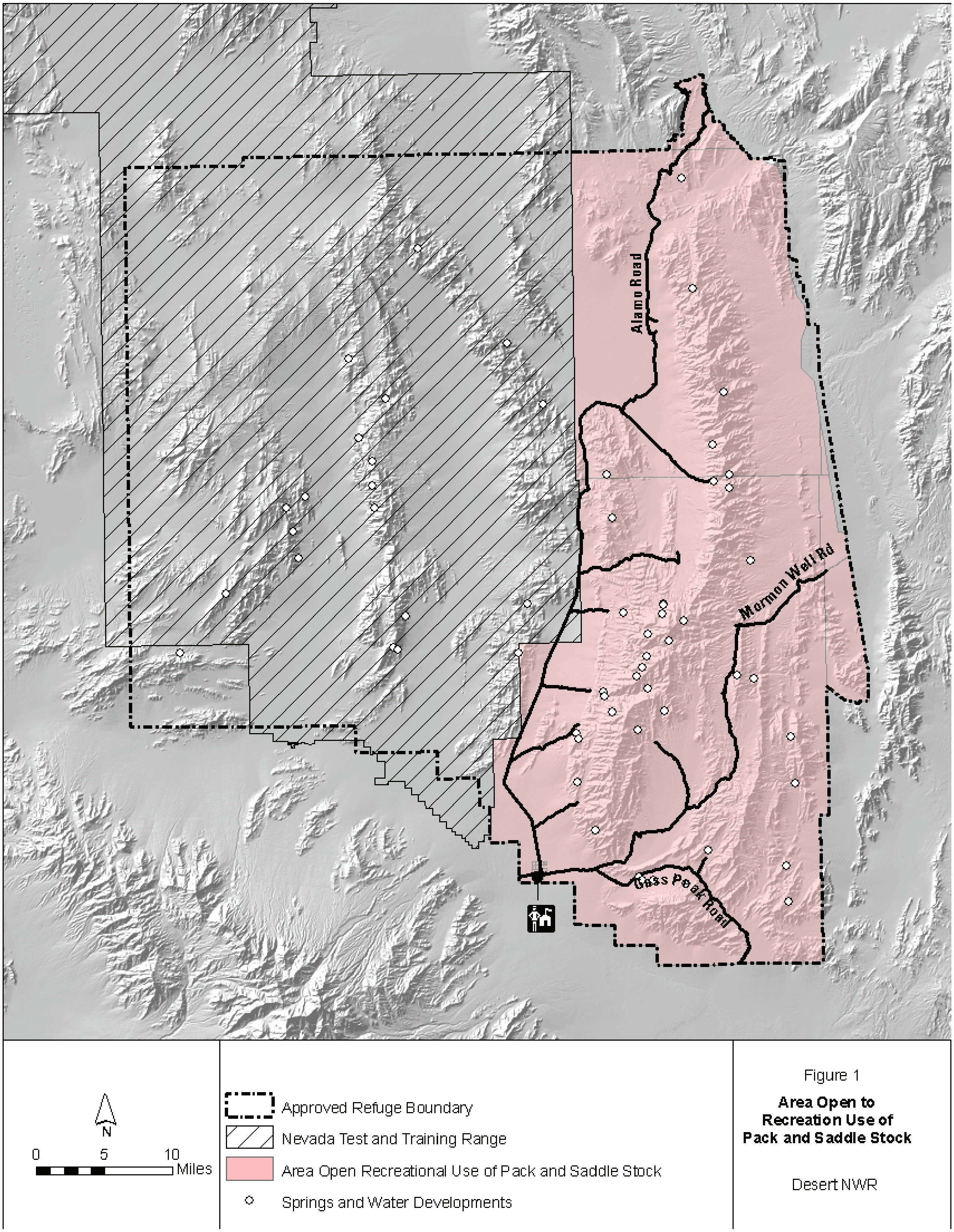

Figure 1

Area Open to Recreation Use of Pack and Saddle Stock

Desert NWR

Horses and other pack/saddle stock are used on the refuge for recreation and/or in support of other uses (e.g. hunting, wildlife observation, wildlife photography). Though the refuge lacks hard numbers about this use, annual observations from staff indicate that this use is infrequent with about one or two groups per month. About 80 percent are horseback riders originate from Corn Creek . The remaining 20 percent trailer their pack/saddle stock into the Refuge for trips in the backcountry (C. McDermott pers. com.). The majority of trips are short day rides. Multi-day trips in the backcountry are uncommon. We propose to continue to allow the recreational use of pack and saddle stock on the Refuge.

Availability of Resources: The following funding/annual costs (based on FY 2008 costs) would be required to administer and manage the activities as described above:

	One-time Costs	Annual Costs
Administration and management	$400	$400
Maintenance (includes treatment for weeds as needed)	$400	$500
Special equipment (signs, trailhead establishment, etc)	$1000	$500
TOTAL	**$1,800**	**$1,400**

Refuge funds will be used to administer these uses.

Anticipated Impacts of Use: Anticipated Impacts of the Use

Possible impacts of the recreational use of pack and saddle stock include disturbance to wildlife and habitat modification. Wildlife can be affected by the sight and sound of recreationists (Boyle and Sampson 1985). Habitat can be affected through vegetation trampling, soil compaction, and erosion (Cole 1983, 1990). Due to the small number of recreational pack and saddle stock users on the Refuge, the impacts on sheep and other wildlife and their habitat are expected to be relatively minor and localized. These potential impacts are described below.

Impacts on Wildlife:
Immediate responses by wildlife to recreational activity can range from behavioral changes including nest abandonment or change in food habits, physiological changes such as elevated heart rates due to flight, or even death (Knight and Cole 1995). The long term effects are more difficult to assess but may include altered behavior, vigor, productivity or death of individuals; altered population abundance, distribution, or demographics; and altered community species composition and interactions.

According to Knight and Cole (1991), there are three wildlife responses to human disturbance: 1) avoidance; 2) habituation; and 3) attraction. The magnitude of the avoidance response may depend on a number of factors including the type, distance, movement pattern, speed, and duration of the disturbance, as well as the time of day, time of year, weather; and the animal's access to food and cover, energy demands, and reproductive status (Knight and Cole 1991; Gabrielsen and Smith 1995).

In otherwise suitable habitat, sheep have been observed to abandon an area, either temporarily or permanently, when their tolerance to disturbance is exceeded (Welles and Welles 1961, Light 1971, Wehausen 1980, Papouchis *et al.* 2001, Thompson *et al.* 2007). If the resulting loss of habitat is significant, the population's carrying capacity could be reduced (Light and Weaver 1973). Furthermore, when disturbance elicits a flight response in sheep, resulting energetic losses and loss of foraging time could negatively affect the physiology of individuals, potentially reduce their survival and reproductive success (MacArthur et al. 1979). Papouchis et al. (2001) found that response of female bighorn sheep to disturbance was greater during the spring lambing period and the response of male sheep was greatest during the fall rut.

In some circumstances, sheep may habituate to predictable human activity (Wehausen et al. 1977, Kovach 1979), including highway traffic (Horesji 1976), hiking (Hicks and Elder 1979, Hamilton et al.

1982, Holl and Bleich 1987), and aircraft (Krausman et al. 1998). Habituation is defined as a form of learning in which individuals stop responding to stimuli that carry no reinforcing consequences for the individuals that are exposed to them (Alcock 1993). A key factor for predicting how wildlife would respond to disturbance is predictability. Gabrielsen and Smith (1995) suggest that most animals seem to have a greater defense response to humans moving unpredictably in the terrain than to humans following a distinct path. Observations by Owen (1973) and others suggest that many species of wildlife are habituated to livestock and are less likely to flee when approached by an observer on horseback than by an observer on foot.

Wildlife may also be attracted to human presence. For example, wildlife may be converted to "beggars" lured by handouts (Knight and Temple 1995), and scavengers are attracted to road kills (Rosen and Lowe 1994).

Impacts on Habitat:
Public use activities can also have adverse impacts on vegetation and soil conditions. Impacts from vegetation trampling can lower species richness, decrease ground cover and plant species density, increase weedy annuals, and induce changes in species composition (Grabherr 1983).

Impacts related to horseback riding include exotic plant seed dispersal (Beck 1993, Hammitt and Cole 1987), soil compaction and erosion (Bainbridge 1974, Hendee et a1. 1990, Hammitt and Cole 1987), trail widening (Whitaker 1978), vegetation trampling (Nagy and Scotter 1974, Weaver and Dale 1978, Whitaker 1978), aesthetic concerns relative to horse manure (Lee 1975), direct wildlife disturbance (Owen 1973), and direct and indirect conflicts with other recreationists.

Invasive plant species can be spread to new sites through forage (e.g., hay containing invasive weed seeds brought in to feed horses) and manure (Beck 1993, Benninger-Truax et al. 1992). Invasive weed establishment is further facilitated by increased trail disturbance, as many exotic plants gain a competitive advantage in highly disturbed sites. Additionally, hoof action tends to dig up and puncture the soil surface (McQuaid-Cook 1978), which causes greater sediment loss than any other form of recreational trail use (Seney and Wilson 1994), and increases the potential for disturbance-tolerant vegetation (e.g., invasive species) to establish. Trail widening is also a consideration, as horses tend to walk on the down slope sides of trails (Whitson 1974). Anticipated results include a wider trail, a much wider area of disturbance, and ongoing trail maintenance problems. Vegetation impacts can be much more pronounced considering that hikers tend to flatten vegetation while horses tend to churn up soil, thus, cutting plants off at the rootstalk (Whittaker 1978). This can increase spread of previously established invasives by providing loose disturbed soil for germination and spreading reproductive plant structures. This impact initially increases invasive plant species encroachment with light to moderate trail use, and eventually lowers (native) species richness values to near zero with heavy impacts (Hendee et al. 1990).

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Pack goats and llamas will not be permitted due to the potential for disease transmission to desert

bighorn sheep
- Vehicles and horse trailers will be restricted to designated roads and parking areas
- The use of certified weed-free hay is required to minimize weed spread.
- Recreational saddle/pack stock users will be required to carry their own water and food for their stock. Water from springs and water developments must not be used.
- Tying off pack/saddle stock to trees is discouraged. If no other tie offs are available, the lead ropes or tie lines must be attached to tree savers (wide straps with round rings attached that prevent damage to tree bark.) Hobbling of horses is strongly encouraged as an alternative.
- Access to certain portions of the Refuge may be restricted during bighorn sheep lambing season and fall rut
- All educational and interpretive materials for riders will emphasize principles of the Leave-No Trace backcountry horse use (www.lnt.org).
- Seasonal fire restrictions will be strictly enforced.
- Open fires will not be permitted

Justification: While not one of the six priority wildlife dependent public uses listed or identified in the National Wildlife Refuge System Administration Act as amended (1997), recreational use of pack and saddle stock is believed to be a compatible public use under the stipulations outlined in this compatibility determination. The primary reasons for this determination include:
1. The recreational use of pack and saddle stock can facilitate priority public uses such as hunting, wildlife observation, and photography.
2. Due to its large size and remote nature, much of the refuge is very difficult to access. Pack and saddle stock help facilitate this access.
2. Pack and saddle stock uses are a target audience not reached through other opportunities; they are potential partners and a potential source of support for the Refuges.
3. Impacts associated with the use of pack and saddle stock would be minimized through implementation of the stipulations noted above.
4. Pack/saddle stock use and impacts will be monitored and the use modified if necessary.

Based upon the information presented here and in the Draft Comprehensive Conservation Plan / Environmental Impact Statement (USFWS 2008), it is determined that recreational use of pack and saddle stock within the Desert National Wildlife Refuge, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System.

Mandatory Re-Evaluation Date:

_____ Mandatory 15-year Re-Evaluation (for priority public uses)

__X__ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X__ Environmental Impact Statement and Record of Decision

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Refuge Determination

Refuge Manager: ______________________________ ________________

(Signature) (Date)

Project Leader Approval: ______________________________ ________________

(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________

(Signature) (Date)

Assistant Regional Director - Refuges: ______________________________ ________________

(Signature) (Date

COMPATIBILITY DETERMINATION

Use: Wildlife Observation and Photography

Refuge Name: Moapa Valley National Wildlife Refuge (Refuge), Clark County, Nevada.

Establishing and Acquisition Authority: Moapa Valley National Wildlife Refuge was established on September 10, 1979, to secure and protect habitat for the endangered Moapa dace (*Moapa coriacea*). This unique native fish lives out its life within the Warm Springs area of the Upper Muddy River headwaters. These headwaters are composed of up to 20 thermal springs which are essential to the Moapa dace's life cycle. Historic uses of the spring pools and the surrounding landscape for agricultural and recreational purposes have altered the habitat of the Moapa dace.

Refuge Purpose(s): Moapa Valley National Wildlife Refuge purpose includes:

"… to conserve (A) fish or wildlife which are listed as endangered species or threatened species … or (B) plants …" 16 U.S.C. §1534 (Endangered Species Act of 1973)

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: The National Wildlife Refuge System Improvement Act of 1997 identifies wildlife observation and photography as well as hunting, fishing, interpretation, and environmental education as wildlife dependent public uses for NWR's. As two of the six priority public uses of the Refuge system, these uses are to be encouraged when compatible with the purposes of the Refuge. The public and communities desire more opportunities for these uses. The Refuge will allow access to designated open areas for observing and photographing scenery and associated flora and fauna. The Refuge will also provide some facilities to support wildlife observation and photography.

Due to the Moapa Valley NWR's small size, fragile habitats, on-going restoration work, and the need to remove unsafe structures, the Refuge has been closed to the public since acquisition began. Agency scientists with the U.S. Geological Survey (USGS) and Nevada Department of Wildlife (NDOW), as well as local conservation and community organizations, are working with Service staff to restore the historical landscape and habitat on the Refuge, which is critical to the survival of the Moapa dace, other rare fish and invertebrates, and a variety of migratory birds.

Under alternative C of the CCP (the preferred alternative), the Service would open the Refuge to the public daily. Visitor services would be improved to target 1,000 visitors annually. Interpretive materials, such as brochures and fact sheets, would be developed to guide and enhance visitor experience and provide information on the Moapa dace, its habitat requirements and the history of the Refuge. To encourage schools to visit the Refuge, the Service would organize local school contacts and generate enthusiasm for visiting the Refuge and experiencing its endemic species.

Several new facilities would be constructed or installed for visitor use, including:

a) Potable water lines and public restrooms
b) Shade structures, parking areas, and a school bus/RV turnout
c) Self-guided trail system
d) An overlook trail on the top of the hill on the Plummer Unit,

e) A wheelchair-accessible trail along the spring heads, pools, and riparian corridor on the Plummer Unit.
f) Visitor contact station.

Signs would also be installed along Interstate 15, U.S. Highway 93 and NV 168 to promote and direct the public to the Refuge.

Wildlife observation and photography are considered together in this compatibility determination because all are considered to be wildlife-dependent, non-consumptive uses and many elements of these programs are similar. Both of these public uses are dependent upon the completion of the trail system, potable water lines, public restrooms, a visitor contact station, and parking areas on the Refuge. An estimated 1,000 annual visitors will participate in these activities.

Availability of Resources: The following funding/annual costs (based on FY 2008 costs) would be required to administer and manage the activities as described above:

	One-time Costs	Annual Costs
Administration (Refuge Manager, utilities, vehicle, etc)	$325,000	$250,000
Maintain public restrooms, trails, parking lot, shade structure		$5,000
Maintenance worker	$200,000	$150,000
TOTAL	$525,000	$405,000

Anticipated Impacts of Use: Once considered “non-consumptive”, it is now recognized that wildlife observation and wildlife photography can negatively impact wildlife by altering wildlife behavior, reproduction, distribution, and habitat (Purdy et al. 1987, Knight and Cole 1995).

Purdy et al. (1987) and Pomerantz et al. (1988) described six categories of impacts to wildlife as a result of visitor activities. They are:

1) Direct mortality: immediate, on-site death of an animal;
2) Indirect mortality: eventual, premature death of an animal caused by an event or agent that predisposed the animal to death;
3) Lowered productivity: reduced fecundity rate, nesting success, or reduced survival rate of young before dispersal from nest or birth site;
4) Reduced use of refuge: wildlife not using the refuge as frequently or in the manner they normally would in the absence of visitor activity;
5) Reduced use of preferred habitat on the refuge: wildlife use is relegated to less suitable habitat on the refuge due to visitor activity; and
6) Aberrant behavior/stress: wildlife demonstrating unusual behavior or signs of stress that are likely to result in reduced reproductive or survival rates.

Individual animals may be disturbed by human contact to varying degrees. Human activities on trails can result in direct effects on wildlife through harassment, a form of disturbance that can cause physiological effects, behavioral modifications, or death (Smith and Hunt 1995). Many studies have shown that birds can be impacted from human activities on trails when they are disturbed and flushed from feeding, resting, or nesting areas. Flushing, especially repetitive flushing, can strongly impact habitat use patterns of many bird species. Flushing from an area can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Migratory birds are observed to be more sensitive than resident species to disturbance (Klein 1989).

Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976), colonial nesting species (Buckley and Buckley 1976), and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people. In addition, for many passerine species, primary song occurrence and consistency can be impacted by a single visitor (Gutzwiller et al. 1994). In areas where primary song was affected by disturbance, birds appeared to be reluctant to establish nesting territories (Reijnen and Foppen 1994).

Of the wildlife observation techniques, wildlife photographers tend to have the largest disturbance impacts (Klein 1993, Morton 1995, Dobb 1998). While wildlife observers frequently stop to view species, wildlife photographers are more likely to approach wildlife (Klein 1993). Even slow approach by wildlife photographers tends to have behavioral consequences to wildlife species (Klein 1993). Other impacts include the potential for photographers to remain close to wildlife for extended periods of time, in an attempt to habituate the wildlife subject to their presence (Dobb 1998) and the tendency of casual photographers, with low-power lenses, to get much closer to their subjects than other activities would require (Morton 1995), including wandering off trails. This usually results in increased disturbance to wildlife and habitat, including trampling of plants. Klein (1993) recommended that refuges provide observation and photography blinds to reduce disturbance of waterbirds when approached by visitors.

Education is critical for making visitors aware that their actions can have negative impacts on birds, and will increase the likelihood that visitors will abide by restrictions on their actions. For example, Klein (1993) demonstrated that visitors who spoke with refuge staff or volunteers were less likely to disturb birds. Increased surveillance and imposed fines may help reduce visitor caused disturbance (Knight & Gutzwiller 1995). Monitoring is recommended to adjust management techniques over time, particularly because it is often difficult to generalize about the impacts of specific types of recreation in different environments. Local and site -specific knowledge is necessary to determine effects on birds and to develop effective management strategies (Hockin et al. 1992; Klein et al. 1995; Hill et al. 1997).

The construction and maintenance of trails and parking lots will have minor impacts on soils and vegetation around the trails. This could include an increased potential for erosion, soil compaction (Liddle 1975), reduced seed emergence (Cole and Landres 1995), alteration of vegetative structure and composition, and sediment loading (Cole and Marion 1988). However, by concentrating foot traffic onto the trails other habitats on the Refuge will remain undisturbed.

Disturbance of wildlife is the primary concern regarding these uses. Disturbance to wildlife, such as the flushing of feeding, resting, or nesting birds, is inherent to these activities. There is some temporary disturbance to wildlife due to human activities on trails (walking, bird watching) however, the disturbance is generally localized and will not adversely impact overall populations. Increased facilities and visitation would cause some displacement of habitat and increase some disturbance to wildlife, although this is expected to be minor given the size of the Refuge and by avoiding or minimizing intrusion into important wildlife habitat.

Anticipated Impacts of Uses on Future Lands within the Approved Boundary: The following conditions must be met before allowing existing uses to occur on newly acquired lands: (1) There is no indirect, direct, or cumulative threat anticipated to human health or safety; (2) There is no indirect, direct, or cumulative threat anticipated to natural or cultural resources; (3) The use is consistent with management of existing Moapa Valley NWR lands and would contribute to achieving Refuge goals. In particular, existing Refuge regulations would not be compromised; (4) The newly acquired lands represent a meaningful unit within which to manage the activity; and (5) There are no anticipated conflicts with priority public uses.

Public Review and Comment: Public review and comments will be solicited in conjunction with distribution of the Draft CCP/EIS for the Desert National Wildlife Refuge Complex.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Regulations and wildlife friendly behavior (e.g., requirements to stay on designated trails, etc.) will be described in brochures and posted.
- Access to the Refuge will be allowed only between sunrise and sunset.
- Seasonally restricting or prohibiting recreation activity may be necessary during spring and fall migration to alleviate disturbance to migratory birds (Burger 1981, 1986; Boyle & Samson 1985; Klein et al. 1995; Hill et al. 1997).
- Regulatory and directional signs will clearly mark areas closed to the public and designated routes of travel.
- Maps and public use information will be available at the visitor contact station.
- Refuge staff will conduct regular monitoring of public activities on the Refuge. The data will be analyzed and used by the Refuge Manager to develop modifications, if necessary, to ensure compatibility of the wildlife observation and photography programs.
- Commercial photography would require a Special Use Permit.

Justification: These wildlife-dependent uses are priority public uses of the National Wildlife Refuge System. Providing opportunities for wildlife observation and photography, would contribute toward fulfilling provisions of the National Wildlife Refuge System Administration Act, as amended in 1997, and one of the goals of the Moapa Valley National Wildlife Refuge (Goal 3, Chapter 3, CCP). Wildlife observation and photography would provide an excellent forum for allowing public access and increasing understanding of Refuge resources. The stipulations outlined above should minimize potential impacts relative to wildlife/human interactions. Based upon impacts described in the Draft Comprehensive Conservation Plan and Environmental Impact Statement (USFWS 2008), it is determined that wildlife observation and photography within the Moapa Valley National Wildlife Refuge, as described herein, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System. In our opinion, these wildlife dependent uses will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Re-Evaluation Date:

__X__ Mandatory 15-year Re-Evaluation (for priority public uses)

_____ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X__ Environmental Impact Statement and Record of Decision

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<u>Refuge Determination</u>

Refuge Manager:	______________________________ (Signature)	________________ (Date)
Project Leader Approval:	______________________________ (Signature)	________________ (Date)

<u>Concurrence</u>

Refuge Supervisor:	______________________________ (Signature)	________________ (Date)
Assistant Regional Director - Refuges:	______________________________ (Signature)	________________ (Date

COMPATIBILITY DETERMINATION

Use: Environmental Education and Interpretation

Refuge Name: Moapa Valley National Wildlife Refuge (Refuge), Clark County, Nevada.

Establishing and Acquisition Authority: Moapa Valley National Wildlife Refuge was established on September 10, 1979, to secure and protect habitat for the endangered Moapa dace (*Moapa coriacea*). This unique small fish lives out its life within the Warm Springs area of the Upper Muddy River headwaters. These headwaters are composed of up to 20 thermal springs which are essential to the Moapa dace's life cycle. Historic uses of the spring pools and the surrounding landscape for recreational purposes and agriculture have altered the habitat of the Moapa dace.

Refuge Purpose(s): Moapa Valley National Wildlife Refuge's purpose is:

"… to conserve (A) fish or wildlife which are listed as endangered species or threatened species … or (B) plants …" 16 U.S.C. §1534 (Endangered Species Act of 1973)

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: The National Wildlife Refuge System Improvement Act of 1997 identifies wildlife observation and photography as well as hunting, fishing, interpretation, and environmental education as wildlife dependent public uses for NWR's. As two of the six priority public uses of the Refuge system, these uses are to be encouraged when compatible with the purposes of the Refuge. The public and communities desire more opportunities for these uses. The Refuge will allow access to designated open areas for environmental education and interpretation. The Refuge will also provide some facilities to support environmental education and interpretation.

Due to Moapa Valley NWR's small size, fragile habitats, on-going restoration work, and the need to remove unsafe structures, the Refuge has been closed to the public since acquisition began. Agency scientists with the U.S. Geological Survey (USGS) and Nevada Department of Wildlife (NDOW), as well as local conservation and community organizations, are working with Service staff to restore the historical landscape and habitat on the Refuge, which is critical to the survival of the Moapa dace.

Wit funding form the Southern Nevada Public Lands Management Act, the Service has completed several facilities that are necessary for environmental education and interpretation to occur on the Refuge, including: parking for buses and cars; restrooms; shade structures; self-guided trail system; and a stream profile viewing chamber.

Under Alternative C of the CCP (the preferred alternative), the Service would open the Refuge to the public daily. Visitor services would be improved to target 1,000 visitors annually. Interpretive materials, such as brochures and fact sheets, would be developed to guide and enhance visitor experience and provide information on the Moapa dace, its habitat requirements, and the history of the Refuge. To encourage schools to visit the Refuge, the Service would organize local school contacts and generate enthusiasm for visiting the Refuge and experiencing its endemic species.

To improve outreach for the Refuge, the Service would conduct an annual public open house to encourage interactions and foster relationships between Refuge staff and local constituents, and they would explore opportunities for community-based outreach, such as participation in off-Refuge activities. Docents would be recruited to staff the Refuge on weekends and facilitate tours, and the Service would collect data on the number of visitors to modify their visitor services accordingly.

The Service would construct a permanent environmental education display at the Moapa Valley Community Center (Moapa, NV) or another public venue. Cultural resources interpretive efforts would be incorporated into Refuge interpretation materials through development of regionally-focused cultural resources materials for self-guided tours and incorporation of the history of the Moapa Band of the Paiutes, including their knowledge of native plant and animal species.

The Service would also work with NDOT to install signs along Interstate 15, U.S. Highway 93, and NV 168 to promote and direct the public to the Refuge.

Environmental education and interpretation are considered together in this compatibility determination because all are considered to be wildlife-dependent, non-consumptive uses and many elements of these programs are similar. Both of these public uses are dependent upon the completion of the trail system, potable water lines, public restrooms, a visitor contact station, and parking areas on the Refuge. An estimated 1,000 annual visitors will participate in these activities.

Availability of Resources: The following funding/annual costs (based on FY 2009 costs) would be required to administer and manage the activities as described above:

	One-time Costs	Annual Costs
Administration and management	$60,000	$60,000
Develop interpretive materials	$35,000	$2,500
Education display at Moapa Valley Community Center	$2,000	$200
Maintain public use facilities and grounds		$55,000
TOTAL	**97,000**	**$117,700**

Anticipated Impacts of Use: Once considered "non-consumptive", it is now recognized that activities such as environmental education and interpretation can negatively impact wildlife by altering wildlife behavior, reproduction, distribution, and habitat (Purdy et al. 1987, Knight and Cole 1995).

Purdy et al. (1987) and Pomerantz et al. (1988) described six categories of impacts to wildlife as a result of visitor activities. They are:

1) Direct mortality: immediate, on-site death of an animal;
2) Indirect mortality: eventual, premature death of an animal caused by an event or agent that predisposed the animal to death;
3) Lowered productivity: reduced fecundity rate, nesting success, or reduced survival rate of young before dispersal from nest or birth site;
4) Reduced use of refuge: wildlife not using the refuge as frequently or in the manner they normally would in the absence of visitor activity;
5) Reduced use of preferred habitat on the refuge: wildlife use is relegated to less suitable habitat on the refuge due to visitor activity; and
6) Aberrant behavior/stress: wildlife demonstrating unusual behavior or signs of stress that are likely to result in reduced reproductive or survival rates.

Individual animals may be disturbed by human contact to varying degrees. Human activities on trails can result in direct effects on wildlife through harassment, a form of disturbance that can cause physiological effects, behavioral modifications, or death (Smith and Hunt 1995). Many studies have shown that birds can be impacted from human activities on trails when they are disturbed and flushed from feeding, resting, or nesting areas. Flushing, especially repetitive flushing, can strongly impact habitat use patterns of many bird species. Flushing from an area can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Migratory birds are observed to be more sensitive than resident species to disturbance (Klein 1989).

Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976) and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people. In addition, for many passerine species, primary song occurrence and consistency can be impacted by a single visitor (Gutzwiller et al. 1994). In areas where primary song was affected by disturbance, birds appeared to be reluctant to establish nesting territories (Reijnen and Foppen 1994).). Seasonally restricting or prohibiting recreation activity may be necessary during spring and fall migration to alleviate disturbance to migratory birds (Burger 1981, 1986; Boyle & Samson 1985; Klein et al. 1995; Hill et al. 1997).

Education is critical for making visitors aware that their actions can have negative impacts on birds, and will increase the likelihood that visitors will abide by restrictions on their actions. For example, Klein (1993) demonstrated that visitors who spoke with refuge staff (or volunteers) were less likely to disturb birds. Increased surveillance and imposed fines may help reduce visitor caused disturbance (Knight & Gutzwiller 1995). Monitoring is recommended to adjust management techniques over time, particularly because it is often difficult to generalize about the impacts of specific types of recreation in different environments. Local and site -specific knowledge is necessary to determine effects on birds and to develop effective management strategies (Hockin et al. 1992; Klein and Temple 1995; Hill et al. 1997). Informed management decisions coupled with sufficient public education could do much to mitigate disturbance effects of wildlife-dependent recreations (Purdy et al 1987).

The disturbance by environmental education activities is considered to be of minimal impact because: (1) students and teachers will be instructed in trail etiquette and the best ways to view wildlife with minimal disturbance; (2) education groups will be required to have a sufficient number of adults to supervise the group; (3) trail design will provide adequate cover for wildlife; and (4) observation areas and scopes are provided to view wildlife at a distance which reduces disturbance.

Education staff will coordinate with biologists regarding activities associated with restoration or monitoring projects to ensure that impacts to both wildlife and habitat are minimal. As with any restoration and monitoring activities conducted by Refuge personnel, these activities conducted by students would be at a time and place where the least amount of disturbance would occur.

Anticipated Impacts of Uses on Future Lands within the Approved Boundary: The following conditions must be met before allowing existing uses to occur on newly acquired lands: (1) There is no indirect, direct, or cumulative threat anticipated to human health or safety; (2) There is no indirect, direct, or cumulative threat anticipated to natural or cultural resources; (3) The use is consistent with management of existing Moapa Valley NWR lands and would contribute to achieving Refuge goals. In particular, existing Refuge regulations would not be compromised; (4) The newly acquired lands represent a meaningful unit within which to manage the activity; and (5) There are no anticipated conflicts with priority public uses.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Participants in the Refuge's environmental education program will be restricted to established trails including the kiosk and parking areas, the visitor contact station, and other designated sites.
- All groups using the Refuge for environmental education will be required to make reservations in advance through the Refuge office. This process, which takes the place of a Special Use Permit (SUP), allows Refuge staff and volunteers to manage the number of Refuge visitors on a given day. There is a current refuge policy that educational groups are not charged a fee or required to have a SUP. A daily limit of 100 students participating in the education program will be maintained through this reservation system. Efforts will be made to spread out use by large groups while reservations are made, reducing disturbance to wildlife and over-crowding of Refuge facilities during times of peak demand.
- Trail etiquette including ways to reduce wildlife disturbance will be discussed with teachers during orientation workshops and with students upon arrival during their welcome session. On the Refuge, the teacher(s) is responsible for ensuring that students follow required trail etiquette.
- The Refuge manager will conduct regular surveys of public activities on the refuge. The data will be analyzed and used by the Refuge Manager to develop future modifications if necessary to ensure compatibility of environmental education programs.
- Educational groups are required to have a sufficient number of adults to supervise their groups, a minimum of 1 adult per 12 students.

Justification: These wildlife-dependent uses are priority public uses of the National Wildlife Refuge System. Providing opportunities for environmental education and interpretation, would contribute toward fulfilling provisions of the National Wildlife Refuge System Administration Act, as amended in 1997, and one of the goals of the Moapa Valley Refuge (Goal 3, Chapter 3, CCP). Environmental education and interpretation would provide an excellent forum for allowing public access and increasing understanding of Refuge resources. Environmental education and interpretation activities generally support Refuge purposes and impacts can largely be minimized (Goff et al. 1988). The minor resource impacts attributed to these activities are generally outweighed by the benefits gained by educating present and future generations about refuge resources. Environmental education is a public use management tool used to develop a resource protection ethic within society. While it targets school age children, it is not limited to this group. This tool allows us to educate refuge visitors about endangered and threatened species management, wildlife management and ecological principles and communities. A secondary benefit of environmental education is that it instills an 'ownership' or 'stewardship' ethic in visitors and most likely reduces vandalism, littering and poaching; it also strengthens service visibility in the local community.

The stipulations outlined above should minimize potential impacts relative to wildlife/human interactions. Based upon impacts described above and in the Draft Comprehensive Conservation Plan /Environmental Impact Statement (USFWS 2008), it is determined that environmental education and interpretation within the Moapa Valley National Wildlife Refuge, as described herein, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System. In our opinion, these wildlife dependent uses will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Re-Evaluation Date:

__X____ Mandatory 15-year Re-Evaluation (for priority public uses)

_______ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X__ Environmental Impact Statement and Record of Decision

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Refuge Determination

Refuge Manager: ____________________________ _______________
(Signature) (Date)

Project Leader Approval: ____________________________ _______________
(Signature) (Date)

Concurrence

Refuge Supervisor: ____________________________ _______________
(Signature) (Date)

Assistant Regional Director - Refuges: ____________________________ _______________
(Signature) (Date

COMPATIBILITY DETERMINATION

Use: Research

Refuge Name: Moapa Valley National Wildlife Refuge (Refuge), Clark County, Nevada.

Establishing and Acquisition Authority: Moapa Valley National Wildlife Refuge was established on September 10, 1979, to secure and protect habitat for the endangered Moapa dace (*Moapa coriacea*). This unique small fish lives out its life within the Warm Springs area of the Upper Muddy River headwaters. These headwaters are composed of up to 20 thermal springs which are essential to the Moapa dace's life cycle. Historic uses of the spring pools and the surrounding landscape for recreational purposes and agriculture have altered the habitat of the Moapa dace.

Refuge Purpose(s): Moapa Valley National Wildlife Refuge's purpose is:

"… to conserve (A) fish or wildlife which are listed as endangered species or threatened species … or (B) plants …" 16 U.S.C. §1534 (Endangered Species Act of 1973)

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: Two provisions of the National Wildlife Refuge Improvement Act are to "maintain biological integrity, diversity and environmental health" and to conduct "inventory and monitoring." Monitoring and research are an integral part of National Wildlife Refuge management. Plans and actions based on research and monitoring provide an informed approach, which analyzes the management affects on refuge wildlife.

When the Refuge receives requests to conduct scientific research at the Refuge, Special Use Permits (SUPs) are required to be issued for research and monitoring. SUPs are only issued for monitoring and investigations which contribute to the enhancement, protection, preservation, and management of native Refuge plant and wildlife populations and their habitats. Research applicants are required to submit a proposal that outlines: (1) objectives of the study; (2) justification for the study; (3) detailed methodology and schedule; (4) potential impacts on Refuge wildlife or habitat, including disturbance (short and long term), injury, or mortality (this includes a description of measures the researcher will take to reduce disturbance or impacts); (5) research personnel required; (6) costs to Refuge, if any; and (7) progress reports and end products (i.e., reports, thesis, dissertations, publications). Research proposals are reviewed by Refuge staff and conservation partners, as appropriate. SUPs are issued by the refuge manager, if the proposal is approved.

Evaluation criteria will include, but not be limited to, the following:

- Research that will contribute to specific Refuge management issues will be given higher priority over other research requests.
- Research that will conflict with other ongoing research, monitoring, or management programs will not be granted.
- Research projects that can be accomplished off-Refuge are less likely to be approved.
- Research which causes undue disturbance or is intrusive will likely not be granted. Level and type of disturbance will be carefully evaluated when considering a request.
- Refuge evaluation will determine if any effort has been made to minimize disturbance through study design, including considering adjusting location, timing, scope, number of permittees, study methods, number of study sites, etc.

- If staffing or logistics make it impossible for the Refuge to monitor researcher activity in a sensitive area, the research request may be denied, depending on the specific circumstances.
- The length of the project will be considered and agreed upon before approval. Projects will be reviewed annually.

These criteria will also apply to any properties acquired in the future within the approved boundary of the Refuge.

Availability of Resources: The Refuge receives approximately 1 - 3 research requests per year. Some permit requests require up to one hour to process, others could take longer, depending on the complexity of the research request. On average, the program costs approximately $500.00/year. Refuge operational funds are currently available through the Service budget process to administer this program.

	One-time Costs	Annual Costs
General Administration		$500
TOTAL		$500

Anticipated Impacts of Use: Possible impacts of research include disturbance to wildlife and habitat modification. Potential impacts associated with research activities would be mitigated/minimized because sufficient restrictions would be included as part of the study design and researcher activities would be monitored by Refuge staff. Due to the small number of researchers that use the Refuge and with the restrictions outlined in the stipulations section below, the impacts on migratory birds and other wildlife and their habitat are expected to be relatively minor and localized. These potential impacts are described below.

Impacts on Wildlife:
According to Knight and Cole (1991), there are three categories of wildlife responses to human disturbance: 1) avoidance; 2) habituation; and 3) attraction. The magnitude of the avoidance response may depend on a number of factors including the type, distance, movement pattern, speed, and duration of the disturbance, as well as the time of day, time of year, weather; and the animal's access to food and cover, energy demands, and reproductive status (Knight and Cole 1991; Gabrielsen and Smith 1995).

Individual animals may be disturbed by human contact to varying degrees. Many studies have shown that birds can be impacted from human activities when they are disturbed and flushed from feeding, resting, or nesting areas. Flushing, especially repetitive flushing, can strongly impact habitat use patterns of many bird species. Flushing from an area can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Migratory birds are observed to be more sensitive than resident species to disturbance (Klein 1989). Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976), colonial nesting species (Buckley and Buckley 1976), and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people. In addition, for many passerine species, primary song occurrence and consistency can be impacted by a single visitor (Gutzwiller et al. 1994). In areas where primary song was affected by disturbance, birds appeared to be reluctant to establish nesting territories (Reijnen and Foppen 1994).

Habituation is defined as a form of learning in which individuals stop responding to stimuli that carry no reinforcing consequences for the individuals that are exposed to them (Alcock 1993). A key factor for predicting how wildlife would respond to disturbance is predictability. Gabrielsen and Smith (1995) suggest that most animals seem to have a greater defense response to humans moving unpredictably in the terrain than to humans following a distinct path.

Wildlife may also be attracted to human presence. For example, wildlife may be converted to "beggars" lured by handouts (Knight and Temple 1995), and scavengers are attracted to road kills (Rosen and Lowe 1994).

Impacts on Habitat:
Research activities could also have impacts on vegetation, soil, and/or water. However, most of these effects would be short-term because only the minimum of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates) required for identification and/or experimentation and statistical analysis would be permitted. Off trail walking by researchers could have similar effects as hikers in general who can alter habitats by trampling vegetation, compacting soil, and increasing the potential of erosion (Liddle 1975; Hendee *et al*. 1990). Soil compaction makes root penetration more difficult, making it difficult for seedlings to become established (Cole and Landres 1995). In moderate cases of soil compaction, plant cover and biomass is decreased. In highly compacted soils, plant species abundance and diversity is reduced in the long-term as only the most resistant species survive (Liddle 1975). Impacts from vegetation trampling can lower species richness, decrease ground cover and plant species density, increase weedy annuals, and induce changes in species composition (Grabherr 1983).

Anticipated Impacts of Uses on Future Lands within the Approved Boundary: The following conditions must be met before allowing existing uses to occur on newly acquired lands: (1) There is no indirect, direct, or cumulative threat anticipated to human health or safety; (2) There is no indirect, direct, or cumulative threat anticipated to natural or cultural resources; (3) The use is consistent with management of existing Moapa Valley NWR lands and would contribute to achieving Refuge goals. In particular, existing Refuge regulations would not be compromised; (4) The newly acquired lands represent a meaningful unit within which to manage the activity; and (5) There are no anticipated conflicts with priority public uses.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility: The criteria for evaluating a research proposal, outlined in the Description of Use section above, will be used when determining whether a proposed study will be approved on the Refuge. If proposed research methods are evaluated and determined to have potential adverse impacts on refuge wildlife or habitat, then the refuge would determine the utility and need of such research to conservation and management of refuge wildlife and habitat. If the need was demonstrated by the research permittee and accepted by the refuge, then measures to minimize potential impacts (e.g., reduce the numbers of researchers entering an area, restrict research in specified areas) would be developed and included as part of the study design and on the SUP. SUPs will contain specific terms and conditions that the researcher(s) must follow relative to activity, location, duration, seasonality, etc. to ensure continued compatibility. All Refuge rules and regulations must be followed unless otherwise accepted in writing by Refuge management.

All information, reports, data, collections, or documented sightings and observations, that are obtained as a result of this permit are the property of the Service and can be accessed by the Service at any time from the permittee at no cost. The Refuge also requires the submission of annual or final reports and any/all publications associated with the work done on the Refuge. Each SUP may have additional criteria. Each SUP will also be evaluated individually to determine if a fee will be charged and for the length of the permit.

Extremely sensitive wildlife habitat areas would be avoided unless sufficient protection from research activities (i.e., disturbance, collection, capture and handling) is implemented to limit the area and/or wildlife potentially impacted by the proposed research. Where appropriate, some areas may be temporarily/seasonally closed so that research would be permitted when impacts to wildlife and habitat are no longer a concern. Research activities will be modified to avoid harm to sensitive wildlife and habitat when unforeseen impacts arise.

Refuge staff will monitor researcher activities for potential impacts to the refuge and for compliance with conditions on the SUP. The refuge manager may determine that previously approved research and SUPs be terminated due to observed impacts. The refuge manager will also have the ability to cancel a SUP if the researcher is out of compliance with the conditions of the SUP.

Justification: Refuge monitoring and research will directly benefit and support refuge goals, objectives and management plans and activities. Fish, wildlife, plants and their habitat will improve through the application of knowledge gained from monitoring and research. Biological integrity, diversity and environmental health would benefit from scientific research conducted on natural resources at the refuge. The wildlife-dependent, priority public uses (wildlife viewing and photography, environmental education and interpretation, fishing and hunting) would also benefit as a result of increased biodiversity and wildlife and native plant populations from improved restoration and management plans and activities associated with monitoring and research investigations which address specific restoration and management questions.

Mandatory Re-Evaluation Date:

__X__ Mandatory 15-year Re-Evaluation (for priority public uses)

_____ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X__ Environmental Impact Statement and Record of Decision

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Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader
Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional
Director - Refuges: ______________________________ ________________
(Signature) (Date

COMPATIBILITY DETERMINATION

Use: Wildlife Observation and Photography

Refuge Name: Pahranagat National Wildlife Refuge (Refuge), located in Lincoln County, Nevada.

Establishing and Acquisition Authority(ies): Pahranagat National Wildlife Refuge was established on August 16, 1963, to provide habitat for migratory birds, especially waterfowl. It encompasses 5,380 acres of marshes, open water, native grass meadows, cultivated croplands, and riparian habitat approximately 90 miles north of Las Vegas.

Refuge Purpose(s): Pahranagat National Wildlife Refuge purpose includes:

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…" (16 USC 715d).

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: The National Wildlife Refuge System Improvement Act of 1997 identifies wildlife observation and photography as well as hunting, fishing, interpretation, and environmental education as priority public uses for the National Wildlife Refuge System. The uses are to be encouraged when compatible with the purposes of the refuge. This compatibility determination covers both wildlife observation and photography. Many elements of wildlife observation and photography are similar to opportunities provided in the environmental education and interpretation programs.

Pahranagat NWR allows the year-round access to designated open areas for observing and photographing scenery and associated flora and fauna. Wildlife observation is available throughout the Refuge, and bird watching is the most common activity. A bird list is available at the Refuge office or online. The large bodies of water and riparian habitat provide excellent opportunities for birders to view a variety of waterfowl and other migratory birds.

Pahranagat NWR receives visitors from the nearby communities as well as from other states and foreign countries. Visitation numbers are gathered in two ways on the Refuge: traffic counters at the entrances and a sign-in sheet at the Refuge headquarters. Visitation at the Refuge is expected to increase as the nearby communities grow. Based on current estimates, the Refuge accommodates approximately 30,000 visitors per year (USFWS 2008). The nature trails and fishing/observation pier are the most common facilities used by the public. In FY 2007, over 500 people visited the Refuge to fish, and more than 25,000 people hiked along the nature trails or participated in wildlife observation of some kind.

The Service provides several facilities to support wildlife observation and photography activities on the Refuge. The Refuge administrative office serves as a visitor contact station with brochures, maps, and fact sheets. The office is open Monday through Friday from 8:00 a.m. to 4:00 p.m., or as staff is available. An outside contact station and interpretive kiosk is located at the north end of the Refuge just east of the dike which separates North Marsh from Upper Pahranagat Lake. Vault toilets and dumpsters are also provided in this area. A fishing pier/observation platform is located at the south end of Upper Pahranagat Lake. In addition, a natural trail runs from this point and traverses the east side of Upper Pahranagat Lake. A hunting blind/observation platform is also available at Middle Marsh. Parking is available in several places along designated roads.

Principal public access to Pahranagat NWR is from Highway 93, about 60 miles north of the junction with Interstate 15. Two unpaved roads lead to Lower Lake and Middle Marsh from the highway. A sign along the highway marks the gravel road to the Refuge headquarters. This road connects to Alamo Road and continues through the Refuge and onto the Desert NWR. About four miles north of the headquarters road, an unpaved road leads to the North Marsh and Upper Pahranagat Lake and associated facilities. Vehicles must remain on the designated roads. All-terrain vehicles are prohibited on the Refuge. Boat launching is limited to car-top only (no ramps) and only non-motorized boats or boats with electric motors are permitted on Upper Pahranagat Lake, Middle Marsh, and Lower Lake. No boats, rafts or any other types of flotation devices are allowed at North Marsh.

The Refuge will continue to provide wildlife observation opportunities and photography opportunities. Under Alternative D of CCP (the preferred alternative), the Service would improve opportunities for these two uses on the Refuge. A wildlife observation trail system potentially along historic farming and ranching roads would be developed. Photography and observation blinds along the trail route would also be constructed. To improve public access and awareness of the Refuge, the Service would install directional signs along Highway 93 and Interstate 15 with assistance of Nevada Department of Transportation.

Availability of Resources: The following funding/annual costs (based on FY 2009 costs) would be required to administer and manage the activities as described above:

	One-time Costs	Annual Costs
Manage Current Use		
Administration		$15,000
Law enforcement		$2,000
Volunteers		$4,000
Improve and Enhance Use		
Design and construct wildlife observation trail system	$5,000	$500
Construct photography/observation blinds along trail route.	$3,000	$500
TOTAL	$7,000	$22,000

Anticipated Impacts of Use: Once considered “non-consumptive”, it is now recognized that wildlife observation and wildlife photography can negatively impact wildlife by altering wildlife behavior, reproduction, distribution, and habitat (Purdy et al. 1987, Knight and Cole 1995).

Purdy et al. (1987) and Pomerantz et al. (1988) described six categories of impacts to wildlife as a result of visitor activities. They are:

1) Direct mortality: immediate, on-site death of an animal;
2) Indirect mortality: eventual, premature death of an animal caused by an event or agent that predisposed the animal to death;
3) Lowered productivity: reduced fecundity rate, nesting success, or reduced survival rate of young before dispersal from nest or birth site;
4) Reduced use of refuge: wildlife not using the refuge as frequently or in the manner they normally would in the absence of visitor activity;
5) Reduced use of preferred habitat on the refuge: wildlife use is relegated to less suitable habitat on the refuge due to visitor activity; and
6) Aberrant behavior/stress: wildlife demonstrating unusual behavior or signs of stress that are likely to result in reduced reproductive or survival rates.

Individual animals may be disturbed by human contact to varying degrees. Human activities on trails can result in direct effects on wildlife through harassment, a form of disturbance that can cause physiological effects, behavioral modifications, or death (Smith and Hunt 1995). Many studies have shown that birds can be impacted from human activities on trails when they are disturbed and flushed from feeding, resting, or nesting areas. Flushing, especially repetitive flushing, can strongly impact habitat use patterns of many bird species. Flushing from an area can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Migratory birds are observed to be more sensitive than resident species to disturbance (Klein 1989).

Herons and shorebirds were observed to be the most easily disturbed (when compared to gulls, terns and ducks) by human activity and flushed to distant areas away from people (Burger 1981). A reduced number of shorebirds were found near people who were walking or jogging, and about 50 percent of flushed birds flew elsewhere (Burger 1981). In addition, the foraging time of sanderlings decreased and avoidance (e.g., running, flushing) increased as the number of humans within 100 meters increased (Burger and Gochfeld 1991). Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976), colonial nesting species (Buckley and Buckley 1976), and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people. In addition, for many passerine species, primary song occurrence and consistency can be impacted by a single visitor (Gutzwiller et al. 1994). In areas where primary song was affected by disturbance, birds appeared to be reluctant to establish nesting territories (Reijnen and Foppen 1994).

Depending on the species (especially migrants vs. residents), some birds may habituate to some types of recreation disturbance and either are not disturbed or will immediately return after the initial disturbance (Hockin et al. 1992; Burger et al. 1995; Knight & Temple 1995; Madsen 1995; Fox & Madsen 1997). Rodgers & Smith (1997) calculated buffer distances that minimize disturbance to foraging and loafing birds based on experimental flushing distances for 16 species of waders and shorebirds. They recommended 100 meters as an adequate buffer against pedestrian traffic, however, they suggest this distance may be reduced if physical barriers (e.g., vegetation screening) are provided, noise levels are reduced, and traffic is directed tangentially rather than directly toward birds. Screening may not effectively buffer noise impacts, thus visitors should be educated on the effects of noise and noise restrictions should be enforced (Burger 1981, 1986; Klein 1993; Bowles 1995; Burger & Gochfeld 1998). Seasonally restricting or prohibiting recreation activity may be necessary during spring and fall migration to alleviate disturbance to migratory birds (Burger 1981, 1986; Boyle & Samson 1985; Klein et al. 1995; Hill et al. 1997).

Of the wildlife observation techniques, wildlife photographers tend to have the largest disturbance impacts (Klein 1993, Morton 1995, Dobb 1998). While wildlife observers frequently stop to view species, wildlife photographers are more likely to approach wildlife (Klein 1993). Even slow approach by wildlife photographers tends to have behavioral consequences to wildlife species (Klein 1993). Other impacts include the potential for photographers to remain close to wildlife for extended periods of time, in an attempt to habituate the wildlife subject to their presence (Dobb 1998) and the tendency of casual photographers, with low-power lenses, to get much closer to their subjects than other activities would require (Morton 1995), including wandering off trails. This usually results in increased disturbance to wildlife and habitat, including trampling of plants. Klein (1993) recommended that refuges provide observation and photography blinds to reduce disturbance of waterbirds when approached by visitors.

Education is critical for making visitors aware that their actions can have negative impacts on birds, and will increase the likelihood that visitors will abide by restrictions on their actions. For example, Klein (1993) demonstrated that visitors who spoke with refuge staff or volunteers were less likely to disturb birds. Increased surveillance and imposed fines may help reduce visitor caused disturbance (Knight & Gutzwiller 1995). Monitoring is recommended to adjust management techniques over time, particularly because it is often difficult to generalize about the impacts of specific types of recreation in different environments. Local and site -specific knowledge is necessary to determine effects on birds and to develop effective management strategies (Hockin et al. 1992; Klein et al. 1995; Hill et al. 1997).

The construction and maintenance of trails, photography blinds, and parking lots will have minor impacts on soils and vegetation around the trails. This could include an increased potential for erosion, soil compaction (Liddle 1975), reduced seed emergence (Cole and Landres 1995), alteration of vegetative structure and composition, and sediment loading (Cole and Marion 1988). However, by concentrating foot traffic onto the trails other habitats on the Refuge will remain undisturbed.

Disturbance of wildlife is the primary concern regarding wildlife observation and photography. Disturbance to wildlife, such as the flushing of feeding, resting, or nesting birds, is inherent to these activities. There is some temporary disturbance to wildlife due to human activities on trails (hiking, bird watching) however, the disturbance is generally localized and will not adversely impact overall populations. Increased facilities and visitation would cause some displacement of habitat and increase some disturbance to wildlife, although this is expected to be minor given the size of the Refuge and by avoiding or minimizing intrusion into important wildlife habitat.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Regulations and wildlife friendly behavior (e.g., requirements to stay on designated trails, dogs must be kept on a leash, etc.) will be described in brochures and posted at the Visitor Contact Station(s).
- Access to the Refuge will be allowed only between sunrise and sunset.
- Regulatory and directional signs will clearly mark areas closed to the public and designated routes of travel.
- Maps and public use information will be available at the Refuge Headquarters and kiosk.
- Refuge staff will conduct regular monitoring of public activities on the Refuge. The data will be analyzed and used by the refuge manager to develop future modifications if necessary to ensure compatibility of the wildlife observation and photography programs.
- Commercial photography would require a Special Use Permit.

Justification: These wildlife-dependent uses are priority public uses of the National Wildlife Refuge System. Providing opportunities for wildlife observation and photography, would contribute toward fulfilling provisions of the National Wildlife Refuge System Administration Act, as amended in 1997, and one of the goals of the Pahranagat Refuge (Goal 3, Chapter 3, CCP). Wildlife observation and photography would provide an excellent forum for allowing public access and increasing understanding of Refuge resources. The stipulations outlined above should minimize potential impacts relative to wildlife/human interactions. Therefore, it is determined that wildlife observation and photography within the Pahranagat National Wildlife Refuge, as described herein, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System. In our opinion, these wildlife dependent uses will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

<u>Mandatory Re-Evaluation Date</u>:

__X____ Mandatory 15-year Re-Evaluation (for priority public uses)

_______ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

<u>NEPA Compliance for Refuge Use Decision</u> (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X__ Environmental Impact Statement and Record of Decision

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Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional Director - Refuges: ______________________________ ________________
(Signature) (Date

COMPATIBILITY DETERMINATION

Use: Environmental Education and Interpretation

Refuge Name: Pahranagat National Wildlife Refuge (Refuge), located in Lincoln County, Nevada.

Establishing and Acquisition Authority(ies): Pahranagat National Wildlife Refuge was established on August 16, 1963, to provide habitat for migratory birds, especially waterfowl. It encompasses 5,380 acres of marshes, open water, native grass meadows, cultivated croplands, and riparian habitat approximately 90 miles north of Las Vegas.

Refuge Purpose(s): Pahranagat National Wildlife Refuge purpose includes:

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…" (16 USC 715d).

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: The National Wildlife Refuge System Improvement Act of 1997 identifies wildlife observation, photography well as hunting, fishing, interpretation, and environmental education as priority public uses for National Wildlife Refuge System. These wildlife-dependent uses are to be encouraged when compatible with the purposes of the refuge. This compatibility determination covers both environmental education and interpretation. Many elements of environmental education and interpretation programs are also similar to opportunities provided in the wildlife observation and photography programs.

Pahranagat NWR allows the year-round access to designated areas for environmental education and interpretation. Numerous recreational opportunities are available at Pahranagat NWR. Wildlife observation, fishing, and hunting are the more popular activities enjoyed by Refuge visitors (USFWS 2008).

Pahranagat NWR receives visitors from the nearby communities as well as from other states and foreign countries. Specific data on visitation are not available; however, visitation at the Refuge is expected to increase as the nearby communities grow. Based on current estimates, the Refuge accommodates approximately 30,000 visitors per year. Refuge staff estimate approximately 700 people travel to the refuge to participate in environmental education activities annually.

The Refuge provides limited facilities to support environmental education and interpretation.
The Refuge administrative office currently serves as a visitor contact station with brochures, maps, and fact sheets. The office is open Monday through Friday from 8:00 a.m. to 4:00 p.m., or as staff is available. An outside contact station and interpretive kiosk is located at the north end of the Refuge just east of the dike between North Marsh and Upper Pahranagat Lake. Vault toilets and dumpsters are also provided in this area. Parking is available in several places along designated roads. Principal public access to Pahranagat NWR is from Highway 93, about 60 miles north of the junction with Interstate 15.

The Refuge will continue to provide environmental education and interpretation opportunities. Under Alternative D of CCP (the preferred alternative), the Service would enhance existing and provide new opportunities for environmental education and interpretation. A new visitor contact station and parking area would be constructed at the headquarters unit. Existing interpretive panels would be replaced and new panels would be developed. Environmental education and interpretive materials would also be developed including "wanted posters" for invasive plant species. Education and interpretive programs would incorporate information about traditional and/or sacred cultural resources to increase public awareness about these sensitive resources. The Service would also construct a new interpretive walking trail that connects Upper Pahranagat Lake with the Headquarters Unit. To improve public access and awareness of the Refuge, the Service would install directional signs along Highway 93 and Interstate 15 with assistance of Nevada Department of Transportation. In addition, an interpretive plan for the refuge would be developed.

Availability of Resources: The following funding/annual costs (based on FY 2008 costs) would be required to administer and manage the activities as described above:

	One-time Costs	Annual Costs
Manage Existing Use		
Administration		**$15,000**
Develop environmental education and interpretive materials	**$12,000**	**$3,000**
Improve/Enhance Use		
Construct and maintain new visitor contact station	**$1,000,000**	**$15,000**
Develop kiosk and interpretive panels	**$5,000**	
Develop interpretive walking trail	**$5,000**	**$500**
Volunteers		**$4,000**
TOTAL	**$1,019,000**	**$37,500**

Anticipated Impacts of Use: Once considered "non-consumptive", it is now recognized that uses such as environmental education and interpretation can negatively impact wildlife by altering wildlife behavior, reproduction, distribution, and habitat (Purdy et al. 1987, Knight and Cole 1995).

Purdy et al. (1987) and Pomerantz et al. (1988) described six categories of impacts to wildlife as a result of visitor activities. They are:

1) Direct mortality: immediate, on-site death of an animal;
2) Indirect mortality: eventual, premature death of an animal caused by an event or agent that predisposed the animal to death;
3) Lowered productivity: reduced fecundity rate, nesting success, or reduced survival rate of young before dispersal from nest or birth site;
4) Reduced use of refuge: wildlife not using the refuge as frequently or in the manner they normally would in the absence of visitor activity;
5) Reduced use of preferred habitat on the refuge: wildlife use is relegated to less suitable habitat on the refuge due to visitor activity; and
6) Aberrant behavior/stress: wildlife demonstrating unusual behavior or signs of stress that are likely to result in reduced reproductive or survival rates.

Disturbance of wildlife is the primary concern regarding these uses. Disturbance to wildlife, such as the flushing of feeding, resting, or nesting birds, is inherent to these activities. There is some temporary disturbance to wildlife due to human activities on trails (walking, bird watching) however, the disturbance is generally localized and will not adversely impact overall populations. Increased visitation and new facilities such as the interpretive trail and visitor contact station would cause some loss of habitat and increase disturbance to some wildlife, although this is expected to be minor given the size of the Refuge and by avoiding or minimizing intrusion into important wildlife habitat.

Individual animals may be disturbed by human contact to varying degrees. Human activities on trails can result in direct effects on wildlife through harassment, a form of disturbance that can cause physiological effects, behavioral modifications, or death (Smith and Hunt 1995). Many studies have shown that birds can be impacted from human activities on trails when they are disturbed and flushed from feeding, resting, or nesting areas. Flushing, especially repetitive flushing, can strongly impact habitat use patterns of many bird species. Flushing from an area can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Migratory birds are observed to be more sensitive than resident species to disturbance (Klein 1989).

Herons and shorebirds were observed to be the most easily disturbed (when compared to gulls, terns and ducks) by human activity and flushed to distant areas away from people (Burger 1981). A reduced number of shorebirds were found near people who were walking or jogging, and about 50 percent of flushed birds flew elsewhere (Burger 1981). In addition, the foraging time of sanderlings decreased and avoidance (e.g., running, flushing) increased as the number of humans within 100 meters increased (Burger and Gochfeld 1991). Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976), colonial nesting species (Buckley and Buckley 1976), and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people. In addition, for many passerine species, primary song occurrence and consistency can be impacted by a single visitor (Gutzwiller et al. 1994). In areas where primary song was affected by disturbance, birds appeared to be reluctant to establish nesting territories (Reijnen and Foppen 1994).

Depending on the species (especially migrants vs. residents), some birds may habituate to some types of recreation disturbance and either are not disturbed or will immediately return after the initial disturbance (Hockin et al. 1992; Burger et al. 1995; Knight & Temple 1995; Madsen 1995; Fox & Madsen 1997). Rodgers & Smith (1997) calculated buffer distances that minimize disturbance to foraging and loafing birds based on experimental flushing distances for 16 species of waders and shorebirds. They recommended 100 meters as an adequate buffer against pedestrian traffic, however, they suggest this distance may be reduced if physical barriers (e.g., vegetation screening) are provided, noise levels are reduced, and traffic is directed tangentially rather than directly toward birds. Screening may not effectively buffer noise impacts, thus visitors should be educated on the effects of noise and noise restrictions should be enforced (Burger 1981, 1986; Klein 1993; Bowles 1995; Burger & Gochfeld 1998). Seasonally restricting or prohibiting recreation activity may be necessary during spring and fall migration to alleviate disturbance to migratory birds (Burger 1981, 1986; Boyle & Samson 1985; Klein et al. 1995; Hill et al. 1997).

Education is critical for making visitors aware that their actions can have negative impacts on birds, and will increase the likelihood that visitors will abide by restrictions on their actions. For example, Klein (1993) demonstrated that visitors who spoke with refuge staff or volunteers were less likely to disturb birds. Increased surveillance and imposed fines may help reduce visitor caused disturbance (Knight & Gutzwiller 1995). Monitoring is recommended to adjust management techniques over time, particularly because it is often difficult to generalize about the impacts of specific types of recreation in different environments. Local and site -specific knowledge is necessary to determine effects on birds and to develop effective management strategies (Hockin et al. 1992; Klein et al. 1995; Hill et al. 1997). Informed management decisions coupled with sufficient public education could do much to mitigate disturbance effects of wildlife-dependent recreations (Purdy et al 1987).

The disturbance by environmental education activities is considered to be of minimal impact because: (1) the total number of students permitted through the reservation system is limited to 100 per day; (2) students and teachers will be instructed in trail etiquette and the best ways to view wildlife with minimal disturbance; (3) education groups will be required to have a sufficient number of adults to supervise the group; (4) trail design will provide adequate cover for wildlife; and (5) observation areas and scopes are provided to view wildlife at a distance which reduces disturbance.

Refuge staff will coordinate with biologists regarding activities associated with restoration or monitoring projects to ensure that impacts to both wildlife and habitat are minimal. As with any restoration and monitoring activities conducted by Refuge personnel, these activities conducted by students would be at a time and place where the least amount of disturbance would occur.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Participants in the Refuge's environmental education program will be restricted to established trails, the visitor contact station, and other designated sites.
- All groups using the Refuge for environmental education will be required to make reservations in advance through the Refuge office. This process, which takes the place of a Special Use Permit (SUP), allows refuge staff to manage the number and location of visitors for each unit. There is a current refuge policy that educational groups are not charged a fee or required to have a SUP. A daily limit of 100 students participating in the education program will be maintained through this reservation system. Efforts will be made to spread out use by large groups while reservations are made, reducing disturbance to wildlife and over-crowding of Refuge facilities during times of peak demand.
- Trail etiquette including ways to reduce wildlife disturbance will be discussed with teachers during orientation workshops and with students upon arrival during their welcome session. On the Refuge, the teacher(s) is responsible for ensuring that students follow required trail etiquette.
- Refuge staff will conduct regular monitoring of public activities on the refuge. The data will be analyzed and used by the refuge manager to develop future modifications if necessary to ensure compatibility of environmental education programs.
- Educational groups are required to have a sufficient number of adults to supervise their groups, a minimum of 1 adult per 12 students.
- Regulations and wildlife friendly behavior (e.g., requirements to stay on designated trails, dogs must be kept on a leash, etc.) will be described in brochures and posted at the Visitor Contact Station(s).
- Access to the Refuge will be allowed only between sunrise and sunset.
- Regulatory and directional signs will clearly mark areas closed to the public and designated routes of travel.

Justification: These wildlife-dependent uses are priority public uses of the National Wildlife Refuge System. Providing opportunities for environmental education and interpretation, would contribute toward fulfilling provisions of the National Wildlife Refuge System Administration Act, as amended in 1997, and one of the goals of the Pahranagat Refuge (Goal 3, Chapter 3, CCP). Environmental education and interpretation would provide an excellent forum for allowing public access and increasing understanding of Refuge resources. Environmental education and interpretation activities generally support Refuge purposes and impacts can largely be minimized (Goff et al. 1988). The minor resource impacts attributed to these activities are generally outweighed by the benefits gained by educating present and future generations about refuge resources. Environmental education is a public use management tool used to develop a resource protection ethic within society. While it targets school age children, it is not limited to this group. This tool allows us to educate refuge visitors about endangered and threatened species management, wildlife management and ecological principles and communities. A secondary benefit of environmental education is that it instills an 'ownership' or 'stewardship' ethic in visitors and most likely reduces vandalism, littering and poaching; it also strengthens service visibility in the local community.

The stipulations outlined above should minimize potential impacts relative to wildlife/human interactions. Therefore, it is determined that environmental education and interpretation within the Pahranagat National Wildlife Refuge, as described herein, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System. In our opinion, these wildlife dependent uses will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Re-Evaluation Date:

__X__ Mandatory 15-year Re-Evaluation (for priority public uses)

_____ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X__ Environmental Impact Statement and Record of Decision

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USFWS. 2008. Desert National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Impact Statement. U.S. Fish and Wildlife Service, Region 8.

Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional Director - Refuges: ______________________________ ________________
(Signature) (Date

COMPATIBILITY DETERMINATION

Use: Hunting

Refuge Name: Pahranagat National Wildlife Refuge (Refuge), located in Lincoln County, Nevada.

Establishing and Acquisition Authority(ies): Pahranagat National Wildlife Refuge was established on August 16, 1963, to provide habitat for migratory birds, especially waterfowl. It encompasses 5,380 acres of marshes, open water, native grass meadows, cultivated croplands, and riparian habitat approximately 90 miles north of Las Vegas.

Refuge Purpose(s): Pahranagat National Wildlife Refuge purpose includes:

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds…" (16 USC 715d).

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: Hunting is identified in the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-ee) as a priority use for refuges when it is compatible with the refuge purposes and mission of the Refuge System. As a result, the Service is proposing to continue to allow goose, duck, coot, moorhen, snipe, dove, quail, and rabbit hunting on approximately 900 acres of Pahranagat Refuge. The Proposed Action (Alternative D) analyzed in the Draft Comprehensive Conservation Plan (CCP/EIS) (USFWS 2008), which is incorporated by reference, contains maps and descriptions of where hunting will be allowed on the Refuge. The hunting program will provide high quality, safe, and cost-effective hunting opportunities, and will be carried out consistent with State regulations. The guiding principles of the Refuge System's hunting programs (Service Manual 605 FW 2) are to:

- Manage wildlife populations consistent with Refuge System-specific management plans approved after 1997 and, to the extent practicable, State fish and wildlife conservation plans;
- Promote visitor understanding of and increase visitor appreciation for America's natural resources;
- Provide opportunities for quality recreational and educational experiences consistent with criteria describing quality found in 605 FW 1.6;
- Encourage participation in this tradition deeply rooted in America's natural heritage and conservation history; and
- Minimize conflicts with visitors participating in other compatible wildlife-dependent recreational activities.

The Refuges' hunting program will comply with the Code of Federal Regulations Title 50, 32.1 and be managed in accordance with Service Manual 605 FW2, Hunting.

Hunting will be permitted in accordance with State and Federal regulations and seasons (Table 1 gives an example of annual State hunt seasons for areas within the Refuges) to ensure that it will not interfere with the conservation of fish and wildlife and their habitats. Therefore, the sport hunting of migratory birds and upland game birds on the Refuges is in compliance with State regulations and seasons, the National Wildlife Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-ee), and the Refuge Recreation Act of 1962 (16 U.S.C. 460k).

Table 1. Pahranagat Refuge, Hunting Season Bag Limit Summary for 2006-2007

Species	Dates	Daily Bag Limits
Waterfowl – Ducks	October 14 – January 27	Up to 7 ducks; see below; possession double the bag limit*
Waterfowl – Geese	October 21 – January 28	Up to 4 geese any species; possession double the bag limit
American Coot and Common Moorhen	Concurrent with duck season	25/day, 25 in possession, either all of one species or a mixture of these species
Snipe	Concurrent with duck season	8/day; possession double the bag limit
Dove	September 1 - 30	10/day; possession double the bag limit
Quail	October 14 – January 31	10/day; possession double the bag limit
Rabbit	October 14 – February 28	10/day; possession double the bag limit

*Duck Bag Limits: 7 ducks/ but not more than 2 hen mallards, 1 pintail, 1 canvasback, 2 redhead, 3 scaup, throughout the season

Hunting is permitted on the designated portion of Pahranagat Refuge (Figure 4.5.3 in the CCP/EIS). Hunting of waterfowl, coot, common moorhen, snipe, quail and rabbit is permitted Tuesdays, Thursday, and Saturday during hunting seasons established by the Nevada Fish and Game Commission. Dove hunting is permitted every day during the hunt season.

The Refuge has approximately 600 annual waterfowl hunting visits and 100 upland game visits each year. Field checks by refuge law enforcement officers will be planned, conducted, and coordinated with staff and other agencies to maintain compliance with regulations and assess species and number harvested. Dogs will be required to be kept on a leash, except for hunting dogs engaged in authorized hunting activities and under the immediate control of a licensed hunter.

Availability of Resources: The following funding/annual costs (based on FY 2008 costs) would be required to administer and manage hunting activities as described above:

	One-Time Costs	Annual Costs
Printing (brochures, signs, posters, etc)		0
Law Enforcement (permit compliance, access control, protection) (approx. 20 days/season)		$5,500
Maintenance (parking lot, trash cleanup, toilet)		$3,000
Personnel Services (managerial)		$1,500
TOTAL		**$10,000**

Anticipated Impacts of Use: Direct effects of hunting include mortality, wounding, and disturbance (De Long 2002). Hunting can alter behavior (i.e. foraging time), population structure, and distribution patterns of wildlife (Owens 1977, Raveling 1979, White-Robinson 1982, Thomas 1983, Bartelt 1987, Madsen 1985, and Cole and Knight 1990). There also appears to be an inverse relationship between the numbers of birds using an area and hunting intensity (DeLong 2002). In Connecticut, lesser scaup were observed to forage less in areas that were heavily hunted (Cronan 1957). In California, the numbers of northern pintails on Sacramento Refuge non-hunt areas increased after the first week of hunting and remained high until the season was over in early January (Heitmeyer and Raveling 1988). Following the close of hunting season, ducks generally increased their use of the hunt area; however, use was lower than before the hunting season began. Human disturbance associated with hunting includes loud noises and rapid movements, such as those produced by shotguns and boats powered by outboard motors. This disturbance, especially when repeated over a period of time, compels waterfowl to change food habits, feed only at night, lose weight, or desert feeding areas (Madsen 1995, Wolder 1993).

These impacts can be reduced by the presence of adjacent sanctuary areas where hunting does not occur, and birds can feed and rest relatively undisturbed. At Pahranagat Refuge, Upper Pahranagat Lake and North Marsh are the sanctuary areas. Sanctuaries or non-hunt areas have been identified as the most common solution to disturbance problems caused from hunting (Havera et. al 1992). Prolonged and extensive disturbances may cause large numbers of waterfowl to leave disturbed areas and migrate elsewhere (Madsen 1995, Paulus 1984). In Denmark, hunting disturbance effects were experimentally tested by establishing two sanctuaries (Madsen 1995). Over a 5-year period, these sanctuaries became two of the most important staging areas for coastal waterfowl. Numbers of dabbling ducks and geese increased 4 to 20 fold within the sanctuary (Madsen 1995). Thus, sanctuary and non-hunt areas are very important to minimize disturbance to waterfowl populations to ensure their continued use of the Refuges.

Intermittent hunting can be a means of minimizing disturbance, especially if rest periods in between hunting events are weeks rather than days (Fox and Madsen 1997). It is common for Refuges to manage hunt programs with non-hunt days. At Sacramento Refuge, 3-16 percent of pintails were located on hunted units during non-hunt days, but were almost entirely absent in those same units on hunt days (Wolder 1993). In addition, northern pintails, American wigeon, and northern shovelers decreased time spent feeding on days when hunting occurred on public shooting areas, as compared to non-hunt days (Heitmeyer and Raveling 1988). The intermittent hunting program of three hunt days per week at Sacramento Refuge results in lower pintail densities on hunt areas during non-hunt days than non-hunt areas (Wolder 1993). However, intermittent hunting may not always greatly reduce hunting impacts.

Hunting is a highly regulated activity, and generally takes place at specific times and seasons (fall and winter) when the game animals are less vulnerable, and other wildlife-dependent activities (e.g., wildlife observation, environmental education and interpretation) are less common, reducing the magnitude of disturbance to refuge wildlife. Managed and regulated hunting will not reduce species populations to levels where other wildlife-dependent uses will be affected.

The use of retrieving dogs would be permitted and encouraged in all areas open to waterfowl hunting. These dogs would be required to be under control at all times. Any hunter who allows his/her dog to disturb wildlife is not well received by other hunters who do not want waterfowl disturbed on the ponds that they are hunting. Law enforcement officers will enforce regulations requiring owners to maintain control over their dogs while on the Refuges. Although the use of dogs is not a form of wildlife-dependent recreation; they do in this case support a wildlife dependent use. Implementing the prescribed restrictions outlined in the Stipulations section should alleviate any substantial impacts.

Hunting is an appropriate wildlife management tool that can be used to manage wildlife populations. Some wildlife disturbance will occur during the hunting seasons. Proper zoning, regulations, and

Refuge seasons will be designated to minimize any negative impacts to wildlife populations using the Refuges. Harvesting these species, or any other hunted species, would not result in a substantial decrease in biological diversity on the Refuge.

Conflicts between hunting and other public uses will be minimized by the following:

Wildlife populations on the Refuge are able to sustain hunting and support other wildlife-dependent priority uses. To manage the populations to support hunting, the Refuge adopts harvest regulations set by the State within Federal framework guidelines.

By its very nature, hunting has very few positive effects on the target species while the activity is occurring. However, hunting can give people a deeper appreciation of wildlife and a better understanding of the importance of conserving their habitat, which ultimately contributes to fulfilling the Refuge System mission. Furthermore, despite the potential impacts of hunting, a goal of Pahranagat Refuge is to provide visitors of all ages an opportunity to enjoy wildlife-dependent recreation. Of key concern is to offer a safe and quality program and to ensure adverse impacts remain at an acceptable level.

Recreational hunting will remove individual animals, but does not negatively affect wildlife populations. To assure that populations are sustainable, the Nevada Fish and Game Commission, in consultation with the NDOW, annually review the population censuses to establish season lengths and harvest levels.

The Service believes that there will be minimal conflicts between hunters and the other wildlife-dependent recreational uses. The uses differ seasonally and are not occurring on the same area at the same time.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

Refuge Specific Regulations:

A. Migratory Game Bird Hunting. We allow hunting of goose, duck, coot, moorhen, snipe, and dove on designated areas of the refuge in accordance with State regulations subject to the following conditions:
    1. We allow hunting only on designated days.
    2. We only allow motorless boats or boats with electric motors on the refuge hunting area during the migratory waterfowl hunting season.
    3. You may only possess approved nontoxic shot while in the field (see Sec. 32.2(k)).
B. Upland Game Hunting. We allow hunting of quail and rabbit on designated areas of the refuge in accordance with State regulations subject to the following conditions:
    1. We only allow hunting on designated days.
    2. Condition A3 applies.

- All hunting activities and operations will be reviewed annually to ensure compliance with all applicable laws, regulations, and policies.
- Population censuses will be reviewed annually with the NDOW to ensure that harvest from hunting is not unacceptably impacting the targeted populations. The program will be modified accordingly.
- Refuge specific hunting information will be available via signs, information panels, and brochures
- Refuge officers will patrol, monitor, and collect data on hunting activities in the field to assure that it does not interfere with wildlife resources and other wildlife dependent uses on a weekly basis. The program will be modified accordingly.
- Non-hunting and hunting acres are physically separated.
- Hunting will be limited to occur only on Tuesday, Thursday, and Saturday during the hunt season. Exceptions are opening weekend. Dove hunting is allowed daily during the regular State season
- Boundary and hunting area signs will be maintained to clearly define the designated hunting areas.
- Allow vehicle traffic only on designated roads and parking areas.
- Parking areas will be signed and gated to allow only pedestrian access.
- The hunting program will be highly regulated and managed in strict accordance with all applicable Federal laws (Code of Federal Regulations, Title 50 subchapter C) and to the extent practicable, consistent with applicable State laws.
- Provide information about the refuge hunting program through signs, kiosks, and brochures
- No camping or tents are allowed on the Refuge

Justification: Hunting is a wildlife-dependent recreational use listed in the National Wildlife Refuge System Improvement Act. Providing a quality hunting program contributes to achieving one of the Refuge goals (Goal 3, Objective 3.1, Appendix F of the CCP). By facilitating this use on the Refuge, we will increase the visitors' knowledge and appreciation of fish and wildlife, which may lead to increased public stewardship of wildlife and their habitats on the Refuge. Increased public stewardship will support and complement the Service's actions in achieving the Refuge's purposes and the mission of the National Wildlife Refuge System.

Based upon impacts and stipulations described above, it is determined that hunting within Pahranagat National Wildlife Refuge, as described herein, will not materially interfere with or detract from the purposes for which the Refuge were established or the mission of the Refuge System.

Mandatory Re-Evaluation Date:

__X__ Mandatory 15-year Re-Evaluation (for priority public uses)

_____ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X_ Environmental Impact Statement and Record of Decision

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Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader
Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional
Director - Refuges: ______________________________ ________________
(Signature) (Date

COMPATIBILITY DETERMINATION

Use: Fishing

Refuge Name: Pahranagat National Wildlife Refuge, located in Lincoln County, Nevada.

Establishing and Acquisition Authority(ies): Pahranagat National Wildlife Refuge (Refuge) was established in January 1964 under authority of the Migratory Bird Conservation Act. Additional lands were withdrawn from public domain for the Refuge by Public Land Order 3348 in March of 1964.

Refuge Purpose(s): Pahranagat National Wildlife Refuge purposes include:

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 715d]) (Public Land Order 3348).

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: Fishing is identified in the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-ee) as a priority use for refuges when it is compatible with the refuge purposes and mission of the Refuge System. The Service is proposing to continue to allow fishing on Pahranagat Refuge. The fishing program will be carried out consistent Code of Federal Regulations Title 50, 32.5 and 32.47 and be managed in accordance with Service Manual 605 FW3, Fishing, and State of Nevada regulations. The guiding principles of the Refuge System's fishing programs (Service Manual 605 FW 3) are to:

A. Effectively maintain healthy and diverse fish communities and aquatic ecosystems through the use of scientific management techniques;
B. Promote visitor understanding of, and increase visitor appreciation for, America's natural resources;
C. Provide opportunities for quality recreational and educational experiences consistent with criteria describing quality found in 605 FW 1.6;
D. Encourage participation in this tradition deeply rooted in America's natural heritage and conservation history; and
E. Minimize conflicts with visitors participating in other compatible wildlife-dependent recreational activities.

Game fish species present in refuge waters include large-mouth bass, crappie, blue gill, catfish, and carp. The Upper Pahranagat Lake, Middle Pond, and Lower Pahranagat Lake will be open to fishing year-round. We allow both bank fishing and fishing from motorless boats or boats with electric motors in these Refuge waters. North Marsh will be open from February 2 to September 30 each year. We prohibit the use of boats, rubber rafts, or other flotation devices on the North Marsh.

In FY 2006, the Refuge received approximately 2,000 visits associated with fishing. The number of visitors is expected to increase if the populations of Alamo and the Coyote Springs Valley grow as expected.

Availability of Resources:
Limited funding and staffing would be required to manage the bank fishing on the Refuge. The U.S. Fish and Wildlife Service Nevada Zone law enforcement officer and game wardens from the Nevada Department of Wildlife (NDOW) both conduct law enforcement patrols and enforce state and federal

fishing and boating laws and regulations. Approximately $7,500 per year is spent administering the fishing program at the Refuge.

Funding would be sought through the Service budget process. Other sources include: strengthened partnerships, grants, additional coordination with other law enforcement agencies, and additional Refuge operations. This funding will support a safe, quality public use program as described above.

Anticipated Impacts of the Use(s):
Fishing activities may also influence the composition of bird communities, as well as distribution, abundance, and productivity of waterbirds (Tydeman 1977, Burger 1981, Bouffard 1982, Bell and Austin 1985, Bordignon 1985, Edwards and Bell 1985, and Cooke 1987). Shoreline activities, such as human noise, do cause some birds to flush and go elsewhere (Klein 1993). Disturbance and destruction of riparian vegetation, bank stability, and water quality may result from high levels of bank fishing activities. Boating associated with fishing can alter bird distribution, reduce use of particular habitats or entire areas by waterfowl and other waterbirds, alter feeding behavior and nutritional status, and cause premature departure from areas (Knight and Cole 1995).

Cumulative impacts of increased use also have correlating effects on wildlife, habitat and the fisheries resource (Buckley and Buckley 1976; Glinski 1976; Miller et al. 1998; Reijnen and Foppen 1994; Smith and Hunt 1995).

NDOW has determined that existing fish resources found within the Refuge are healthy and robust enough to support regulated fishing, complimenting the other activities available to the public in their enjoyment of their public resources.

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:
- Refuge Specific Regulations: Sport Fishing. We allow sport fishing on designated areas of the refuge in accordance with State regulations subject to the following conditions:
  - The North Marsh will be closed to all boating and floatation devices.
  - The North Marsh will be closed to bank fishing at all times to diminish waterfowl disturbance and allow it to serve as a sanctuary for migratory waterfowl.
- Monitor fishing use to ensure that facilities are adequate and disturbance to wildlife continues to be minimal.
- Parking areas, roads, and related access facilities will be maintained as necessary to ensure public safety and to prevent erosion or habitat damage.
- Providing information in Refuge kiosks.
- Proper zoning and regulations will be designated.
- Law enforcement patrols by game wardens, and refuge officers to enforce state and federal regulations.
- Use Best Management Practices when maintaining parking areas, roads, and access facilities to prevent erosion or habitat damage.
- Providing educational information at Refuge kiosks.
- Monitor fishing activities to ensure facilities are adequate and wildlife disturbance is minimal.

- Law enforcement patrols will be conducted by game wardens, and refuge officers to enforce state and federal regulations.
- Some human disturbance of forest and shrub bird species may occur during nesting and spring/fall migration periods. Access to trails and fishing areas may be limiting during key nesting periods.
- Provide information about the Refuge fishing program by installing informational signs/kiosks, creating and distributing brochures, and utilizing the Refuge's website.
- Install public use ethics panel, including the importance of removing fishing line, not littering and displaying the "pack it in and pack it out" message at appropriate access points. .

Justification: Fishing is an appropriate wildlife-dependent recreational activity. Based upon impacts described in the Comprehensive Conservation Plan, it is determined that fishing within the Pahranagat National Wildlife Refuge will not materially interfere with or detract from the purposes for which the Refuge was established or mission of the National Wildlife Refuge System.

Fishing is a priority public use listed in the Improvement Act. By facilitating this use on the Refuge, the visitors' knowledge and appreciation of fish and wildlife will increase, which may lead to increased public stewardship of wildlife and their habitats on the Refuge. Increased public stewardship will support and complement the Service's actions in achieving the Refuge's purposes and the mission of the National Wildlife Refuge System.

Because of the number of visitors to the Refuge, this would not pose a problem and could be handled with existing staff. This program as described is determined to be compatible and will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Re-Evaluation Date:

__X____ Mandatory 15-year Re-Evaluation (for priority public uses)

_______ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_X__ Environmental Impact Statement and Record of Decision

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Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional Director - Refuges: ______________________________ ________________
(Signature) (Date

COMPATIBILITY DETERMINATION

Use: Boating

Refuge Name: Pahranagat National Wildlife Refuge, located in Lincoln County, Nevada.

Establishing and Acquisition Authority(ies): Pahranagat National Wildlife Refuge (Refuge) was established in January 1964 under authority of the Migratory Bird Conservation Act. Additional lands were withdrawn from public domain for the Refuge by Public Land Order 3348 in March of 1964.

Refuge Purpose(s): Pahranagat National Wildlife Refuge purposes include:

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (Migratory Bird Conservation Act [16 U.S.C. 715d])

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: The Service plans to continue to offer recreational boating opportunities on Pahranagat Refuge as a means of facilitating the wildlife-dependent priority public uses: hunting, fishing, and wildlife observation/photography. Both Upper and Lower Pahranagat Lakes will be open to boating year round.

Boat ramps are currently located at the south end of Upper Pahranagat Lake Campground and at campsite #6. Under Alternative D of the Draft CCP/EIS (the preferred alternative), the campground would be converted to a walk-in day use area. In addition, the boat ramps would be closed and converted to a car-top boat launch or a separate car-top launch site would be designated. Aside from human powered craft, only electric powered motors will be permitted. No boats with gas powered motors on board will be allowed to launch on waters of the Refuge.

Approximately 30,000 people visit Pahranagat Refuge each year. Of those visitors, a very small percentage participates in some form of recreational boating on the Refuge. An estimated 20 boats per year are launched at Upper Pahranagat Lake (M. Maxwell, pers. com.). Almost all the recreational boating is done in association with fishing.

<u>Availability of Resources:</u> Limited funding and staffing would be required to manage the boating program and could be handled with existing Refuge staff and volunteers. The U.S. Fish and Wildlife Service Nevada Zone law enforcement officer and game wardens from the Nevada Department of Wildlife (NDOW) both conduct periodic law enforcement patrols and enforce state and federal fishing and boating laws and regulations. Approximately $7,500 per year is spent administering the boating program at the Refuge.

<u>Anticipated Impacts of Use:</u> Purdy et al. (1987) and Pomerantz et al. (1988) described six categories of impacts to wildlife as a result of visitor activities. They are:

1) Direct mortality: immediate, on-site death of an animal;
2) Indirect mortality: eventual, premature death of an animal caused by an event or agent that predisposed the animal to death;
3) Lowered productivity: reduced fecundity rate, nesting success, or reduced survival rate of young before dispersal from nest or birth site;

4) Reduced use of refuge: wildlife not using the refuge as frequently or in the manner they normally would in the absence of visitor activity;
5) Reduced use of preferred habitat on the refuge: wildlife use is relegated to less suitable habitat on the refuge due to visitor activity; and
6) Aberrant behavior/stress: wildlife demonstrating unusual behavior or signs of stress that are likely to result in reduced reproductive or survival rates.

Individual animals may be disturbed by human contact to varying degrees. Many studies have shown that birds can be impacted from human activities when they are disturbed and flushed from feeding, resting, or nesting areas. Flushing, especially repetitive flushing, can strongly impact habitat use patterns of many bird species. Flushing from an area can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Migratory birds are observed to be more sensitive than resident species to disturbance (Klein 1989).

Though motorized boats generally have a greater effect on wildlife, even non-motorized boat use can alter distribution, reduce use of particular habitats by waterfowl and other birds, alter feeding behavior and nutritional status, and cause premature departure from areas (Knight and Cole1995). However, compared to motorboats, canoes and kayaks appear to have less disturbance effects on most wildlife species (Jahn and Hunt 1964, Huffman 1999, DeLong 2002) and disturbance to birds in general is reduced when boats travel at or below the 5 mph speed limit.

Herons and shorebirds were observed to be the most easily disturbed (when compared to gulls, terns and ducks) by human activity and flushed to distant areas away from people (Burger 1981). In the Ozark National Scenic Riverway, green heron activity declined on survey routes when canoes and boat use increased on the main river channel (Kaiser and Fritzell 1984). Canoes or slow moving boats have also been observed to disturb nesting great blue herons (Vos et al. 1985).

Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976), colonial nesting species (Buckley and Buckley 1976), and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people. In addition, for many passerine species, primary song occurrence and consistency can be impacted by a single visitor (Gutzwiller et al. 1994). In areas where primary song was affected by disturbance, birds appeared to be reluctant to establish nesting territories (Reijnen and Foppen 1994).

Depending on the species (especially migrants vs. residents), some birds may habituate to some types of recreation disturbance and either are not disturbed or will immediately return after the initial disturbance (Hockin et al. 1992; Burger et al. 1995; Knight & Temple 1995; Madsen 1995; Fox & Madsen 1997). Rodgers & Smith (1997) calculated buffer distances that minimize disturbance to foraging and loafing birds based on experimental flushing distances for 16 species of waders and shorebirds. They recommended 100 meters as an adequate buffer against pedestrian traffic, however, they suggest this distance may be reduced if physical barriers (e.g., vegetation screening) are provided, noise levels are reduced, and traffic is directed tangentially rather than directly toward birds. Screening may not effectively buffer noise impacts, thus visitors should be educated on the effects of noise and noise restrictions should be enforced (Burger 1981, 1986; Klein 1993; Bowles 1995; Burger & Gochfeld 1998). Seasonally restricting or prohibiting recreation activity may be necessary during spring and fall migration to alleviate disturbance to migratory birds (Burger 1981, 1986; Boyle & Samson 1985; Klein et al. 1995; Hill et al. 1997).

Education is critical for making visitors aware that their actions can have negative impacts on birds, and will increase the likelihood that visitors will abide by restrictions on their actions. For example, Klein (1993) demonstrated that visitors who spoke with refuge staff or volunteers were less likely to disturb birds. Increased surveillance and imposed fines may help reduce visitor caused disturbance (Knight & Gutzwiller 1995). Monitoring is recommended to adjust management techniques over time, particularly because it is often difficult to generalize about the impacts of specific types of recreation in different environments. Local and site -specific knowledge is necessary to determine effects on birds and to develop effective management strategies (Hockin et al. 1992; Klein et al. 1995; Hill et al. 1997).

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

______Use is Not Compatible

___X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility: The following stipulations are required to ensure that recreational boating is compatible:

- Only electric powered motors will be permitted throughout Refuge waters.
- Seasonal closures may be implemented to reduce disturbance to wintering, nesting and breeding birds and other wildlife.
- The use of boats, rubber rafts, or other floatation devices is not permitted on the North Marsh.
- Signs will be installed and maintained to mark closed areas on the Refuge.
- Periodic law enforcement will help ensure compliance with regulations and area closures. Regulations will be described in brochures and posted at Refuge headquarters and at boat launch sites. Recreational boaters are required to be in compliance with all applicable Refuge, U.S. Coast Guard, and State of Nevada laws.
- Monitoring of boating activities and associated effects on waterfowl, shorebirds, raptors and other wildlife will be conducted. Monitoring data will be used by the Refuge Manager in the periodic re-evaluation of this Compatibility Determination.

Justification: Boating itself is not considered a wildlife-dependent recreation, but many wildlife dependent recreational activities (waterfowl hunting, fishing, wildlife observation/photography, and environmental education and interpretation) are associated with boating. Providing opportunities for wildlife-dependent priority public uses would contribute toward fulfilling provisions under the National Wildlife Refuge System Administration Act as amended in 1997.

Although boating has a potential to impact wildlife, implementing the prescribed measures listed in the stipulations section will reduce many of these impacts. An adequate amount of habitat will be available to wintering and breeding waterfowl, raptors and other wetland birds because high wildlife use areas will be closed to boating during critical periods. Boating regulations will be maintained and enforced in order to minimize the impact of visitor use on wildlife and wildlife habitat. Thus, we anticipate that birds will find sufficient food resources and resting places such that their abundance and use of the Refuge will not be measurably lessened, the physiological condition and production of waterfowl and other waterbirds will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall status will not be impaired. The Refuge will also implement a monitoring program to help assess disturbance effects on wildlife and habitat. Improved outreach and educational information for Refuge visitors involved in activities associated with boating would also help to reduce the impacts associated with boating activities.

Mandatory Reevaluation Date:

______ Mandatory 15-Year Reevaluation (for priority public uses)

__X__ Mandatory 10-Year Reevaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

______Categorical Exclusion without Environmental Action Statement

______Categorical Exclusion and Environmental Action Statement

______Environmental Assessment and Finding of No Significant Impact

__X__Environmental Impact Statement and Record of Decision

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Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional Director - Refuges: ______________________________ ________________
(Signature) (Date

COMPATIBILITY DETERMINATION

Use: Research

Refuge Name: Pahranagat National Wildlife Refuge, located in Lincoln County, Nevada.

Establishing and Acquisition Authority(ies): Pahranagat National Wildlife Refuge (Refuge) was established in January 1964 under authority of the Migratory Bird Conservation Act. Additional lands were withdrawn from public domain for the Refuge by Public Land Order 3348 in March of 1964.

Refuge Purpose(s): Pahranagat National Wildlife Refuge purposes include:

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. § 715d (Migratory Bird Conservation Act) (Public Land Order 3348).

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-ee]).

Description of Use: Two provisions of the National Wildlife Refuge Improvement Act are to "maintain biological integrity, diversity and environmental health" and to conduct "inventory and monitoring." Monitoring and research are an integral part of National Wildlife Refuge management. Plans and actions based on research and monitoring provide an informed approach, which analyzes the management affects on refuge wildlife.

When the Service receives requests to conduct scientific research at the Refuge, Special Use Permits (SUPs) are required before the use can be allowed. SUPs are only issued for monitoring and investigations which contribute to the enhancement, protection, preservation, and management of native Refuge plant and wildlife populations and their habitats. Research applicants are required to submit a proposal that outlines: (1) objectives of the study; (2) justification for the study; (3) detailed methodology and schedule; (4) potential impacts on Refuge wildlife or habitat, including disturbance (short and long term), injury, or mortality (this includes a description of measures the researcher will take to reduce disturbance or impacts); (5) research personnel required; (6) costs to Refuge, if any; and (7) progress reports and end products (i.e., reports, thesis, dissertations, publications). Research proposals are reviewed by Refuge staff and conservation partners, as appropriate. SUPs are issued by the refuge manager, if the proposal is approved.

Evaluation criteria will include, but not be limited to, the following:

- Research that will contribute to Refuge management issues and ecosystem understanding will be given higher priority over other research requests.
- Research that can be accomplished off-Refuge will be less likely to be approved.
- Research which causes undue disturbance or is intrusive will likely not be granted. Level and type of disturbance will be carefully evaluated when considering a request.
- Refuge evaluation will determine if any effort has been made to minimize disturbance through study design, including considering adjusting location, timing, scope, number of permittees, study methods, number of study sites, etc.
- If staffing or logistics make it impossible for the Refuge to monitor researcher activity in a sensitive area, the research request may be denied, depending on the specific circumstances.
- The length of the project will be considered and agreed upon before approval. Projects will be reviewed annually.

These criteria will also apply to any properties acquired in the future within the approved boundary of the Refuge.

Examples of types of research that have been permitted in the past include: nest and habitat investigations related to the productivity of southwest willow flycatchers, abundance of southwest willow flycatchers, the effects of brown-headed cowbird parasitism on southwestern willow Flycatchers, nest predation studies, spring inventory and monitoring, and yellow-billed cuckoo surveys. Use of the Refuge for research is not expected to increase substantially.

Availability of Resources: The Refuge receives approximately 2-5 research requests per year. Some special use permit requests require 4-8 hours to process, others may take as long as 20 hours, depending on the complexity of the request. Costs to administer this program average about $500 per request.

Anticipated Impacts of Use: Possible impacts of research include disturbance to wildlife and habitat modification. Potential impacts associated with research activities would be mitigated/minimized because sufficient restrictions would be included as part of the study design and researcher activities would be monitored by Refuge staff. Due to the small number of researchers that use the Refuge and with the restrictions outlined in the stipulations section below, the impacts on migratory birds and other wildlife and their habitat are expected to be relatively minor and localized. These potential impacts are described below.

Impacts on Wildlife:
According to Knight and Cole (1991), there are three categories of wildlife responses to human disturbance: 1) avoidance; 2) habituation; and 3) attraction. The magnitude of the avoidance response may depend on a number of factors including the type, distance, movement pattern, speed, and duration of the disturbance, as well as the time of day, time of year, weather; and the animal's access to food and cover, energy demands, and reproductive status (Knight and Cole 1991; Gabrielsen and Smith 1995).

Individual animals may be disturbed by human contact to varying degrees. Many studies have shown that birds can be impacted from human activities when they are disturbed and flushed from feeding, resting, or nesting areas. Flushing, especially repetitive flushing, can strongly impact habitat use patterns of many bird species. Flushing from an area can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Migratory birds are observed to be more sensitive than resident species to disturbance (Klein 1989). Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976), colonial nesting species (Buckley and Buckley 1976), and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people. In addition, for many passerine species, primary song occurrence and consistency can be impacted by a single visitor (Gutzwiller et al. 1994). In areas where primary song was affected by disturbance, birds appeared to be reluctant to establish nesting territories (Reijnen and Foppen 1994).

Habituation is defined as a form of learning in which individuals stop responding to stimuli that carry no reinforcing consequences for the individuals that are exposed to them (Alcock 1993). A key factor for predicting how wildlife would respond to disturbance is predictability. Gabrielsen and Smith (1995) suggest that most animals seem to have a greater defense response to humans moving unpredictably in the terrain than to humans following a distinct path.

Wildlife may also be attracted to human presence. For example, wildlife may be converted to "beggars" lured by handouts (Knight and Temple 1995), and scavengers are attracted to road kills (Rosen and Lowe 1994).

Impacts on Habitat:
Research activities could also have impacts on vegetation, soil, and/or water. However, most of these effects would be short-term because only the minimum of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates) required for identification and/or experimentation and statistical analysis would be permitted. Off trail walking by researchers could have similar effects as hikers in general who can alter habitats by trampling vegetation, compacting soil, and increasing the potential of erosion (Liddle 1975; Hendee *et al*. 1990). Soil compaction makes root penetration more difficult, making it difficult for seedlings to become established (Cole and Landres 1995). In moderate cases of soil compaction, plant cover and biomass is decreased. In highly compacted soils, plant species abundance and diversity is reduced in the long-term as only the most resistant species survive (Liddle 1975). Impacts from vegetation trampling can lower species richness, decrease ground cover and plant species density, increase weedy annuals, and induce changes in species composition (Grabherr 1983).

Public Review and Comment: Public review and comments were solicited in conjunction with distribution of the Draft CCP/EIS for Desert NWR Complex. No comments on this compatibility determination were received.

Determination:

_______Use is Not Compatible

___X___Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility: The criteria for evaluating a research proposal, outlined in the Description of Use section above, will be used when determining whether a proposed study will be approved on the Refuge. If proposed research methods are evaluated and determined to have potential adverse impacts on refuge wildlife or habitat, then the refuge would determine the utility and need of such research to conservation and management of refuge wildlife and habitat. If the need was demonstrated by the research permittee and accepted by the refuge, then measures to minimize potential impacts (e.g., reduce the numbers of researchers entering an area, restrict research in specified areas) would be developed and included as part of the study design and on the SUP. SUPs will contain specific terms and conditions that the researcher(s) must follow relative to activity, location, duration, seasonality, etc. to ensure continued compatibility. All Refuge rules and regulations must be followed unless otherwise accepted in writing by Refuge management.

All information, reports, data, collections, or documented sightings and observations, that are obtained as a result of this permit are the property of the Service and can be accessed by the Service at any time from the permittee at no cost. The Refuge also requires the submission of annual or final reports and any/all publications associated with the work done on the Refuge. Each SUP may have additional criteria. Each SUP will also be evaluated individually to determine if a fee will be charged and for the length of the permit.

Extremely sensitive wildlife habitat areas would be avoided unless sufficient protection from research activities (i.e., disturbance, collection, capture and handling) is implemented to limit the area and/or wildlife potentially impacted by the proposed research. Where appropriate, some areas may be temporarily/seasonally closed so that research would be permitted when impacts to wildlife and habitat are no longer a concern. Research activities will be modified to avoid harm to sensitive wildlife and habitat when unforeseen impacts arise.

Refuge staff will monitor researcher activities for potential impacts to the refuge and for compliance with conditions on the SUP. The refuge manager may determine that previously approved research and SUPs be terminated due to observed impacts. The refuge manager will also have the ability to cancel a SUP if the researcher is out of compliance with the conditions outlined in the SUP.

Justification: This program as described is determined to be compatible. Based upon impacts described above and in the Comprehensive Conservation Plan and Environmental Impact Statement (USFWS 2008), it is determined that research within the Refuge, as described herein, will not materially interfere with or detract from the purposes for which the Refuge was established or the mission of the Refuge System. Refuge monitoring and research will directly benefit and support refuge goals, objectives and management plans and activities. Fish, wildlife, plants and their habitat will improve through the application of knowledge gained from monitoring and research. Biological integrity, diversity and environmental health would benefit from scientific research conducted on natural resources at the Refuge. The wildlife-dependent, priority public uses (wildlife viewing and photography, environmental education and interpretation, fishing and hunting) would also benefit as a result of increased biodiversity and wildlife and native plant populations from improved restoration and management plans and activities associated with monitoring and research investigations which address specific restoration and management questions.

Mandatory Re-Evaluation Date:

________ Mandatory 15-year Re-Evaluation (for priority public uses)

____X___ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_X__ Environmental Impact Statement and Record of Decision

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Miller, S. G., R. L. Knight, and C. K. Miller. 1998. Influence of recreational trails on breeding bird communities. Ecol. Appl. 8:162-169.

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Refuge Determination

Refuge Manager: ______________________________ ________________
(Signature) (Date)

Project Leader
Approval: ______________________________ ________________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ________________
(Signature) (Date)

Assistant Regional
Director - Refuges: ______________________________ ________________
(Signature) (Date

Appendix H.
Biological Resources

SE ROA 13341

Vegetation

Table 1 displays a list of the special status plants that may occur on the refuges in the Desert National Wildlife Refuge Complex (Desert Complex). The table identifies the federal status (U.S. Fish and Wildlife Service [Service] and U.S. Bureau of Land Management [BLM]) and Nevada state status, if any. Species accounts for the federally listed species and some of the special status species are provided, in alphabetical order by common name, following the table.

Table 1. Special Status Plant Species That May Occur at the Desert National Wildlife Refuge Complex

		Status[1]			*Refuge*[2]			
Common Name	*Scientific Name*	*FWS*	*NV*	*BLM*	*AHME*	*DEST*	*MOVA*	*PAHR*
White bearpoppy	*Arctomecon merriamii*	NS	-	N	x	x		
Meadow Valley sandwort	*Arenaria stenomeres*	NS	-	-		x		
Ackerman milkvetch	*Astragalus ackermanii*	NS	-	-		x		
Sheep Mountain milkvetch	*Asrtragalus amphioxys var. musimonum*	NS	-	N		x		
Black woolly-pod	*Astragalus funereus*	NS	-	N		x		
Halfring milkvetch	*Astragalus mohavensis* var. *hemigyrus*	NS	CE	S		x		
Nye milkvetch	*Astragalus nyensis*	NS	-	-				x
Ash Meadows milkvetch[3]	*Astragalus phoenix*	T	CE	S	x			
Alkali mariposa lily	*Calochortus striatus*	NS	-	N	x			
Spring-loving centaury[3]	*Centaurium namophilum*	T	CE	S	x			
Remote rabbitbush	*Chrysothamnus eremobius*	NS	-	N		x		
Virgin River thistle	*Cirsium virginense*	NS	-	-			x	
Tecopa birdsbeak[3]	*Cordylanthus tecopensis*	NS	-	N	x			
Ash Meadows sunray[3]	*Enceliopsis nudicaulis* var. *corrugata*	T	CE	S	x			
Antelope Canyon goldenbush	*Ericameria cervina*	NS	-	-		x		
Charleston goldenbush	*Ericameria compacta*	NS	-	-		x		
Sheep fleabane	*Erigeron ovinus*	NS	-	N		x		
Darin buckwheat	*Eriogonum concinnum*	NS	-	-	x			
Clokey buckwheat	*Eriogonum heermanii* var. *clokeyi*	NS	-	N		x		
Smooth dwarf greasebush	*Glossopetalon pungens* var. *glabrum*	NS	-	N		x		
Rough dwarf greasebush	*Glossopetalon pungens* var. *pungens*	NS	-	N		x		
Ash Meadows gumplant[3]	*Grindelia fraxino-pratensis*	T	CE	S	x			
Ash Meadows ivesia[3]	*Ivesia kingii* var. *eremica*	T	CE	S	x			
Ash Meadows blazing star[3]	*Mentzelia leucophylla*	T	CE	S	x			
Amargosa niterwort[3]	*Nitrophila mohavensis*	E	CE	S	x			

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Table 1. Special Status Plant Species That May Occur at the Desert National Wildlife Refuge Complex

		Status[1]			Refuge[2]			
Common Name	*Scientific Name*	*FWS*	*NV*	*BLM*	*AHME*	*DEST*	*MOVA*	*PAHR*
Rosy twotone beardtongue	*Penstemon bicolor* ssp. *roseus*	NS	-	N		x		
Jaeger beardtongue	*Penstemon thompsoniae* ssp. *jaegeri*	NS	-	-		x		
Clarke phacelia	*Phacelia filiae*	NS	-	N		x		
Parish's phacelia	*Phacelia parishii*	NS	-	N	x	x		
Pygmy poreleaf	*Porophyllum pygmaeum*	NS	-	N		x		
Clokey mountain sage	*Salvia dorrii* var. *clokeyi*	NS	-	N		x		
Death Valley sage	*Salvia funerea*	NS	-	-	x			
Death Valley blue-eyed grass	*Sisyrinchium funereum*	NS	-	-	x			
Ash Meadows lady's tresses[3]	*Spiranthes infernalis*	NS	-	-	x			
Charleston grounddaisy	*Townsendia jonesii* var. *tumulosa*	NS	-	N		x		

[1]Status: E = Endangered
T = Threatened
NS = No Status; these species were previously considered species of concern
CE = Critically endangered
CE# = Proposed as critically endangered
N = Nevada special status species
S = Federally protected and/or protected by Nevada state law

[2]Refuges: AHME- Ash Meadows NWR; DEST- Desert NWR; MOVA- Moapa Valley NWR; PAHR- Pahranagat NWR

[3]Endemic to Refuge

Sources: Service 2006b; NNHP 2005; Otis Bay and Stevens Ecological Consulting 2006

Special Status Species Accounts

Alkali mariposa lily (*Calochortus striatus*) is a member of the lily family (Liliaceae) (Morefield 2001). It is a perennial herb with an underground bulb and a height of 4 to 20 inches. This species has a subumbellate inflorescence with white to pale lavender flowers with a purple stripe. Preferred habitat includes moist alkaline meadows near springs in creosote bush scrub. This plant's elevation range is from 2,100 to 3,700 feet above mean sea level (msl). It is known to occur in a 13.2-mile range in Nevada and also occurs in portions of California.

Amargosa niterwort (*Nitrophila mohavensis*) is a member of the goosefoot family (Chenopodiaceae) and is a long-lived, herbaceous plant (Service 1985). It reaches a maximum height of about 3 inches and has small, bright green leaves and inconspicuous flowers. The Amargosa niterwort is found on salt-encrusted alkaline flats at the south end of Carson Slough and below Crystal Reservoir on the Ash Meadows National Wildlife Refuge (NWR). These flats are saline and alkaline sinks that occur near the terminuses of seepage from springs that are found in Ash Meadows, many miles to the north and east of Carson Slough. The niterwort's elevation range is from 2,100 to 2,160 feet above msl. This niterwort species was federally listed as endangered with associated critical habitat on May 20, 1985 (50 FR 20777). Critical habitat was designated in Inyo County, California, in Sections 5, 6, 7, and 8 of

Township 25 North, Range 6 East. This designation includes 1,200 acres of salt-encrusted alkaline flats. An additional 1,360 acres were also proposed at the time of the original designation, and they were expected to be added in the near future. No final designation has been made on the additional critical habitat. Threats to this species include off-road vehicles, mining, and groundwater depletion that has the potential to affect spring flow, which could dry up the plant's extremely restricted habitat.

Ash Meadows blazing star (*Mentzelia leucophylla*) is a member of the loasa family (Loasaceae) (Service 1985). It is a biennial or short-lived perennial plant with white stems and light yellow flowers. The number of stems varies from one to several, and they reach a height of about 20 inches. The flowers grow in broad inflorescences. This plant is endemic to Nevada and grows on upland alkaline soils found in arroyos and on knolls at an elevation range of 2,200 to 6,500 feet above msl. Ash Meadows blazing star is often associated with Ash Meadows milkvetch and Ash Meadows sunray. This blazing star species was listed as threatened with associated critical habitat on May 20, 1985 (50 FR 20777). Critical habitat was designated in four areas within Ash Meadows. This designation includes 1,240 acres of preferred habitat, which includes sandy or saline clay soils along canyon washes and on alkaline mounds in the more xeric portion of Ash Meadows. Historic populations (more than 30 years ago) have been greatly reduced due to habitat disturbance from road construction and peat mining in Carson Slough. Current threats include alteration of storm drainage patterns through arroyos, and habitat destruction in locations of proposed roads.

Ash Meadows gumplant (*Grindelia fraxino-pratensis*) is a member of the aster family (Service 1985). It is an erect biennial or perennial plant that averages 35 inches high. It has yellow flowers in heads measuring less than 0.5 inches across. This gumplant is not restricted to a specific habitat, but it primarily occurs in saltgrass meadows along streams and pools at elevations between 2,100 and 2,300 feet above msl. Other suitable habitat includes alkali clay soils in drier areas and other riparian areas where soil moisture is maintained by perched groundwater. This gumplant species was listed as threatened with associated critical habitat on May 20, 1985 (50 FR 20777). Critical habitat was designated in 14 areas within Ash Meadows in Inyo County, California, and Nye County, Nevada. This designation includes 1,968 acres of suitable habitat. An additional 40 acres of habitat in Inyo County were also proposed, but a final designation has not been made. Suitable habitat has been dramatically reduced by water diversion into pipes and concrete ditches, agricultural development, and groundwater depletion (Service 1985). Other threats to this species include mining of clay, road construction, and loss of moist habitat due to a decline in spring discharge that occurred during historical agricultural groundwater withdrawals.

Ash Meadows ivesia (*Ivesia eremica*) is a member of the rose family (Rosaceae) (Service 1985). It is a perennial plant with inflorescences and leaf tufts emerging from a woody root crown. There are only a few flowers, with 0.3-inch-long petals, on each inflorescence. This species is limited to specific soils, including light-colored clay uplands and saline seep areas at an elevation range of 2,190 to 2,300 feet above msl. Ash Meadows ivesia is endemic to Nevada. This ivesia species was listed as threatened with associated critical habitat on May 20, 1985 (50 FR 20777). Critical habitat was designated in six areas within Ash Meadows. This designation includes 880 acres of saline seep areas of light-colored clay uplands. Reasons for the decline of this species in the past have included loss of habitat due to road construction and agricultural development, including cropland development, spring alteration, and stream channelization and diversion (Service 1985). The main threat to the continued existence of this species is groundwater depletion, which can dry up ivesia habitat by decreasing spring discharge.

Ash Meadows lady's tresses (*Spiranthes infernalis*) is a member of the orchid family (Orchidaceae) (Morefield 2001). It is a tuberous perennial herb with small flowers that bloom in late spring or early summer. The flowers are yellowish-white with green at the base. This species closely resembles other species in the genus Spiranthes. It is limited to permanently to seasonally wet alkaline meadows and is often found near the edges of spring outflows. Associated vegetation includes creosote bush, bursage, and shadscale. The plant's elevation range is from 2,190 to 2,340 feet above msl. In Nevada, this species is dependent on aquatic and wetland habitats, and its total population size is estimated at 1,107 individuals over 28.2 acres. It is endemic to Ash Meadows and is threatened by orchid collectors.

Ash Meadows milkvetch (*Astragalus phoenix*) is a member of the pea family (Fabaceae/ Leguminosae) (Service 1985). It is a low-matted perennial plant with pink or purple flowers on short, erect stems. The mat forms a 15- to 20-inch-wide mound, and the flowers are about one inch long. This milkvetch species was federally listed as threatened with associated critical habitat on May 20, 1985 (50 FR 20777). Critical habitat was designated in nine locations within Ash Meadows, Nye County, Nevada. This designation includes 1,200 acres of dry, hard, white, barren saline, clay flats, knolls, and slopes, which is the only suitable habitat for this plant. Its elevation range is from 2,200 to 2,380 feet above msl. Ash Meadows milkvetch is endemic to Nevada and grows in small, widely scattered populations throughout the eastern portion of the Ash Meadows NWR. The greatest decline in this species' population occurred between 1970 and 1985 due to loss of suitable habitat by farming activities. Other specific threats to the Ash Meadows milkvetch have included alterations of storm drainage patterns by road construction activities, mining on lands occupied by populations not located within Ash Meadows NWR, and elimination of individual plants during planned road construction.

Ash Meadows sunray (*Enceliopsis nudicaulis* var. *corrugata*) is a member of the aster family (Asteraceae/Compositae) (Service 1985). It is a perennial plant that grows in clumps averaging 10 inches high. The yellow flowers are borne singly on a leafless stalk and are one to 1.5 inches across. Preferred habitat is dry washes with whitish saline soil associated with outcrops of pale, hard limestone. The plant's elevation range is 2,200 to 2,360 feet above msl. This sunray species was listed as threatened with associated critical habitat on May 20, 1985 (50 FR 20777). Critical habitat was designated in nine areas within Ash Meadows. This designation includes 1,760 acres of dry washes and whitish, saline soil associated with outcrops of a pale whitish limestone. Ash Meadows sunray is a more common, endemic plant of Ash Meadows, but its population was dramatically reduced between 1970 and 1985 due to habitat loss from agricultural production, initial phases of development, and road construction. Current threats include off-road vehicles and road construction.

Death Valley sage (*Salvia funerea*) is a member of the mint family (Lamiaceae) (Morefield 2001). It is a shrub that flowers in the spring. Preferred habitat includes dry limestone cliffs, crevices, and adjacent wash gravels at an elevation range of 2,600 to 3,500 feet above msl. It typically grows in deep, sheltered canyons or on north-facing exposures, and nearby vegetation usually consists of shadscale and creosote bush. Four occurrences of this species have been mapped in Nye County, but the overall population size and range are unknown. This species also occurs in portions of California.

Parish's phacelia (*Phacelia parishii*) is a member of the waterleaf family (Hydrophyllaceae) (Morefield 2001). It is a small annual that flowers in late spring. This species grows in sparsely vegetated alkaline flats at an elevation range of 2,200 to 6,000 feet msl. Suitable habitat conditions include moist to superficially dry soils, mostly barren soils, and salt-crusted silty-clay soils on valley bottom flats, lake deposits, and playa edges. It is often found near seepage areas and sometimes found on gypsum deposits. The dominant nearby habitat type is saltbush scrub. In Nevada, this species is dependent on wetland and aquatic habitats, and its estimated total population size is 37 million individuals over 4,600 acres. Although the population is fairly large, it is declining from historic estimates.

Nye milkvetch (*Astragalus nyensis*) is a member of the legume family (Morefield 2001). It is an annual herb that occurs at elevations between 1,100 and 5,600 feet above msl. This herb flowers in the spring and has one to four white flowers with upper petals that are tinted a faint lilac color. This plant is found on foothills of desert mountains, in calcareous outwash fans and gravelly flats, and sometimes in sandy soil. It is associated with the desert upland community in the Mojave and Great Basin Deserts. Its total estimated population is 1,126 individuals. Nye milkvetch is found in Lincoln, Nye, and Clark counties.

Spring-loving centaury (*Centaurium namophilum*) is a member of the pea family (Service 1985). It is an erect, annual plant with pink flowers that grows to a height of about 18 inches. Preferred habitat consists of moist to wet clay soils along the banks of streams or in seepage areas at an elevation range of at 2,100 to 2,350 feet above msl. The spring-loving centaury is found in similar habitat as the Ash Meadows gumplant and is often associated with this plant. This centaury species was listed as threatened with associated critical habitat on May 20, 1985 (50 FR 20777). Critical habitat was designated in 11 areas within Ash Meadows. This designation includes 1,840 acres of suitable habitat. The spring-loving centaury was historically (more than 30 years ago) found in several areas outside of Ash Meadows. As of 1973, it was considered extirpated from those areas and is now an endemic plant of Ash Meadows (Reveal et al. 1973). Reasons for the decline of this species in the past included loss of riparian habitat due to groundwater depletion, water diversion, spring alteration, peat mining in Carson Slough, and land development for agriculture and municipal facilities (Service 1985). Current threats include groundwater depletion leading to decreases in spring discharge, road construction through riparian areas, and trampling and overgrazing by horses.

Tecopa birdsbeak (*Cordylanthus tecopensis*) is a member of the figwort family (Scrophulariaceae) (Morefield 2001). It is an annual terrestrial hemiparasite that flowers in summer or early fall. This plant grows in open, moist to saturated, alkali-crusted clay soils of seeps, springs, outflow drainages, and meadows. In Nevada, this species is dependent on wetland margin areas, and its total population size is estimated at 4,379 individuals over 11.1 acres in Ash Meadows and Fishlake Valley (Nye and Esmeralda counties). This species also occurs in portions of California. Its elevation range is from 2,100 to 4,900 feet above msl.

Virgin River thistle (*Cirsium virginense*) is a member of the sunflower family (Morefield 2001). It is a spiny perennial herb that ranges from 20 to 80 inches in height. The stems are covered in white, wooly hairs, and the small, pale purple flowers bloom in late summer (June to September). This plant is found on open, moist, alkaline clay soils in seep and spring areas or on gypsum knolls. It is dependent on aquatic or wetland habitat in Nevada. This species can be found in Clark County and has a range of about 17 miles. Its Nevada population is estimated at approximately 105 individuals.

White bearpoppy (*Arctomecon merriamii*) is a member of the poppy family (Papaveraceae) (Morefield 2001). It is a flowering dicot and evergreen, perennial herb that grows on a wide variety of dry to sometimes moist basic soils, including alkaline clay and sand, gypsum, calcareous alluvial gravels, and carbonate rock outcrops. This plant's elevation range is from 2,000 to 6,280 feet above msl. Its current distribution includes Clark, Lincoln, and Nye counties in Nevada and parts of California. Past surveys have estimated a total of more than 20,000 individuals over an area of about 1,000 acres, but the plant's overall population trend is declining.

Noxious Weeds

Table 2 provides a list of the noxious weeds that may occur at each of the refuges in the Desert Complex. Some of these species are known to occur on one or more of the refuges, while others have not yet been identified. A brief description and comments on the species' growing patterns are also provided. Camelthorn is a common weed along streams and ditches (BLM 1999). Puncturevine is widespread, but is most common on farm and range land. Yellow starthistle is common along roads and in waste areas, but it can be found on various soil types. Salt cedar infests riparian areas and can cause streams, springs, and seeps to dry up. Tall whitetop can be found in wet areas, ditches, along roads, on croplands, and in waste areas (Young et al. 2005). Russian knapweed is not limited to specific habitat types, but it is typically found in disturbed areas and tends to avoid healthy, natural habitats (Carpenter and Murray 1998).

Table 2. Noxious Weeds in Southern Nevada

Common Name	Scientific Name	Habit/ Duration[1]	Description	Comments
Russian knapweed	*Acroptilon repens*	H/P	1–3 ft tall; cone-shaped pink or bluish flowers	Forms dense colonies in riparian areas; deeply-rooted
Camelthorn	*Alhagi maurorum*	S/P	1.5-4 ft tall; small, pealike, purplish to maroon flowers	Forms dense stands; extensive system of rhizomes
Sahara mustard	*Brassica tournefourtii*	H/A	0.5-3.5 ft tall; dull yellow racemes	Relies on rain for blooming; common on wind-blown sand deposits and disturbed areas
Hoary cress	*Cardaria draba*	H/P	1-1.5 ft tall; white flat-top cluster flowers	Forms taproot; resprouts from damaged roots
Spotted knapweed	*Centaurea maculosa*	H/B	0.5-4 ft tall; purple to pink flower heads	Forms taproot; prefers well-drained, light-textured soils
Malta starthistle	*Centaurea melitensis*	H/A or B	1–2 ft tall; small, tubular yellow flowers on flower head	Grows from a taproot; common in disturbed areas
Yellow starthistle	*Centaurea solstitialis*	H/A	Up to 3 ft tall; 1-inch long stiff spines around single yellow flower heads	Forms dense, impenetrable stands; can harm horses
Leafy spurge	*Euphorbia esula*	H/P	2-3.5 ft tall; small, greenish-yellow flowers with yellow bracts	Most aggressive in dry soils; uses plant toxins to out-compete natives
Tall whitetop	*Lepidium latifolium*	H/P	1-3 ft tall; dense, white flowers in inflorescences	Grows in disturbed and wet areas; deep-seated rootstocks
White horse-nettle	*Solanum elaeagnifolium*	H/P	1-4 ft tall; blue or violet flowers with bright yellow stamens	Poisonous to livestock; crowds out native plants
Sorghum	*Sorghum bicolor*	G/P	1.5-15 ft tall; tall, grass-like plant with inflorescense and thick leaves	Poisonous to livestock; crowds out native plants
Johnson grass	*Sorghum halepense*	G/P	3–7 ft tall; bright green, 2-foot-long leaf blades; many branched flowering tops	Forms colonies in moist areas; forms underground roots and rhizomes that greatly branch
Tamarisk	*Tamarix parviflora*	T/P	10–20 ft tall; myriad of little, deep pink to white flowers	Scattered stands near ground or surface water
Salt cedar	*Tamarix ramosissima*	T/P	10–15 ft tall; myriad of little, deep pink to white flowers	Scattered stands near ground or surface water
Puncture vine	*Tribulus terrestris*	H/A	1–8 ft long stems; low-growing; solitary, bright yellow flowers; burr-like fruit	Thrives in sandy and sandy loam soils and in disturbed areas

Table 2. Noxious Weeds in Southern Nevada

Common Name	*Scientific Name*	*Habit/ Duration*[1]	*Description*	*Comments*

[1]Habit: G = Graminoid (grass or grass-like plant)
H = Herb/Forb (non-woody, vascular plant)
S = Shrub (multi-stemmed, woody plant, less than 15-ft tall)
T= Tree (single-stemmed, woody plant, or multi-stemmed, more than 15-ft tall)

Duration: A = Annual
B = Biennial
P = Perennial

Sources: Service 2006a; Parker 1990; Thunhorst and Swearingen 1999; Carpinelli 2003

Wildlife

This section contains a list of management priority bird species and species accounts for game species occurring on the Desert NWR, federally listed or candidate wildlife species, and birds of conservation concern that potentially occur on the refuges in the Desert Complex. Species accounts are provided in alphabetical order by common name. Table 3 provides status information for the special status species and identifies at which refuge they may occur. Lists of common wildlife species are also provided for each of the refuges at the end of this appendix.

Management Priority Bird Species

A variety of bird management plans have been developed to identify management goals for various bird species throughout the U.S., Intermountain West, and Nevada, including the North American Landbird Conservation Plan (LCP, Rich et al. 2004), Intermountain West Waterbird Conservation Plan (IWWCP, Ivey and Herziger 2005), North American Waterfowl Management Plan (WMP, Service 1986), United States Shorebird Conservation Plan (SCP, Brown et al. 2001), North American Waterbird Conservation Plan (NAWCP, Kushlan et al. 2002), Nevada Bird Plan (NBP, Nevada Partners in Flight 1999), and Nevada Wildlife Action Plan (WAP, NDOW 2005). These plans identify management priority bird species for the region and state. Many of the priority bird species occur on the refuges in the Desert Complex or have potential to occur based on the presence of suitable habitat. A list of these species, their status, and the management plans they occur in are provided in Table 4. Information on the habitat(s) these species occur in and their presence at each refuge is provided in Table 5.

Table 3. Special Status Wildlife Species That May Occur at the Desert National Wildlife Refuge Complex

		Status[1]			Refuge[2]			
Common Name	*Scientific Name*	*FWS*	*NV*	*BLM*	*AHME*	*DEST*	*MOVA*	*PAHR*
Amphibian								
Southwestern toad	*Bufo microscaphus*	NS	SCP	N		x	x	
Relict leopard frog	*Rana onca*	C	SCP	-			x	x
Northern leopard frog	*Rana pipiens*	-	SCP	N				x
Reptiles								
Desert tortoise	*Gopherus agassizii*	T	SCP	S	x	x		x
Banded gila monster	*Heloderma suspectum cinctum*	NS	SCP	S	x	x	x	x
Common chuckwalla	*Sauromalus ater*	NS	SCP	N	x	x	x	x
Birds								
Northern goshawk	*Accipiter gentilis*	NS	SCP	P		x		x
Golden eagle	*Aquila chrysaetos*	-	SCP	N	x			x
Short-eared owl	*Asio flammeus*	-	SCP	N				x
Western burrowing owl	*Athene cunicularia hypugea*	BCC	SCP	P	x	x	x	x
Ferruginous hawk	*Buteo regalis*	BCC	SCP	P	x	x		x
Black tern	*Chlidonias niger*	NS	SCP	N	x	x	x	x
Yellow-billed cuckoo	*Coccyzus americanus*	BCC, C	SCP	P		x	x	x
Olive-sided flycatcher	*Contopus cooperi*	BCC	SCP	U	x	x	x	x
Yellow warbler	*Dendroica petechia*	BCC	SCP	P	x			x
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	SCP	S	x		x	x
Gray flycatcher	*Empidonax wrightii*	BCC	SS	U	x	x	x	x
Peregrine falcon	*Falco peregrinus*	BCC	SCP	S	x	x		x
Common yellow throat	*Geothlypis trichas*	-	SCP	P	x			x
Blue grosbeak	*Guiraca caerulea*	NS	SS	U	x	x	x	x
Bald eagle	*Haliaeetus leucocephalus*	BCC	SCP	S	x	x		x
Least bittern	*Ixobrychus exilis hesperis*	NS	SCP	-	x	x	x	x
Osprey	*Pandion haliaetus*	-	SCP	P	x			x
American white pelican	*Pelecanus erythrorhynchos*	-	SCP	P	x			x
Phainopepla	*Phainopepla nitens*	NS	SCP	N	x	x	x	x
Summer tanager	*Piranga rubra*	NS	SS	U	x	x	x	x
White-faced ibis	*Plegadis chihi*	NS	SCP	P	x	x	x	x
Vermilion flycatcher	*Pyrocephalus rubinus*	-	-	-	x			
Yuma clapper rail	*Rallus longirostris yumanensis*	E	SCP	-	x		x	x

Table 3. Special Status Wildlife Species That May Occur at the Desert National Wildlife Refuge Complex

		Status[1]			Refuge[2]			
Common Name	*Scientific Name*	*FWS*	*NV*	*BLM*	*AHME*	*DEST*	*MOVA*	*PAHR*
Lucy's warbler	*Vermivora luciae*	NS	SCP	U	x	x	x	x
Arizona Bell's vireo	*Vireo bellii arizonae*	BCC	SCP	P	x	x	x	x
Mammals								
Pallid bat	*Anitrozous pallidus*		SCP	S	x	x	x	x
Townsend's big-eared bat	*Corynorhinus townsendii*	NS	SCP	N	x	x	x	x
Desert kangaroo rat	*Dipodomys deserti deserti*		SCP		x			
Spotted bat	*Euderma maculatum*	NS	SCP	S	x	x	x	x
Greater western mastiff-bat	*Eumops perotis californicus*	NS		N	x	x	x	x
Allen's big-eared bat	*Idionycteris phyllotis*	NS	SCP	N	x	x	x	x
Silver-haired bat	*Lasionycteris noctivagans*		SCP		x			
Western red bat	*Lasiurus blossevillii*		SCP		x		x	
Hoary bat	*Lasiurus cinereus*		SCP		x		x	
Western yellow bat	*Lasiurus xanthinus*		SCP		x		x	
California leaf-nosed bat	*Macrotus californicus*	NS	SCP	S			x	
Pahranagat Valley montane vole	*Microtus montanus fucosus*	NS	SCP	N				x
Ash Meadows montane vole[3,4]	*Microtus montanus nevadensis*	NS	SCP	N	x			
Western small-footed myotis	*Myotis ciliolabrum*	NS	SCP	N	x	x	x	x
Long-eared myotis	*Myotis evotis*	NS	SCP	N	x	x	x	x
Fringed myotis	*Myotis thysanodes*	NS	SCP	N	x	x	x	x
Long-legged myotis	*Myotis volans*	NS		N	x	x	x	x
Yuma myotis	*Myotis yumanensis*	NS		N	x	x	x	x
Big free-tailed bat	*Nyctinomops macrotis*	NS	SCP	N	x	x	x	x
Desert bighorn sheep	*Ovis Canadensis nelsoni*		SCP		x			
Brush mouse	*Peromyscus boylei*		SCP		x			
Brazilian free-tailed bat	*Tadarida brasiliensis*		S	S	x	x	x	x
Hidden Forest Uinta chipmunk	*Tamias umbrinus nevadensis*	NS	SCP			x		
Kit fox	*Vulpes marcotis arsipus*		S		x			
Fish								
Moapa White River springfish[3]	*Crenichthys baileyi moapae*	NS	SCP				x	
Devils Hole pupfish[3]	*Cyprinodon diabolis*	E	SCP	S	x			
Ash Meadows Amargosa pupfish[3]	*Cyprinodon nevadensis mionectes*	E	SCP	S	x			
Warm Springs Amargosa pupfish[3]	*Cyprinodon nevadensis pectoralis*	E	SCP	S	x			

Table 3. **Special Status Wildlife Species That May Occur at the Desert National Wildlife Refuge Complex**

		Status[1]			Refuge[2]			
Common Name	*Scientific Name*	*FWS*	*NV*	*BLM*	*AHME*	*DEST*	*MOVA*	*PAHR*
Pahrump poolfish	*Empetrichthys latos latos*	E	SCP	S		x		
Pahranagat roundtail chub	*Gila robusta jordani*	E	SCP	S				x
Virgin River chub (Muddy River)	*Gila seminuda*	NS	SCP	S			x	
Moapa dace[3]	*Moapa coriacea*	E	SCP	S			x	
Fish, continued								
Moapa speckled dace[3]	*Rhinichthys osculus moapae*	NS	SCP	P			x	
Ash Meadows speckled dace[3]	*Rhinichthys osculus nevadensis*	E	SCP	S	x			
Pahranagat speckled dace	*Rhinichthys osculus velifer*	NS	SCP	P				x
Invertebrates								
Death Valley Agabus diving beetle	*Agabus rumppi*	NS	-	-	x			
Ash Meadows naucorid[3]	*Ambrysus amargosus*	T	-	S	x			
MacNeil sootywing skipper	*Hesperopsis gracielae*	NS	-	N			x	
Nevada admiral	*Limenitus weidemeyerii nevadae*	NS	-	N		x		
Warm Springs naucorid[3]	*Ambrysus relictus*	NS	-	-			x	
Amargosa naucorid	*Pelocoris shoshone amargosus*	NS	-	-	x			
Pahranagat naucorid	*Pelocoris shoshone shoshone*	NS	-	N			x	x
Ash Meadows alkali skipperling	*Pseudocopaeodes eunus alinea*	NS	-	-	x			
Moapa pebblesnail[3]	*Pyrgulopsis avernalis*	NS	SCP	-			x	
Moapa Valley springsnail	*Pyrgulopsis carinifera*	NS	SCP	-			x	
Crystal Spring springsnail[3]	*Pyrgulopsis crystalis*	NS	SCP	-	x			
Ash Meadows pebblesnail[3]	*Pyrgulopsis erythropoma*	NS	-	-	x			
Fairbanks springsnail[3]	*Pyrgulopsis fairbanksensis*	NS	SCP	-	x			
Corn Creek springsnail	*Pyrgulopsis fausta*	NS	SCP	-		x		
Elongate-gland springsnail[3]	*Pyrgulopsis isolata*	NS	SCP	-	x			
Pahranagat pebblesnail	*Pyrgulopsis merriami*	NS	SCP	N				x
Oasis Valley springsnail	*Pyrgulopsis micrococcus*	NS	SCP	N	x			
Distal-gland springsnail[3]	*Pyrgulopsis nanus*	NS	SCP	-	x			
Median-gland Nevada springsnail[3]	*Pyrgulopsis pisteri*	NS	SCP	-	x			
Southeast Nevada springsnail	*Pyrgulopsis turbatrix*	NS	SCP	-		x		
Devils Hole Warm Spring riffle beetle[3]	*Stenelmis calida calida*	NS	-	N	x			
Moapa Warm Spring riffle beetle[3]	*Stenelmis moapa*	NS	-	N			x	x
Sportinggoods tryonia[3]	*Tryonia angulata*	NS	SCP	-	x			

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Table 3. **Special Status Wildlife Species That May Occur at the Desert National Wildlife Refuge Complex**

		Status[1]			Refuge[2]			
Common Name	*Scientific Name*	*FWS*	*NV*	*BLM*	*AHME*	*DEST*	*MOVA*	*PAHR*
Grated tryonia	*Tryonia clathrata*	NS	SCP	N			x	x
Point of Rocks tryonia[3]	*Tryonia elata*	NS	SCP	-	x			
Minute tryonia[3]	*Tryonia ericae*	NS	SCP	-	x			
Amargosa tryonia	*Tryonia variegata*	NS	SCP	-	x			
Invertebrates, continued								
Virile Amargosa snail	Undescribed	-	-	-	x			
Amphipod	Undescribed	-	-	-	x			

[1]Status: BCC=Bird of Conservation Concern; C=Candidate for listing under ESA; E=Endangered; N=Nevada special status species, sensitive; NS=No Status; these species were previously considered species of concern; P=proposed Nevada special status species, proposed sensitive; S=Nevada special status species, state or federal protected or federal candidate; SCP=Species of Conservation Priority (Many of these species also fall under Nevada special status species); SS=Stewardship Species; T=Threatened; U=Unknown status

[2]Refuges: AHME- Ash Meadows NWR; DEST- Desert NWR; MOVA- Moapa Valley NWR; PAHR- Pahranagat NWR

[3]Endemic to Refuge

[4]Possibly extinct

Sources: Service 2006b; NNHP 2004; Service 2002a; NDOW 2005.

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Table 4. Management Priority Bird Species in Nevada: Status

Common Name	*Scientific Name*	*Service*	*State*	*Status*[1] *G-Rank*	*S-Rank*	*Management Plan Status*[2]
Waterbirds						
Eared Grebe	*Podiceps nigricollis*	BCC	YES	G5	S4	WAP priority; NAWCP moderate concern; IWWCP high concern
Western Grebe	*Aechmophorus occidentalis*		YES	G5	S4	WAP priority; NAWCP moderate concern; IWWCP high concern
American White Pelican	*Pelecanus erythrorhynchos*		YES	G3	S2	NBP priority; WAP priority; NAWCP moderate concern; IWWCP high concern
Black-crowned Night-heron	*Nycticorax nycticorax*		YES	G5	S5	NAWCP moderate concern; IWWCP moderate concern
Franklin's Gull	*Larus pipixcan*		YES	G4G5	S3	WAP priority; NAWCP moderate concern; IWWCP high concern
California Gull	*Larus californicus*		YES	G5	S5	NAWCP moderate concern; IWWCP moderate concern
Forster's Tern	*Sterna forsteri*		YES	G5	S3	WAP priority; NAWCP moderate concern; IWWCP moderate concern
Black Tern	*Chlidonias niger*		YES	G4	S2S3	NBP priority; WAP priority; NAWCP moderate concern; IWWCP high concern
Clark's Grebe	*Aechmophorus clarkii*		YES	G5	S4	NBP priority; WAP priority; NAWCP low concern
White-faced Ibis	*Plegadis chihi*		YES	G5	S3	NBP priority; WAP priority; NAWCP low concern; IWWCP high concern
Snowy Egret	*Egretta thula*		YES	G5	S4	WAP priority; NAWCP high concern; IWWCP high concern
Shorebirds						
Marbled Godwit	*Limosa fedoa*	BCC	YES	G5	S3	Audubon Society declining; SCP high concern
Western Sandpiper	*Calidris mauri*		YES	G5	S5	Audubon Society rare; SCP high concern
Dunlin	*Calidris alpina*		YES	G5	S4	SCP high concern
Wilson's Phalarope	*Phalaropus tricolor*		YES	G5	S2S3	SCP high concern
Snowy Plover	*Charadrius alexandrinus*	BCC	YES	G4	S3	Audubon Society declining; NBP priority; WAP priority; SCP highly imperiled
Long-billed curlew	*Numenius americanus*	BCC	YES	G5	S2S3	Audubon Society declining; NBP priority; WAP priority; SCP highly imperiled

Table 4. Management Priority Bird Species in Nevada: Status

Common Name	Scientific Name	Status[1] Service	Status[1] State	Status[1] G-Rank	Status[1] S-Rank	Management Plan Status[2]
Landbirds						
Bendire's Thrasher	*Toxostoma bendirei*	BCC		G4G5	S1	LCP watch list and increase population 100%; Audubon Society highest concern; WAP priority
White-throated Swift	*Aeronautes saxatalis*		YES	G5	S4	LCP watch list and increase population 100%; WAP priority
Pinyon Jay	*Gymnorhinus cyanocephalus*	BCC	YES	G5	S3S4	LCP watch list and increase population 100%; Audubon Society declining; NBP priority; WAP priority
Arizona Bell's Vireo	*Vireo bellii arizonae*		YES	G5	S2	LCP watch list and increase population 100%; Audubon Society highest concern; WAP priority
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	BCC/E	YES	G5	S1	LCP watch list and increase population 50%; Audubon Society declining; NBP priority; WAP priority
Black-chinned Sparrow	*Spizella atrogularis*	BCC	YES	G5	S3	LCP watch list and increase population 50%; Audubon Society highest concern; WAP priority
Virginia's Warbler	*Vermivora virginiae*	BCC	YES	G5	S4	LCP watch list and maintain/increase population; Audubon Society rare; NBP priority; WAP priority
Costa's Hummingbird	*Calypte costae*	BCC	YES	G5	S3	LCP watch list and maintain/increase population; Audubon Society rare; WAP priority
LeConte's Thrasher	*Toxostoma lecontei*	BCC	YES	G3	S2	LCP watch list and maintain/increase population; Audubon Society rare; NBP priority; WAP priority
Lucy's Warbler	*Vermivora luciae*	BCC	YES	G5	S2S3	LCP watch list and maintain/increase population; Audubon Society rare; NBP priority; WAP priority
Abert's Towhee	*Pipilo aberti*		YES	G3G4	S3	LCP watch list and maintain/increase population; Audubon Society rare; WAP priority
Lewis's Woodpecker	*Melanerpes lewis*	BCC	YES	G4	S3	LCP watch list and maintain/increase population; NBP priority; WAP priority

Table 4. Management Priority Bird Species in Nevada: Status

		Status[1]				
Common Name	*Scientific Name*	*Service*	*State*	*G-Rank*	*S-Rank*	*Management Plan Status*[2]
Landbirds, continued						
Flammulated Owl	*Otus flammeolus*	BCC		G4	S4	LCP watch list and maintain/increase population; Audubon Society rare; NBP priority
Gray Vireo	*Vireo vicinior*	BCC	YES	G4	S3	LCP watch list and maintain population; Audubon Society rare; NBP priority; WAP priority
Gambel's Quail	*Callipepla gambelii*		YES	G5	S5	LCP stewardship and maintain population
Red-naped Sapsucker	*Sphyrapicus nuchalis*		YES	G5	S4S5	LCP stewardship and maintain population; NBP priority
Dusky Flycatcher	*Empidonax oberholseri*		YES	G5	S4	LCP stewardship and maintain population
Gray Flycatcher	*Empidonax wrightii*		YES	G5	S4	LCP stewardship and maintain population; NBP priority
Verdin	*Auriparus flaviceps*		YES	G5	S3	LCP stewardship and maintain population; WAP priority
Cactus Wren	*Campylorhynchus brunneicapillus*		YES	G5	S4	LCP stewardship and maintain population
Black-tailed Gnatcatcher	*Polioptila melanura*		YES	G5	S4	LCP stewardship and maintain population
Mountain Bluebird	*Sialia currucoides*		YES	G5	S4	LCP stewardship and maintain population
Crissal Thrasher	*Toxostoma crissale*		YES	G5	S3	LCP stewardship and maintain population; WAP priority
Phainopepla	*Phainopepla nitens*		YES	G5	S2	LCP stewardship and maintain population; NBP priority; WAP priority
Black-throated Gray Warbler	*Dendroica nigrescens*		YES	G5	S5	LCP stewardship and maintain population; NBP priority
Green-tailed Towhee	*Pipilo chlorurus*	BCC	YES	G5	S5	LCP stewardship and maintain population
Black-throated Sparrow	*Amphispiza bilineata*		YES	G5	S5	LCP stewardship and maintain population
Sage Sparrow	*Amphispiza belli*	BCC	YES	G5	S4	LCP stewardship and maintain population; Audubon Society declining; NBP priority; WAP priority
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*		YES	G5	S4	LCP stewardship and maintain population
Scott's Oriole	*Icterus parisorum*		YES	G5	S4	LCP stewardship and maintain population; NBP priority; WAP priority
Peregrine Falcon	*Falco peregrinus*	BCC	YES	G4	S2	LCP stewardship
Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	BCC/C	YES	G5	S1	WAP priority

Table 4. Management Priority Bird Species in Nevada: Status

Common Name	*Scientific Name*	*Status[1]* *Service*	*State*	*G-Rank*	*S-Rank*	*Management Plan Status[2]*
Western Burrowing Owl	*Athene cunicularia hypugea*		YES	G4	S3	WAP priority
Waterfowl						
American Wigeon	*Anas americana*			G5	S4	No WMP plan trend
Canada Goose	*Branta canadensis*			G5	S5	Increasing WMP plan trend
Canvasback	*Aythya valisineria*			G5	S3	No WMP plan trend; WAP priority
Cinnamon Teal	*Anas cyanoptera*			G5	S5	No WMP plan trend; WAP priority
Gadwall	*Anas strepera*			G5	S4	Increasing WMP plan trend
Greater White-fronted Goose	*Anser albifrons*			G5	S4	Increasing WMP plan trend
Green-winged Teal	*Anas crecca*			G5	S4	Increasing WMP plan trend
Lesser Scaup	*Aythya affinis*			G5	S4	Decreasing WMP plan trend
Lesser snow goose	*Chen caerulescens caerulescens*			G5	S4	No WMP plan trend
Mallard	*Anas platyrhynchos*			G5	S5	No WMP plan trend
Northern Pintail	*Anas acuta*			G5	S5	Decreasing WMP plan trend; WAP priority
Northern Shoveler	*Anas clypeata*			G5	S4	Increasing WMP plan trend
Redhead	*Aythya americana*			G5	S4	No WMP plan trend; WAP priority
Ring-necked Duck	*Aythya collaris*			G5	S4	Increasing WMP plan trend
Tundra Swan	*Cygnus columbianus*			G5	S4	Increasing WMP plan trend
Wood Duck	*Aix sponsa*			G5	S4	Increasing WMP plan trend

[1]Status: BCC=Service Bird of Conservation Concern, E=Endangered under Endangered Species Act, YES=State of Nevada listed wildlife species, G3=Vulnerable, G4=Apparently secure, G5=Secure, S1=Critically imperiled, S2=Imperiled, S3=Vulnerable, S4=Apparently secure, S5=Secure.

G-rank is the global rank indicator based on worldwide distribution at the species level, S-rank is the state rank indicator based on distribution within the state at the lowest taxonomic level. Status is based on the Nevada Natural Heritage Program ranking.

[2]Sources and Acronyms: LCP=North American Landbird Conservation Plan (Rich et al. 2004), IWWCP=Intermountain West Waterbird Conservation Plan (Ivey and Herziger 2005), WMP=North American Waterfowl Management Plan (Service 1986), SCP=United States Shorebird Conservation Plan (Brown et al. 2001), NAWCP=North American Waterbird Conservation Plan (Kushlan et al. 2002), NBP=Nevada Bird Plan (Nevada Partners in Flight 1999), and WAP=Nevada Wildlife Action Plan (NDOW 2005).

Table 5. Management Priority Bird Species in Nevada: Habitat Preferences on Each Refuge

	Ash Meadows NWR						Desert NWR				Moapa Valley NWR					Pahranagat NWR				
Common Name	*Wet Mead*[1]	*Upl*	*Mes Bos/ Rip*	*Em Mar*	*Spr/ Chan*	*Des Scr*	*P-J*	*Pon Pine*	*Spr/ Chan*	*Mes Bos/ Rip*	*Spr/ Chan*	*Rip*	*Mes Bos*	*Em Mar*	*Des Scr*	*Open Water*	*Em Mar*	*Wet Mead*	*Alkali Flat*	*Rip*
Waterbirds																				
Eared Grebe			x	x	x				x	x	x	x	x	x		x	x			x
Western Grebe			x	x						x		x	x	x		x	x			x
American White Pelican																x				
Black-crowned Night-heron			x	x	x				x	x	x	x	x	x			x			x
Franklin's Gull	x			x										x			x	x		
California Gull	x			x										x			x	x		
Forster's Tern	x			x										x			x	x		
Black Tern	x			x										x			x	x		
Clark's Grebe			x	x						x		x	x	x		x	x			x
White-faced Ibis	x			x										x			x	x		
Snowy Egret	x		x	x	x				x	x	x	x	x	x			x	x		x
Shorebirds																				
Marbled Godwit	x															x		x		
Western Sandpiper	x															x				
Dunlin	x															x				
Wilson's Phalarope	x			x												x	x	x		
Snowy Plover	x																		x	
Long-billed curlew	x																	x		
Landbirds																				
Bendire's Thrasher						x									x					
White-throated Swift		x				x												x		
Pinyon Jay							x													x
Arizona Bell's Vireo			x							x		x	x							x
Southwestern Willow Flycatcher			x							x		x	x							x
Black-chinned Sparrow							x												x	
Virginia's Warbler			x							x		x	x							x
Costa's Hummingbird		x	x			x				x		x	x		x					x
LeConte's Thrasher		x				x									x				x	

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Table 5. Management Priority Bird Species in Nevada: Habitat Preferences on Each Refuge

	Ash Meadows NWR						Desert NWR				Moapa Valley NWR						Pahranagat NWR			
Common Name	*Wet Mead*[1]	*Upl*	*Mes Bos/ Rip*	*Em Mar*	*Spr/ Chan*	*Des Scr*	*P-J*	*Pon Pine*	*Spr/ Chan*	*Mes Bos/ Rip*	*Spr/ Chan*	*Rip*	*Mes Bos*	*Em Mar*	*Des Scr*	*Open Water*	*Em Mar*	*Wet Mead*	*Alkali Flat*	*Rip*
Lucy's Warbler			x							x		x	x							x
Landbirds, continued																				
Abert's Towhee			x							x		x								x
Lewis's Woodpecker																				x
Flammulated Owl								x												
Gray Vireo			x				x			x		x								x
Gambel's Quail		x	x			x				x		x			x				x	x
Red-naped Sapsucker			x					x		x		x								x
Dusky Flycatcher			x							x		x								x
Gray Flycatcher			x				x			x		x								x
Verdin		x	x			x				x		x	x		x					x
Cactus Wren		x				x									x				x	
Black-tailed Gnatcatcher		x	x			x				x		x	x		x					x
Mountain Bluebird			x				x			x										x
Crissal Thrasher		x	x			x				x		x	x		x					x
Phainopepla			x							x		x	x							x
Black-throated Gray Warbler			x				x	x		x		x	x							x
Green-tailed Towhee			x				x			x		x	x							x
Black-throated Sparrow		x				x									x				x	
Sage Sparrow		x				x									x				x	
Yellow-headed Blackbird				x										x			x			x
Scott's Oriole		x	x			x	x			x		x	x		x					x
Peregrine Falcon	x	x	x	x	x	x			x	x	x	x	x	x	x		x	x		x
Western Yellow-billed Cuckoo			x							x		x	x							x
Western Burrowing Owl		x	x			x				x		x	x		x			x		x
Waterfowl																				
American Wigeon																				
Canada Goose																				
Canvasback				x										x		x	x			
Cinnamon Teal																				

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Table 5. Management Priority Bird Species in Nevada: Habitat Preferences on Each Refuge

	Ash Meadows NWR						Desert NWR				Moapa Valley NWR						Pahranagat NWR			
Common Name	*Wet Mead*[1]	*Upl*	*Mes Bos/ Rip*	*Em Mar*	*Spr/ Chan*	*Des Scr*	*P-J*	*Pon Pine*	*Spr/ Chan*	*Mes Bos/ Rip*	*Spr/ Chan*	*Rip*	*Mes Bos*	*Em Mar*	*Des Scr*	*Open Water*	*Em Mar*	*Wet Mead*	*Alkali Flat*	*Rip*
Gadwall																				
Waterfowl, continued																				
Greater White-fronted Goose																				
Green-winged Teal																				
Lesser Scaup																				
Lesser snow goose																				
Mallard																				
Northern Pintail				x										x			x	x		
Northern Shoveler																				
Redhead																x				
Ring-necked Duck																				
Tundra Swan																				
Wood Duck																				

Sources: Rich et al. 2004, Ivey and Herziger 2005, Service 1986, Brown et al. 2001, Kushlan et al. 2002, Nevada Partners in Flight 1999, and NDOW 2005.

[1]Habitats: Wet Mead=Alkali wet meadow or montane wet meadow, Upl=Native upland, Mes Bos=Mesquite bosque, Rip=Lowland riparian or riparian, Em Mar=Emergent marsh, Spr/Chan=Spring/Channel, Des Scr=Desert scrub, P-J=Pinyon-juniper woodland (prescribed burns), Pon Pine=Ponderosa pine forest (prescribed burn),

Desert NWR Big Game Species Accounts

Desert bighorn sheep are a subspecies of the bighorn sheep (*Ovis canadensis*). *O. canadensis* is a large, herbivorous ungulate that lives in open grasslands or shrub-steppe communities in mountains, foothills, or river canyons (Shackleton 1985). Escape terrain, such as cliffs and talus slopes, are a necessary habitat requirement for the bighorn sheep. During winter months, as much as 86 percent of their time is spent near escape terrain. In southern Nevada, *O. canadensis nelsoni* lives at higher elevations and moves to lower elevations during the cold winter months (Air Warfare Center 1999). This vertical migration coincides with the increasing abundance of new growth and presence of snow at higher elevations. During spring and summer, new growth begins to appear and provides food for the bighorn sheep as they return to the higher elevations.

Desert bighorn sheep are adapted to survival in the desert by being able to withstand 10 days without water (Warrick and Krausman 1989). They will eat barrel cactus to satisfy their water requirements. The mating season for desert bighorns is in the fall and may encompass several months (Shackleton 1985). Lambs are born in early spring, usually March, and are weaned in 4 to 6 months. Females live with their young, and males live apart from both during most of the year.

Desert bighorn sheep utilize habitat within the Desert NWR along all of the major mountain ranges: Pintwater, Sheep, Spotted, Desert, and Las Vegas (BLM 2001). They forage, breed, and raise young on barren cliffs along these mountain ranges. The Desert NWR is one of the largest intact blocks of habitat for the bighorn sheep in the southwestern United States. Water is a limiting resource, so 30 springs and 26 “guzzlers,” or catchments, have been improved to maintain a permanent water source. Hunting is permitted for three weeks in late fall to winter in the Spotted and Pintwater Ranges depending on the current population estimate of the herd (Air Warfare Center 1999).

Mule deer (*Odocoileus hemionus*) are herbivorous ungulates that browse on a wide variety of woody plants and graze on grasses and forbs (Anderson and Wallmo 1984). Feeding on agricultural crops and eating mushrooms in the fall are also common forage habits for mule deer. Preferred habitat types for the mule deer include coniferous forest, desert shrub, chaparral, and grasslands with shrubs. They are often associated with successional growth near agricultural fields. Precipitation patterns tend to trigger migration in mule deer.

Mating occurs in late November to mid-December, and young are born the following spring or as late as July or August in some cases (Anderson and Wallmo 1984). Litter size is 1 to 2 young and varies with the age and condition of the female. Young are usually weaned by their fourth month and depend heavily on sufficient cover to survive to adulthood. Predation by mountain lions and coyotes is a major threat to fawns.

Mule deer utilize habitat on the Desert NWR along the Pintwater Range, the Sheep Range, and the Desert Mountain Range, as well as other areas outside the Desert NWR (BLM 2001).

Special Status Species Accounts

Arizona Bell’s vireo (*Vireo bellii arizonae*) is considered a Bird of Conservation Concern by the Service. In southern Nevada, the Arizona Bell’s vireo occurs along rivers and streams, in desert washes, and in mesquite bosques (NDOW 2005). The vireo’s preferred habitat consists of dense undergrowth with low, shrubby vegetation. It occupies riparian areas, brushy fields, young second-growth forest or woodland, scrub oak, and mesquite woodlands. Nests are built on branches in dense bushes and small trees and occassionally in herbaceous vegetation. This bird’s diet consists primarily of insects and spiders.

The **Ash Meadows Amargosa pupfish** (*Cyprinodon nevadensis mionectes*) was federally listed as endangered with critical habitat on September 2, 1983 (48 FR 40178). It is only found in ten spring areas within Ash Meadows, all of which have been designated as critical habitat (Service 1990). The pupfish's habitat ranges from large, deep springs (Crystal Pool) to small spring pools with no overflow discharge (Five Springs complex). Streamflow from several of the springs joins at some point on the Ash Meadows NWR, but many do not as a result agricultural diversions; thus habitat fragmentation has occurred. Other threats to this pupfish have included drying of springs due to pumping of groundwater, elimination of riparian vegetation, and the introduction of non-native species (e.g., crayfish, bullfrog).

The **Ash Meadows naucorid** (*Ambrysus relictus*) is an aquatic beetle that was listed as threatened with critical habitat on May 20, 1985 (50 FR 20777). The naucorid is known to exist at Point of Rocks Springs within the Ash Meadows NWR, where it occupies an extremely restricted habitat where flowing water passes over rock and pebble substrates (Service 1990). It can also be found on stones and rocky substrates in thermal swift currents (Hershler and Sada 1987). If factors threaten the naucorid, such as non-native species, the naucorid is more susceptible to extirpation given its limited distribution.

The **Ash Meadows speckled dace** (*Rhinichthys osculus nevadensis*) was federally listed as endangered with critical habitat on September 2, 1983 (48 FR 40178). It is only found in four springs on the Ash Meadows NWR: Bradford, Big, Tubbs, and Jackrabbit Springs (Service 1990). Flowing streams are the preferred habitat for the dace because they like to feed on drifting insects. Females lay eggs over stream riffles, and males fertilize them as they drift to the substrate. The dace's naturally limited range and presence of introduced species are the main threats to this species' population.

The **bald eagle** (*Halieaaetus leucocephalus*) was adopted as the United States national emblem in 1782 (Service 1999). Bald eagles are large brown raptors with wingspans up to 8 feet across. As adults, they have white heads and yellow beaks. Juveniles are brown with some white spots on their bodies and black beaks. Habitat for bald eagles consists of streams, rivers, lakes, and ponds with tall trees nearby for perching and nesting (Service 1999).

The bald eagle's range is from Alaska and southern Canada to Florida (Alaska Department of Natural Resources 2001). It is only found on the North American continent. The bald eagle was listed as endangered in most of the lower 48 states in 1973. Since then, populations have increased, and it was downlisted to threatened status in 1995. In 1999, the Service proposed that the bald eagle be de-listed, and on August 8, 2007, the bald eagle was officially de-listed (72 FR 37345-37372). Populations are considered stable in the lower 48 states with an estimate of 6,000 nesting pairs.

The **desert tortoise** (*Gopherus agassizii*) occurs in the Mojave, Colorado, and Sonoran Deserts in North America and is listed as threatened in the Mojave Desert (Berry 1997). It is most commonly found in creosote bush scrub communities in the lower Sonoran life zones. Habitat often consists of well-drained sandy loam soils, suitable for burrowing. Tortoise burrows may be found in washes and arroyos or in other locations with suitable soil in the Mojave Desert.

Tortoises utilize their underground burrows to escape the heat in summer, rest, and find warmth in winter. They often use multiple burrows within a short time frame (about 1 week) (Berry 1997). Tortoises also have separate burrows for the winter and summer months and can sometimes be found under bushes at night. Eggs are laid in shallow depressions near or inside a burrow. Eggs are often laid in late spring/early summer and are relatively large in size, with a diameter of 30 to 40 millimeters and weight of 20 to 40 grams. Clutch size can be up to 15 eggs, but averages 3 to 7. Incubation period and size and sex of the hatchlings depend on the temperature; cooler temperatures yield longer periods and mostly larger, male hatchlings.

Desert tortoises can live more than 50 years, with juveniles reaching sexual maturity between 13 and 16 years of age (Berry 1997). Juveniles have distinct growth rings on their carapaces, and their growth rate is much higher than an adult's growth rate. At about 20 to 25 years of age, these rings begin to fade and wear out. Tortoise age can be easily determined up to this point when the vegetation growth season is known for the area. Rings are grown annually when there is only one growth season and multiple times a year for more than one season. Adult tortoises have a 20- to 36-centimeter-long carapace, and males are larger than females. Males can also be distinguished by their longer gular shield and larger chin glands on both sides of the lower jaw.

Tortoise populations are generally stable in Arizona, but they are declining in other areas. Destruction of habitat is the main reason for their decline, but other factors such as disease and mortality caused by humans also contribute to the decrease in tortoise populations in the Southwest.

The final rule for critical habitat for the Mojave Desert population was made in 1994, but it is subject to change if the need arises from future management plans. This ruling used 14 Desert Wildlife Management Areas determined by the Desert Tortoise Recovery Plan as the basis for critical habitat units and designated approximately 10,000 square miles of critical habitat (Berry 1997). These areas contain ideal habitat for the desert tortoise and help divide the populations into smaller areas, so they can be monitored more easily. The desert tortoise population on the Desert NWR is part of the Northeastern Mojave Desert Recovery Unit. All of the Desert NWR is located within the Coyote Spring Desert Wildlife Management Area. The desert tortoise has also been detected in the Pahranagat Valley foothills and likely occurs on Pahranagat NWR (Manville 2007).The Moapa Valley and Ash Meadows NWRs are located within desert tortoise habitat, and it is likely that tortoises occupy lands on or around these refuges.

The **Devils Hole pupfish** (*Cyprinodon diabolis*) was listed as endangered by the Service on March 11, 1967 (32 FR 4001). It was also listed as critically endangered by the State of Nevada on January 1, 1969 (Service 1980). Devils Hole is the only natural habitat for this species, so it was designated as a detached part of Death Valley National Monument on January 17, 1952, in order to protect the fish.

Devils Hole is the opening to a deep, water-filled limestone cavern, and it is the smallest habitat in the world containing the entire population of a vertebrate species (Service 1980). The segment of the water table that is exposed to sunlight measures approximately 10 by 70 feet, and it is this area that the pupfish use for feeding and reproduction. As water level declined in the late 1960s and early 1970s due to groundwater pumping for irrigation, less area was exposed to sunlight, limiting habitat for the pupfish. A minimum water level was established in the late 1970s to ensure the survival of this species by maintaining its only natural habitat.

Two refugia were established in the 1970s and 1980s to support additional populations of Devils Hole pupfish (Service 1980). One of the refugia was located at Hoover Dam and was constructed by the U.S. Bureau of Reclamation. The second alternate population was started at Amargosa Pupfish Station on Ash Meadows NWR. The objective of the pupfish's recovery plan is to down-list the fish from endangered to threatened and manage it as such in its natural habitat. Nearby groundwater pumping has been halted, but more recent threats to the pupfish in its natural habitat include habitat degradation from surface runoff, vandalism, accidents, and impacts associated with major land use changes in the surrounding area.

The **ferruginous hawk** (*Buteo regalis*) is considered a Bird of Conservation Concern by the Service. It occurs throughout Nevada and is a year-round resident in southern Nevada (NDOW 2005). Ferruginous hawks occur in montane shrublands, open land, and lower montane woodlands. Nests are primarily built in live Utah juniper trees, but some nests have been observed on hills, banks, tall trees, or other tall structures. The breeding and nesting period is generally late February to early October.

The **Moapa dace** (*Moapa coriacea*) was federally listed as endangered under the Endangered Species Preservation Act of 1966 on March 11, 1967 (32 FR 4001), and has been protected under the ESA since its inception in 1973.

The Moapa dace is unique because it is the only representative of the genus Moapa (Service 1983). Its habitat is restricted to the headwaters of the Muddy River where water temperatures occur in the narrow range between 82° and 90°F. The dace does not extend beyond the headwater springs because further from the spring orifice, the water becomes cooler and more silty. Currently, the dace's distribution is even more restricted to portions of three springs and less than 2 miles of streams in the Warm Springs area. The remainder of the spring system has been invaded by tilapia (*Oreochromis aurea*), a non-native fish, and made unsuitable for the dace by other habitat modifications (Service 1996).

Moapa dace habitat is managed under the Moapa Dace Recovery Plan (Service 1983) and the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem (Service 1996). Attempts to transplant this species into waters of two other habitats failed. During a snorkel survey conducted in January 2001, 935 Moapa dace were recorded in the Muddy River and its tributaries (Heinrich 2001). Of those observed during the survey, 580 dace were on the Pedersen Unit and 59 were on the Plummer Unit. The population of this species was estimated at 1,000 individuals in 2002, which declined from 4,000 in 1995 after the invasion of the tilapia (*Oreochromis aureus*) (Scoppettone 2002). More recent snorkel surveys in 2007 reported 1,172 Moapa dace in the Muddy River and its tributaries. Of those observed during the 2007 surveys, 565 Moapa dace were located at the Moapa Valley NWR (Goodchild 2007). Reasons for decline in dace populations include competition with shortfin molly and other introduced species and destruction and modification of habitat; efforts to remove introduced species and improve habitat have allowed the dace population to increase.

The **Pahranagat roundtail chub** (*Gila robusta jordani*) is a subspecies of the roundtail chub (G. robusta) in the Colorado River system (Service 1998). The Pahranagat roundtail chub is greenish in color with black blotches and reaches a total length of approximately 10 inches. Historically, the Pahranagat roundtail chub was found in streams, creeks, and ditches throughout the Pahranagat Valley. In 1997, the population was estimated to contain 150 to 260 adults. It is restricted to the Ash Spring outflow, including a portion of Pahranagat Creek and an irrigation ditch, in the Pahranagat Valley (NDOW 2005).

The Pahranagat roundtail chub was listed as endangered in October 1970 (35 FR 16047). Recovery criteria for the Pahranagat roundtail chub include improved habitat within the Pahranagat Creek and Ditch and along the outflow stream of Crystal Spring, reduced impacts to the species such that they no longer threaten the fish, and establishment of a self-sustaining population in the Crystal Spring outflow stream and Pahranagat Creek/Ditch (Service 1998).

The **Pahrump poolfish** (*Empetrichthys latos*), also known as the Pahrump killifish, is a small, slender, omnivorous fish about 2 inches long (Service 1993). It spawns in spring, but may spawn during any time of the year under proper conditions. The poolfish is a thermal species that can be found in warm springs with little fluctuation in temperature. Their tolerant range is between 74 and 77 degrees

Fahrenheit. The Pahrump poolfish is native to Manse Springs in Pahrump Valley. In 1975 its habitat was dessicated due to groundwater pumping.

The Pahrump poolfish was listed as endangered in March 1967, but in 1993, it was proposed for reclassification as threatened (Service 1993). As of 1993, it was found in Nevada at only three sites where the populations had to be introduced. Two were outside of Las Vegas: one in the Spring Mountains and one on the Desert NWR. The third was in Shoshone Springs outside of Ely. Corn Creek Springs on the Desert NWR was home to one of the populations that was introduced in the 1970s. The Spring Mountain Ranch State Park population was established in an irrigation reservoir after the species became extirpated from its natural home. Non-native species forced the poolfish out of the population in Corn Creek Springs during the last 10 years. Bullfrogs and crayfish out-competed the poolfish, but in June 2003, it was reintroduced to a refugium at Corn Creek.

The **peregrine falcon** (*Falco peregrinus*) is considered a Bird of Conservation Concern by the Service. It occurs throughout Nevada as a permanent resident (NDOW 2005). Peregrine falcons occur in open areas, developed areas, marsh habitat, and in or near cliffs and canyons. This species nests on rocky cliff faces or ledges and forages in farmland, developed areas, along rivers, and in marshes. Nests are typically found on ledges with a sheltering overhang. The breeding and nesting period is generally late April to early September.

The **southwestern willow flycatcher** (*Empidonax traillii extimus*) was listed as endangered on February 27, 1995 (60 FR 10693), and critical habitat was designated on October 19, 2005 (70 FR 60885). The critical habitat designation includes 120,824 acres or 737 miles of suitable habitat along several streams and rivers in California, Arizona, Nevada, Utah, and New Mexico (Service 1997). This flycatcher subspecies nests in dense, riparian woodlands with trees averaging 13 to 23 feet tall. Common species associated with flycatcher habitat include willow, seep willow, boxelder (*Acer negundo*), stinging nettle (*Urtica* spp.), blackberry (*Rubus* spp.), cottonwood, and arrowweed (*Tessaria sericea*) (Service 2002b). Riparian habitat in the Southwest has, however, declined dramatically over the past 100 years, and this loss of habitat has been a major threat to flycatcher populations.

The southwestern willow flycatcher is only found in six states in the southwestern U.S. (Finch and Stoleson 2000). During winter months it can be found in Central America. A survey of flycatcher populations between 1993 and 1996 estimated less than 1,000 individuals in the U.S. New Mexico had the most abundant population with around 300 individuals. Only three individuals were estimated to occur in Nevada according to surveys conducted between 1993 and 1996 (Finch and Stoleson 2000). The flycatcher is known to occur at Ash Meadows NWR, and resident and/or breeding individuals have been reported on the Refuge since 1999 (NDOW 2007). It may also occur at Moapa Valley NWR because it has been observed along the Muddy River, near its confluence with the Colorado River. Surveys are conducted annually at Pahranagat NWR. In 2005, 37 adult southwestern willow flycatchers were detected in the riparian habitats on the refuge with 11 breeding individuals, and 21 nestlings were observed at 7 nest sites (Koronkiewicz et.al 2006). Preliminary data for 2006 surveys estimate 34 adult flycatchers with 15 breeding pairs (McLeod 2006).

Habitat loss and brood parasitism are the common causes of the decline of this subspecies (Finch and Stoleson 2000). The brown-headed cowbird (*Molothrus ater*) often lays its eggs in flycatcher nests and reduces the survival rate of young flycatchers.

The **Virgin River chub** (*Gila seminuda*, Muddy River population) is a silvery colored fish with olive shading on the back (Service 1995). It can reach a maximum length of 18 inches and has a streamlined body with a deeply forked tail. Virgin River chub occur in two distinct populations in the Muddy and

Virgin Rivers. These populations were historically connected prior to establishment of Lake Mead; however, since Lake Mead filled, there has been no movement between the two populations. In the mid-1990s, the Muddy River population in the main stem was estimated at more than 20,000 individuals. Muddy River chub are monitored annually by NDOW using hoop nets and other methods (NDOW 2005).

The **Warm Springs pupfish** (*Cyprinodon nevadensis pectoralis*) was federally listed as endangered on October 13, 1970 (35 FR 16047). It occupies six small, isolated springs less than 1 mile west of Devils Hole (Service 1990). These springs encompass an area less than 0.77 square mile. Alteration of the springs has decreased the available water, reduced the quality of the habitat, and threatened the survival of the Warm Springs pupfish. Since this pupfish's habitat is located within the area surrounding Devils Hole that is protected from groundwater withdrawal, its ability to survive is similar to the Devils Hole pupfish. The introduction of predatory and/or competing species has also threatened the pupfish's small population. Factors threatening the Warm Springs pupfish, such as alteration of springs and non-native fish, can make the species more susceptible to extirpation given its limited distribution.

The **western burrowing owl** (*Athene cunicularia hypugea*) is considered a Bird of Conservation Concern by the Service (NDOW 2005). It migrates to Nevada in the spring, and some individuals may spend most of the year in Nevada. Preferred habitat for western burrowing owl consists of short vegetation with fresh small mammal burrows. Because this species is a ground-nesting bird, burrow use is influenced by availability, soils, and dynamics of the small mammals population. This species often uses rodent burrows to nest in and may use satellite burrows to relocate young and avoid predation.

The **yellow-billed cuckoo** (*Coccyzus americanus*) is a federal candidate species in the western continental U.S.. The most recent review of this species categorizes it as a lower priority species for listing although evidence shows that its populations are declining as suitable habitat continues to decline in the West (Service 2002c). The main cause for this species' decline is habitat loss, degradation, and fragmentation. The loss of riparian habitats in Arizona is estimated at 90 to 95 percent.

The preferred breeding habitat for cuckoos in the western U.S. includes large blocks of riparian woodland habitat consisting of cottonwoods, willows, and tamarisk. Nests are built in trees with dense understory foliage, and breeding occurs from mid-June to August, which overlaps with the emergence of large insects. Foraging occurs in the same habitat as nesting, and typical prey species include caterpillars, katydids, and cicadas.

The **Yuma clapper rail** (*Rallus longirostris yumanensis*) was listed as endangered without critical habitat on March 11, 1967 (32 FR 4001). The clapper rail utilizes freshwater or brackish stream sides and marshlands at elevations less than 4,500 feet (Service 2002d). It is known to occur in Arizona, and its current range is along portions of the Colorado, Gila, and Salt Rivers; Picacho Reservoir; and Tonto Creek. In Nevada, the clapper rail occurs along the Colorado River (south of Lake Mead toward Mexico), Las Vegas Wash, Virgin River, Muddy River, Pahranagat Valley, and Amargosa Valley. Loss of habitat is the main reason for the decline of this species. The clapper rail has been documented to nest in the Muddy River drainage adjacent to Moapa Valley NWR and along the Colorado and Virgin Rivers in Nevada. It has also been reported at Ash Meadows NWR and in the Pahranagat Valley and likely occurs at Pahranagat NWR (Manville 2007). Habitat restoration at all refuges, but especially at Moapa Valley NWR, could result in additional breeding pairs and expansion of their range within Nevada.

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Species Lists: Ash Meadows NWR

Birds

Loons

Common loon	*Gavia immer*
Pacific loon	*Gavia pacifica*

Grebes

Clark's grebe	*Aechmophorus clarkii*
Western grebe	*Aechmophorus occidentalis*
Horned grebe	*Podiceps auritus*
Eared grebe	*Podiceps nigricollis*
Pied-billed grebe	*Podilymbus podiceps*

Pelicans and Cormorants

American white pelican	*Pelecanus erythrorhynchos*
Double-crested cormorant	*Phalacrocorax auritus*

Bitterns, Herons, and Ibis

Great egret	*Ardea alba*
Great blue heron	*Ardea herodias*
American bittern	*Botaurus lentiginosus*
Cattle egret	*Bubulcus ibis*
Green heron	*Butorides virescens*
Snowy egret	*Egretta thula*
Least bittern	*Ixobrychus exilis*
Black-crowned night-heron	*Nycticorax nycticorax*
White-faced ibis	*Plegadis chihi*

Waterfowl

Wood duck	*Aix sponsa*
Northern pintail	*Anas acuta*
American wigeon	*Anas americana*
Northern shoveler	*Anas clypeata*
Green-winged teal	*Anas crecca*
Cinnamon teal	*Anas cyanoptera*
Blue-winged teal	*Anas discors*
Mallard	*Anas platyrhynchos*

Waterfowl, continued

Gadwall	*Anas strepera*
Greater white-fronted goose	*Anser albifrons*
Lesser scaup	*Aythya affinis*
Redhead	*Aythya americana*
Ring-necked duck	*Aythya collaris*
Greater scaup	*Aythya marila*
Canvasback	*Aythya valisineria*
Canada goose	*Branta canadensis*
Bufflehead	*Bucephala albeola*
Common goldeneye	*Bucephala clangula*
Snow goose	*Chen caerulescens*
Tundra swan	*Cygnus columbianus*
Hooded merganser	*Lophodytes cucullatus*
Common merganser	*Mergus merganser*
Red-breasted merganser	*Mergus serrator*
Ruddy duck	*Oxyura jamaicensis*

Vultures

Turkey vulture	*Cathartes aura*

Raptors

Cooper's hawk	*Accipiter cooperii*
Sharp-shinned hawk	*Accipiter striatus*
Golden eagle	*Aquila chrysaetos*
Red-tailed hawk	*Buteo jamaicensis*
Rough-legged hawk	*Buteo lagopus*
Red-shouldered hawk	*Buteo lineatus*
Ferruginous hawk	*Buteo regalis*
Swainson's hawk	*Buteo swainsoni*
Northern harrier	*Circus cyaneus*
White-tailed kite	*Elanus caeruleus*
Merlin	*Falco columbarius*
Prairie falcon	*Falco mexicanus*
Peregrine falcon	*Falco peregrinus*
American kestrel	*Falco sparverius*
Bald eagle	*Haliaeetus leucocephalus*
Osprey	*Pandion haliaetus*

Gallinaceous Birds

Chuckar	*Alectoris chuckar*
Gambel's quail	*Callipepla gambelii*

Rails

American coot	*Fulica americana*
Common moorhen	*Gallinula chloropus*
Sora	*Porzana carolina*
Virginia rail	*Rallus limicola*

Shorebirds

Spotted sandpiper	*Actitis macularia*
Ruddy turnstone	*Arenaria interpres*
Sanderling	*Calidris alba*
Western sandpiper	*Calidris mauri*
Least sandpiper	*Calidris minutilla*
Willet	*Catoptrophorus semipalmatus*
Snowy plover	*Charadrius alexandrinus*
Semipalmated plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferus*
Dunlin	*Clidris alpina*
Common snipe	*Gallinago gallinago*
Black-necked stilt	*Himantopus mexicanus*
Long-billed dowitcher	*Limnodromus scolopaceus*
Marbled godwit	*Limosa fedoa*
Long-billed curlew	*Numenius americanus*
Red-necked phalarope	*Phalaropus lobatus*
Wilson's phalarope	*Phalaropus tricolor*
Black-bellied plover	*Pluvialis squatarola*
American avocet	*Recurvirostra americana*
Lesser yellowlegs	*Tringa flavipes*
Greater yellowlegs	*Tringa melanoleuca*
Solitary sandpiper	*Tringa solitaria*

Gulls and Terns

Black tern	*Chlidonias niger*
California gull	*Larus californicus*
Ring-billed gull	*Larus delawarensis*
Bonaparte's gull	*Larus philadelphia*
Forster's tern	*Sterna forsteri*
Common tern	*Sterna hirundo*

Doves

Rock dove	*Columba livia*
Mourning dove	*Zenaida macroura*

Cuckoos

Greater roadrunner	*Geococcyx californianus*

Owls

Long-eared owl	*Asio otus*
Burrowing owl	*Athene cunicularia*
Great horned owl	*Bubo virginianus*
Common barn owl	*Tyto alba*

Goatsuckers

Lesser nighthawk	*Chordeiles acutipennis*
Common poorwill	*Phalaenoptilus nuttallii*

Swifts

White-throated swift	*Aeronautes saxatalis*

Hummingbirds

Black-chinned hummingbird	*Archilochus alexandri*
Costa's hummingbird	*Calypte costae*
Broad-tailed hummingbird	*Selasphorus platycercus*
Rufous hummingbird	*Selasphorus rufus*

Kingfishers

Belted kingfisher	*Ceryle alcyon*

Woodpeckers

Northern flicker	*Colaptes auratus*
Ladder-backed woodpecker	*Picoides scalaris*
Red-naped sapsucker	*Sphyrapicus nuchalis*

Flycatchers

Olive-sided flycatcher	*Contopus borealis*
Wood-pewee	*Contopus sordidulus*
Dusky flycatcher	*Empidonax oberholseri*
Cordilleran flycatcher	*Empidonax occidentalis*
Willow flycatcher	*Empidonax traillii*
Gray flycatcher	*Empidonax wrightii*
Ash-throated flycatcher	*Myiarchus cinerascens*
Brown-crested flycatcher	*Myiarchus tyrannulus*
Black phoebe	*Sayornis nigricans*
Say's phoebe	*Sayornis saya*
Western kingbird	*Tyrannus verticalis*

Shrikes

Northern shrike	*Lanius excubitor*
Loggerhead shrike	*Lanius ludovicianus*

Vireos

Bell's vireo	*Vireo bellii*
Plumbeousvireo	*Vireo solitarius*
Warbling vireo	*Vireo gilvus*

Jays and Crows

Western scrub jay	*Aphelocoma californica*
Common raven	*Corvus corax*

Larks

Horned lark	*Eremophila alpestris*

Swallows

Cliff swallow	*Hirundo pyrrhonota*
Barn swallow	*Hirundo rustica*
Bank swallow	*Riparia riparia*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Tree swallow	*Tachycineta bicolor*
Violet-green swallow	*Tachycineta thalassina*

Verdins and Bushtits

Bushtit	*Psaltriparus minimus*
Verdin	*Auriparus flaviceps*

Wrens

Marsh wren	*Cistothorus palustris*
Rock wren	*Salpinctes obsoletus*
Bewick's wren	*Thryomanes bewickii*
House wren	*Troglodytes aedon*

Kinglets and Gnatcatchers

Golden-crowned kinglet	*Regulus satrapa*
Ruby-crowned kinglet	*Regulus calendula*
Blue-gray gnatcatcher	*Polioptila caerulea*

Thrushes

Hermit thrush	*Catharus guttatus*
Swainson's thrush	*Catharus ustulatus*
Townsend's solitaire	*Myadestes townsendi*
Mountain bluebird	*Sialia currucoides*
American robin	*Turdus migratorius*

Mockingbirds and Thrashers

Northern mockingbird	*Mimus polyglottos*
Sage thrasher	*Oreoscoptes montanus*
Crissal thrasher	*Toxostoma crissale*
Le Conte's thrasher	*Toxostoma lecontei*

Pipits

American pipit	*Anthus spinoletta*

Starlings

European starling	*Sturnus vulgaris*

Waxwings

Cedar waxwing	*Bombycilla cedrorum*

Silky Flycatchers

Phainopepla	*Phainopepla nitens*

Warblers

Yellow-rumped warbler	*Dendroica coronata*
Black-throated gray warbler	*Dendroica nigrescens*
Yellow warbler	*Dendroica petechia*
Townsend's warbler	*Dendroica townsendi*
Common yellowthroat	*Geothlypis trichas*
Yellow-breasted chat	*Icteria virens*
Macgillivray's warbler	*Oporornis tolmiei*
Orange-crowned warbler	*Vermivora celata*
Lucy's warbler	*Vermivora luciae*
Virginia's warbler	*Vermivora virginiae*
Wilson's warbler	*Wilsonia pusilla*

Tanagers

Western tanager	*Piranga ludoviciana*

Grosbeaks, Buntings, and Sparrows

Sage sparrow	*Amphispiza belli*
Black-throated sparrow	*Amphispiza bilineata*
Lark sparrow	*Chondestes grammacus*
Dark-eyed junco	*Junco hyemalis*
Song sparrow	*Melospiza melodia*
Lincoln's sparrow	*Melospize lincolnii*
Savannah sparrow	*Passerculus sandwichensis*
Blue grosbeak	*Passerina caerulea*
Lazuli bunting	*Passerina amoena*
Indigo bunting	*Passerina cyanea*
Black-headed grosbeak	*Pheucticus melanocephalus*
Green-tailed towhee	*Pipilo chlorurus*
Spotted towhee	*Pipilo maculates*
American tree sparrow	*Spizella arborea*
Brewer's sparrow	*Spizella breweri*
Chipping sparrow	*Spizella passerina*
White-crowned sparrow	*Zonotrichia leucophrys*

Meadowlarks, Blackbirds, and Orioles

Red-winged blackbird	*Agelaius phoeniceus*
Brewer's blackbird	*Euphagus cyanocephalus*
Bullock's oriole	*Iceterus bullockii*
Hooded oriole	*Icterus cucullatrus*
Brown-headed cowbird	*Molothrus ater*
Great-tailed grackle	*Quiscalus mexicanus*
Western meadowlark	*Sturnella neglecta*
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*

Finches

Pine siskin	*Carduelis pinus*
Lesser goldfinch	*Carduelis psaltria*
American goldfinch	*Carduelis tristis*
House finch	*Carpodacus mexicanus*

Weaver Finches

House sparrow	*Passer domesticus*

Mammals

Pallid bat	*Antrozous pallidus*
Townshend's big eared bat	*Corynohinus townsendii*
Pacific Western big-eared bat	*Corynorhinus townsedii townsedii*
Big brown bat	*Eptesicus fuscus*
Pacific Western big-eared bat	*Corynorhinus townsedii townsedii*
Big brown bat	*Eptesicus fuscus*
Spotted bat	*Euderma maculatum*
Greater western mastiff-bat	*Eumops perotis californicus*
Allen's big-eared bat	*Idionycteris phyllotis*
Silver-haired bat	*Lasionycteris noctivagans*
Hoary bat	*Lasiurus cinereus*
Western red bat	*Lasiurus blossevillii*
Western yellow bat	*Lasiurus xanthinus*
California leaf-nosed bat	*Macrotus californicus*
California myotis	*Myotis californicus*
Long-eared myotis	*Myotis evotis*
Western small-footed myotis	*Myotis ciliolabrum*
Fringed myotis	*Myotis thysanodes*
Long-legged myotis	*Myotis volans*
Yuma myotis	*Myotis yumanensis*
Big free-tailed bat	*Nyctinomops macrotis*
Western parastrelle	*Parastrellus hesperus*
Brazilian free-tailed bat	*Tadarida brasiliensis*
Black-tailed jackrabbit	*Lepus californicus deserticolai*
Desert cottontail	*Sylvilagus audubonii arizonae*
White-tailed ground squirrel	*Ammospermophilus leucurus leucurus*
Long-tailed pocket mouse	*Chaetodipus formosus mohavensis*
Desert pocket mouse	*Chaetodipus penicillatus*
Desert kangaroo rat	*Dipodomys deserti deserti*
Merriam's kangaroo rat	*Dipodomys merriami merriami*
Chisel-toothed kangaroo rat	*Dipodomys microps occidentalis*
Porcupine	*Erethizon dorsatum epixanthum*
Ash Meadows montane vole	*Microtus montanus nevadensis*
House mouse	*Mus musculus*
Desert wood rat	*Neotoma lepida lepida*
Southern grasshopper mouse	*Onychomys torridus longicaudus*
Little pocket mouse	*Perognathus longimembris panamintinus*
Brush mouse	*Peromyscus boylei*
Canyon mouse	*Peromyscus crinitus stephensi*
Cactus mouse	*Peromyscus eremicus eremicus*
Deer mouse	*Peromyscus maniculatus sonoriensis*
Norway rat	*Rattus norvegicus*
Western harvest mouse	*Reithrodontomys megalotis megalotis*
Round-tailed ground squirrel	*Spermophilus tereticaudus tericaudus*
Botta's pocket gopher	*Thomomys bottae centralis*

Ringtail	*Bassariscus astutus nevadensis*
Coyote	*Canis latrans mearnsi*
Mountain lion	*Puma concolor kaibabensis*
Bobcat	*Felis rufus baileyi*
Striped skunk	*Mephitis mephitis estor*
Western spotted skunk	*Spilogale gracilis gracilis*
American badger	*Taxidea taxus berlandieri*
Gray fox	*Urocyon cinereoargenteus scottii*
Kit fox	*Vulpes macrotis arsipus*
Pronghorn antelope	*Antilocapra americanus*
Mule deer	*Odocoileus hemionus*
Desert bighorn sheep	*Ovis canadensis nelson*

Reptiles and Amphibians

Reptiles

Desert tortoise	*Gopherus agassizii*
Great Basin Whiptail	*Aspidoscelis tigris tigris*
Western Zebra-tailed Lizard	*Callisaurus draconoides rhodostictus*
Desert Banded Gecko	*Coleonyx variegatus variegatus*
Great Basin Collared Lizard	*Crotaphytus bicinctores*
Northern Desert Iguana	*Dipsosaurus dorsalis dorsalis*
Long-nosed Leopard Lizard	*Gambelia wislizenii*
Banded Gila Monster	*Heloderma suspectum cinctum*
Southern Desert Horned Lizard	*Phrynosoma platyrhinos calidiarum*
Western Red-tailed Skink	*Plestiodon gilberti rubricaudatus*
Common Chuckwalla	*Sauromalus ater*
Northern Sagebrush Lizard	*Sceloporus graciosus graciosus*
Great Basin Fence Lizard	*Sceloporus occidentalis longipes*
Yellow-backed Spiny Lizard	*Sceloporus uniformis*
Nevada Side-blotched Lizard	*Uta stansburiana nevadensis*
Desert night lizard	*Xantusia vigilis*
Desert Glossy Snake	*Arizona elegans eburnata*
Mojave Shovel-nosed Snake	*Chionactis occipitalis occipitalis*
Red Racer	*Coluber flagellum piceus*
Desert Striped Whipsnake	*Coluber taeniatus taeniatus*
Mojave Desert Sidewinder	*Crotalus cerastes cerastes*
Northern Mohave Rattlesnake	*Crotalus scutulatus scutulatus*
Panamint rattlesnake	*Crotalus stephensi*
Northern Desert Nightsnake	*Hypsiglena chlorophaea deserticola*
California Kingsnake	*Lampropeltis getula californiae*
Southwestern Threadsnake	*Leptotyphlops humilis humilis*
Spotted Leaf-nosed Snake	*Phyllorhynchus decurtatus*
Great Basin Gopher Snake	*Pituophis catenifer deserticola*
Long-nosed Snake	*Rhinocheilus lecontei*
Mohave Patch-nosed Snake	*Salvadora hexalepis mohavensis*
Variable Ground Snake	*Sonora semiannulata semiannulata*
Smith's Black-headed Snake	*Tantilla hobarismithi*
Wandering Garter Snake	*Thamnophis elegans vagrans*
Sonoran Lyresnake	*Trimorphodon biscutatus lambda*

Amphibians

Western Toad	*Anaxyrus boreas*
Red-spotted Toad	*Anaxyrus punctatus*
Rocky Mountain Toad	*Anaxyrus woodhousii woodhousii*
American Bullfrog	*Lithobates catesbeiana*
Northern Pacific Treefrog	*Pseudacris regilla*

Fish and Invertebrates

Fish

Brown bullhead	*Ameiurus nebulosus*
Convict cichlid	*Cichlasoma nigrofasciatum*
Devil's Hole pupfish	*Cyprinodon diabolis*
Ash Meadows Amargosa pupfish	*Cyprinodon nevadensis mionectes*
Warm Springs pupfish	*Cyprinodon nevadensis pectoralis*
Mosquito fish	*Gambusia affinis*
Green sunfish	*Lepomis cyanellus*
Largemouth bass	*Micropterus salmoides*
Black bass	*Micropterus salmoides floridanus*
Sailfin molly	*Poecelia latipinna*
Ash Meadows speckled dace	*Rhinichthys osculus nevadensis*

Invertebrates

Warm Springs naucorid	*Ambrysus relictus*
Death Valley agabus diving beetle	*Agabus rumppi*
Ash Meadows alkali skipper	*Pseudocopaeodes eunus alinea*
Unnamed riffle beetle	*Microcylloepus similis*
Death Valley june beetle	*Polyphylla erratica*
Amargosa naucorid	*Pelocoris shoshone amargosus*
Devil's Hole Warm Spring riffle beetle	*Stenelmis calida calida*
Ash Meadows pebble snail	*Pyrgulopsis erythropoma*
Crystal Springs snail	*Pyrgulopsis crystalis*
Distal-gland springsnail	*Pyrgulopsis nanus*
Elongate gland springsnail	*Pyrgulopsis isolatus*
Fairbanks Spring snail	*Pyrgulopsis fairbanksensis*
Ash Meadows naucorid	*Ambrysus amargosus*
Median-gland Nevada spring snail	*Pyrgulopsis pisteri*
Oasis Valley springsnail	*Pyrgulopsis micrococcus*
Amargosa tryonia	*Tryonia variegata*
Minute tryonia	*Tryonia ericae*
Point of Rocks tryonia	*Tryonia elata*
Sportinggoods tryonia	*Tryonia angulata*
Virile Amargosa snail	*Unknown*
Ash Meadows blazing star	*Mentzelia leucophylla*
Red-rimmed melania	*Melanoides tuberculata*
Lousiana crayfish	*Procambarus clarkii*
Honeybee	*Apis mellifera*
American rubyspot	*Hetaerina americana*
Ground beetle	*Bembidion sp.*
Great Basin tiger beetle	*Cicindela amargosae*
Tiger beetle	*Cicindela hemorrhagica*
Salt Creek tiger beetle	*Cicindela nevadica*
Oblique tiger beetle	*Cicindela tranquebarica*
Lady beetle	*Hippodamia convergens*
Kiowa dancer	*Argia immunda*

Invertebrates, continued

Aztec dancer	*Argia nahuana*
Blue-ringed dancer	*Argia sedula*
Damsel fly	*Argia sp.*
Vivid dancer	*Argia vivida*
Familiar bluet	*Enallagma civile*
Bluet	*Enallagma sp.*
Pacific forktail	*Ischnura cervula*
Desert forktail	*Ishnura Barberi*
Black-fronted forktail	*Ishnura denticollis*
California dancer	*Argia agrioides*
Paiute dancer	*Argia alberta*
Large water boatmen	*Hesperocorixa laevigata*
Western malaria mosquito	*Anopheles freeborni*
Western encephalitis mosquito	*Culex tarsalis*
Cool-weather mosquito	*Culiseta incidens*
Winter marsh mosquito	*Culiseta inornata*
Unnamed riffle beetle	*Microcylloepus similis*
Carpenter ant	*Campanotus sp.*
Bicolored pyramid ant,	*Dorymyrmex bicolor*
Toad bug	*Gelastocoris oculatus*
Water striders	*Gerris gillettei*
White-belted ringtail	*Erpetogomphus compositus*
Gray sanddragon	*Progomphus borealis*
Field crickets	*Gryllus sp.*
Sweat bee	*Halictus ligatus*
Water scavenger family	*Tropisternus sublaevis*
Microcaddisfly	*Hydroptila ajax*
Western pondhawk	*Erythemis collocata*
Comanche skimmer	*Libellula comanche*
Bleached skimmer	*Libellula composita*
Widow skimmer	*Libellula luctuosa*
Flame skimmer	*Libellula saturata*
Marl pennant	*Macrodiplax balteata*
Wandering glider	*Pachydiplax flavescens*
Blue dasher	*Pachydiplax longipennis*
Variegated meadowhawk	*Sympetrum corruptum*
Striped meadowhawk	*Sympetrum pallipes*
Black saddlebags	*Tramea lacerata*
Red saddlebags	*Tramea onusta*
Caddisfly	*Limnephilus assimilis*
Western pigmy blue	*Brephidium exile*
Ceraunus blue	*Hemiargus ceraunus*
Reakirt's blue	*Hemiargus isola*
Marine blue	*Leptotes marina*
Mantis	*Stagmomantis sp.*
Water treaders	*Mesovelia amoena*
Wasp	*Chyphotes melaniceps*

Velvet ant	*Dasymutilla sp.*

Invertebrates, continued

Ant	*Odontophotopsis melicausa*
Velvet ant	*Sphaeropthalma blakeii*
Velvet ant	*Sphaeropthalma helicaon*
Creeping water bug	*Ambrysus mormon*
Warm Springs naucorid	*Limnocoris moapensis*
Moth	*Bulia deducta*
Arizona bird-dropping moth	*Conochares arizonae*
Moth	*Heliothis paradoxus*
Corn earworm	*Heliothis zeae*
Melipotis moth	*Melipotis jucunda*
Beet armyworm	*Spodoptera exigua*
Cabbage looper	*Trichoplusia ni*
Noctuid moths	*Catocala sp.*
Sagebrush checkerspot	*Chlosyne acastus*
Monarch butterfly	*Danaus plexippus*
Buckeye	*Junonia coenia*
Damselfly	*Coenagrionidae*
Stink bug	*Chlorocoris sp.*
Caddisfly	*Chimarra sp.*
Desert orangetip	*Anthocharis cethura*
White butterfly	*Pontia sp.*
Western white	*Pontia occidentalis*
Checkered white	*Pontia protodice*
Arenivaga	*sand cockroaches*
Spider hunter	*Pepsis pallidolimbata*
Threadlegged bug	*Emesaya brevipennis*
Assassin bug	*Zelus sp.*
Palmer's metalmark	*Apodemia palmerii*
Sand wasps	*Bembix*
Blue mud wasp	*Chalybion californicum*
Wasp	*Chlorion*
Hornworm	*Hyles lineata*
Deer flies	*Chrysops*
Horse flies	*Tabanus sp.*
Sand obligate beetle	*Edrotes ventricosus*
Darkling beetle	*Eleodes armata*
Sooty longwing	*Capnobotes fuliginosus*
Wasp	*Brachycistis timberlakei*
Veliid	*Microvelia americana*
Broad-shouldered water striders	*Rhagovelia sp.*
Veliid	*Rhagovelia distincta*
Wasp	*Odynerus cinnabarinus*
Paper wasp	*Polistes sp.*
Potter wasp	*Eumenes sp.*

Giant darner	*Anax walsinghami*
Blue-eyed darner	*Rhionaeshna multicolor*
American rubyspot	*Heptaerina sp.*

Invertebrates, continued

Giant water bugs,	*Belostoma sp.*
Bird grasshoppers	*Schistocerca sp.*
Grasshopper	*Trimerotropis sp.*
Green darner	*Anax junius sp.*
Giant darner	*Anax walsinghami*

Species Lists: Desert NWR

Birds

Grebes

Western grebe	*Aechmophorus occidentalis*
Eared grebe	*Podiceps nigricollis*
Pied-billed grebe	*Podilymbus podiceps*

Cormorant

Double-crested cormorant	*Phalacrocorax auritus*

Bitterns, Herons, Egrets and Ibis

Great egret	*Ardea alba*
Great blue heron	*Ardea herodias*
American bittern	*Botaurus lentiginosus*
Green heron	*Butorides virescens*
Snowy egret	*Egretta thula*
Black-crowned night-heron	*Nycticorax nycticorax*
White-faced ibis	*Plegadis chihi*

Waterfowl

Wood duck	*Aix sponsa*
Northern pintail	*Anas acuta*
American wigeon	*Anas americana*
Northern shoveler	*Anas clypeata*
Green-winged teal	*Anas crecca*
Cinnamon teal	*Anas cyanoptera*
Blue-winged teal	*Anas discors*
Mallard	*Anas platyrhynchos*
Gadwall	*Anas strepera*
Greater white-fronted goose	*Anser albifrons*
Lesser scaup	*Aythya affinis*
Redhead	*Aythya americana*
Ring-necked duck	*Aythya collaris*
Canvasback	*Aythya valisineria*
Canada goose	*Branta canadensis*
Bufflehead	*Bucephala albeola*
Common goldeneye	*Bucephala clangula*
Ruddy duck	*Oxyura jamaicensis*

Vultures

Turkey vulture	*Cathartes aura*

Raptors

Cooper's hawk	*Accipiter cooperii*
Northern goshawk	*Accipiter gentilis*
Sharp-shinned hawk	*Accipiter striatus*
Golden eagle	*Aquila chrysaetos*
Red-tailed hawk	*Buteo jamaicensis*
Rough-legged hawk	*Buteo lagopus*
Ferruginous hawk	*Buteo regalis*
Swainson's hawk	*Buteo swainsoni*
Northern harrier	*Circus cyaneus*
Merlin	*Falco columbarius*
Prairie falcon	*Falco mexicanus*
Peregrine falcon	*Falco peregrinus*
American kestrel	*Falco sparverius*
Bald eagle	*Haliaeetus leucocephalus*
Osprey	*Pandion haliaetus*

Gallinaceous Birds

Gambel's quail	*Callipepla gambelii*

Rails

American coot	*Fulica americana*
Common moorhen	*Gallinula chloropus*
Sora	*Porzana carolina*
Virginia rail	*Rallus limicola*

Shorebirds

Spotted sandpiper	*Actitis macularia*
Western sandpiper	*Calidris mauri*
Least sandpiper	*Calidris minutilla*
Killdeer	*Charadrius vociferus*
Common snipe	*Gallinago gallinago*
Black-necked stilt	*Himantopus mexicanus*
Long-billed dowitcher	*Limnodromus scolopaceus*
Marbled godwit	*Limosa fedoa*
Long-billed curlew	*Numenius americanus*
Red phalarope	*Phalaropus fulicaria*
Wilson's phalarope	*Phalaropus tricolor*
American avocet	*Recurvirostra americana*
Lesser yellowlegs	*Tringa flavipes*
Greater yellowlegs	*Tringa melanoleuca*
Solitary sandpiper	*Tringa solitaria*

Gulls and Terns

Black tern	*Chlidonias niger*
California gull	*Larus californicus*
Ring-billed gull	*Larus delawarensis*
Bonaparte's gull	*Larus philadelphia*

Doves

Rock dove	*Columba livia*
Band-tailed pigeon	*Columba fasciata*
Common ground-dove	*Columbina passerina*
White-winged dove	*Zenaida asiatica*
Mourning dove	*Zenaida macroura*

Cuckoos

Yellow-billed cuckoo	*Coccyzus americanus*
Greater roadrunner	*Geococcyx californianus*

Owls

Northern saw-whet owl	*Aegolius acadicus*
Short-eared owl	*Asio flammeus*
Long-eared owl	*Asio otus*
Burrowing owl	*Athene cunicularia*
Great horned owl	*Bubo virginianus*
Northern pygmy-owl	*Glaucidium gnoma*
Flammulated owl	*Otus flammeolus*
Western screech-owl	*Otus kennicottii*
Barn owl	*Tyto alba*

Goatsuckers

Whip-poor-will	*Caprimulgus vociferus*
Lesser nighthawk	*Chordeiles acutipennis*
Common nighthawk	*Chordeiles minor*
Common poorwill	*Phalaenoptilus nuttallii*

Swifts

White-throated swift	*Aeronautes saxatalis*
Vaux's Swift	*Chaetura vauxi*

Hummingbirds

Black-chinned hummingbird	*Archilochus alexandri*
Anna's hummingbird	*Calypte anna*
Costa's hummingbird	*Calypte costae*
Broad-tailed hummingbird	*Selasphorus platycercus*
Rufous hummingbird	*Selasphorus rufus*
Allen's hummingbird	*Selasphorus sasin*
Calliope hummingbird	*Stellula calliope*

Kingfisher

Belted kingfisher	*Ceryle alcyon*

Woodpeckers

Northern flicker	*Colaptes auratus*
Lewis' woodpecker	*Melanerpes lewis*
Ladder-backed woodpecker	*Picoides scalaris*
Hairy woodpecker	*Picoides villosus*
Red-breasted sapsucker	*Sphyrapicus ruber*
Williamson's sapsucker	*Sphyrapicus thyroideus*
Yellow-bellied sapsucker	*Sphyrapicus varius*

Flycatchers

Olive-sided flycatcher	*Contopus cooperi*
Western wood-pewee	*Contopus sordidulus*
Western flycatcher	*Empidonax difficilis*
Hammond's flycatcher	*Empidonax hammondii*
Dusky flycatcher	*Empidonax oberholseri*
Willow flycatcher	*Empidonax traillii*
Gray flycatcher	*Empidonax wrightii*
Ash-throated flycatcher	*Myiarchus cinerascens*
Vermilion flycatcher	*Pyrocephalus rubinus*
Black phoebe	*Sayornis nigricans*
Say's phoebe	*Sayornis saya*
Eastern kingbird	*Tyrannus tyrannus*
Western kingbird	*Tyrannus verticalis*
Cassin's kingbird	*Tyrannus vociferans*

Shrikes

Loggerhead shrike	*Lanius ludovicianus*

Vireos

Bell's vireo	*Vireo bellii*
Warbling vireo	*Vireo gilvus*
Hutton's vireo	*Vireo huttoni*
Red-eyed vireo	*Vireo olivaceus*
Solitary vireo	*Vireo solitarius*
Gray vireo	*Vireo vicinior*

Jays, Magpies, and Crows

Scrub jay	*Aphelocoma californica*
American crow	*Corvus brachyrhynchos*
Common raven	*Corvus corax*
Steller's jay	*Cyanocitta stelleri*
Pinyon jay	*Gymnorhinus cyanocephalus*
Clark's nutcracker	*Nucifraga columbiana*

Larks

Horned lark	*Eremophila alpestris*

Swallows

Barn swallow	*Hirundo rustica*
Cliff swallow	*Petrochelidon pyrrhonota*
Bank swallow	*Riparia riparia*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Tree swallow	*Tachycineta bicolor*
Violet-green swallow	*Tachycineta thalassina*

Chickadees and Titmouse

Plain titmouse	*Parus inornatus*
Mountain chickadee	*Poecile gambeli*

Verdins

Verdin	*Auriparus flaviceps*

Bushtits

Bushtit	*Psaltriparus minimus*

Nuthatches

Red-breasted nuthatch	*Sitta canadensis*
White-breasted nuthatch	*Sitta carolinensis*
Pygmy nuthatch	*Sitta pygmaea*

Creepers

Brown creeper	*Certhia americana*

Wrens

Cactus wren	*Campylorhynchus brunneicapillus*
Canyon wren	*Catherpes mexicanus*
Marsh wren	*Cistothorus palustris*
Rock wren	*Salpinctes obsoletus*
Bewick's wren	*Thryomanes bewickii*
House wren	*Troglodytes aedon*
Winter wren	*Troglodytes troglodytes*

Kinglets and Gnatcatchers

Blue-gray gnatcatcher	*Polioptila caerulea*
Black-tailed gnatcatcher	*Polioptila melanura*
Ruby-crowned kinglet	*Regulus calendula*
Golden-crowned kinglet	*Regulus satrapa*

Thrushes

Hermit thrush	*Catharus guttatus*
Swainson's thrush	*Catharus ustulatus*
Varied thrush	*Ixoreus naevius*
Townsend's solitaire	*Myadestes townsendi*
Mountain bluebird	*Sialia currucoides*
Western bluebird	*Sialia mexicana*
American robin	*Turdus migratorius*

Mockingbirds and Thrashers

Northern mockingbird	*Mimus polyglottos*
Sage thrasher	*Oreoscoptes montanus*
Bendire's thrasher	*Toxostoma bendirei*
Crissal thrasher	*Toxostoma crissale*
Le conte's thrasher	*Toxostoma lecontei*

Wagtails and Pipits

American pipit	*Anthus rubescens*

Waxwings

Cedar waxwing	*Bombycilla cedrorum*
Bohemian waxwing	*Bombycilla garrulus*

Phainopepla

Phainopepla	*Phainopepla nitens*

Starlings

European starling	*Sturnus vulgaris*

Warblers

Blue warbler	*Dendroica caerulescens*
Yellow-rumped warbler	*Dendroica coronata*
Grace's warbler	*Dendroica graciae*
Black-throated gray warbler	*Dendroica nigrescens*
Hermit warbler	*Dendroica occidentalis*
Yellow warbler	*Dendroica petechia*
Townsend's warbler	*Dendroica townsendi*
Black-throated	*Dendroica virens*
Common yellowthroat	*Geothlypis trichas*
Yellow-breasted chat	*Icteria virens*
Black-and-white warbler	*Mniotilta varia*
Painted redstart	*Myioborus pictus*
Macgillivray's warbler	*Oporornis tolmiei*
Northern parula	*Parula americana*
Northern waterthrush	*Seiurus noveboracensis*
American redstart	*Setophaga ruticilla*
Orange-crowned warbler	*Vermivora celata*

Lucy's warbler	*Vermivora luciae*

Warblers, continued

Tennessee warbler	*Vermivora peregrina*
Nashville warbler	*Vermivora ruficapilla*
Virginia's warbler	*Vermivora virginiae*
Wilson's warbler	*Wilsonia pusilla*

Tanagers

Western tanager	*Piranga ludoviciana*
Summer tanager	*Piranga rubra*

Grosbeaks and Buntings

Blue grosbeak	*Guiraca caerulea*
Lazuli bunting	*Passerina amoena*
Indigo bunting	*Passerina cyanea*
Rose-breasted grosbeak	*Pheucticus ludovicianus*
Black-headed grosbeak	*Pheucticus melanocephalus*

Towhees and Sparrows

Sage sparrow	*Amphispiza belli*
Black-throated sparrow	*Amphispiza bilineata*
Lark bunting	*Calamospiza melanocorys*
Lapland longspur	*Calcarius lapponicus*
Chestnut-collared longspur	*Calcarius ornatus*
Lark sparrow	*Chondestes grammacus*
Dark-eyed junco	*Junco hyemalis*
Swamp sparrow	*Melospiza georgiana*
Lincoln's sparrow	*Melospiza lincolnii*
Song sparrow	*Melospiza melodia*
Savannah sparrow	*Passerculus sandwichensis*
Fox sparrow	*Passerella iliaca*
Abert's towhee	*Pipilo aberti*
Green-tailed towhee	*Pipilo chlorurus*
Rufous-sided towhee	*Pipilo erythrophthalmus*
Vesper sparrow	*Pooecetes gramineus*
American tree sparrow	*Spizella arborea*
Black-chinned sparrow	*Spizella atrogularis*
Brewer's sparrow	*Spizella breweri*
Chipping sparrow	*Spizella passerina*
White-throated sparrow	*Zonotrichia albicollis*
Golden-crowned sparrow	*Zonotrichia atricapilla*
White-crowned sparrow	*Zonotrichia leucophrys*

Blackbirds, Meadowlarks, and Orioles

Red-winged blackbird	*Agelaius phoeniceus*
Brewer's blackbird	*Euphagus cyanocephalus*
Bullock's oriole	*Icterus bullockii*

Blackbirds, Meadowlarks, and Orioles, continued

Hooded oriole	*Icterus cucullatus*
Scott's oriole	*Icterus parisorum*
Brown-headed cowbird	*Molothrus ater*
Great-tailed grackle	*Quiscalus mexicanus*
Western meadowlark	*Sturnella neglecta*
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*

Finches

Pine siskin	*Carduelis pinus*
Lesser goldfinch	*Carduelis psaltria*
American goldfinch	*Carduelis tristis*
Cassin's finch	*Carpodacus cassinii*
House finch	*Carpodacus mexicanus*
Evening grosbeak	*Coccothraustes vespertinus*
Red crossbill	*Loxia curvirostra*

Weaver Finches

House sparrow	*Passer domesticus*

Mammals

Townsend's big-eared bat	*Corynorhinus townsendii*
Spotted bat	*Euderma maculatum*
Greater western mastiff-bat	*Eumops perotis californicus*
Allen's big-eared bat	*Idionycteris phyllotis*
California leaf-nosed bat	*Macrotus californicus*
Western small-footed myotis	*Myotis ciliolabrum*
Long-eared myotis	*Myotis evotis*
Small-footed myotis	*Myotis Leibii*
Fringed myotis	*Myotis thysanodes*
Cave myotis	*Myotis velifer*
Long-legged Myotis	*Myotis volans*
Long-legged myotis	*Myotis volans*
Yuma myotis	*Myotis yumanensis*
Big free-tailed bat	*Nyctinomops macrotis*
Blacktail jackrabbit	*Lepus alleni*
Desert cottontail	*Sylvilagus auduboni*
Whitetail antelope squirrel	*Ammospermophilus leucurus*
Merriam kangaroo rat	*Dipldomys merriami*
Cliff chipmunk	*Neotamias dorsalis*
Hidden Forest Uinta chipmunk	*Neotamias umbrinus nevadensis*
Desert woodrat	*Neotoma lepida*
Deer mouse	*Peromyscus maniculatus*
Valley pocket gopher	*Thomomys bottae*
Coyote	*Canis lutrans*
Mountain lion	*Felis concolor*
Bobcat	*Felis rufus*
Badger	*Taxidea taxus*
Gray fox	*Urocyon cinereoargenteus*
Kit fox	*Vulpes macrotis*
Pronghorn antelope	*Antilocapra americanus*
Mule deer	*Odocoileus hemionus*
Desert bighorn sheep	*Ovis canadensis*

Reptiles and Amphibians

Reptiles

Desert tortoise	*Gopherus agassizii*
Red-eared turtle	*Trachemys scripta*
Western whiptail lizard	*Aspidoscelis tigris*
Zebra-tailed lizard	*Callisaurus draconoides*
Banded gecko	*Coleonyx variegatus*
Collared lizard	*Crotaphytus collaris*
Desert iguana	*Dipsosauraus dorsalis*
Leopard lizard	*Gambelia wislizenii*
Banded Gila monser	*Heloderma suspectum cinctum*
Desert horned lizard	*Phrynosoma platyrhinos*
Gilbert's skink	*Plestiodon gilberti*
Western skink	*Plestiodon skiltoniamus*
Chuckwalla	*Sauromalus ater*
Sagebrush lizard	*Sceloporus graciosus*
Western fenced lizard	*Sceloporus occidentalis*
Yellow-backed spiny lizard	*Sceloporus uniformis*
Long-tailed brush lizard	*Urosaurus graciosus*
Side-blotched lizard	*Uta stansburiana*
Desert night lizard	*Xantusla vigilis*
Glossy snake	*Arizona elegans*
Western shovel-nosed snake	*Chionactis occipitalis*
Coachwhip	*Coluber flagellum*
Striped whipsnake	*Coluber taeniatus*
Sidewinder	*Crotalus cerastes*
Southwestern speckled rattlesnake	*Crotalus mitchellii*
Mohave rattlesnake	*Crotalus scutulatus*
Panamint rattlesnake	*Crotalus stephensi*
Desert night snake	*Hypsiglena chlorophaea*
Common kingsnake	*Lampropeltis getula*
Western thread snake	*Leptotyphlops humilis*
Red racer	*Masticophis flagellum piceus*
Spotted leaf-nosed snake	*Phyllorhyncus ecuriatus*
Gopher snake	*Pituophis catenifer*
Long-nosed snake	*Rhinocheilus lecontei*
Western patch-nosed snake	*Salvadora hexalepis*
Western ground snake	*Sonora semiannulata*
Western lyresnake	*Trimorphodon biscutatus*

Amphibians

Bullfrog	*Rana catesbeiana*
Pacific tree frog	*Hyla regilla*

Fish and Invertebrates

Fish

Carp	*Cyprinus carpio*
Goldfish	*Carassius auratus*
Pahrump poolfish	*Empetrichthys latos*

Invertebrates

Nevada admiral	*Limenitis weidemeyerii nevadae*
Louisiana crayfish	*Procambarus clarkii*
Corn Creek springsnail	*Pyrgulopsis fausta*
Southeastern Nevada springsnail	*Pyrgulopsis turbatrix*

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Species Lists: Moapa Valley NWR

Birds

Bitterns and Ibis

Least bittern	*Ixobrychus exilis*
White-faced ibis	*Plegadis chihi*

Vultures

Turkey vulture	*Cathartes aura*

Raptors

Cooper's hawk	*Accipiter cooperii*
Sharp-shinned hawk	*Accipiter striatus*
Red-tailed hawk	*Buteo jamaicensis*
Red-shouldered hawk	*Buteo lineatus*
Ferruginous hawk	*Buteo regalis*
Common black-hawk	*Buteogallus anthracinus*
American kestrel	*Falco sparverius*
Mississippi kite	*Ictinia mississippiensis*

Rails

Sandhill crane	*Grus canadensis*
Yuma clapper rail	*Rallus longirostris yumanensis*

Gulls and Terns

Black tern	*Chlidonias niger*

Cuckoos

Western yellow-billed cuckoo	*Coccyzus americanus*

Owls

Western burrowing owl	*Athene cunicularia hypugea*

Hummingbirds

Black-chinned hummingbird	*Archilochus alexandri*

Flycatchers

Olive-sided flycatcher	*Contopus cooperi*
Southwestern willow flycatcher	*Empidonax traillii extimus*
Gray flycatcher	*Empidonax wrightii*
Ash-throated flycatcher	*Myiarchus cinerascens*
Vermilion flycatcher	*Pyrocephalus rubinus*
Black phoebe	*Sayornis nigricans*
Western kingbird	*Tyrannus verticalis*

Shrikes

Loggerhead shrike	*Lanius ludovicianus*

Vireos

Arizona Bell's vireo	*Vireo bellii arizone*

Wrens

Marsh wren	*Cistothorus palustris*

Thrashers

Crissal thrasher	*Toxostoma crissale*

Pipits

American pipit	*Anthus rubescens*

Phainopepla

Phainopepla	*Phainopepla nitens*

Warblers

Yellow warbler	*Dendroica petechia*
Yellow-breasted chat	*Icteria virens*
Lucy's warbler	*Vermivora luciae*
Orange-crowned warbler	*Vermivora celata*

Tanagers

Summer tanager	*Piranga rubra*

Grosbeaks and Buntings

Blue grosbeak	*Guiraca caerulea*
Indigo bunting	*Passerina cyanea*

Blackbirds, Meadowlarks, and Orioles

Bullock's oriole	*Icterus bullockii*
Hooded oriole	*Icterus cucullatus*

Finches

House finch	*Carpodacus mexicanus*

Mammals

Pallid bat	*Antrozous pallidus*
Townsend's big-eared bat	*Corynorhinus townsendii*
Big brown bat	*Eptesicus fuscus*
Spotted bat	*Euderma maculatum*
Greater western mastiff-bat	*Eumops perotis californicus*
Allen's big-eared bat	*Idionycteris phyllotis*
Yellow bat	*Lasiurus xanthinus*
California leaf-nosed bat	*Macrotus californicus*
Long-eared myotis	*Myotis evotis*
Small-footed myotis	*Myotis leibii*
Fringed myotis	*Myotis thysanodes*
Cave myotis	*Myotis velifer*
Long-legged myotis	*Myotis volans*
Yuma myotis	*Myotis yumanensis*
Big free-tailed bat	*Nyctinomops macrotis*
Western pipistrelle	*Pipistrellus hesperus*
Desert cottontail	*Sylvilagus audubonii*
Desert pocket mouse	*Chaetodipus penicillatus*
Ringtail	*Bassariscus astutus*
Spotted skunk	*Spilogale gracilis*
Kit fox	*Vulpes macrotis*

Reptiles and Amphibians

Reptiles

Soft-shelled turtle	*Apalone spinifera*
Desert tortoise	*Gopherus agassizii*
Western whiptail	*Aspidoscelis tigris*
Zebra-tailed lizard	*Callisaurus draconoides*
Banded gecko	*Coleonyx variegatus*
Great Basin collared lizard	*Crotaphytus bicinctores*
Desert iguana	*Dipsosaurus dorsalis*
Long-nosed leopard lizard	*Gambelia wislizenii*
Chuckwalla	*Sauromalus ater*
Desert horned lizard	*Phrynosoma platyrhinos*
Chuckwalla	*Sauromalus ater*
Sagebrush lizard	*Sceloporus graciosus*
Western fenced lizard	*Sceloporus occidentalis*
Yellow-backed spiny lizard	*Sceloporus uniformis*
Side-blotched lizard	*Uta stansburiana*
Long-tailed brush lizard	*Urosaurus graciosus*
Ornate tree lizard	*Urosaurus ornatus*
Desert night lizard	*Xantusia vigilis*
Glossy snake	*Arizona elegans*
Coachwhip	*Coluber flagellum*
Striped whipsnake	*Coluber taeniatus*
Sidewinder	*Crotalus cerastes*
Southwestern speckled rattlesnake	*Crotalus mitchellii*
Mohave rattlesnake	*Crotalus scutulatus*
Desert night snake	*Hysiglena chlorophaea*
Common kingsnake	*Lampropeltis getula*
Western thread snake	*Laptotyphlops humilis*
Spotted leaf-nosed snake	*Phyllorhyncus ecurtatus*
Gopher snake	*Pituophis catenifer*
Long-nosed snake	*Rhinocheilus lecontei*
Western patched-nose snake	*Salvadora hexalepis*
Western ground snake	*Sonora semiannulata*
Western lyresnake	*Trimorphodon biscutatus*

Amphibians

Southwestern toad	*Bufo microscaphus*
Red-spotted toad	*Bufo punctatus*
Fowler's toad	*Bufo woodhousii*
Tree frog	*Hyla regilla*
Bullfrog	*Rana catesbeiana*

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Fish and Invertebrates

Fish

Moapa White River springfish	*Crenichthys baileyi moapae*
Mosquitofish	*Gambusia affinis*
Virgin River chub	*Gila seminuda*
Moapa dace	*Moapa coriacea*
Tilapia	*Oreochromis aurea*
Shortfin mollies	*Poecilia mexicana*
Moapa speckled dace	*Rhinichthys osculus moapae*

Invertebrates

Creeping water bug	*Ambrysus mormon*
MacNeil sootywing skipper	*Hesperopsis gracielae*
Warm Springs naucorid	*Limnocoris moapensis*
Moapa riffle beetle	*Microcylloepus moapus*
Amargosa naucorid	*Pelocoris shoshone amargosus*
Shoshone naucorid	*Pelocoris shoshone shoshone*
Moapa pebblesnail	*Pyrgulopsis avernalis*
Moapa Valley springsnail	*Pyrgulopsis carinifera*
Moapa water strider	*Rhagovelia becki*
Moapa Warm Spring riffle beetle	*Stenelmis moapa*
Grated tryponia	*Tryonia clathrata*
Moapa naucorid	*Usingerina moapensis*

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Species Lists: Pahranagat NWR

Birds

Loons

Common loon	*Gavia immer*
Pacific loon	*Gavia pacifica*
Red-throated loon	*Gavia stellata*

Grebes

Clark's grebe	*Aechmophorus clarkii*
Western grebe	*Aechmophorus occidentalis*
Horned grebe	*Podiceps auritus*
Red-necked grebe	*Podiceps grisegena*
Eared grebe	*Podiceps nigricollis*
Pied-billed grebe	*Podilymbus podiceps*

Pelicans and Cormorants

American white pelican	*Pelecanus erythrorhynchos*
Double-crested cormorant	*Phalacrocorax auritus*

Bitterns, Herons, and Ibises

Great blue heron	*Ardea herodias*
Great egret	*Ardea alba*
American bittern	*Botaurus lentiginosus*
Cattle egret	*Bubulcus ibis*
Green heron	*Butorides virescens*
Little blue heron	*Egretta caerulea*
Reddish egret	*Egretta rufenscens*
Snowy egret	*Egretta thula*
Least bittern	*Ixobrychus exilis*
Wood stork	*Mycteria americana*
Black-crowned night-heron	*Nycticorax nycticorax*
Roseate spoonbill	*Platalea ajaja*
White-faced ibis	*Plegadis chihi*

Waterfowl

Wood duck	*Aix sponsa*
Northern pintail	*Anas acuta*
American wigeon	*Anas americana*

Waterfowl, continued

Northern shoveler	*Anas clypeata*
Green-winged teal	*Anas crecca*
Cinnamon teal	*Anas cyanoptera*
Blue-winged teal	*Anas discors*
Eurasian wigeon	*Anas penelope*
Mallard	*Anas platyrhynchos*
Gadwall	*Anas strepera*
Greater white-fronted goose	*Anser albifrons*
Lesser scaup	*Aythya affinis*
Redhead	*Aythya americana*
Ring-necked duck	*Aythya collaris*
Canvasback	*Aythya valisineria*
Canada goose	*Branta canadensis*
Cackling goose	*Branta hutchinsii*
Bufflehead	*Bucephala albeola*
Common goldeneye	*Bucephala clangula*
Snow goose	*Chen caerulescens*
Ross' goose	*Chen rossii*
Tundra swan	*Cygnus columbianus*
Fulvous whistling-duck	*Dendrocygna bicolor*
Hooded merganser	*Lophodytes cucullatus*
Surf scoter	*Melanitta perspicillata*
Common merganser	*Mergus merganser*
Red-breasted merganser	*Mergus serrator*
Ruddy duck	*Oxyura jamaicensis*

Vulture

Turkey vulture	*Cathartes aura*

Raptors

Cooper’s hawk	*Accipiter cooperii*
Sharp-shinned hawk	*Accipiter striatus*
Golden eagle	*Aquila chrysaetos*
Zone-tailed hawk	*Buteo albonotatus*
Red-tailed hawk	*Buteo jamaicensis*
Rough-legged hawk	*Buteo lagupus*
Red-shouldered hawk	*Buteo lineatus*
Ferruginous hawk	*Buteo regalis*
Swainson's hawk	*Buteo swainsoni*
Common black hawk	*Buteogallus anthracinus*
Crested caracara	*Caracara cheriway*
Northern harrier	*Circus cyaneus*
White-tailed kite	*Elanus leucurus*

Raptors, continued

Merlin	*Falco columbarius*
Prairie falcon	*Falco mexicanus*
Peregrine falcon	*Falco peregrinus*
American kestrel	*Falco sparverius*
Bald eagle	*Haliaeetus leucocephalus*
Osprey	*Pandion haliaetus*
Harris hawk	*Parabuteo unicinctus*

Gallinaceous Birds

Gambel's quail	*Callipepla gambelii*
Ring-necked pheasant	*Phasianus colchicus*

Rails

American coot	*Fulica americana*
Common moorhen	*Gallinula chloropus*
Sandhill crane	*Grus canadensis*
Sora	*Porzana carolina*
Virginia rail	*Rallus limicola*

Shorebirds

Spotted sandpiper	*Actitis macularia*
Sanderling	*Calidris alba*
Baird’s sandpiper	*Calidris bairdii*
Western sandpiper	*Calidris mauri*
Pectoral sandpiper	*Calidris melanotos*
Least sandpiper	*Calidris minutilla*
Semipalmated sandpiper	*Calidris pusilla*
Willet	*Catoptrophorus semipalmatus*
Semipalmated plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferus*
Wilson's snipe	*Gallinago gallinago*
Black-necked stilt	*Himantopus mexicanus*
Short-billed dowitcher	*Limnodromus griseus*
Long-billed dowitcher	*Limnodromus scolopaceus*
Marbled godwit	*Limosa fedoa*
Long-billed curlew	*Numenius americanus*
Red-necked phalarope	*Phalaropus lobatus*
Wilson’s phalarope	*Phalaropus tricolor*
Black-bellied plover	*Pluvialis squatarola*
American avocet	*Recurvirostra americana*
Lesser yellowlegs	*Tringa flavipes*
Greater yellowlegs	*Tringa melanoleuca*
Solitary sandpiper	*Tringa solitaria*

Gulls and Terns

Black tern	*Chlidonias niger*
Caspian tern	*Hydroprogne caspia*
Herring gull	*Larus argentatus*
California gull	*Larus californicus*
Mew gull	*Larus canus*
Ring-billed gull	*Larus delawarensis*
Bonaparte's gull	*Larus philadelphia*
Franklin's gull	*Larus pipixcan*
Forster's tern	*Sterna forsteri*
Common tern	*Sterna hirundo*
Sabine's gull	*Xema sabini*

Doves

Band-tailed pigeon	*Columba fasciata*
Rock dove	*Columba livia*
Common ground-dove	*Columbina passerina*
Eurasian collared-dove	*Streptopelia decaocto*
White-winged dove	*Zenaida asiatica*
Mourning dove	*Zenaida macroura*

Cuckoos

Yellow-billed cuckoo	*Coccyzus americanus*
Greater roadrunner	*Geococcyx californianus*

Owls

Short-eared owl	*Asio flammeus*
Long-eared owl	*Asio otus*
Burrowing owl	*Athene cunicularia*
Great horned owl	*Bubo virginianus*
Western screech-owl	*Otus kennicottii*
Barn owl	*Tyto alba*

Goatsuckers

Lesser nighthawk	*Chordeiles acutipennis*
Common nighthawk	*Chordeiles minor*
Common poorwill	*Phalaenoptilus nuttallii*

Kingfisher

Belted kingfisher	*Ceryle alcyon*

Swift

White-throated swift	*Aeronautes saxatalis*

Hummingbirds

Black-chinned hummingbird	*Archilochus alexandri*
Anna's hummingbird	*Calypte anna*

Costa's hummingbird	*Calypte costae*

Hummingbirds, continued

Broad-tailed hummingbird	*Selasphorus platycercus*
Rufous hummingbird	*Selasphorus rufus*
Calliope hummingbird	*Stellula calliope*

Woodpeckers

Northern flicker	*Colaptes auratus*
Acorn woodpecker	*Melanerpes formicivorus*
Lewis' woodpecker	*Melanerpes lewis*
Downy woodpecker	*Picoides pubescens*
Ladder-backed woodpecker	*Picoides scalaris*
Hairy woodpecker	*Picoides villosus*
Red-naped sapsucker	*Sphyrapicus nuchalis*

Flycatchers

Northern beardless tyrrannlet	*Camptostoma imberbe*
Olive-sided flycatcher	*Contopus cooperi*
Western wood-pewee	*Contopus sordidulus*
Western flycatcher	*Empidonax difficilis*
Yellow-bellied flycatcher	*Empidonax flaviventris*
Hammond's flycatcher	*Empidonax hammondii*
Dusky flycatcher	*Empidonax oberholseri*
Cordilleran flycatcher	*Empidonax occidentalis*
Traill's willow flycatcher	*Empidonax traillii*
Southwestern willow flycatcher	*Empidonax traillii extimus*
Gray flycatcher	*Empidonax wrightii*
Ash-throated flycatcher	*Myiarchus cinerascens*
Brown-crested flycatcher	*Myiarchus tyrannulus*
Phainopepla	*Phainopepla nitens*
Vermilion flycatcher	*Pyrocephalus rubinus*
Black phoebe	*Sayornis nigricans*
Say's phoebe	*Sayornis saya*
Tropical kingbird	*Tyrannus melancholicus*
Eastern kingbird	*Tyrannus tyrannus*
Western kingbird	*Tyrannus verticalis*
Cassin's kingbird	*Tyrannus vociferans*

Shrikes

Northern Shrike	*Lanius excubitor*
Loggerhead Shrike	*Lanius ludovicianus*

Vireos

Bell's vireo	*Vireo bellii*
Cassin's vireo	*Vireo cassinii*
Warbling vireo	*Vireo gilvus*
While-eyed vireo	*Vireo griseus*
Plumbeous vireo	*Vireo plumbeus*

Jays and Crows

Scrub jay	*Aphelocoma californica*
American crow	*Corvus brachyrhynchos*
Steller's jay	*Cyanocitta stelleri*
Pinyon jay	*Gymnorhinus cyanocephalus*
Common raven	*Corvus Corax*

Lark

Horned lark	*Eremophila alpestris*

Swallows

Cliff swallow	*Hirundo pyrrhonota*
Barn swallow	*Hirundo rustica*
Bank swallow	*Riparia riparia*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Tree swallow	*Tachycineta bicolor*
Violet-green swallow	*Tachycineta thalassina*

Chickadees

Black capped chicadee	*Poecile atricapillus*
Mountain chickadee	*Poecile gambeli*

Verdins

Verdin	*Auriparus flaviceps*

Bushtit

Common bushtit	*Psaltriparus minimus*

Creepers

Brown creeper	*Certhia americana*

Wrens

Cactus wren	*Campylorhynchus brunneicapillus*
Canyon wren	*Catherpes mexicanus*
Marsh wren	*Cistothorus palustris*
Rock wren	*Salpinctes obsoletus*
Bewick's wren	*Thryomanes bewickii*
House wren	*Troglodytes aedon*
Winter wren	*Troglodytes troglodytes*

Kinglets and Gnatcatchers

Blue-gray gnatcatcher	*Polioptila caerulea*
Ruby-crowned kinglet	*Regulus calendula*
Golden-crowned kinglet	*Regulus satrapa*

Thrushes

Wood thrush	*Hylocichla mustelina*
Varied thrush	*Ixoreus naevius*
Mountain bluebird	*Sialia currucoides*
Western bluebird	*Sialia mexicana*
American robin	*Turdus migratorius*

Mockingbirds and Thrashers

Gray catbird	*Dumetella carolinensis*
Northern mockingbird	*Mimus polyglottos*
Sage thrasher	*Oreoscoptes montanus*
Crissal thrasher	*Toxostroma crissale*
Le conte's thrasher	*Taxostroma lecontei*

Pipits

American pipit	*Anthus rubescens*

Waxwings

Cedar waxwing	*Bombycilla cedrorum*

Starlings

European starling	*Sturnus vulgaris*

Warblers

Common yellowthroat	*Ceothlypis trichas*
Bay-breasted warbler	*Dendroica castanea*
Yellow-rumped warbler	*Dendroica coronata*
Black-throated gray warbler	*Dendroica nigrescens*
Yellow warbler	*Dendroica petechia*
Worm-eating warbler	*Helmitheros vermivora*
Yellow-breasted chat	*Icteria virens*
Macgillivrays warbler	*Oporornis tolmiei*
Northern parula	*Parula americana*
Prothonotary warbler	*Protonotaria citrea*
Northern waterthrush	*Seiurus noveboracensis*
Orange-crowned warbler	*Vermivora celata*
Hooded warbler	*Wilsonia citrina*
Willsons warbler	*Wilsonia pusilla*

Tanagers

Western tanager	*Piranga ludoviciana*
Summer tanager	*Piranga rubra*

Grosbeaks and Buntings

Blue grosbeak	*Buiranca caerulea*
Lazuli bunting	*Passerina amoena*
Indigo bunting	*Passerina cyanea*

Black-headed grosbeak	*Pheucticus melanocephalus*

Towhees and Sparrows

Rufus-crowned sparrow	*Aimophila ruficeps*
Sage sparrow	*Amphispiza belli*
Black-throated sparrow	*Amphispiza bilineata*
Lark sparrow	*Chondestes grammacus*
Dark-eyed junco	*Junco hyermalis*
Lincolns sparrow	*Melospiza lincolnii*
Song sparrow	*Melospiza melodia*
Savannah sparrow	*Passerculus sandwichensis*
Fox sparrow	*Passerelia iliaca*
Green-tailed towhee	*Pipilo chlorurus*
Spotted towhee	*Pipilo maculatus*
Vesper sparrow	*Pooecetes gramineus*
Brewer's sparrow	*Spizella breweri*
Chipping sparrow	*Spizella passerina*
Golden-crowned sparrow	*Zonotrichia atricapilla*
White crown sparrow	*Zonotrichia leucophrys*
Harris's sparrow	*Zonotrichia querula*

Blackbirds, Meadowlarks, and Orioles

Red-winged blackbird	*Agelaius phoeniceus*
Rusty blackbird	*Euphagus carolinus*
Brewer's blackbird	*Euphagus cyanocephalus*
Bullock's oriole	*Iceterus bullockii*
Hooded oriole	*Icterus cucullatus*
Scott's oriole	*Icterus parisorum*
Brown-headed cowbird	*Molothrus ater*
Great-tailed grackle	*Quiscalus mexicanus*
Western meadowlark	*Sturnella neglecta*
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*

Finches

Pine siskin	*Carduelis pinus*
Lesser goldfinch	*Carduelis psaltria*
American goldfinch	*Carduelis tristis*
Cassin's finch	*Carpodacus cassinii*
House finch	*Carpodacus mexicanus*

Weaver Finch

House sparrow	*Passer domesticus*

Mammals

Gray shrew	*Notiosorex crawfordi*
Pallid bat	*Antrozous pallidus*
Big brown bat	*Eptesicus fuscus*
Spotted bat	*Euderma maculatum*
Greater western mastiff-bat	*Eumops perotis californicus*
Allen's big-eared bat	*Idionycteris phyllotis*
Silver-haired bat	*Lasionycteris noctivagans*
Western red bat	*Lasiurus blossevillii*
Big brown bat	*Lasiurus borealis*
Hoary bat	*Lasiurus cinereus*
California leaf-nosed bat	*Macrotus californicus*
California myotis	*Myotis californicus*
Western small-footed myotis	*Myotis ciliolabrum*
Long-eared myotis	*Myotis evotis*
Small-footed myotis	*Myotis leibii*
Fringed myotis	*Myotis thysanodes*
Cave myotis	*Myotis velifer*
Long-legged myotis	*Myotis volans*
Yuma myotis	*Myotis yumanensis*
Big free-tailed bat	*Nyctinomops macrotis*
Western pipistrel	*Pipistrellus hesperus*
Townsend big-eared bat	*Plecotus townsendii*
Brazilian free-tailed bat	*Tadarida brasiliensis*
Pygmy rabbit	*Brachylagus idahoenis*
Black-tailed jackrabbit	*Lepus californicus*
Desert cottontail rabbit	*Sylvilagus audubonii*
White-tailed antelope squirrel	*Ammospermophilus leucurus*
Desert kangaroo rat	*Caloprymnus campestris*
Desert pocket mouse	*Chaetodipus penicillatus*
Merriam kangaroo rat	*Dipodomys merriami*
Desert Valley kangaroo mouse	*Microdipodops megacephalus albiventer*
Pahranagat Valley montane vole	*Microtus montanus fucosus*
House mouse	*Mus musculus*
Desert woodrat	*Neotoma lepida*
Muskrat	*Ondatra zibethicus*
Southern grasshopper mouse	*Onychomys torridus*
Deer mouse	*Peromyscus maniculatus*
Western harvest mouse	*Reithrodontomys megalotis*
Rock squirrel	*Spermophilus variegatus*
Valley pocket gopher	*Thomomys bottae*
Ringtail	*Bassariscus astutus*
Coyote	*Canis latrans*
Mountain lion	*Felis concolor*
Bobcat	*Felis rufus*

Mammals, continued

Striped skunk	*Mephitis mephitis*
Long tailed weasel	*Mustela frenata*
Raccoon	*Procyon lotor*
Badger	*Taxidea taxus*
Gray fox	*Urocyon cinereoargenteus*
Kit fox	*Vulpes macrotis*
Pronghorned antelope	*Antilocapra americana*
Elk	*Cervus elaphus*
Mule deer	*Odocoileus hemionus*

Reptiles and Amphibians

Reptiles

Desert tortoise	*Gopherus agassizii*
Western whiptail lizard	*Aspidoscelis tigris*
Zebra-tailed lizard	*Cnemidophorus tigris*
Western banded gecko	*Coleonyx variegatus*
Great Basin collard lizard	*Crotaphytus bicinctores*
Desert iguana	*Dispsosaurus dorsalis*
Western skink	*Gambelia wislizenii*
Desert horned lizard	*Gambelia wislizenii*
Western skink	*Plestiodon skiltonianus*
Chuckwalla	*Sauromalus ater*
Sagebrush lizard	*Sceloporus graciosus*
Western fenced lizard	*Sceloporus occidentalis*
Yellow-backed spiny lizard	*Sceloporus uniformis*
Side-blotched lizard	*Uta stansburiana*
Desert night lizard	*Xantusia vigilis*
Coachwhip	*Coluber flagellum*
Striped whipsnake	*Coluber taeniatus*
Sidewinder	*Crotalus cerastes*
Great basin rattlesnake	*Crotalus oreganus lutosus*
Mojave rattlesnake	*Crotalus scutulatus*
Ring-necked snake	*Diadophis punctatus*
Night snake	*Hypsiglena chlorophaea*
Common kingsnake	*Lampropeltis getula*
Western thread snake	*Leptotyphlops humilis*
Gophersnake	*Pituophis catenifer*
Long-nosed snake	*Rhinocheilus lecontei*
Western patch-nosed snake	*Salvadora hexalepis*
Ground snake	*Sonora semiannulata*

Amphibians

Western toad	*Bufo boreas*
Great plains toad	*Bufo cognatus*
Red-spotted toad	*Bufo punctatus*
Woodhouse toad	*Bufo woodhousii*
Pacific tree frog	*Hyla regilla*
Bullfrog	*Rana catesbeiana*
Northern leopard frog	*Rana pipiens*
Tiger salamander	*Ambystoma tigrinum*

Fish and Invertebrates

Fish

Bullhead catfish	*Ameiurus* spp.
Grass carp	*Ctenopharyngodon idella*
Pahranagat spinedace	*Lepidomeda altivelis*
Large-mouthed bass	*Micropterus salmoides*
Crappie	*Pomoxis* spp.
Pahranagat speckled dace	*Rhinichthys osculus velifer*

Invertebrates

Shoshone naucorid	*Pelocoris shoshone shoshone*
Pahranagat pebblesnail	*Pyrgulopsis merriami*
Moapa Warm Spring riffle beetle	*Stenelmis moapa*
Grated tyronia	*Tryonia clathrata*

Appendix I.
Wilderness Review

This appendix contains the wilderness inventory conducted for the Ash Meadows, Moapa Valley, and Pahranagat National Wildlife Refuges (NWRs) as part of the Comprehensive Conservation Plan (CCP) development process. The wilderness inventory concluded that none of the lands within Ash Meadows and Moapa Valley NWRs meet the criteria for wilderness designation. However, three small units of Pahranagat NWR along the western side of the Refuge and adjacent to the proposed Desert Wilderness on Desert NWR do meet the criteria for wilderness designation.

This appendix also contains a copy of the proposal to designate approximately 1.4 million acres of land within the Desert NWR as wilderness. This wilderness proposal was submitted to Congress in 1974 but Congress has yet to act on the proposal. However the Service continues to manage this area to protect its wilderness values. As part of the CCP implementation, the Service plans to prepare a revised proposal which includes technical corrections to the existing proposed wilderness such as: correcting overlap with US Air Force's bombing range; allowing repair/relocation of hazardous sections of roads; and allowing the use of helicopters to repair/maintain water developments and access remote areas for wildlife surveys. Details of these revisions will be provided in a revised proposal.

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APPENDIX I-1

Wilderness Inventory: Ash Meadows, Moapa Valley, and Pahranagat NWRs

Desert National Wildlife Refuge Complex
Clark County, Nevada

United States Department of the Interior
Fish and Wildlife Service

The purpose of a wilderness review is to identify and recommend for Congressional designation National Wildlife Refuge System (System) lands and waters that merit inclusion in the National Wilderness Preservation System (NWPS). Wilderness reviews are a required element of comprehensive conservation plans (CCPs) and conducted in accordance with the refuge planning process outlined in 602 FW 1 and 3, including public involvement and the National Environmental Policy Act (NEPA) compliance.

There are three phases to the wilderness review: 1) inventory, 2) study; and 3) recommendation. Lands and waters that meet the minimum criteria for wilderness are identified in the inventory phase. These areas are called wilderness study areas (WSAs). WSAs are evaluated through the CCP process to determine their suitability for wilderness designation. In the study phase, a range of management alternatives are evaluated to determine if a WSA is suitable for wilderness designation or management under an alternate set of goals and objectives that do not involve wilderness designation. The recommendation phase consists of forwarding or reporting recommendations for wilderness designation from the Director through the Secretary and the President to Congress in a wilderness study report.

If the inventory does not identify any areas that meet the WSA criteria, we document our findings in the administrative record for the CCP, fulfilling the planning requirement for a wilderness review. We inventoried Service lands and waters within Ash Meadows, Moapa Valley, and Pahranagat NWRs and found no areas that meet the eligibility criteria for a WSA as defined by the Wilderness Act. This appendix summarizes the wilderness inventory for these three refuges.

Inventory Criteria

The wilderness inventory is a broad look at the planning area to identify WSAs. These are roadless areas that meet the minimum criteria for wilderness identified in Section 2(c) of the Wilderness Act.

"A wilderness, in contrast with those areas where man and his works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions, and which: (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological or other features of scientific, educational, scenic, or historical value."

A WSA must be a roadless area or island, meet the size criteria, appear natural, and provide outstanding opportunities for solitude or primitive recreation. The process for identification of roadless areas and application of the wilderness criteria are described in the following sections.

Identification of Roadless Areas and Roadless Islands

Identification of roadless areas and roadless islands required gathering and evaluating land status maps, land use and road inventory data, and aerial and satellite imagery for the refuges. "Roadless" refers to the absence of improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use. Only lands currently owned by the Service in fee title or BLM lands managed under a cooperative agreement were evaluated.

Evaluation of the Size Criteria

Roadless areas or roadless islands meet the size criteria if any one of the following standards applies:

- An area with over 5,000 contiguous acres. State and private lands are not included in making this acreage determination.
- A roadless island of any size. A roadless island is defined as an area surrounded by permanent waters or that is markedly distinguished from the surrounding lands by topographical or ecological features.
- An area of less than 5,000 contiguous Federal acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.
- An area of less than 5,000 contiguous Federal acres that is contiguous with a designated wilderness, recommended wilderness, or area under wilderness review by another Federal wilderness managing agency such as the Forest Service, National Park Service, or Bureau of Land Management.

Evaluation of the Naturalness Criteria

In addition to being roadless, a WSA must meet the naturalness criteria. Section 2(c) defines wilderness as an area that "... generally appears to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable." The area must appear natural to the average visitor rather than "pristine." The presence of historic landscape conditions is not required. An area may include some human impacts provided they are substantially unnoticeable in the unit as a whole. Significant human-caused hazards, such as the presence of unexploded ordnance from military activity, and the physical impacts of refuge management facilities and activities are also considered in evaluation of the naturalness criteria. An area may not be considered unnatural in appearance solely on the basis of the "sights and sounds" of human impacts and activities outside the boundary of the unit.

Evaluation of Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation

In addition to meeting the size and naturalness criteria, a WSA must provide outstanding opportunities for solitude or primitive recreation. The area does not have to possess outstanding opportunities for both solitude and primitive and unconfined recreation, and does not need to have outstanding opportunities on every acre. Further, an area does not have to be open to public use and access to qualify under this criteria; Congress has designated a number of wilderness areas in the Refuge System that are closed to public access to protect resource values.

Opportunities for solitude refer to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means non-motorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport. These primitive recreation activities may provide opportunities to experience challenge and risk; self reliance; and adventure.

These two "opportunity elements" are not well defined by the Wilderness Act but, in most cases, can be expected to occur together. However, an outstanding opportunity for solitude may be present in an area offering only limited primitive recreation potential. Conversely, an area may be so attractive for recreation use that experiencing solitude is not an option.

Evaluation of Supplemental Values
Supplemental values are defined by the Wilderness Act as "...ecological, geological, or other features of scientific, educational, scenic, or historic value." These values are not required for wilderness but their presence should be documented.

Inventory Findings:

Ash Meadows NWR

As documented below, none of the lands within Ash Meadows NWR meet the criteria necessary for a WSA. Figure 1 shows the units, and Table 1 summarizes the inventory findings for each unit.

Roadless Areas and Roadless Islands/ Size Criteria
Ash Meadows NWR is a total of approximately 23,488 acres. There are approximately 32 miles of public roads on the Refuge, and these roads divide the refuge into ten units. These units can be classified by their size. Only one unit is greater than 5,000 acres (Area A), and there are numerous unimproved roads within the unit. Three other units are relatively large, consisting of 4,561, 4,058, and 4,461 acres (Areas F, G, & A).

Naturalness Criteria
The land within Ash Meadows NWR was intensively farmed in the 1960s and 1970s, prior to its establishment as a Refuge. As a result, many of the visual qualities associated with that use are still evident. Agricultural fields, fences, utility lines, fences, levees, roads (maintained and not), ditches, and a reservoir are examples of some of the remains of this agricultural legacy. The Refuge is currently in the habitat restoration stage and will likely remain so for years to come.

Of the four sections that are close to being large enough for wilderness management;

- Area A consists of 4,461 acres, includes several levees, the Peterson Reservoir, the Longstreet cabin, approximately 24 miles of unimproved roads, and extensive agricultural fields.
- Area D consists of 5,092 acres, contains Crystal Springs Reservoir and dam, several levees, approximately 23 miles of unimproved roads and old agricultural fields.
- Area F is 4,561 acres, contains the Point of Rocks interpretive site, has approximately 28 miles of unimproved roads, and old agricultural fields.
- Area G consists of 4,058 acres, contains several structures, irrigation or well infrastructure, old agricultural fields, and approximately 17 miles of unimproved roads.

Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation
There are opportunities for solitude or primitive and unconfined recreation; however, sights and sounds from visitors, refuge personnel, or over flights from the military may interfere with solitude.

Supplemental Values
Ash Meadows NWR consists of more than 23,000 acres of spring-fed wetlands and alkaline desert uplands and is a major discharge point for a large underground aquifer system stretching 100 miles to the northeast. Water-bearing strata reach the surface in more than 30 seeps and springs, providing a rich and complex variety of habitats. Wetlands, springs, and springbrook channels are scattered throughout the Refuge. Sandy dunes, rising up to 50 feet above the landscape, appear in the central portions of the Refuge. The Refuge provides habitat for at least 25 plants and animals found nowhere else in the world and provides a unique visual opportunity.

Mesquite and ash groves flourish near wetlands and stream channels and saltbush dominates large portions of the Refuge in dry areas adjacent to wetlands. Creosote bush habitat occurs in the drier elevated areas along the east and southeastern portions of the Refuge. Cacti occur along the outer eastern edge of the Refuge with a variety at Point of Rocks.

The Refuge provides excellent views of the night sky for stargazers due to the lack of light sources in the vicinity.

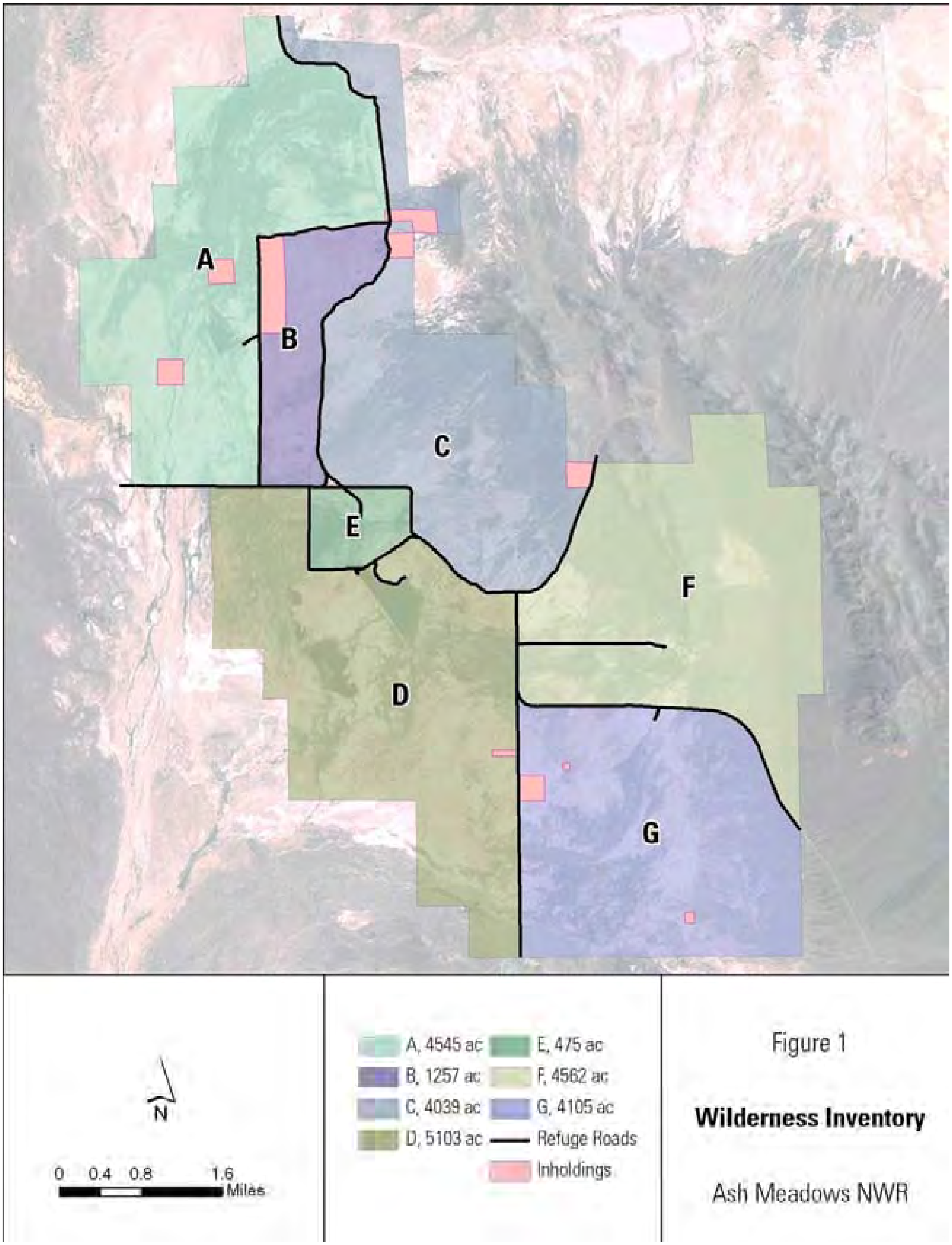

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Table 1 Ash Meadows NWR Roadless Units

Refuge unit and acreage	**Yes/no and Comments**					
	(1) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition;	(2) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;	(3a) has outstanding opportunities for solitude; **or**	(3b) has outstanding opportunities for a primitive and unconfined type of recreation;	(5) contains ecological, geological or other features of scientific, educational, scenic, or historical value.	**Unit qualifies as a wilderness study area (meets criteria 1, 2, and 3a or 3b)**
A	No, 4,461 acres	Includes several levees, the Peterson Reservoir, the Longstreet cabin, approximately 24 miles of dirt roads, and extensive agricultural fields.	Yes	Yes	Yes, Longstreet cabin and ecological, educational, and scenic values.	No, insufficient size and management as wilderness would conflict with restoration plans.
D	Yes, 5,092 acres	Crystal Springs Res. & dam, several levees, approximately 23 miles of dirt roads and old agricultural fields.	Yes	Yes	Yes, ecological, educational, and scenic values.	No, the human imprint on the environment is substantially noticeable.
F	No, 4,561 acres	Contains Point of Rocks interpretive site, has approx. 28 miles of dirt roads, and old agricultural fields.	Yes	Yes	Yes, ecological, educational, and scenic values.,	No, insufficient size and management as wilderness would conflict with restoration plans.

Refuge unit and acreage	Yes/no and Comments					
	(1) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition;	(2) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;	(3a) has outstanding opportunities for solitude;	or (3b) has outstanding opportunities for a primitive and unconfined type of recreation;	(5) contains ecological, geological or other features of scientific, educational, scenic, or historical value.	**Unit qualifies as a wilderness study area (meets criteria 1, 2, and 3a or 3b)**
G	No, 4,058 acres	Contains several structures, irrigation or well infrastructure, old agricultural fields, and approximately 17 miles of dirt roads.	Yes	Yes	Yes, ecological, educational, and scenic values.	No, insufficient size and management as wilderness would conflict with restoration plans.

Moapa Valley NWR

As documented below, none of the parcels in the Moapa Valley NWR meet the criteria necessary for a WSA.

Roadless Areas and Roadless Islands
The Moapa Valley NWR is a total of approximately 116 acres. Warm Springs Road (Hwy 168) parallels the eastern border to the Refuge, and from Warm Springs Road there are Refuge roads leading to the stream viewing chamber, and to the Pederson Unit, which leads to the Pederson residence and outbuildings. The Apcar Unit is also bisected by unimproved roads used by both Refuge staff and by the Moapa Valley Water District to access the capped spring head. The Moapa Valley NWR does not meet the size criteria for a wilderness study area.

Naturalness Criteria

The 116-acres Refuge contains a stream viewing chamber, with parking for visitors. The Refuge is comprised of four adjacent, but visually distinct units. The Pedersen Unit, to the west, is 30 acres in size. The Plummer Unit, to the east, is 28 acres in size. The Apcar Unit is 48 acres in size. The Pederson #2 Unit is 11 acres in size. Each unit has a separate stream system supported by the steady and uninterrupted flow of several springs that come to the surface at various places throughout the Refuge. The Pederson Unit #2 includes a residence and outbuildings. The Apcar Unit has a spring house, and the Plummer Unit contains the stream viewing chamber and parking lot.

With an active restoration program, native riparian species have begun to return, including ash trees, honey mesquite, and screw bean mesquite. Plant species on the drier, upland areas of the Refuge are fourwing saltbush and creosote bush. Removal of non-native species, such as Canadian thistle and salt cedar is an on-going task. A visitor on the Refuge may see either see houses or roads and could hear cars driving on these roads.

Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation
There are no opportunities for solitude or primitive and unconfined recreation due to the size of the Refuge; sights and sounds from Warm Springs Road may interfere with solitude, depending on the amount of traffic on the road.

Supplemental Values
The desert landscape combined with the springs can provide the visitor with an interest in geology and ecology and glimpse into an area where the Moapa Dace is uniquely adapted to life in this harsh landscape. The Refuge was created because of the Moapa Dace, as it is found no where except this valley.

Pahranagat NWR

As documented below, three units within Pahranagat NWR meet the criteria necessary for a WSA. Figure 2 shows the units, and Table 2 summarizes the inventory findings for each unit.

Roadless Areas and Roadless Islands/Size Criteria
Pahranagat NWR consists of 5,382 acres. The Refuge is long and narrow in shape, and varies from 0.5 to 2 miles in width (1.5 mile average), with US Highway 93 paralleling the eastern boundary along the Refuges' approximate 10-mile length. The north half of the Refuge, including Upper Pahranagat Lake is well visited because of a campground located on the east side of the lake and a county road (Old Corn Creek Road) which bisects the Refuge about 1 mile south of Upper Pahranagat Lake. This road continues on to Bureau of Land Management lands, and is used as a boundary for the Proposed Desert Wilderness. There are five levees positioned east-west that are used to cross the lake and wetlands for administrative purposes. By using roads to divide the Refuge into units, and eliminating units less than 100 acres results in 14 units in which to evaluate the refuge for wilderness values.

The middle section of the Refuge includes (immediately west of current US Highway 93) a section of old US Highway 93, currently used by vehicles accessing the Refuge. The lower section of the Refuge contains larger units, none larger than 730 acres.

The Refuge is adjacent to the Proposed Desert Wilderness, on Desert NWR. In 1974, approximately 1.3 million acres of land within the Desert National Wildlife Refuge were proposed for wilderness designation under the Wilderness Act of 1964. In the President's message to Congress accompanying the proposal, he recommended that Congress defer action on the proposal until a mineral survey is completed. The Final EIS for the proposal was released on August of 1975. A mineral assessment of the Refuge was completed in 1993 as part of the mineral withdrawal which was later completed in 1999. However, Congress has yet to act on the wilderness proposal, and the area continues to be managed to protect its wilderness values. The proposed wilderness is directly adjacent to the eastern boundary of Refuge units, 1, 4, 11, and 14. Unit 6 is separated by an administrative road from this proposed wilderness.

Naturalness Criteria
The Refuge encompasses a ten mile stretch of Pahranagat Valley and associated desert uplands at an elevation of slightly less than 4,000 feet above sea level. The White River, an ancient perennial stream which was a tributary of the Colorado River, flowed through the Pahranagat Valley from the north. It established a well-defined, but relatively narrow flood plain. The river bed is dry for many miles upstream and downstream from Pahranagat Valley, but there is water in the valley that comes from large, thermal springs along the flood plain. This spring water is stored in the Refuge's Upper Lake and North Marsh and is released to create conditions which will enhance the growth of wildlife food plants and to supplement lakes, marshes, and grasslands south of the Refuge headquarters. Water from the springs rarely flows past Maynard Lake at the southern end of the Refuge. The inlet to the upper lake is concrete lined for approximately 20 feet on either side of a stop log control structure. There are five levees which are used for water management, and administrative roads on the levees. There is a concrete lined ditch that is used to transfer water. There is a campground with fourteen camp sites, and numerous dirt roads, with three of these roads continuing through the Refuge to the west. Roads created in this desert environment tend to remain as scars on the desert floor for a very long time. Refuge buildings consist of and office/shop, equipment shelter, manager residence, bunkhouse, and fire cache.

Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation
The eastern portion of the Refuge does have opportunities for solitude. The section south of Lower Pahranagat Lake contains the only remaining naturally occurring lake and the only part of the Refuge not accessible by automobile. The section includes an abandoned section of the historic Corn Creek Road that is washed out and can no longer be traveled by auto. Sights and sounds from Highway 93 may interfere with solitude, depending on the amount of traffic on the road.

Supplemental Values
The lower section of the Refuge includes historic dry lake beds, upland desert habitat, a historic (late 1800) home site, naturally occurring springs, petroglyphs, native American artifacts and geological formations including volcanic tuff and other upland areas. The desert landscape, wildlife, and wetland, open water, and riparian habitats on Pahranagat NWR provide significant scenic value to visitors of the Refuge. The Refuge's managed water also provides regionally significant ecological value for migratory birds and other wildlife.

Map and Table
The following map (Fig. 2) and accompanying table (Table 2) show Pahranagat National Wildlife Refuge segmented by roads, and grouped into units greater than 100 acres. Refuge units lesser than 100 acres were deemed too small to be suitable for wilderness management. Adjacent to the Refuge to the west is the Desert Proposed Wilderness.

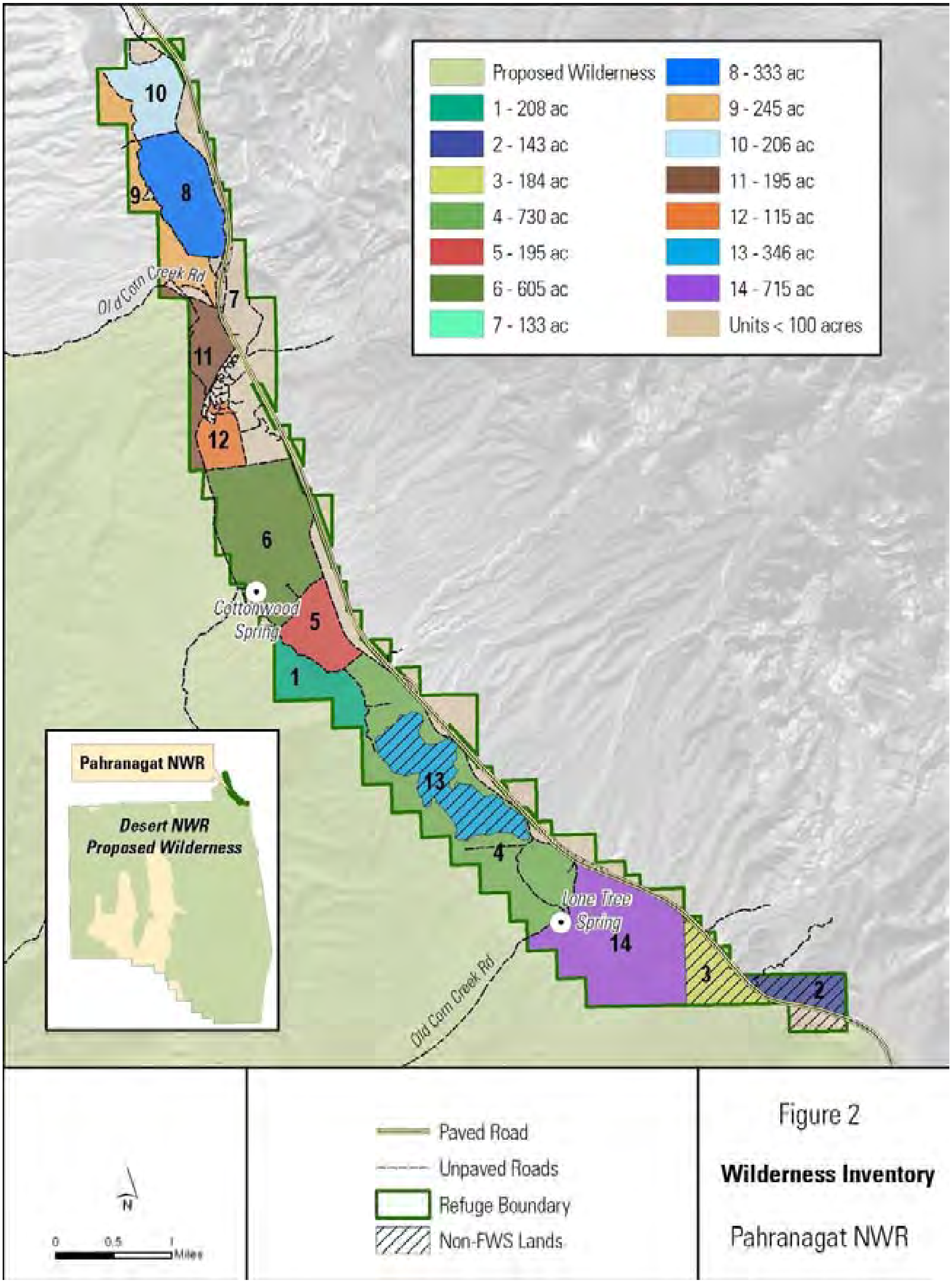


Figure 2

Wilderness Inventory

Pahranagat NWR

Table 2 Pahranagat NWR Roadless Units

Refuge unit and acreage	Yes/no and Comments					
	(1) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition;	(2) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;	(3a) has outstanding opportunities for solitude; **or**	(3b) has outstanding opportunities for a primitive and unconfined type of recreation;	(5) contains ecological, geological or other features of scientific, educational, scenic, or historical value.	**Unit qualifies as a wilderness study area (meets criteria 1, 2, and 3a or 3b)**
1	Yes, 208 acres and Contiguous with Desert Proposed Wilderness.	Yes, unpaved road on east boundary.	Yes, on west boundary.	Yes, if combined with Desert Proposed Wilderness.	Scenic	Yes
2	No, 143 acres	Inholding	No, bordered by highway	No	Yes, contains historic road bed, petroglyphs, geological features, historical rock corrals, rock rings, ecologically important to the area because of shear fault zone, old lake bed, ancient river bed	No, inholding.

Refuge unit and acreage	Yes/no and Comments					
	(1) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition;	(2) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;	(3a) has outstanding opportunities for solitude; **or**	(3b) has outstanding opportunities for a primitive and unconfined type of recreation;	(5) contains ecological, geological or other features of scientific, educational, scenic, or historical value.	**Unit qualifies as a wilderness study area (meets criteria 1, 2, and 3a or 3b)**
3	No, 184 acres	Inholding	No, bordered by highway	No	Yes, Contains historic road bed, petroglyphs, geological features, historical rock corrals, rock rings, ecologically important to the area because of shear fault zone, old lake bed, ancient river bed	No, inholding.
4	Yes, 730 acres and Contiguous with Desert Proposed Wilderness.	No, highway and dirt roads evident, water control structure, water ditch, power lines parallel hwy.	Yes, on the w. boundary.	Yes, if combined with Desert Proposed Wilderness.	Yes, ecological, scenic, historical river channel, historical lake bed, historical home site, spring. .	No

Refuge unit and acreage	Yes/no and Comments					
	(1) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition;	(2) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;	(3a) has outstanding opportunities for solitude;	or (3b) has outstanding opportunities for a primitive and unconfined type of recreation;	(5) contains ecological, geological or other features of scientific, educational, scenic, or historical value.	**Unit qualifies as a wilderness study area (meets criteria 1, 2, and 3a or 3b)**
5	No, 195 acres	No, levees on n. & s. boundary, roads on e. & w. boundary, channelized stream.	Yes, on the w. boundary.	No, too small an area.	Yes, ecological, scenic.	No, insufficient size.
6	No, 605 acres	No, roads on e. and w. boundary, levee on the s. boundary, check dams in stream.	Yes	Yes	Yes, ecological, and Cottonwood Spring.	No, insufficient size.
7	No, 133 acres	Highway, petroglyphs, old agricultural fields, abandoned portion of highway.	No, too close to hwy.	No, too small an area.	Yes, petroglyphs.	No, insufficient size.
8	No, 333 acres	Highway, levee to s. & n., road on e. & w. shore, campsites, levee overlook.	No, lake used for fishing, campers nearby	No, too small an area.	Yes, scenic Upper Pahranagat Lake.	No, insufficient size.
9	No, 245 acres	Eastside road defines boundary.	Yes	No, too small an area.	Yes, scenic desert.	No, insufficient size.

Refuge unit and acreage	Yes/no and Comments					
	(1) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition;	(2) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;	(3a) has outstanding opportunities for solitude; **or**	(3b) has outstanding opportunities for a primitive and unconfined type of recreation;	(5) contains ecological, geological or other features of scientific, educational, scenic, or historical value.	**Unit qualifies as a wilderness study area (meets criteria 1, 2, and 3a or 3b)**
10	No, 206 acres	Water control structure, refuge boundary fence, hwy, levee on south boundary.	No, lake used for fishing, road nearby.	No, too small an area.	Yes, scenic Upper Pahranagat Lake.	No, insufficient size.
11	Yes, 195 acres and Contiguous with Desert Proposed Wilderness.	Unmaintained road, and hwy.	Yes, if combined with Desert Proposed Wilderness.	Yes, if combined with Desert Proposed Wilderness.	Yes, scenic desert.	Yes
12	No, 115 acres	Abandoned agricultural fields, concrete ditch, levee on s. boundary, roads on e. & w. boundary.	No, too close to refuge headquarters.	No, too close to headquarters.	No	No, insufficient size.
13	No, 346 acres	Inholding	No, too small an area.	No	Scenic, ecological.	No, inholding.
14	Yes, 715 acres and Contiguous with Desert Proposed Wilderness.	Highway on the e. boundary.	Yes, on the w. boundary.	Yes, if combined with Desert Proposed Wilderness.	Old farmstead foundation and Lone Tree Spring.	Yes

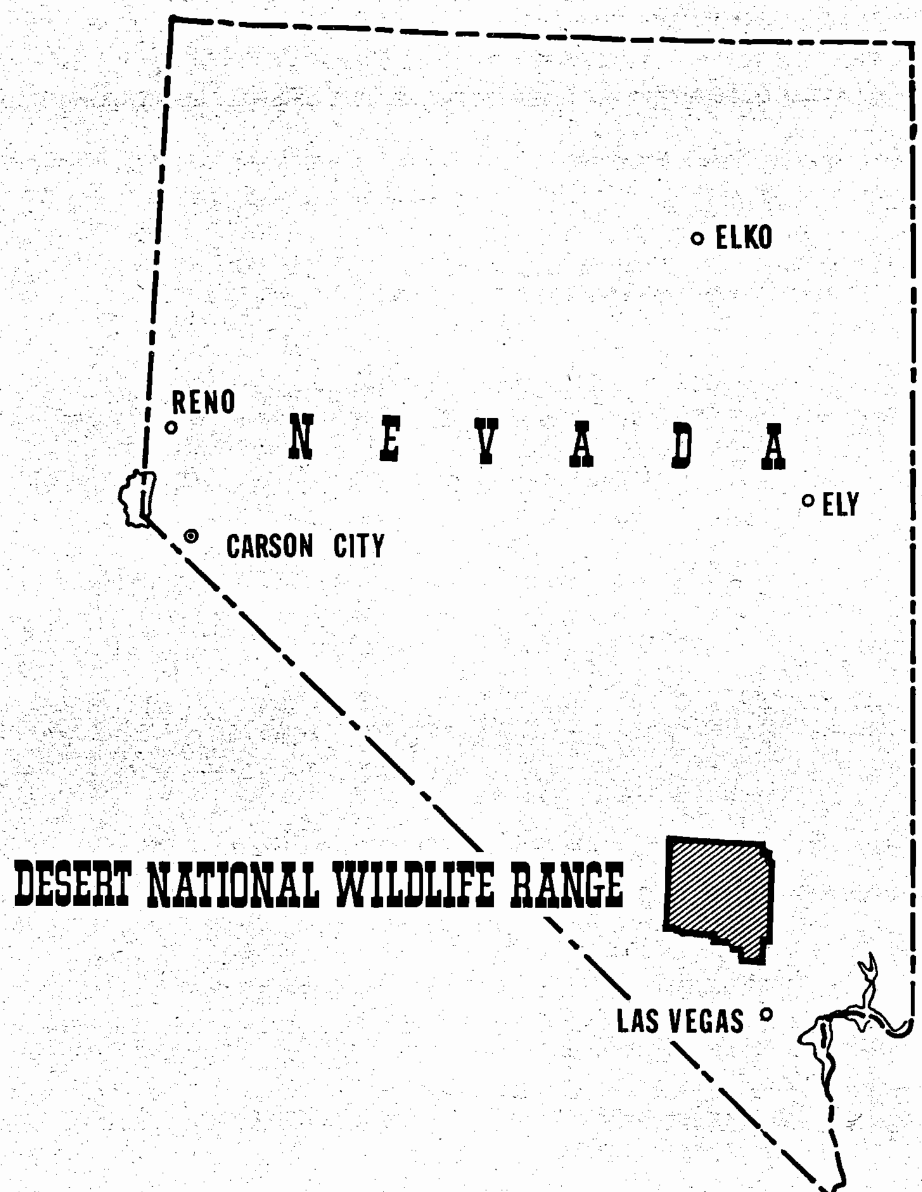
APPENDIX I-2
1971 Desert NWR Wilderness Proposal

Desert National Wildlife Refuge Complex
Clark County, Nevada

United States Department of the Interior
Fish and Wildlife Service

DESERT WILDERNESS PROPOSAL
DESERT NATIONAL WILDLIFE RANGE

NEVADA



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DESERT NATIONAL WILDLIFE RANGE
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PREFACE

The Wilderness Act of September 3, 1964 (Public Law 88-577) requires that the Secretary of the Interior review every roadless area of 5,000 contiguous acres or more and every roadless island, regardless of size, within the National Wildlife Refuge System within ten years after the effective date of the Act and report to the President of the United States his recommendations as to the suitability or nonsuitability of each area or island for preservation as wilderness. A recommendation of the President for designation as wilderness does not become effective unless provided by an Act of Congress.

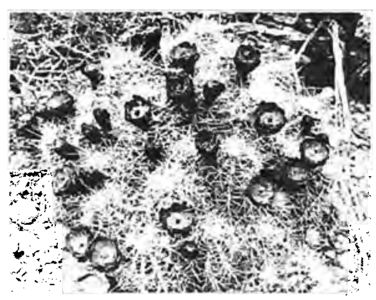
In defining wilderness, the Act also included areas of less than 5,000 acres that are of sufficient size to make preservation and use in an unimpaired condition practicable.

The National Wildlife Refuge System is a National network of lands and water managed and safeguarded for preservation and enhancement of the human benefits associated with wildlife and their environments. It presently consists of over 320 units embracing nearly 30 million acres in 46 states and is administered by the Bureau of Sport Fisheries and Wildlife. About 90 of those units, containing over 25 million acres in 32 states, qualify for study under the Wilderness Act.

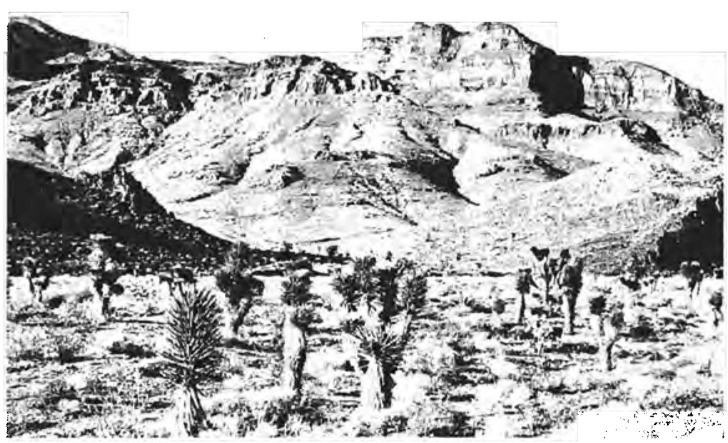
Sections 4(a) and (b) of the Wilderness Act provide that: (1) The Act is to be within and supplemental to the purposes for which units of the Refuge System are established; and (2) Wilderness areas shall be administered so as to preserve their wilderness character and shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation and historical use insofar as primary Refuge System objectives permit. Wilderness designation does not remove or alter an area's status as a unit of the National Wildlife Refuge System.

This brochure concerns a National Wildlife Range that has been studied by the Bureau of Sport Fisheries and Wildlife at the direction of the Secretary of the Interior. Its purpose is to summarize the wilderness study in sufficient detail to enable the reader to form an opinion regarding study conclusions concerning the suitability and desirability of including all or part of the Range within the National Wilderness Preservation System.

Desert tortoise.



Gambel's quail—
common below the pinyon belt.



Typical bighorn lambing area.
Yucca Peak in background. Sheep Range unit.

INTRODUCTION

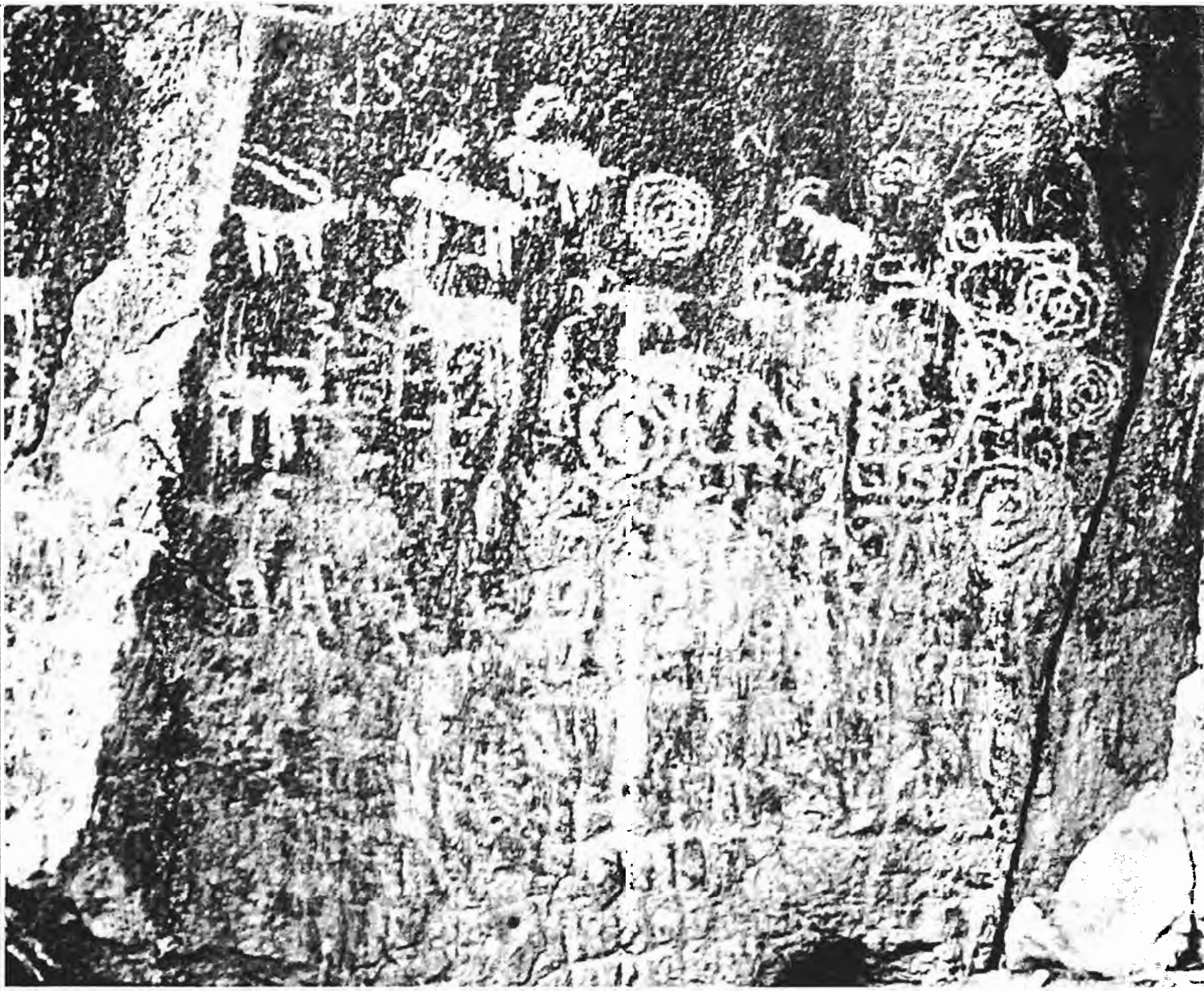
Lying at the very edge of metropolitan Las Vegas, Nevada is the largest unit of the National Wildlife Refuge System outside of Alaska—the Desert National Wildlife Range. Established in 1936 by Executive Order of President Franklin D. Roosevelt, this vast 1,588,000-acre area was set aside for the protection of a remnant population of the desert bighorn sheep—a species believed native to this harsh region for over 300,000 years.

Sensitively intolerant of human settlement and development, the desert bighorn is now largely confined to small, isolated areas within its former range in the Southwestern United States and Mexico. Within the protective confines of the Desert Wildlife Range, its numbers have gradually recovered until there are now an estimated 1,000 animals. This is the largest known population of desert bighorn sheep.

The Range is situated in the northeastern portion of the Mohave Desert in Clark and Lincoln Counties, southern Nevada. The administrative headquarters is in Las Vegas, with a field station at Corn Creek, 23 miles northwest. The southernmost boundary is about one-half mile from the Las Vegas city limits.

The western portion of the Range is used by the U.S. Air Force as an aerial bombing and gunnery range for training purposes. Public access to these lands is restricted.

The wilderness study area comprised the entire Desert National Wildlife Range and 58,000 acres of adjacent public domain lands, included because they are logical ecological and topographical extensions of the Range. The study area was divided into several study units on the basis of Wildlife Range management and development programs and plans, Air Force use, and the status of private inholdings. Permanent road and vehicle trails, contour lines, and legal subdivisions all served as unit boundaries. Approximately 88 percent of the study area, or 1,443,100 acres, were judged suitable for further consideration as wilderness within seven separate units.



Petroglyphs remain as visual reminders of a rich part of America's cultural heritage.

HISTORY

Petroglyphs on canyon walls and in caves attest to the existence of an aboriginal people in southern Nevada. Their primitive way of securing food is also evidenced by the presence of "mescal" pits, a number of which are located on the Wildlife Range.

Paiute Indians were found living near the watering places in the 1770's when Europeans first visited the region. These were Spanish pioneers searching for a more northerly route for the Spanish Trail between their settlements in present-day New Mexico and California.

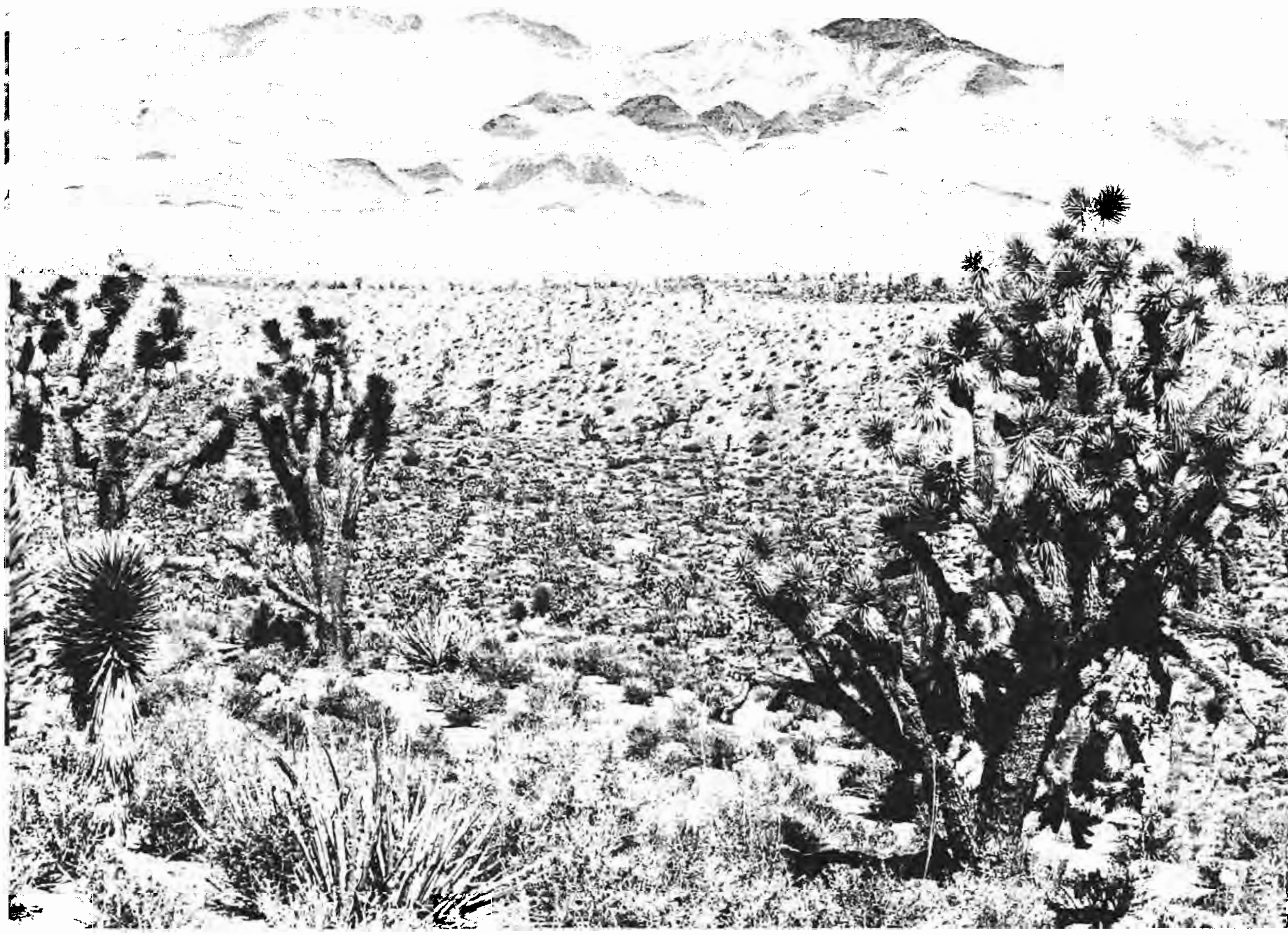
The white man's culture was first introduced in the mid-1880's when Mormon settlers moved into the Las Vegas Valley and settled near the springs. By 1900, a wagon trail linked the gold fields of central Nevada with the railroad in Las Vegas.

Prospector's shelter from another era.

Freight teams traveled north over the Alamo and Mormon Wells Road through what is now the Wildlife Range, hauling supplies and lumber to the mining camps. Corn Creek Springs, purchased in 1939 by the Federal Government, was originally an old ranch site and stagecoach stop. Up until that time, the Range was used by a growing number of prospectors, cattlemen, poachers, bootleggers and lumbermen. Shacks and corrals were built near the best springs. Livestock competed for meager supplies of forage and water. The desert sheep was a ready source of fresh meat, and had little resistance to diseases introduced by domestic animals. Its numbers began to decline.

When originally established, the Wildlife Range comprised over two million acres and was jointly managed with the Bureau of Land Management. Joint administration was terminated in 1966, when a division in administrative responsibility between the two agencies was made. Range boundaries were adjusted accordingly, and the Bureau of Sport Fisheries and Wildlife was granted primary jurisdiction over all lands within the present-day Desert National Wildlife Range, except for about 3,200 acres subject to a primary withdrawal by the Air Force in the southeast corner of the Range.

During the early stages of World War II, an aerial bombing and gunnery training range was superimposed on the western portion of the Wildlife Range, encompassing an area of about 819,000 acres. U. S. Air Force use of this area continues under a Memorandum of Understanding between the respective Secretaries of Interior and the Air Force. Under this agreement, ground operations have been authorized on designated target areas which collectively total about 139,000 acres. Considerable physical disturbance has occurred in these areas. Use of the remaining portion of the bombing and gunnery range is limited by agreement to air space. The land remains essentially undisturbed.



Rug Mountain, from vicinity of Mule Deer Ridge. Rug Mountain unit.

PHYSICAL DESCRIPTION

For long periods of early geological time, southern Nevada was submerged under a shallow sea. It was during this period that the material that now forms the seven distinct mountain ranges found within the study area accumulated. This was followed by constricting, folding and erosion which wore off the tops of the folds, leaving the lower as well as the upper strata in various degrees of exposure.

The steep and generally bare mountain sides are cut by deep ravines and canyons composed almost entirely of bedrock. Remnants of young alluvial aprons found high in the ranges indicate that portions of the mountains were once buried and have only recently been exposed.

Many of the basins are now sites of deposits of alluvial material transported down slope during occasional cloudbursts. The higher parts of the alluvial aprons are composed of coarse debris deposited in the geologically recent past. They are now being gradually eroded and cut by deep gullies. The lowlands or dry lake beds are underlain by fine-grained lake and stream deposits with some windblown materials.

The period of geological rejuvenation is still continuing, but at a slower rate—due to the arid conditions that have developed in this region.

With elevations ranging from 2,600 feet to nearly 10,000 feet, the climate varies widely. The mean temperature is approximately 60°F, with occasional extremes of 117°F in the valleys to below zero in the higher mountains. Summertime temperatures regularly exceed 100°F, broken occasionally by torrential thunderstorms which form quickly and deliver rain in sudden showers. These often cause flash flooding and erosion. Snow occurs almost every year in the Sheep Range, which contains the highest peaks on the area.

The diverse topography, differences in soils, and variations in precipitation and temperature have resulted in the development of several well-defined plant communities. Vegetation varies from low-growing, widely-scattered desert shrubs at lower elevations to a well-developed coniferous forest at the upper elevations. Animal occurrence and distribution also tend to correspond to the different vegetative zones with each species associated with those areas which best fulfill their seasonal requirements.

The study area embraces a veritable mosaic of nearly every ecological type that occurs in Southern Nevada. It exists as a largely pristine, strikingly beautiful example of a unique kind of American wilderness.

RESOURCES

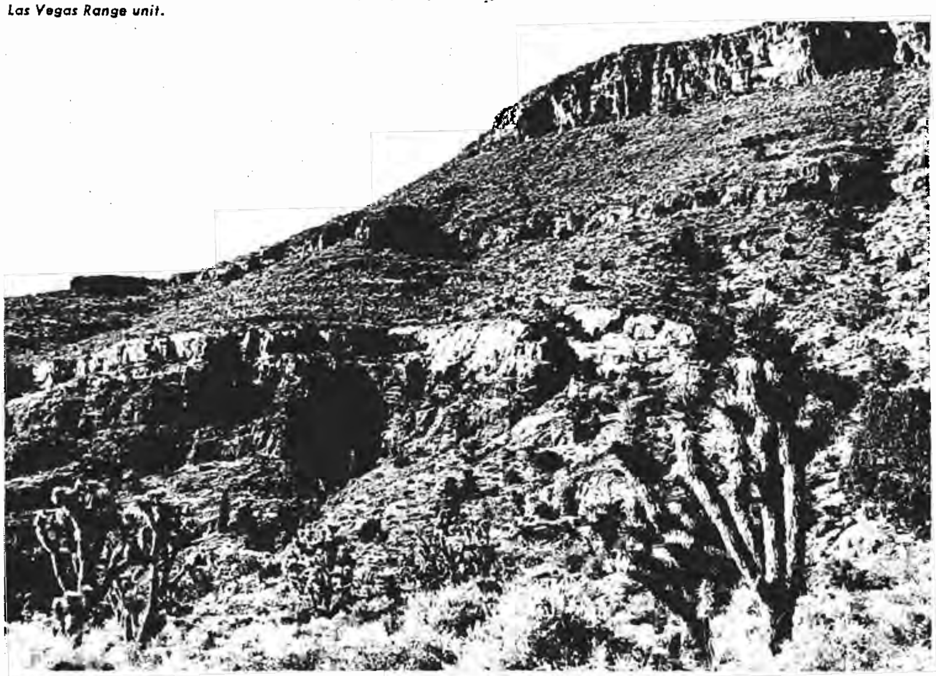
The wide range of elevation and rainfall has created a diverse habitat suited to a wide variety of wildlife species—the most notable, of course, being the desert bighorn sheep.

The overall range of the desert bighorn has not changed markedly since white man's arrival; but the animal has disappeared from many areas within its original range, and its numbers are dangerously low in others. Conversely, available information suggests that their numbers may be as great as they ever were in some parts of their range. The desert bighorn on the Wildlife Range recovered from an estimated low of 300 in the late 1930's to around 1,000 presently. It is estimated that there are about 10,000 desert bighorns in the United States (in Arizona, California, Nevada, New Mexico and Utah —traces in Colorado, Texas and Wyoming); and 4,000 in Mexico (in Baja California and Baja California Sur, Coahuia and Sonora).

Typical desert bighorn habitat cannot support more than a few animals, due to limitations imposed by food and water availability. Further, psychological make-up of the animal seems to inhibit its population size. Because of the typically low population densities, the bighorns' sensitive psychology, and their delicate adjustment to a harsh environment, human interference—even on a small scale—could have disastrous results for the animal. The evidence that desert bighorns cannot successfully coexist with humans and their development is overwhelming.

Bighorns in Southern Nevada commonly use the range of elevations between 3,500 and 8,500 feet. The Desert National Wildlife Range contains the essential requirements of the species within this elevational range—a wide variety of food, available water, mountainous terrain, comparative isolation from disturbance, and space. It is, therefore, imperative that all these requirements be preserved to help assure the desert bighorns' continued existence.

Peek-a-boo Canyon along Mormon Well Road is spring range for bighorn rams.
Las Vegas Range unit.



Collared lizard

Ewe and lamb

Water improvement at Rye Patch Spring.

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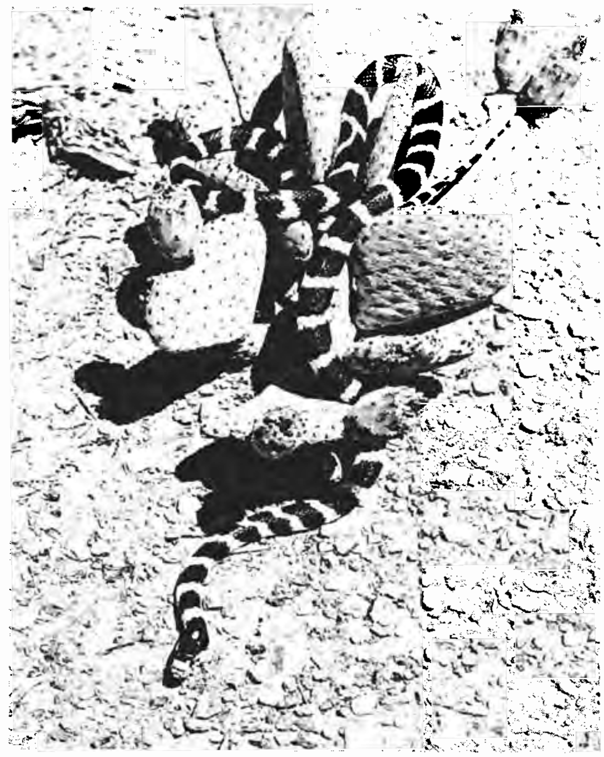
It is doubtful that any part of the State of Nevada offers a greater diversity of animal life than the Desert National Wildlife Range.

The study area supports a total of 53 species of native mammals, including the threatened kit fox, and mule deer at higher elevations. Over 250 species of birds have been recorded, including the rare prairie falcon during migration. The desert tortoise and gila monster are two of the most interesting of the 30 species of amphibians and reptiles that occur on the area.

Water is scarce throughout the study area. There are no free-flowing streams, ponds or marshes, except at Corn Creek. The dry lakes occasionally collect run-off water during wet years, but only remain wet for a few weeks. All known springs and seeps have been improved to enhance the supply of water for wildlife. These are the only natural sources of water.

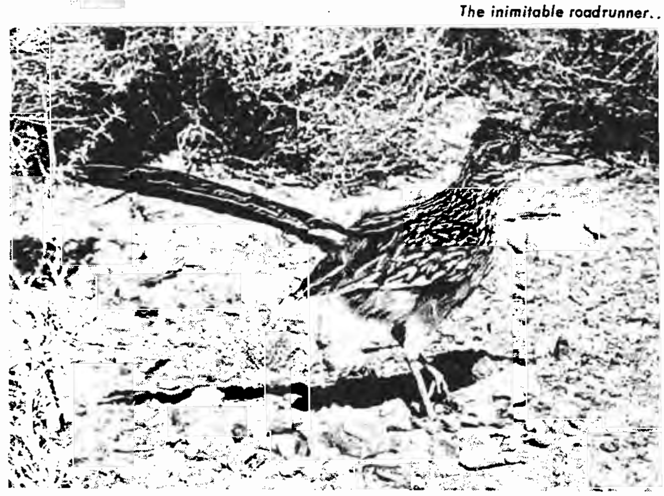
The vegetative zones change markedly with elevation, and seven distinct plant communities are easily recognized by the casual observer. Over 500 species of plants have been identified in plant communities varying from creosote bush on valley floors to pine-fir and bristlecone pine communities at upper elevations. The Sheep Range mountains contain the only well-developed coniferous forest—one of only four bristlecone pine forests occurring in the entire state.



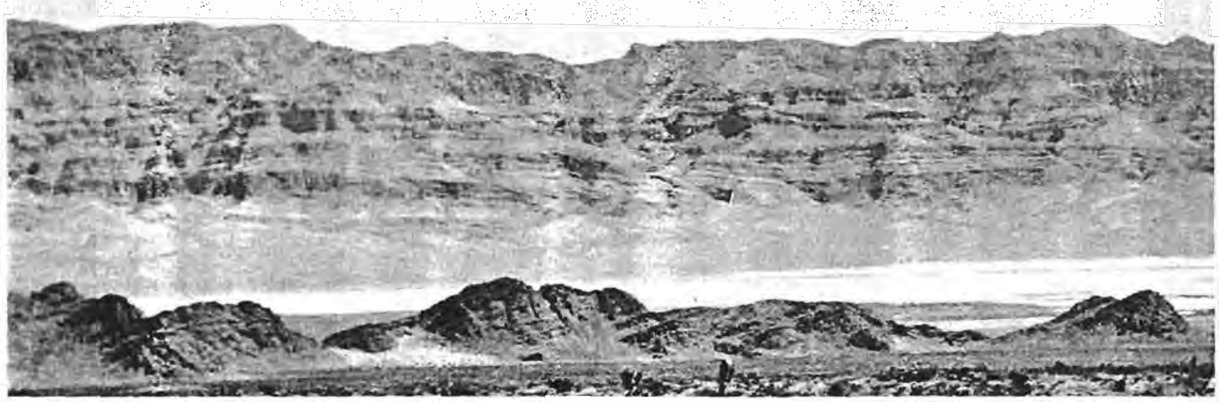
The docile king snake.

The rare mountain lion occurs at higher elevations in Sheep Range.

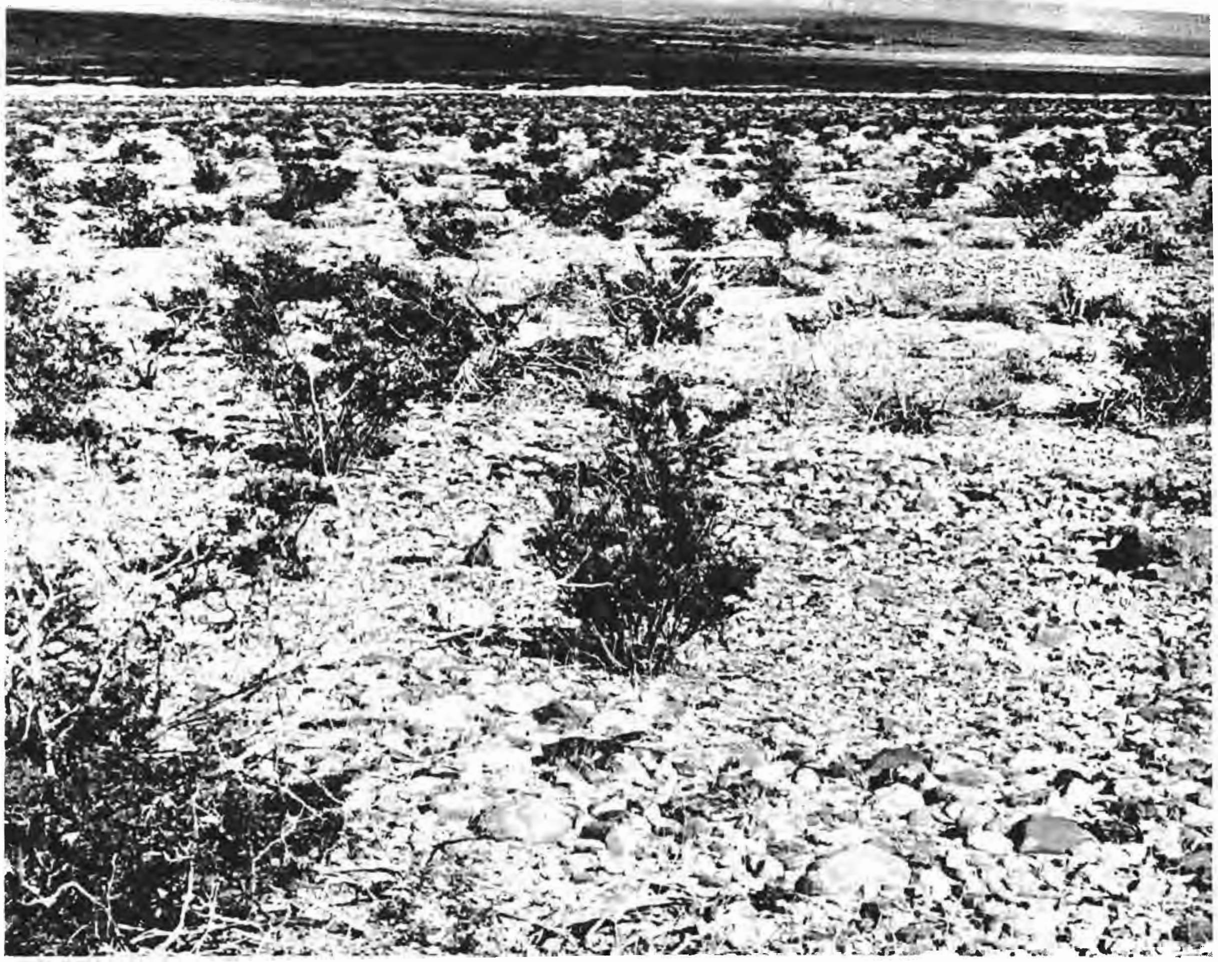
The inimitable roadrunner..



Recent mineral prospect site in Gass Peak unit.



Desert Lake, with north end of Sheep Range in background.



Creosote bush zone typical of low valleys. Corn Creek visible in background—Sheep Range beyond.

The western portion of the Wildlife Range used by the Air Force is closed to location under the mining laws. The remaining lands within the study area are largely open to mineral entry.

No information was found that would indicate that important ore-bearing zones exist within the boundaries of the study area. In fact, peripheral mineral surveys suggest that these lands are probably the least mineralized in Nevada.

No patented mining claims existed within the area at the time of the study. Visual examination of the study area also failed to reveal any valid unpatented mining claims. Prospect sites located were concentrated in the extreme southern portion of the Wildlife Range, and few showed signs of recent activity.

In order to protect the desert bighorn on the Wildlife Range, it is necessary that large areas of undisturbed natural habitat be maintained. It is important, therefore, that the entire Range ultimately be excluded from mineral exploration and development. Plans to accomplish this have been initiated by the Bureau of Sport Fisheries and Wildlife.

Areas considered to be the most critical bighorn sheep habitat have already been excluded from application of the oil and gas leasing laws. Operations associated with oil and gas exploration and development would not be compatible with wilderness.

Solitude high in the Sheep Range.

PUBLIC USE

There are many opportunities on the Wildlife Range for public recreation which is compatible with the requirements of desert bighorn sheep and related natural values. However, the number of people engaged in any one recreational activity at any given time must remain relatively limited to avoid conflict with wildlife and preserve the element of solitude and freedom from human presence that the area possesses. Herein lies one of the very special values of the Desert National Wildlife Range—the opportunity preserved for a truly unique desert wilderness experience.

Public use presently totals about 15,000 visits annually, with the greatest visitation occurring at the Corn Creek subheadquarters. Most of the area is managed as a wild area, with recreation generally limited to day use only. Hiking, wildlife observation, scenic driving, and photography are popular uses of the area. The areas of most interest to visitors are Hidden Forest within the Sheep Range Mountains, Mormon Pass, and Fossil Ridge within the Las Vegas Range Mountains. The Alamo and Mormon Pass Roads provide year-round access for conventional highway vehicles, while a few primitive "spur" roads permit seasonal access to areas which would otherwise seldom be visited because of water scarcity and the rigors of foot travel in the hot temperatures. Public access within the bombing and gunnery range is limited by military restrictions.

Recreational uses near springs and other sources of water are closely regulated to avoid conflicts with wildlife. The hunting program is coordinated with the Nevada State Fish and Game Department, with hunting limited to the taking of a few mature bighorn rams. The qualitative aspects of the hunting experience are emphasized.

Unauthorized cross-country travel by four-wheel drive and so-called "dune buggy" vehicles is an increasing problem and often difficult to control—particularly, along the southern perimeter of the Range. Wilderness designation could be highly beneficial in this respect, in terms of providing additional legislative protection.

One Research Natural Area has been officially designated and two proposed in the Sheep Range, primarily for research and educational purposes. All would be compatible with wilderness designation.

The Wildlife Range's value as outdoor laboratory for educational purposes will increase with passage of time.

MANAGEMENT

The primary management objectives within the Wildlife Range are to preserve and protect natural environmental qualities required for the survival of an optimum population of desert bighorn sheep and other native wildlife. To assure that these objectives will be fulfilled, there is a continuing need for periodic resource inventories, applied research to provide information for management and maintenance, fire suppression, and routine patrol for protection of Wildlife Range values. When vehicles are required, their use will normally be restricted to established roads and trails excluded from the wilderness proposal. Exceptions involve six primitive vehicle trails included in the wilderness for administrative use only. Use of aircraft, including fixed-wing aircraft and helicopters, will continue to be required; however, landings within the proposed wilderness will not be necessary—except in emergencies. Wildlife management requirements within the proposed wilderness are considered entirely compatible with wilderness designation.

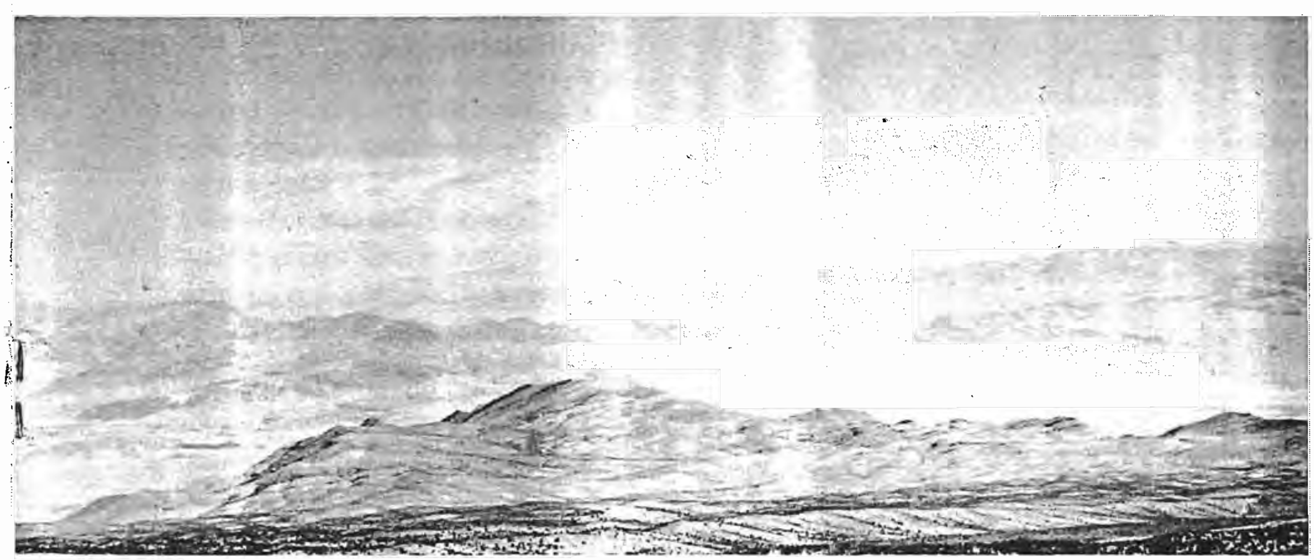
Management and use of lands within that portion of the study area used by the Air Force is governed by the Memorandum of Understanding between the respective Secretaries of the Interior and the Air Force. Essentially, this agreement authorizes exclusive use of the area by the Air Force for training purposes, with provision for access during certain specified periods by Range personnel for wildlife and public use management purposes.

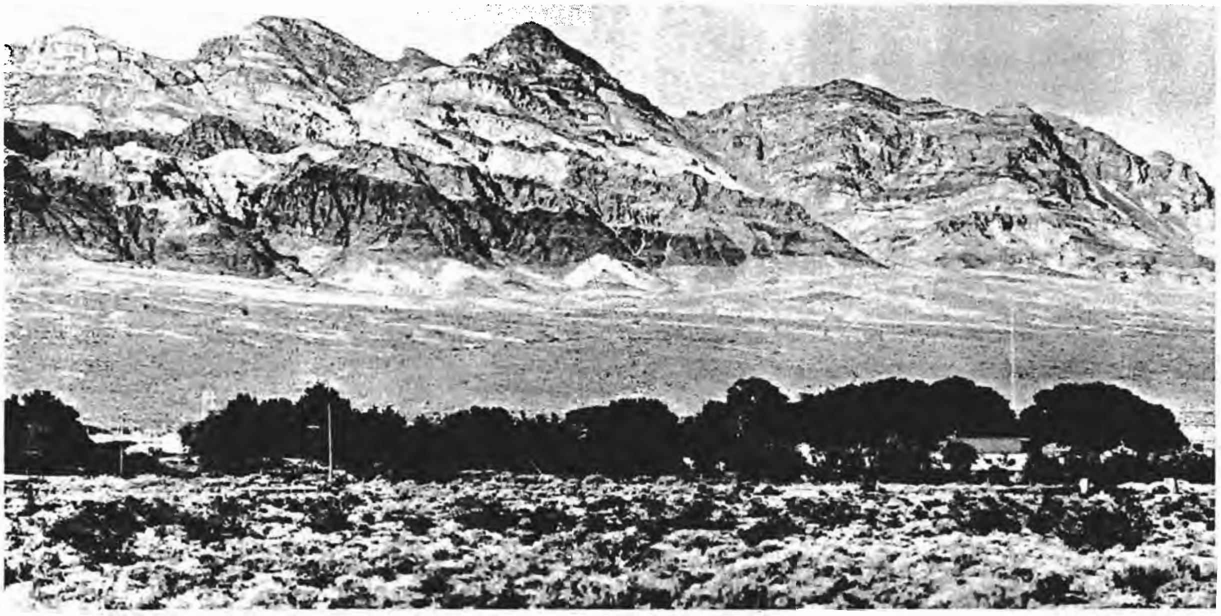
The public domain lands included in the study are managed by the Bureau of Land Management, primarily for livestock grazing as part of much larger grazing districts. However, livestock seldom graze these areas since water is generally unavailable. The lands lack developments of any kind and are wholly natural. With wilderness designation, grazing would be eliminated.

Picnic area at Mormon Pass. Mormon Well Road visible at left.

Bighorns captured in permanent trap near Wamp Spring are used to re-establish populations in areas where species formerly occurred.

View from Angel Peak area south of Wildlife Range. From left to right in background: Indian Springs Valley; Pintwater Range; Three Lakes Valley; and the Desert Range.





Corn Creek Subheadquarters, with Sheep Range in background.

DEVELOPMENT

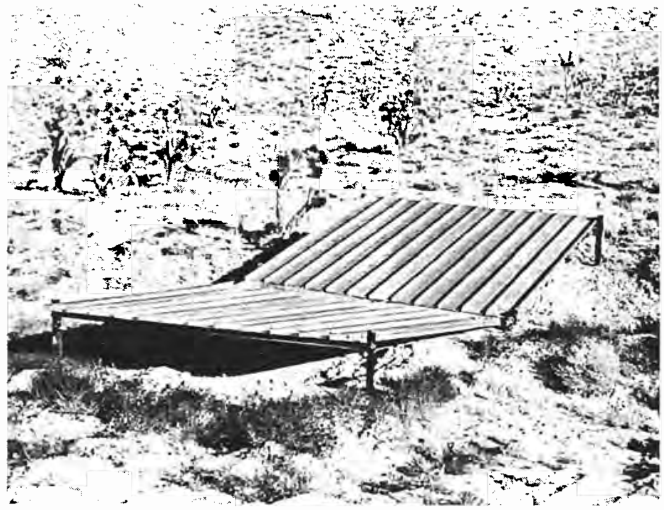
Although the study area is remarkably free of human disturbance, a variety of existing and planned developments have a bearing on wilderness considerations. Many are not compatible with wilderness, while others are minor and will not detract from the natural quality of the area in which they are located.

Developments excluded from the wilderness proposal include lands within the bombing and gunnery range where target facilities are located; permanent roads; Corn Creek subheadquarters; and private inholdings.

Developments included in the proposal are the primitive Nye Canyon, White Sage Gap, Pine Spring, Mormon Well Spring, Wamp Spring, and Quail Spring Trails, which are required for administration of the Range; several abandoned vehicle trails which will gradually revert to their natural condition; the bighorn sheep trap at Wamp Spring; a well used for monitoring purposes by the Atomic Energy Commission; the June Bug Mine, authorized for use as a National Radiation Shelter; water improvements, necessary for proper management of desert bighorn sheep; and mineral prospect sites.

When the June Bug Mine site in the Gass Peak Unit is no longer required for local civil defense purposes, the site and access trail would be suitable for inclusion in the proposed wilderness. The old mine involves a minimum of surface disturbance and represents the type of early-day mining activity which is now very much a part of the American West. The access trail would gradually revert to a natural condition with a minimum of restorative assistance.

At such time as the test well in the Spotted Range Unit is no longer required by AEC in conjunction with their monitoring program, the site and access trail would be suitable for inclusion in the proposed wilderness with a minimum of restoration.



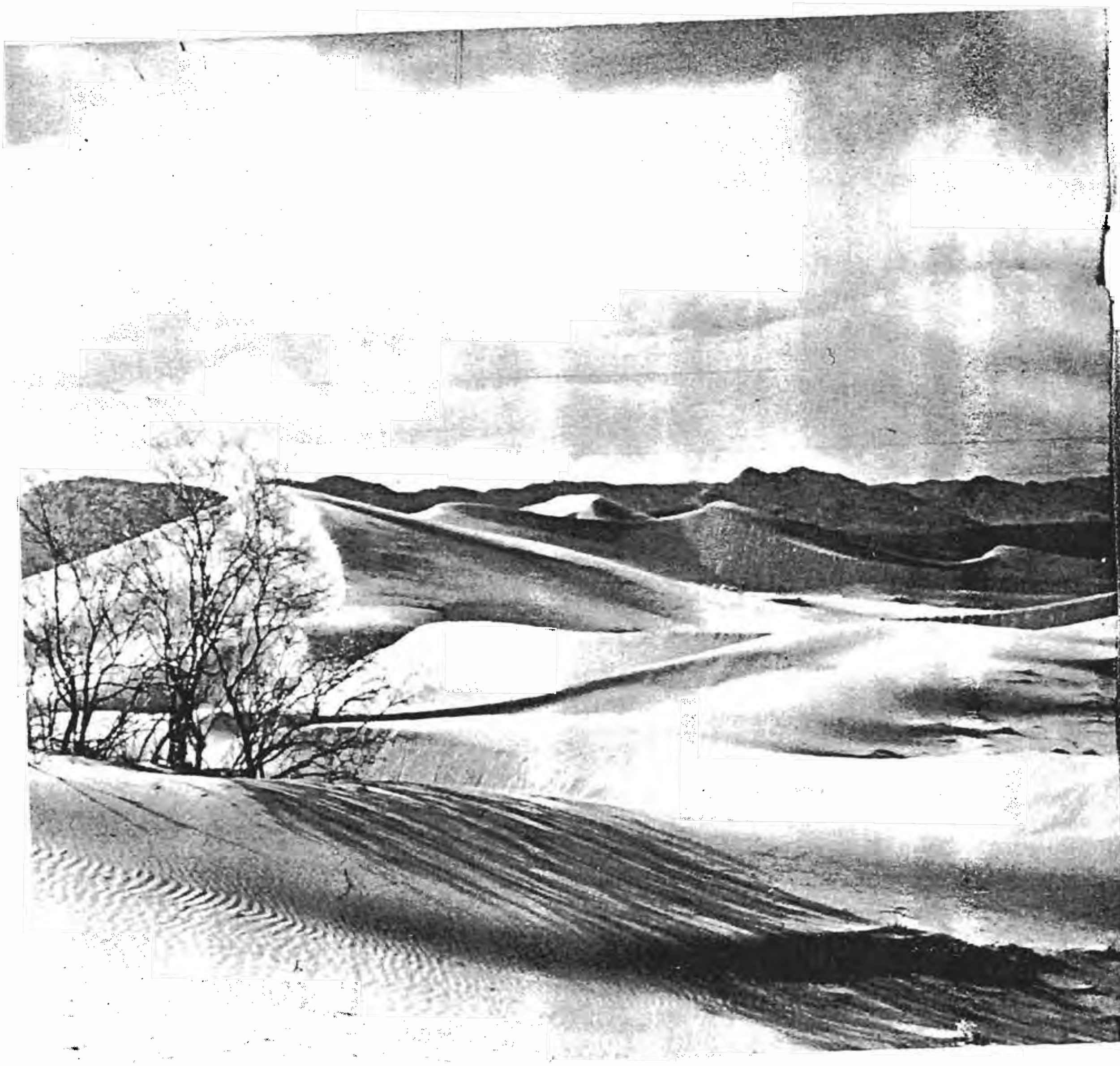
"Guzzler" collects precipitation and delivers it to underground storage tank and small drinking trough.

Looking north along Alamo Road toward Sheep Pass.

Air Force target area west of Spotted Range in Indian Springs—Gunnery Range unit.

Water is a primary requirement of desert bighorns and is in short supply on a large portion of the Wildlife Range. For this reason, 28 springs have been improved and six "guzzlers" have been developed to enhance water availability. The water developments do not significantly detract from the wilderness character of the areas within which they occur. Future "guzzler" installations will be developed in a manner that will minimize their impact on natural values.

Recreational development is planned for certain areas excluded from the proposed wilderness to facilitate public use and enjoyment of the Range. These will generally be rather minimal, with emphasis on environmental interpretation and preservation of the primitive character of the area. The most extensive development will occur at Corn Creek, where facilities planned will include a visitor center complex complete with desert bighorn sheep display areas, photographic blinds, interpretive foot trails, and a ten-mile interpretive automobile loop route.



SOCIO-ECONOMIC CONSIDERATIONS

Sand dunes near Desert Lake.

Las Vegas is one of the fastest growing metropolitan areas in the United States. The resident population of Clark County has increased by more than 157 percent since 1958, from 105,000 to nearly 300,000 at present. It also attracts around 14.5 million annual visitors. Projections made by the Las Vegas City Planning Department indicate that by 1980 the area will contain 700,000 people. The area is also well under a six-hour drive via auto from Southern California metropolitan complexes, with populations collectively in excess of eight million.

The desert is an important part of the recreation environment of southern California. In THE CALIFORNIA DESERT, A CRITICAL ENVIRONMENTAL CHALLENGE, the recent report released by the California State Office of the Bureau of Land Management, it is noted that annual visitor use on public lands of the California desert is increasing at about four times the national average. In the same report, a 1968 survey recorded nearly 5,000,000 visitor days for the area. By the year 2000, the report predicts that use may reach as high as 50 million visitor days.

The above illustrates the expanding use of the desert as a recreation resource by the growing population of southern California. This uncontrolled use of the fragile desert environment for recreation and other purposes has resulted in a widespread deterioration of the resource. Huge areas that no more than a few years ago were *de facto* wilderness are now visibly scarred by indiscriminate and uncontrolled use.

Desert patriarch

The Desert National Wildlife Range's accessibility by highway to the huge Los Angeles metropolitan complex and its proximity to the rapidly expanding Las Vegas metropolitan area make it a prime candidate for desert recreation uses which can adversely affect natural values. The regional recreation picture shown by the data indicates a little more than two percent of the total Class V (primitive) recreation lands now protected by the Wilderness Act. Thus, wilderness designation for the Desert National Wildlife Range would help to balance the regional recreation supply and, at the same time, protect the ecological integrity of at least a portion of the diminishing southwestern American desert.

To date, the economic values derived from mining operations have been negligible. Where there is an intermittent interest in locating claims, the damaging impact on the landscape greatly exceeds the apparent potential economic value of mineral development. Prospecting for minerals and mining operations would not be compatible with wilderness designation.

Since competition for forage and water by domestic livestock is not compatible with wildlife management objectives, grazing is not allowed on the Wildlife Range. As indicated earlier, livestock grazing subject to provisions of the Taylor Grazing Act is permitted on the public domain lands adjacent to the Range. The lands included within the wilderness study are portions of four large allotments which are grazed intermittently when conditions are suitable. Grazing in the desert is quite variable and relies to a great extent on short-lived vegetation. Distribution is difficult to obtain, since animals tend to remain near the limited sources of water and, as a result, seldom drift west of the highway onto the study area. Termination of grazing on these lands would, therefore, have little effect on the economic stability of the area.

Looking northwest from above Cow Camp Spring. Alamo Road visible in near foreground—Desert Range Mountains beyond.

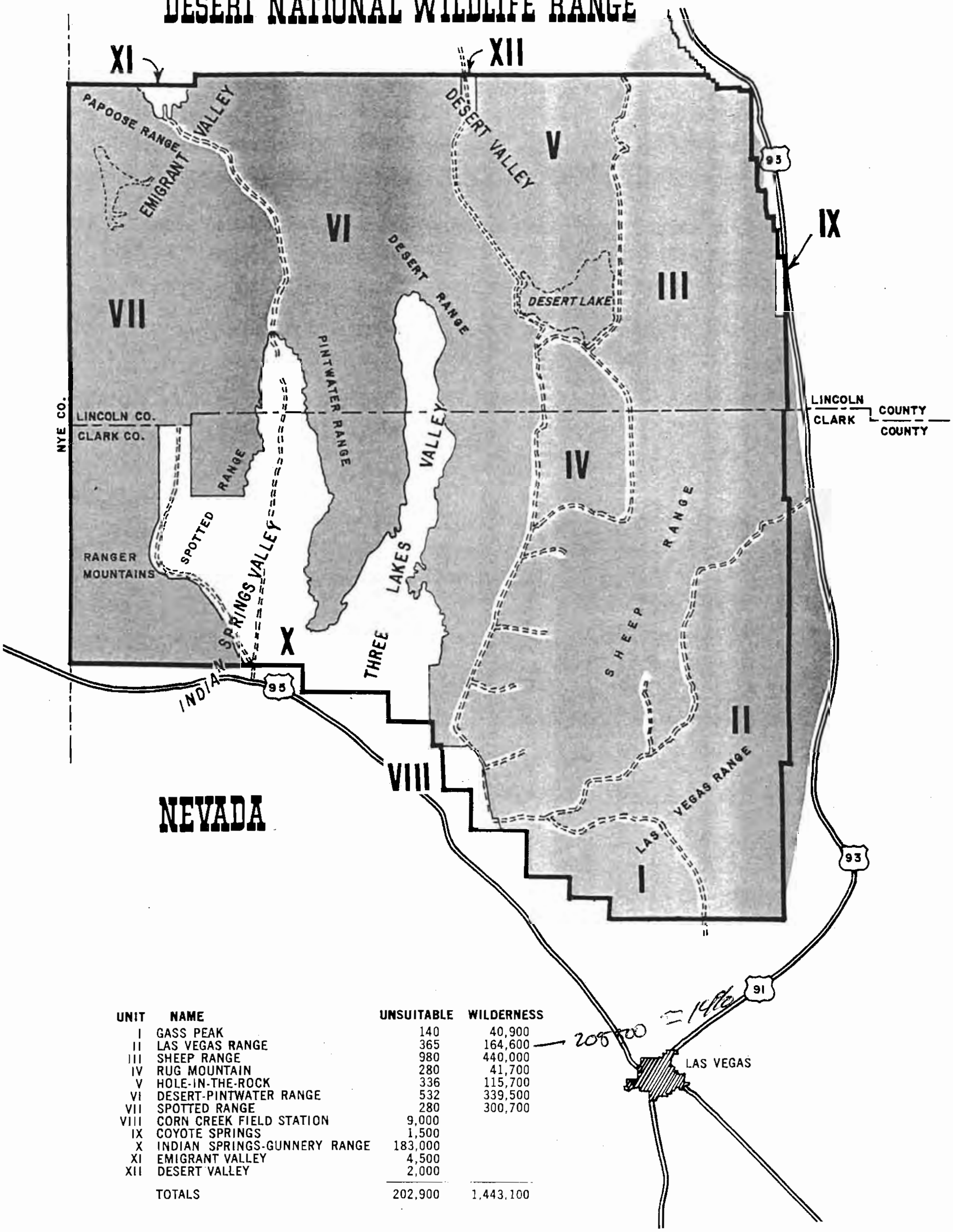
Hiking in year-round bighorn habitat—Sheep Range unit.

Coyote

Winter scene along Alamo Road. Sheep Range in background.

DESERT WILDERNESS PROPOSAL

DESERT NATIONAL WILDLIFE RANGE



UNIT	NAME	UNSUITABLE	WILDERNESS
I	GASS PEAK	140	40,900
II	LAS VEGAS RANGE	365	164,600
III	SHEEP RANGE	980	440,000
IV	RUG MOUNTAIN	280	41,700
V	HOLE-IN-THE-ROCK	336	115,700
VI	DESERT-PINTWATER RANGE	532	339,500
VII	SPOTTED RANGE	280	300,700
VIII	CORN CREEK FIELD STATION	9,000	
IX	COYOTE SPRINGS	1,500	
X	INDIAN SPRINGS-GUNNERY RANGE	183,000	
XI	EMIGRANT VALLEY	4,500	
XII	DESERT VALLEY	2,000	
	TOTALS	202,900	1,443,100

205500 = 14%

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CONCLUSIONS

THE PROPOSAL

A total of about 1,443,100 acres within the Desert National Wildlife Range wilderness study area were found suitable for further consideration as wilderness, and are proposed for designation as a unit of the National Wilderness Preservation System. The proposed Desert Wilderness consists of seven individual wilderness units varying from 40,900 to 440,000 acres in size, with the following proposed stipulations:

- Permanent roads and primitive vehicle trails which serve as wilderness unit boundaries shall be 16 feet in width, with a total right-of-way 116 feet in width, measuring 58 feet on either side of the center line of the existing road or trail. This will provide a suitable area for roadside parking and a buffer for future road maintenance.

- The primitive terminal access vehicle trails excluded from the proposed wilderess shall be 10 feet in width, with a total right-of-way of 110 feet, measuring 55 feet on either side of the center line of the existing trails. The vehicle parking and turn-around area at the end of these trails shall be an area two acres in size.
- Use of vehicles on the Nye Canyon, White Sage Gap, Pine Spring, Mormon Well Spring, Wamp Spring and Quail Spring Trails will be authorized for administrative purposes only.
- Surface exploration for minerals within proposed wilderness units would not be permitted.
- Use of the Wamp Spring sheep trap will be authorized for the trapping and transplanting of desert bighorns.

Caliente Power Line right-of-way forms southeastern boundary of proposed Las Vegas Range Wilderness Unit, at left.

THE EXCLUSIONS

Approximately 202,900 acres of the study area are proposed for exclusion from wilderness, because the lands no longer possess the character of wilderness or have existing or planned uses occurring on them which are currently inconsistent with wilderness.

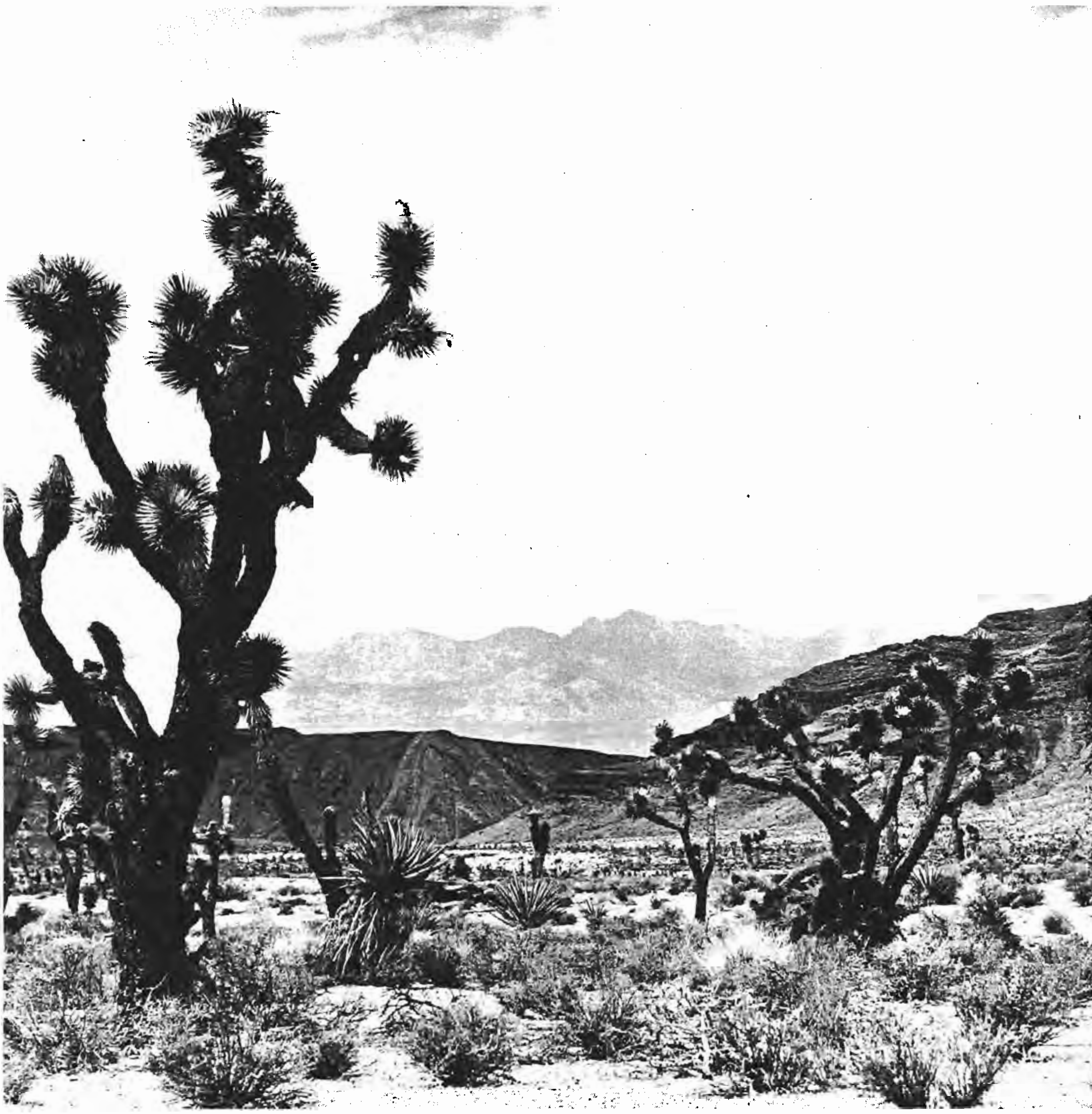
Specific developments in Unit VIII include the Corn Creek administrative subheadquarters, 360 acres of private inholdings involving eight individual owners, and numerous roads.

Unit IX is located along the northeast boundary of the Wildlife Range and contains 600 acres of private inholdings with two individual owners. Both tracts have extensive developments, as well as all-weather access roads from Highway 93.

Unit X includes the lands used for target areas by the Air Force as provided by the agreement which authorizes their use. The areas subject to physical disturbances are located in the valleys below 3,600 feet elevation and were so delineated, as contour lines provide the only practical basis for establishing a wilderness management boundary in the absence of a legal land survey.

Units XI and XII are located along the north boundary of the Wildlife Range within the bombing and gunnery range and contain target facilities used by the Air Force. Much physical disturbance has occurred in conjunction with these activities.

Should military use of lands now proposed for exclusion be discontinued, much of this area would be suitable for addition to the proposed Desert Wilderness. However, rather extensive cleanup and restoration work would be required in some of the practice target areas.



Scenic diversity is outstanding quality of the Desert National Wildlife Range.

SE ROA 13466

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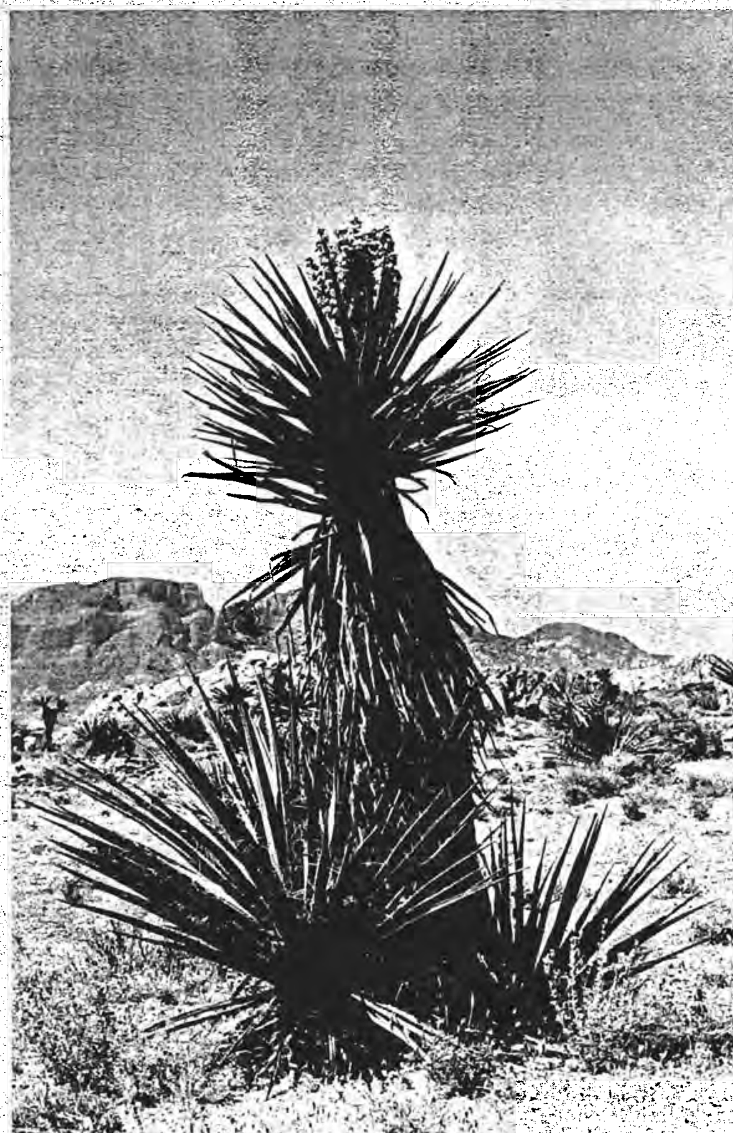
As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

INSPECTION

Anyone interested in this proposal is urged to personally inspect the Desert National Wildlife Range wilderness study area. Additional information may be obtained from the Refuge Manager, Desert National Wildlife Range, 1500 North Decatur Boulevard, Las Vegas, Nevada 89108, or the Regional Director, Bureau of Sport Fisheries and Wildlife, Box 3737, Portland, Oregon 97208.

October 1971



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

CHANGES AS A RESULT OF THE PUBLIC HEARING

There were two changes made in the area proposed for wilderness status as the result of the public hearing and additional information gained subsequent to our initial recommendations. These changes are as follows:

1. The Mule Deer Ridge Trail was determined to be unnecessary and is to be closed and let revert to its natural condition. This, in effect, consolidated Units III and IV into a single unit.

2. The lands outside the existing range suitable for addition to the range and for wilderness status were recalculated at 76,000 acres instead of 58,000 acres. These lands are proposed as "Potential Wilderness Addition".

As a result of these changes the proposed wilderness units are as follows:

UNIT	ACRES	P.W.A.
Unit I Gass Peak	40,900	
Unit II Las Vegas	123,640	40,000
Unit III Sheep Range/Rug Mountain	463,900	36,000
Unit IV Hole-in-the-Rock	115,700	
Unit V Desert Pintwater	339,500	
Unit VI Spotted Range	300,700	
	1,384,340	76,000
	1460,340	

Final Recommendations

Based upon our review, the surface lands of this proposal are suitable for wilderness designation. However, our knowledge of the minerals which may underlie the proposed area is conjectural. Without the benefit of a thorough mineral survey of the area, we are unable to balance its wilderness values and mineral resources. For this reason, we recommend that the Congress appropriate the funds necessary to conduct such a survey and defer action on this proposal until its completion.

Appendix J.
Desert NWR
Bighorn Sheep Discussion

SE ROA 13471

Desert Bighorn Sheep Population Objectives

Prepared by Bruce Zeller

The refuge-wide desert bighorn sheep population objective, as listed in the Refuge Management Plan, Part II (1987) and draft Sheep Management Plan (1990), is 2000. Based on helicopter survey data gathered during the fifteen year period between 1974 and 1988, the refuge-wide desert bighorn population was at or very near the objective level (see Table 1.).

During the last fifteen years, 1989-2003, the refuge-wide desert bighorn population is approximately 1000 individuals below the objective level (see Table 2.). Therefore, a 100% increase or doubling of the population is required to reach the objective level. Most of the shortfall is accounted for by declines in the Sheep Mountains sub-population and the smaller, more transitory sub-population of the adjunct East Desert Mountains.

Table 1. Fall helicopter survey results by mountain range on DNWR, 1974-1988.

Year	No. of Bighorn Recorded Per Mountain Range					
	Las Vegas	Sheep*	E. Desert	Desert	Pintwater	
1974	111	172	97	70	50	
1975	89	183	83	17		
1976						
1977	79	331	91	102	114	
1978	73	239	41	30	82	
1979	21	403	29	10	75	
1980		436			28	
1981	46	297	65	37	37	
1982	27	146			68	
1983	45	346	49	17	120	
1984		205				
1985	38	436	87	38	94	
1986	34	361	73	29	75	
1987	39	280	19	85	104	
1988	11	215	54	48	104	
Total:	613	4050	688	483	951	
Average:	51.1	289.3	62.5	43.9	79.3	
(1)						
Ave. Est. Pop:	194	1096	174	220	300	Grand Total: 1984

*Smaller sample sizes during 1974, 1975, 1978, 1982 & 1984 are directly correlated to reductions in survey hours. Because no adjustment was made for those years when survey hours were reduced, the average estimated population is skewed downward.

Table 2. Fall helicopter survey results by mountain range on DNWR, 1989-2003

Year	No. Bighorn Recorded Per Mountain Range					
	Las Vegas	Sheep*	E. Desert	Desert	Pintwater	
1989	46	146	15	28	51	
1990	53	146	10	62	67	
1991	33	78	31	46	72	
1992	55	66	25	57	60	
1993	87	61	21	47	92	
1994	39	38	20	28	76	
1995	65	60	19	35	56	
1996	41	37	29	34	67	
1997	34	39	4	26	57	
1998	65	42	14	28	47	
1999	43	70	10	27	64	
2000	70	59	25	8	63	
2001		16	17	72	68	
2002	51	50	13	41	46	
2003	53	57	6	48	67	
Total:	735	965	259	587	953	
Average:	49.0	64.3	17.3	39.1	63.5	
(1) Ave. Est. Pop.:	186	244	48	196	241	Grand Total: 915

*Smaller sample sizes during 1996, 1997, 2001 & 2002 may be partially correlated to reductions in survey hours. Because no adjustment was made for those years when survey hours were reduced, the average population estimate may be skewed slightly downward.

(1)Footnote: Population estimates derived by dividing the average no. of sheep recorded by the observation rate or visibility factor (all ranges = 40%) and the percentage of habitat surveyed (Las Vegas, Sheep & Pintwater Ranges = 66%; Desert Range = 50%; East Desert Range = 90%)

As a result of the biological review conducted in April, 2003, there was a recommendation to establish a population objective for each mountain range/sub-population. It was further recommended that a threshold level (minimum sub-population size) be set for each mountain range. Decline below the threshold level would trigger an "all-out", immediate strategy(s) to reverse the trend.

The suggested objectives and thresholds are presented in the following table. All objectives are based on data presented in Table 1., except the Spotted Mountains. The Spotted Mountains resident herd is a relative young sub-population, established by trans-locations in 1993 and 1996, with only three years of helicopter data. Empirical evidence indicates that small desert bighorn populations, those with fewer than 50 individuals, may be susceptible to extinction (Berger 1990, 1991, Krausman et al. 1993, Krausman et al. 1999). This was the basis for using 50 as the threshold level for all ranges except the Sheep Mountains. Fifty desert bighorn in the expansive habitat of the Sheep Mountains would represent an extremely low/unacceptable density; thus, its threshold was set at a higher level.

Table 3. Population objectives and thresholds by mountain range on DNWR.

Mountain Range	Objective	Threshold
Las Vegas	200	50
Sheep	1000	150
East Desert	100*	50
Desert	250	50
Pintwater	300	50
Spotted	150	50
<u>Total:</u>	2000	

*The average population for the East Desert Mountains in Table 1. is believed to be inflated by high numbers of migrants from the Sheep Mountains. The East Desert Range is relative small with only two man-made water developments; therefore, a more realistic resident, bighorn population objective is 100.

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Appendix K.
CCP Implementation

SE ROA 13477

The Comprehensive Conservation Plan (CCP) for the Desert National Wildlife Refuge Complex will be prepared following approval of the Final EIS and issuance of the Record of Decision (ROD), which will identify the selected plan. This appendix combined with Chapters 1 and 4, portions of Chapter 2, and Appendix E of the Final EIS will form the basis for the Final CCP. Implementation of the CCP can begin following the issuance of the ROD. Although it is our intent to implement the proposed strategies (projects) by the established deadlines, the timing of implementation may vary depending upon a variety of factors, including funding, staffing, compliance with Federal regulations, partnerships, and the results of monitoring and evaluation. Some strategies, such as those related to habitat restoration, will require the completion of step-down plans and appropriate environmental compliance documents before they can be implemented. This appendix defines how the preferred alternative for each refuge in the Desert NWR Complex (described in Chapter 3) would be implemented if they are identified as the selected plan in the ROD.

During the 15 years following CCP approval, the CCP will serve as the primary reference document for all refuge planning, operations, and management. Appendix E lists the various wildlife and habitat management and visitor services goals, objectives, and strategies for the preferred alternative for each refuge. Completion of any of these actions would however be dependent upon the various factors. These strategies would be implemented with assistance from new and existing partners, including public agencies, tribes, non-governmental organizations, and the public. Consistent public outreach and continued coordination with refuge constituents are essential components of this implementation process. Some of the partnership opportunities to be explored during the 15-year life of this CCP are described below, as are the stepdown plans, monitoring responsibilities, and staffing and funding requirements needed to successfully implement the CCP.

CCPs are intended to evolve with each Refuge, and the Improvement Act specifically requires that these plans be formally revised and updated at least every 15 years. The formal revision process will follow the same steps as those implemented for the initial CCP development process, with a major emphasis placed on public involvement. Until a formal revision is initiated, the Service will periodically review and update the CCP (at least as often as every five years) to address needs identified as a result of monitoring or in response to adaptive management procedures. This CCP will also be informally reviewed by refuge staff while preparing annual work plans and updating the refuge databases. It may also be reviewed during routine inspections or programmatic evaluations. Results of any or all of these reviews may indicate a need to modify the plan. The goals described in this CCP will not change until they are reevaluated as part of the formal CCP revision process. However, the objectives and strategies may be revised to better address changing circumstances or to take advantage of increased knowledge of refuge resources. If revisions to the CCP are required prior to the initiation of formal revisions, the level of public involvement and associated NEPA documentation will be determined by the Refuge Manager.

Monitoring

Monitoring the effects of management actions on the Refuges' trust resources is an important component of the CCP, as is the documentation of the Refuges' baseline conditions. By completing baseline inventories and monitoring specific management actions, Refuge staff can better understand the species, habitats, and physical processes that occur on the Refuges and the ecological interactions that occur between species. Monitoring is an ongoing management activity at each refuge in the Desert NWR Complex and will continue per available funding. Appendix E identifies several new and/or expanded inventories and monitoring actions for each refuge.

Adaptive Management

Adaptive management involves sequential decision making, integrating project design, management, and monitoring to systematically test assumptions. Based on the data and lessons learned, subsequent phases of an ongoing restoration project or a new restoration project with similar objectives can be revised as necessary to maximize project objectives over time. Adequate baseline data, clearly defined and measurable project objectives, a monitoring plan focused on measurable results, and a process for refining and improving current and future management actions are all essential components of a successful adaptive management approach to restoration. Each of these components would be addressed during step down planning, and the details of the adaptive management approach would be integrated into final restoration plans

Step-Down Plans

Some projects such as public use programs and habitat restoration proposals require more in-depth planning than the CCP process is designed to provide. For these projects, the Service prepares step-down plans. Step-down plans provide additional planning and design details necessary to implement the strategies (projects or programs) identified in the CCP. Several step-down plans are proposed for completion following the approval of the CCP. Table 1 lists the step-down plans proposed for each refuge along with the target date for completion.

Compliance Requirements of Plan Implementation

All projects and step-down plans described in the CCP will be required to comply with NEPA and the Improvement Act, as well as a variety of other Federal regulations, executive orders, and legislative acts, which are described in greater detail in Chapter 6 of this document. The EIS is intended to address all proposed actions at the program level; however, some actions once defined in greater detail may require additional analysis and review under NEPA.

Anticipated Costs and Staffing Needs to Fully Implement the CCP

The estimated costs for the various projects described for the preferred alternatives for each refuge are presented in Table 2. These costs are rough estimates and will be refined as more details are available. To fully implement the proposed actions and achieve the goals and objectives of the CCP for the four Refuges, additional staff will be necessary. Table 3 presents the current and future (proposed) staff needs for management of the each refuge.

Potential Funding Sources for Implementing CCP Projects

Many projects included in the CCP may be implemented in full or in part by sources other than the Refuge annual budget. These projects could be funded through partnerships with other local, state, or federal agencies, special legislative appropriations, or grants (i.e., Southern Nevada Public Lands Management Act, National Fish and Wildlife Foundation, Transportation Enhancement Funds). Other potential sources of funding for restoration projects include: the North American Wetlands Conservation Act Grants Program; and the Cooperative Endangered Species Conservation Fund.

Partnership Opportunities

Many programs on the refuges, both existing and planned, are made possible through a variety of public/private, interagency, and tribal partnerships. Chapter 1 of the EIS includes a brief description the existing partnerships at each refuge.

Table 1. Step-down plans proposed for the Desert NWR Complex

Plan	*Target for Completion*
Ash Meadows NWR	
Restoration plan for Crystal Management Unit	2011
Restoration plan for Carson Slough Management Unit	2011
Site restoration plans for Upper Point of Rocks, Jackrabbit Spring, the Warm Springs Unit (North and South Indian Springs and School Springs), Lower Point of Rocks, Lower Kings Pool, Marsh, Big, Fairbanks, Tubbs, Bradford, Crystal, Forest, and North and South Scruggs Springs	Within 15 years
Transportation Plan	2012
Plan to remove dikes in uplands	2015
Plan for Modification and/or removal of Crystal Reservoir	2012
Environmental Education Plan	2011
Visitor Services Plan	2012
Hunting step-down	Within 3 yrs
Desert NWR	
Sheep Management Plan	2010
Inventory and Monitoring Plan	Within 15 yrs
Restoration Plan for areas along the s. & e. boundaries	Within 15 yrs
Integrated Pest Management Plan	2012
Moapa Valley NWR	
Long-term Water Resources Management Plan	2011
Integrated Pest Management Plan	Within 15 yrs
Inventory and Monitoring Plan	Within 5 yrs
Habitat Management Plan	Within 3 yrs
Pahranagat NWR	
Fisheries Management Plan	2015
Habitat Restoration and Management Plan	2012
Inventory and Monitoring plan	Within 5 yrs
Water Resources Management Plan	2009
Integrated Pest Management Plan	2012
Refugium for endangered and native fish	2012
Interpretive plan	Within 5 yrs

Table 2. Estimated One-Time Project Costs to Implement CCP

Expenditure (Related Strategy)	*Estimated Cost (1000s)*[1]
Ash Meadows NWR	
Conduct baseline inventories on vegetation communities, small mammals, and pollinators (1.1.1)	1,400
Complete a four year baseline inventory and monitoring for endemic fish species and a three year baseline inventory and monitoring for the southwest willow flycatcher (1.1.2)	710
Continue and improve inventory of native species diversity and distribution (1.1.4)	50
Continue and improve inventory of non-native species diversity and distribution (1.1.5)	50
Conduct baseline and periodic monitoring of endangered or threatened bird species (1.1.12)	25
Conduct periodic monitoring of secretive marsh birds and sensitive species of waterfowl (1.1.13)	25
Develop and implement habitat restoration and translocation protocols for target species, including consideration of timing of habitat restoration and genetics (1.3.1)	55
Develop life history and habitat conservation models of target species (1.3.3)	156
Complete and implement Restoration Plans for Upper Point of Rocks, Jackrabbit Spring , and the Warm Springs Unit (North and South Indian Springs and School Springs) (1.3.6)	1,000
Complete and implement the restoration plans for Lower Point of Rocks, Lower Kings Pool, North and South Scruggs, Big, and Fairbanks Springs (1.3.6)	1,250
Develop a restoration plan for Crystal Spring Unit	1,000
Develop and implement restoration plans for Tubbs, Bradford, Crystal, Forest, and Marsh Springs (1.3.10)	1,500
Based on outcome of Carson Slough Restoration Plan, develop and implement restorations plans for Longstreet and Rogers Springs (1.3.11)	1,000
Restore Point of Rocks spring outflow channel habitat to known suitability and monitor parameters (ex. temperature, flow, depth, etc.) to inform adaptive management (1.4.1)	175
Perform experimental planting and monitoring on test sites, representative of Refuge habitat (1.5.2)	22
Conduct habitat suitability study for listed plants (ex. Niterwort) (1.5.6)	45
Complete a feasibility study for construction of an on-site greenhouse to supply plants for restoration on the Refuge (1.5.7)	35
Within 15 years of CCP construct a refugium for the Ash Meadows speckled dace if feasible (1.6.3)	335
Within 5 years, complete a feasibility assessment of on-site and off-site refugia for all other Ash Meadows NWR endemic species (1.6.4)	25
Obtain normal color aerial photography on a decadal scale or more frequently if necessary (2.1.1)	50
Improve Refuge-wide vegetation map through ground surveys and updating of GIS layers (2.1.2)	380
Obtain 1-2 foot contour data for Refuge to aid in restoration and planning activities (2.1.5)	65
Within 10 years obtain baseline data on spring discharge, flood frequency, and groundwater elevation for seventeen springs identified in the Refuge Biological Assessment (2.2.4)	85
Conduct an assessment of berms, ditches, dams, impoundments, and reservoir basins (2.3.1)	45
Pursue funding for and implement the Ash Meadows embedded model within the Death Valley Regional Flow Model (2.2.10)	1,500
After assessment initiate removal of dams, impoundments, and unnecessary roads within the Warm Springs, Jackrabbit/Big Springs, Upper Carson Slough, and Crystal Springs units to restore natural hydrology on a landscape scale (2.3.2)	3,000
Restore natural average and range of variability, flood frequency, water quality and water table	22

[1] A variety of funding sources could be used to pay for project costs, including appropriated funds (annual refuge budget), Southern Nevada Public Lands Management Act, National Fish and Wildlife Foundation, and Transportation Enhancement Funds

elevation for open water at Peterson Reservoir and Horseshoe Reservoir (2.3.4)	
Restore Crystal Spring outflow to historic channel, through the administrative area, when the office/visitor center is relocated (2.3.5)	500
Conduct a study to evaluate nutrient input to streams from roads (2.3.9)	55
Implement the plan for the modification or removal of Crystal Reservoir (2.3.10)	
Install temporary fish barriers until bass eradication is complete at Big and Jackrabbit springs (2.3.12)	80
Inventory, assess, and mitigate landscape disturbances including graded lands, mines, fences and other disturbances (2.3.13)	145
Within ten years, reduce salt cedar and Russian knapweed distribution by 75 to 95% of the 2006 distribution on 4,000 acres of Refuge land of salt cedar (2.4.2)	
Replace or add gates on service or fire roads and sign them (2.6.12)	2.5
Add 11 to 15 road gates to prevent unauthorized use of roads and resource damage (2.6.15)	7.5
Complete the Refuge Transportation Plan (2.6.18)	213
Conduct a study to obtain historic plant distribution through pollen analysis (2.7.4)	175
Restore historic hydrology and revegetate mesquite bosques and dunes along spring channels and in former agricultural fields (2.8.2)	11,000
Rehabilitate 30-45% of old agricultural fields by controlling invasive species and installing native plants (2.8.7)	1,500
Develop and implement plan to remove dikes in uplands	100
Complete a study to obtain biological and geomorphic data to inform demolition and restoration plan for Crystal Reservoir (2.11.1)	254
Establish conservation agreements or acquire in-holdings from willing sellers (2.12.2)	9,000
Conduct a literature review of aquatic invasive species ecology, trophic interactions and eradication treatments, for detrimental species (3.1.1)	3
Conduct experiments on Refuge habitat and species impacts and trophic interactions due to aquatic invasive species (3.1.2)	33
Conduct a study of crayfish ecology on Refuge (3.1.4)	34
Conduct laboratory and field experiments on eradication/control techniques (3.1.5)	33
Study exclusion methods to restrict movement of non-native fish (ex. large mouth bass, green sunfish, etc.) into native fish habitat (3.1.6)	12
Complete studies and analysis of historic data to link uplands, alkali meadows, and springs habitats (3.3.2)	35
Conduct studies to obtain basic life history information for endemic and listed plant species (3.3.3)	60
Conduct taxonomic studies of Refuge plant species (3.3.4)	384
Install a weather station within each of the three major drainage basins (3.4.1)	135
Complete a study to obtain core samples from old spring mounds, Carson Slough, etc. (3.4.2)	45
Conduct tree ring studies to determine growth patterns over long periods of time (3.4.3)	207
Conduct studies of past pollen and spore distribution (palynology studies) (3.4.4)	176
Model climate change impact scenarios and develop adaptation strategies (3.4.6)	750
Conduct a comprehensive Refuge terrestrial species inventory (3.5.2)	1,200
Conduct bat studies (3.5.3)	96
Complete a study to obtain baseline information on reptiles and amphibians (3.5.4)	381
Conduct a one-year assessment on the relationship between coarse woody debris and terrestrial invertebrates and continue monitoring if feasible (3.5.5)	33
Conduct a study to assess contribution of invertebrates associated with coarse woody debris to terrestrial macrofauna diet (3.5.6)	25
Evaluate dust impacts to listed plants through two-year studies (lab and field) and generate recommendations for road management (3.6.2)	45
Complete a study to determine the historic fire regime for Ash Meadows prior to broad	100

establishment of invasive species (3.7.6)	
Identify and archive existing datasets, including hard copy only data (ex. maps, photos, diaries, etc.) (3.8.3)	75
Contract a feasibility study for location and design of an on-site research facility (3.9.2)	65
Complete an assessment of visitor education needs and opportunities (4.1.3)	3
Develop an outreach Plan to support the Carson Slough Restoration Plan (4.1.12)	8
Develop a an educational video on the endemic fish and other wildlife of Ash Meadows NWR (4.1.13)	45
Design and construct boardwalks to follow Kings Pool Stream from parking lot to Kings Pool, with a pool overlook (4.2.1)	700
Design and construct interpretative displays for new boardwalks to be installed at Point of Rocks (4.2.2)	144
Design and construct boardwalk to the Longstreet Cabin and an overlook for the Longstreet Spring pool (4.2.3)	132
Improve Point of Rocks and Longstreet Cabin parking areas (4.2.5)	91
Conduct a study of Refuge visitation to determine the number and purpose of visits (4.2.7)	35
Improve signs on Refuge boundary (4.2.8)	360
Develop multi-lingual interpretative materials and construct new interpretive facilities at Point of Rocks, Longstreet, and Crystal Springs and entrances to Refuge (4.2.11)	35
Design and construct other interpretive facilities identified in the Interpretive Plan (4.2.12)	4,500
Develop and implement a comprehensive Visitor Services Plan by 2009	25
Improve existing roadways and parking areas to good condition as described in the Ash Meadows Refuge Roads Inventory (2004) (4.2.15)	2,500
Contract for a feasibility study for location and design of new headquarters/visitor contact station building (4.6.2)	145
Contract for construction of the new facility (4.6.3)	3,600
Compile all existing baseline data on cultural resources sites, surveys, and reports within, and near, the Ash Meadows NWR. And create digital, GIS, and hard copy databases, maps, and a library. Share data with the Nevada SHPO as developed. (5.1.5)	15
Prepare evaluation criteria and conduct a cultural resource inventory at all public use areas, roads, impacted areas, and other destinations on Ash Meadows NWR and areas that would be affected by Refuge projects (5.2.1)	544
Inventory, evaluate, mitigate adverse effects and stabilize samples of cultural resources on Ash Meadows NWR using a research design prepared in consultation with appropriate tribes and the scientific community (5.2.3)	65
Conduct a study of ethnobotany and traditional plant use locations on Ash Meadows NWR in consultation with appropriate tribes (5.2.4)	80
Update Refuge brochures and interpretive signs with appropriate cultural resources information (5.3.8)	20
Identify and evaluate cultural resources subject to looting/vandalism, erosion, or deterioration and implement steps, including barriers and signs to reduce these threats and preserve the resources (5.4.1)	35
Total	**39,261**
Desert NWR	
Determine connectivity between sub-populations and their habitats on- and off-Refuge using historical records, random sightings, and radio-tracking data. (1.1.9)	50
Remove highly flammable vegetation around catchments as needed to protect from wildfires and limit cover for bighorn sheep predators (1.1.11)	50
Evaluate and adjust as necessary the current population monitoring methodology to determine adequacy for trend analyses. (1.1.12)	25
Construct additional rainwater catchments if existing sources are determined to be inadequate.	50

(1.1.13)	
Conduct a radio telemetry study to assess bighorn sheep mortality factors, particularly mountain lion predation, home ranges and habitat utilization/abandonment, and other research priorities. Coordinate radio telemetry with Air Force so that an appropriate band can be assigned to prevent transmission problems or equipment failure. (1.1.15)	100
Collect blood and fecal samples to determine general health of herd, diet composition and nutrient uptake, and genetic diversity. (1.1.16)	50
Develop and implement a Sheep Management Plan in cooperation with NDOW. The Plan would be flexible and address a number of issues such as management of water developments, herd health, predator management, habitat management (prescribed fire) and population management (translocations). (1.1.18)	100
Develop survey and mapping data using GIS tools and following the standards provided in the USFWS WH8 Promises Team report regarding biotic and abiotic data layers. (2.1.4)	50
Develop and implement an inventory and monitoring plan in coordination with FWS Endangered Species Program, NDOW, DOD and academic institutions. (2.1.5)	50
Establish permanent, representative sample plots in each major plant community on the refuge. At each site, conduct baseline inventory of plant and animal species composition and abundance. Repeat inventories every five years. (2.1.6)	250
Model climate change impact scenarios and develop adaptation strategies (2.1.7)	1,000
Construct and maintain a steel post and cable fence along the southern boundary. (2.2.9)	2,000
Where necessary, fence and maintain the eastern boundary using a steel post and cable construction method. (2.2.12)	2,000
Develop and implement plan to close illegal trails and rehabilitate damaged habitat along the southern boundary. (2.2.14)	500
Use prescribed fire and naturally ignited fires to restore vegetation characteristics representative of a natural fire regime (assume helicopter ignition, 2,000 ac/year for five years) (2.3.2)	100
Work with partners to fill data gaps in fire ecology of Desert NWR plant communities. (2.3.3)	50
Prepare Integrated Pest Management Plan and associated NEPA compliance (2.3.4)	100
Work with the Air Force to update the MOU as required by Public Law 106-65. (3.1.1)	50
Survey and rectify the RNA boundaries with accurate legal descriptions and ground markers. (3.2.1)	50
Conduct photographic reconnaissance and documentation of all RNAs. (3.2.2)	25
Develop cultural resources interpretive and environmental education materials in coordination with the Native American tribes. (4.1.7)	25
Develop live “sheep cam” at water development and stream video through website and to visitor contact station/center. Apply for SNPLMA funds, or other appropriate sources to develop the webcam. (4.1.8)	50
Develop and install interpretive panels and signs at designated entry point(s). (4.1.9)	50
Develop and install a permanent environmental education/interpretive display at a prominent public venue such as McCarran International Airport. (4.2.1)	25
Develop and distribute a Desert Refuge video in the community. (4.2.3)	45
Evaluate potential sites and construct blinds for wildlife observation and photography. (4.3.3)	10
Improve and maintain Mormon Well and Alamo Roads to fair condition based on the 2002 Refuge Road Inventory. (4.3.4)	10,000
Map existing trails using GPS and develop trail guide. (4.3.5)	5
Use post and cable fencing to designate specific parking turnouts along Alamo, Mormon Well and Gass Peak Roads. (4.3.6)	5
Construct an entrance sign and information kiosk at the east end of Mormon Well Road. (4.3.7)	35
Compile all existing baseline data on cultural resources sites, surveys, and reports within, and near Desert NWR and create secure digital, GIS, and hard copy databases, maps, and library. (5.1.2)	30
Prepare evaluation criteria and conduct a cultural resource inventory at all public use facilities and	500

areas that would be affected by Refuge projects. (5.2.1)	
Inventory, evaluate, and nominate Traditional Cultural Properties and sacred sites to the National Register, in consultation with culturally affiliated Tribes and the Nevada SHPO. (5.2.2)	150
Inventory, evaluate and mitigate adverse effects and stabilize samples of cultural resources on Desert NWR using a research design prepared in consultation with culturally affiliated Tribes and the scientific community. (5.2.3)	65
Conduct a study of ethnobotany and traditional plant use at locations on Desert NWR in consultation with culturally affiliated Tribes. (5.2.4)	80
Create a cultural resource layer in a NWR complex GIS database that aids in the identification, planning, monitoring, and interpretation of cultural sites. (5.2.5)	25
Coordinate with the Consolidated Group of Tribal Organizations and the Nevada SHPO to identify potential critical/priority cultural sites on the non-military overlay of the Desert Refuge. Develop a cooperative program to survey and record these sites. (5.3.3)	50
Work with culturally affiliated Tribes on projects to restore habitats of important native plants and to harvest (for traditional non-commercial purposes) native plant foods. (5.3.4)	25
Consult with culturally affiliated Tribes, the Nevada SHPO, and other stakeholders to design and implement educational materials, programs and activities that would be used to address traditional or sacred resources, and to increase awareness on- and off-Refuge about the sensitivity of cultural resources to visitor impacts and the penalties for vandalism. (5.3.6)	50
Identify and evaluate cultural resources subject to looting/vandalism, erosion, or deterioration and implement steps, including barriers and signs to reduce these threats and preserve the resources. (5.4.1)	35
Coordinate with existing site stewardship volunteer program. (5.4.4)	25
Total	**17,935**
Moapa Valley NWR	
Continue channel restoration on the Pedersen Unit by planting native species. (1.1.1)	2
Complete restoration of the spring heads and channels on Apcar Unit. (1.1.2)	450
Restore native overstory, mid-level and understory vegetation (using local seed and/or seedlings) to riparian corridors, transitional upland sites and any disturbed or newly exposed areas. (1.1.3)	2
Develop strategies to remove non-native fish species, including mollies and mosquito fish, from Refuge streams in coordination with the USFWS Endangered Species program and NDOW. (1.1.15)	2
Inventory Refuge habitat consistent with the Moapa Dace Recovery Plan. (1.2.2)	5
Develop a GIS-enabled species inventory program, beginning with Moapa dace inventory data. (1.2.3)	10
Model climate change impact scenarios and develop adaptation strategies (1.2.5)	150
Develop a long-term water resources management plan for the Refuge by 2009. (1.3.5)	50
Purchase and install water monitoring equipment. (1.3.7)	10
Develop and implement an Integrated Pest Management Plan to control and eradicate invasive species encroachment. (1.4.6)	50
Monitor habitat changes, maintain and continue improvements for restoration efforts and other landscape improvements, and provide adequate level of monitoring and maintenance for invasive species control and fire management. (1.4.10)	50
Conduct baseline inventories of federally listed, proposed, candidate and species of concern on the refuge; conduct baseline inventories of aquatic habitat for invertebrates and amphibians to determine species composition and abundance; and inventory existing upland habitat for migratory birds, mammals, and reptiles. (1.5.1)	50
Develop a long-term inventory and monitoring plan for federally listed, proposed, candidate and species of concern on the Refuge. (1.5.5)	50
Prepare step down habitat management plan for lands acquired within the proposed expansion area. (1.6.1)	100
Complete volunteer needs assessment, create position descriptions, and coordinate with outdoor	10

recreation planner to recruit, hire, and train volunteers. (2.1.1)	
Develop interpretive and environmental education materials. (2.1.6)	50
Erect a Refuge entrance sign near Warm Springs Road. (2.1.8)	2
Develop regionally focused cultural resources environmental education and interpretation materials for self guided tours. (2.1.15)	25
Confer with the Moapa Band of Paiutes to incorporate their history and native plant and animal species knowledge as part of the interpretive program at the Refuge. (2.1.16)	5
Coordinate the installation of a permanent environmental education display at the Moapa Valley Community Center or other suitable public venue. (2.1.17)	3
Construct an overlook trail with interpretive panels and shade structure on top of the hill on the Plummer unit for viewing the Refuge and the Moapa Valley. (2.1.18)	100
Design and install new interpretive panels. (2.1.19)	100
Total	**1,276**
Pahranagat NWR	
Assess the effectiveness of rotenone treatments to control carp and encourage growth of submerged aquatic vegetation. (1.1.6)	2
Model climate change impact scenarios and develop adaptation strategies	250
Implement a geotechnical engineering study of Upper Pahranagat Lake to evaluate levee integrity and water loss through the lake bottom. (1.1.10)	25
Develop a rainfall-runoff analysis for Upper Pahranagat. (1.1.12)	40
Develop and implement a habitat management plan to improve quality of existing open water habitat for waterfowl, waterbirds, shorebirds and other migratory birds. (1.1.14)	318
Control spread of bulrush at Middle marsh by chemical and mechanical means using the Integrated Pest Management (IPM) Plan protocol. (1.2.5)	100
Investigate methods to increase efficiency of water delivery from Upper Lake. (1.3.2)	318
Continue limited IPM efforts in existing 112-acre grassland habitat to contain spread by knapweed and reduce its extent. (1.3.6)	331
Determine population status, distribution and demography of Pahranagat Valley montane vole on the Refuge. (1.3.7)	10
Control salt cedar and other invasive species on 215 acres near Lower Pahranagat Lake and the Pahranagat Wash/Lower Lake area and restore Lower Pahranagat Lake edge with native plant species. (1.4.1)	331
Develop and implement a species inventory and monitoring plan to identify species composition, relative abundance, seasonality, health and distribution of waterfowl, waterbirds and shorebirds. (1.4.1)	469
Survey existing groundwater wells and repair or cap as appropriate. (1.5.3)	97
Install a new pump in Well No. 3 and monitor for flow to document beneficial use of allocation and support the water right. (1.5.4)	10
Install a flume or weir at the outflow of Lower Pahranagat Lake to assist in development of the water budget. (1.5.5)	10
Install and monitor flow meters and data loggers on each of the three groundwater wells located on the Refuge. (1.5.6)	6
Develop a Refuge-wide water budget (1.5.7)	164
Install gages and data logging equipment at springs adjacent to Middle Marsh. (1.5.8)	6
Determine the status of groundwater wells of record, and repair and/or abandon as appropriate, and apply for change(s) in point of use with Nevada Division of Water Resources. (1.5.11)	164
Determine the appropriate water restoration delivery system changes, prioritize restoration and develop an implementation strategy. (1.5.12)	212
Investigate the feasibility of planting native grasses between Upper Pahranagat Lake and Middle Marsh, to control invasives such as knapweed and provide forage for sandhill cranes, waterfowl and geese. (1.6.3)	10

Complete and implement an IPM Plan. (1.7.2)	10
Use mechanical methods and prescribed fire to reduce fuels in the cottonwood/willow areas of Upper Pahranagat Lake and north Marsh. (2.1.1)	7
Secure (apply for, re-apply for) additional water rights to provide necessary water for establishment of new willow wetland habitat. (2.1.2)	4
Conduct wetland habitat vegetation surveys that include percent cover, density, age, and structure. (2.1.7)	4
Monitor the response of migratory birds, the southwestern willow flycatcher in particular, to the wetland establishment efforts. (2.1.9)	4
Restore wetland habitat on the east side of Upper Pahranagat Lake and North of the North Marsh. (2.1.10)	10
Conduct fish, invertebrate, bird, mammal and plant inventories of each spring head. (2.2.2)	40
Investigate historic photos and other records to determine pre-development characteristics of springs. (2.2.3)	10
Prepare a springhead and channel restoration plan in coordination with NDOW and USFWS Endangered Species Program. (2.2.4)	50
Implement springhead and channel restoration. (2.2.5)	500
Install physical barriers to prevent vehicle traffic in closed areas. (2.3.4)	6
Plan and design a refugium on the Refuge in coordination with NDOW and FWS-ES (2.4.1)	106
Construct a refugium for the roundtail chub on the refuge (2.4.2)	100
Post and maintain designated hunting area signs on Refuge and provide hunting information to the public through brochures, fact sheets and maps. (3.1.4)	4
Update the Fisheries Management Plan for the Refuge in coordination with NDOW. (3.2.2)	10
Improve and maintain existing restroom facilities for visitor use at Upper Pahranagat Lake. (3.2.9)	10
Assess the effects of increased water withdrawals from Upper Pahranagat Lake and North Marsh for wetlands management in Middle Marsh and Lower Pahranagat Lake on sport fisheries. (3.2.10)	6
Design and construct a wildlife viewing trail system possibly along historic farming and ranching roads and trails. (3.3.3)	10
Construct photography and observation blinds along the trail route. (3.3.4)	20
Develop and implement an interpretive plan for the Refuge by working with partners. (3.4.3)	20
Develop Refuge-specific environmental education materials. (3.4.4)	20
Develop signs, such as "least-wanted" posters, for invasive plant species. (3.4.5)	4
Construct a new visitor contact station and office space at refuge headquarters unit. (3.4.8)	2,000
Construct interpretive walking trail that connects Upper Pahranagat Lake with the Headquarters Unit. (3.4.9)	10
Focus outreach effort on six major Refuge System events: International Migratory Bird Day, the Junior Duck Stamp Program, and the National Wildlife Refuge Week, Public Lands Day, Earth Day, National Fishing Day. (3.5.2)	3
Compile all existing baseline data on cultural resources sites, surveys, and reports within, and near, Pahranagat NWR and create secure digital, GIS, and hard copy databases, maps, and library. (4.1.2)	20
Prepare evaluation criteria and conduct a cultural resource inventory at all public use facilities and Areas that would be affected by Refuge projects. (4.2.1)	50
Inventory, evaluate, and nominate Traditional Cultural Properties and sacred sites to the National Register, in consultation with culturally affiliated Tribes. (4.2.2)	150
Inventory, evaluate, mitigate adverse effects on and stabilize samples of cultural resources on Pahranagat NWR using a research design prepared in consultation with culturally affiliated Tribes and the scientific community. (4.2.3)	200
Conduct a study of ethnobotany and traditional plants use locations on Pahranagat NWR in consultation with culturally affiliated Tribes. (4.2.4)	60
Create a cultural resource layer in the NWR complex GIS that aids in the identification, planning	25

and monitoring, and interpretation of cultural sites. (4.2.5)	
Identify and evaluate cultural resources subject to looting/vandalism, erosion, or deterioration and implement steps, including barriers and signs to reduce these threats and preserve the resources. (4.4.1)	150
Create and implement a site stewardship volunteer program to assist in site monitoring, delivery of educational and interpretive literature and programs, and to promote cultural resources conservation in neighboring communities. (4.4.4)	25
Total	**6,521**

Table 3. Estimated Annual Salary and Non-Salary Operation and Maintenance Costs to Fully Implement CCP[2]

Position (grade)	Quantity	Unit	Unit Cost[3]	Total Cost
Desert NWR Complex				
Project Leader (GS-14)	1	FTE	$140,424	$140,424
Deputy Project Leader (GS-13)	1	FTE	$118,838	$118,838
ORP/Volunteer Coordinator (GS-11/12)	1	FTE	$99,934	$99,934
Supervisory Fish and Wildlife Biologist (GS-12/13)	1	FTE	$118,838	$118,838
Fisheries Biologist (GS-9/11)	1	FTE	$83,376	$83,376
Wildlife Biologist (GS-9/11)	1	FTE	$83,376	$83,376
Botanist (GS-9/11)	1	FTE	$83,376	$83,376
Fish Facility Manager (GS-11/12)	1	FTE	$99,934	$99,934
Archeologist/Tribal Coordinator (GS-11)	1	FTE	$83,376	$83,376
SNPLMA Coordinator (GS-13)	1	FTE	$99,934	$99,934
Administrative Officer (GS-9/11)	1	FTE	$83,376	$83,376
Administrative Assistant (GS-5/7)	1	FTE	$56,334	$56,334
Administrative/Office Assistant (GS-5)	1	FTE	$45,477	$45,477
Fire Management Officer (GS-11/12)	1	FTE	$99,934	$99,934
Assistant FMO (GS-9/11)	1	FTE	$83,376	$83,376
Seasonal Range Technician (GS-06)	0.5	FTE	$50,697	$25,349
Engine Captain (GS-6/7)	1	FTE	$56,334	$56,334
Forestry Technician (GS-5/6)	3	FTE	$50,697	$152,091
Supervisory Law Enforcement Officer (GS-11/12)	1	FTE	$99,934	$99,934
Refuge Law Enforcement Officer (GS-5/7/9)	4	FTE	$68,915	$275,659
Refuge Law Enforcement Officer (GS-5/7/9)	1	FTE	$68,915	$68,915
Information and Education Specialist (GS-11/12)	1	FTE	$99,934	$99,934
Environmental Education Specialist (GS-9/11)	1	FTE	$83,376	$83,376
Ash Meadows NWR				
Refuge Manager (GS-12)	1	FTE	$99,934	$99,934
Fish and Wildlife Biologist (GS-9/11)	1	FTE	$83,376	$83,376
Engineering Equipment Operator (WG-8)	1	FTE	$65,651	$65,651
Fish and Wildlife Biologist (GS-9/11)	1	FTE	$83,376	$83,376
Park Ranger (Visitor Services) (GS-9)	1	FTE	$68,915	$68,915
Laborer (WG-5)	1	FTE	$55,795	$55,795
Wildlife Refuge Specialist (GS-9/11)	1	FTE	$83,376	$83,376
Biological Technician (GS-5/7)	3	FTE	$56,334	$169,002
Administrative/Office Assistant (GS-5)	1	FTE	$45,477	$45,477
Desert NWR				
Refuge Manager (GS-12)	1	FTE	$99,934	$99,934
Wildlife Refuge Specialist (GS-9/11)	1	FTE	$83,376	$83,376
Engineering Equipment Operator (WG-8)	1	FTE	$65,651	$65,651

[2] Note: Costs could be funded through both appropriated (annual refuge budget) and non-appropriated sources (see end of table for key)

[3] Note: Salary costs based on OPM's FY2008 salary table for "Rest of US" (at step 5 of highest grade) and includes 25% for benefits and 10% for overhead (awards, travel, equipment, etc)

Environmental Education Specialist (GS-9/11)	1	FTE	$83,376	$83,376
Visual Information Specialist (GS-11)	1	FTE	$83,376	$83,376
Biological Technician (GS-5/7)	2	FTE	$56,334	$56,334
Laborer (WG-5)	1	FTE	$55,795	$55,795
Administrative/Office Assistant (GS-5)	1	FTE	$45,477	$45,477
Moapa Valley NWR				
Refuge Manager (GS-11)	1	FTE	$83,376	$83,376
Engineering Equipment Operator (WG-8)	1	FTE	$65,651	$65,651
Fish & Wildlife Biologist (GS-7/9)	1	FTE	$68,915	$68,915
Pahranagat NWR				
Refuge Manager (GS-11)	1	FTE	$83,376	$83,376
Engineering Equipment Operator (WG-8)	1	FTE	$65,651	$65,651
Wildlife Refuge Specialist (GS-9/11)	1	FTE	$83,376	$83,376
Youth Conservation Corps Team Leader (GS-5)	1	FTE	$9,620	$9,620
Youth Conservation Corps Team Members	4	PTE	$2,026	$8,104
Biological technician (GS-5/7)	2	FTE	$56,334	$56,334
Environmental Education Specialist (GS-9/11)	1	FTE	$83,376	$83,376
Administrative/Office Assistant (GS-5)	1	FTE	$45,477	$45,477
Total (current positions)	**36.5**			**$3,388,871**
Total Proposed (all positions)	**57.5**			**$4,222,972**
Estimated Non-Salary Operation and Maintenance Need				$1,386,669

Normal font = paid with appropriated funds
Italic font = paid with non-appropriated funds
indented = new position

Appendix L. Land Protection Plan and Conceptual Management Plan for Moapa Valley NWR

SE ROA 13492

APPENDIX L
LAND PROTECTION PLAN

Proposed Moapa Valley
National Wildlife Refuge Expansion
Clark County, Nevada

United States Department of the Interior
Fish and Wildlife Service

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Land Protection Plan
Proposed Moapa Valley
National Wildlife Refuge Expansion

Clark County, Nevada

Prepared by
U.S. Fish and Wildlife Service
Region 8

December 2008

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Regional Director, Region 8 Date
Sacramento, California

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APPENDIX L

LAND PROTECTION PLAN

Maps/Tables

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LAND PROTECTION PLAN

Proposed Moapa Valley
National Wildlife Refuge Expansion
Clark County, Nevada

Introduction

This land protection plan outlines resource protection needs, priorities, and habitat protection methods the U.S. Fish and Wildlife Service (Service) would use for the proposed Moapa Valley National Wildlife Refuge (Refuge) expansion in Clark County, Nevada. This plan proposes cooperative agreement, memorandum of understanding, and transfer as the primary protection tools needed to meet habitat and wildlife management goals for the project area. Fee title purchase may be used on smaller parcels. The Environmental Impact Statement (EIS) for the Desert Comprehensive Conservation Plan evaluates the environmental effects of expanding the approved refuge acquisition boundary to conserve and where appropriate, restore approximately 1,765 additional acres, which includes warm springs and their outflows, riparian corridors and adjacent lands where land use directly affects water quality and associated vegetation.

The Refuge is located about 60 miles northeast of Las Vegas in Clark County, and is part of a unique system of thermal springs that are part of the headwaters of the Muddy River, which eventually flows into Lake Mead east of Las Vegas. The Refuge is located on the southern side of State Highway 168 and the Muddy River, between I-15 and Hwy 93. The entire Refuge lies within the Moapa Valley. It is bounded on the north by Warm Springs Road, on the south and west by BLM lands, and on the east by private property (Figure 1).

Nothing in this plan constitutes an offer to purchase private property, or a usurpation of the authority of the State of Nevada, Clark County, or any other jurisdiction to regulate land use within the proposed refuge boundary. This plan is intended to guide the Service's proposed land protection activities subject to the availability of funds and other constraints. To complement this plan, the Service has prepared a conceptual management plan (Appendix B) that describes the general management approaches for the Refuge.

Project Description

The Service proposes to establish an approved refuge land acquisition boundary and provide protection and management within the proposed expanded boundary of the Refuge. The Service's proposed action encompasses approximately 1,765 acres, which includes warm springs and their outflows, riparian corridors and adjacent lands where land use directly affects water quality and associated vegetation. (See Chapter 3, Alternative B of the EIS). The refuge study area adjoins the existing Refuge in northeast Clark County (see map 1).

Purpose and Goals of Moapa Valley NWR

The Refuge was established on September 10, 1979, to secure and protect habitat for the endangered Moapa dace *(Moapa coriacea).* The purpose of the Refuge comes from the Endangered Species Act of 1973, as amended (Act):

> *"...to conserve (A) fish or wildlife which are listed as endangered species or threatened species...or (B) plants..."* (16 USC §1534).

The Service developed two goals for management of Moapa Valley NWR. These goals were used to identify appropriate objectives and strategies and develop alternatives.

Endemic and Special Status Species (Goal 1). Protect and restore, when possible, healthy populations of endemic and special status species, such as the endangered Moapa dace, within the Muddy River headwaters.

Visitor Services (Goal 2). Provide local communities and others with opportunities to enjoy and learn about the resources of Moapa Valley NWR and participate in its restoration.

The authorities for the acquisition are the Endangered Species Act of 1973, as amended (16 U.S.C. 1532-1544, 87 Stat. 884), Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742(a)-754), Migratory Bird Conservation Act of 1929 (16 U.S.C. 715-715d) and Refuge Recreation Act of 1962, as amended (16 U.S.C. 460k-460k-4). The Endangered Species Act of 1973, Fish and Wildlife Act of 1956, and Refuge Recreation Act of 1962 authorize the Service to use funds made available under the Land and Water Conservation Fund Act of 1965 (16 U.S.C. 4601-4601-11) to acquire lands, waters, or interests therein for fish and wildlife conservation purposes. Federal monies used to acquire private lands through the Land and Water Conservation Fund are derived primarily from oil and gas leases on the outer continental shelf, excess motorboat fuel tax revenues, and the sale of surplus Federal property.

Objectives of the Proposed Action

The primary objectives of this proposal are to ensure the conservation and perpetuation of aquatic, wetland, and mesquite bosque habitats needed for the recovery of Moapa dace and other endemic wildlife species in the upper Moapa Valley. Our areas of emphasis are twofold: (1) the warm springs and their outflows, which provide the only habitat of the Moapa dace, and (2) riparian corridors and adjacent lands where land use directly affects water quality. Also important is the opportunity to improve riparian habitat conditions for the yellow-billed cuckoo, the southwestern willow flycatcher, and other species. The expansion of the Refuge is a crucial step toward recovery of the Moapa dace and would advance and expand habitat restoration and other important recovery actions. Additionally, protection of this habitat could preclude the need to list other rare aquatic species in the future. The proposed project provides opportunities for Federal, Tribal, State, and local government partnerships with private property owners. These partnerships are the basis for achieving mutual conservation goals while maintaining the rural lifestyle and economic vitality of the Moapa Valley.

Protection of the lands considered would fulfill the habitat criterion of the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem (Recovery Plan) (USFWS 1995). The proposed expansion area includes about 1,765 acres of land adjacent to the Refuge that are occupied by species listed as threatened or endangered under the Endangered Species Act of 1973, as amended (Act). The proposed expansion area also contains other listed and species of concern, has restorable habitat, and potential to contribute significantly to species recovery.

Threats to and Status of the Resource to be Protected

Threats to the upper Moapa Valley and its species include incompatible land use, decline in quantity and quality of the regional aquifer, introduction of exotic aquatic species, and spread of invasive plant species.

Clark County is one of the fastest growing counties in the United States, with a population forecasted to grow to approximately 2.5 million people by 2030 (Clark County 2000). Residential development may include risks such as increased contaminants, human disturbance, risk of wildfire, exotic species establishment, increased draw on the aquifer, and increased agriculture or ranching. Historically, ranching activities such as water diversion, ditching and draining of wetlands, grazing, haying, burning, and clearing have adversely affected habitats in the upper Moapa Valley. Many of these activities continue to contribute to the decline of native wildlife populations.

Groundwater pumping may draw down the aquifer and reduce spring flow. Pumping of groundwater in the immediate vicinity of the springs is probably causing declines in the flow in the upper Muddy River. The reduction in stream flow is caused by the interception of water discharging from the carbonate aquifer to the stream through the alluvium.

Water discharging at Pedersen and other nearby springs on the Refuge, is probably isolated from the alluvium, but has a more direct connection with the carbonate aquifer. Small declines in the spring pool elevation have occurred at Pedersen spring, and it is presently unclear if the discharge rate is declining because of other factors that affect the relationship between pool level and discharge-rate measurements (Waddell, pers. comm.).

Continued pumping from the carbonate aquifer will likely further decrease the water levels in the carbonate aquifer beneath the Refuge, and cause a measurable, and possibly significant reduction in discharge rate at Pedersen and nearby springs. Computer modeling of the groundwater system predicts that groundwater production from the carbonate aquifer beneath California Wash and Coyote Springs Valley will reduce groundwater discharge rates in the upper Muddy River area. This reduction will be in addition to the reduction caused by more local pumping. Because Pederson and nearby springs are located at higher elevation than the springs located in the center of the valley, they will probably be more affected by pumping than the other springs, such as those in the proposed expansion area (Waddell, pers. comm.).
The introduction, both intentional and accidental, of nonnative species has adversely affected endemic species through predation, competition, and infestation by parasites. Predation by tilapia and bullfrogs is of particular concern, and these species, as well as shortfin mollies and

mosquitofish, also compete with native species for resources. Crayfish (*Procambarus clarkii*), already present in the lower Muddy River, could spread upriver and create additional pressures on endemic species in the proposed expansion area.

The spread of California fan palms continues to have deleterious effects on the hydrology of the proposed expansion area. Young palms are growing and increasing in numbers along the stream channels. As a result, the streams have narrowed and channelized creating higher velocities unsuitable for the Moapa dace. The presence of these palms also increases the risk of wild fire. A fire in 1994 virtually eliminated Moapa dace on the Refuge (USFWS 1995). To lessen the probability of fire occurring again over Moapa dace habitat, Refuge staff developed a management plan for both wild and prescribed fires.

The invasion of weeds poses a threat to the integrity of habitats supporting listed species and other species of concern in the Moapa Valley. Nonnative shrubs, such as tamarisk (*Tamarix spp.*) and Russian olive (*Elaeagnus angustifolius*), are increasing in numbers in the study area, competing with native riparian species, and potentially lowering the water table. Eel grass (*Vallisneria spp.*) is flourishing in many portions of the streams and threatens to alter stream hydrology further. Upland weeds, such as Russian thistle (*Salsola tragus*) and knapweed (*Centaurea* spp.), have affected habitat quality of the upland areas and will continue to proliferate in disturbed areas.

Protection Methods

A variety of habitat protection methods can be used to conserve the natural resources of the area within the boundary of the proposed Refuge expansion. Service policy is to adopt habitat protection measures and strategies that involve acquiring the minimum possible interest or rights in lands and waters. The goal is to leave as large a proportion of these rights as possible in private ownership and still meet the defined resource objectives. On lands owned and managed by public agencies, cooperative agreements and coordinated planning/management efforts, including shared resources, could be used to conserve natural resources within the proposed refuge boundary. The Service could protect habitat through acquisition of land or interest therein for inclusion in the National Wildlife Refuge System. The Service could acquire fee-title, conservation easements, long-term leases, and/or cooperative agreements with willing public agencies and willing landowners through purchase, donation, transfer, exchange, or written agreement.

Since the majority of the lands within the proposed expansion area (tracts 1, 3, and 23) were purchased with public funding, habitat protection objectives could be achieved through a combination of cooperative agreements, memorandum of understanding, or transfer. Therefore, expansion of the Refuge would provide a coordinated effort to protect native habitats and assist recovery of declining fish and wildlife populations of the Muddy River Ecosystem. The reminder of the tracts are small in acreage and privately owned, thus we propose to acquire these lands in fee-title.

Management Considerations

The Southern Nevada Water Authority (SNWA) owns and manages the Warm Springs Natural Area, which contains 90 percent of Moapa dace habitat, and consists of 1,218 acres. The Warm Springs Natural Area includes two inholdings: a 72-acre tract owned by the Church of Latter Day Saints and a six-acre parcel owned by TNES, LLC. The Bureau of Land Management has title to the 400 acre riparian area south of the Refuge, and Mary Premo owns three acres situated between the Refuge and the Warm Springs Natural Area. The Nature Conservancy owns 72 acres along the river, south of Warm Spring Road.

SNWA acquired the Warm Springs Natural Area with Southern Nevada Public Lands Management Act funds in 2007, specifically to restore Moapa dace habitat as a mitigation measure (see below). Though SNWA purchased the property without water rights, the point of diversion for the existing surface water rights is downstream of the majority of the dace habitat. Furthermore, the expansion would allow the implementation of on-the-ground recovery and conservation actions. The implementation of these actions would be through the Muddy River Recovery Implementation Program, which includes SNWA, Moapa Valley Water District, Moapa Band of Paiutes, The Nature Conservancy, Nevada Department of Wildlife, Coyote Springs Investment, LLC, and the Service.

The Service, Moapa Band of Paiutes, SNWA, Moapa Valley Water District, and Coyote Springs Investments, LLC (CSI) are signatories in a Memorandum of Agreement (MOA). The MOA establishes a Recovery Implementation Program (RIP) to outline and implement necessary protection and recovery activities for the Moapa dace. The MOA also provides for funding to develop the RIP, dedication of certain water rights to preserve in-stream flows, pumping restrictions whereby the parties agree to curtail pumping in the event spring flows in the existing Refuge decline to specified "trigger levels." Other conservation measures in the MOA include:

- Dedication of the Jones water right (Apcar spring) to provide in-stream flows.
- Dedication of a portion of CSI's water rights from the Coyote Spring Valley.
- Habitat restoration and recovery measures, including funding for; restoration of Moapa dace habitat, development of an ecological model for the Moapa dace, construction of fish barriers, eradication of non-native fish species, and cultivation of native vegetation.
- Protection of in-stream flows through the establishment of minimum in-stream flow levels that would trigger a range of conservation actions including restriction of groundwater pumping.
- Establishment of a Hydrologic Review Team to coordinate data collection, analyses of impacts, and assessments of pumping restrictions.
- Acquisition of additional land and water rights to assist in the recovery of the Moapa dace.
- Operational coordination among the Service, SNWA, CSI, and MVWD.
- Adaptive management measures, including additional conservation measures for the conservation and recovery of the Moapa dace.

On January 30, 2006, the USFWS issued a final programmatic biological opinion (BO) on the MOA (Service File 1-5-05-FW-536). The Service determined that the cumulative groundwater withdrawal of 16,100 afy from two hydrographic basins, Coyote Spring Valley and California Wash is likely to adversely affect the Moapa dace. The Service concluded that the proposed action, combined with the conservation measures outlined in the MOA would not jeopardize the Moapa dace.

Summary of Planning and Land Acquisition Processes

The Director of the Fish and Wildlife Service, in consultation with the Regional Director, Region 8, would approve the expansion of the refuge boundary upon completion of the planning and environmental coordination process. This process includes compliance with the National Environmental Policy Act (NEPA), the Endangered Species Act, and other federal laws, regulations, policies and executive orders.

With the selection of an approved boundary and successful completion of the NEPA process, the selected project alternative can be implemented as described in this Land Protection Plan and Conceptual Management Plan.

The Service's planning process includes the following steps:

- ❑ Preliminary agency planning
- ❑ Public scoping period
- ❑ Draft environmental impact statement released (includes draft land protection plan and conceptual management plan)
- ❑ Public review period of planning documents
- ❑ Final environmental impact statement released (includes final land protection plan and conceptual management plan)
- ❑ Record of Decision (to expand the Refuge or not)

Public Scoping and Involvement

This expansion is being conducted concurrently with the development of the Desert Complex Comprehensive Conservation Plan (CCP). Throughout the scoping process, the Service consulted with a number of federal, state, and local elected officials and agencies and private organizations to solicit their views of the proposal. Parties contacted have included: the Southern Nevada Water Authority, Moapa Valley Water District, Nevada Division of Wildlife, Bureau of Land Management, Clark County Comprehensive Planning, and the U.S. Geological Survey-Biological Resources Division.

On August 21, 2002, the Service published a Notice of Intent (NOI) in the Federal Register for the preparation of an EIS for the Desert Complex CCP. The NOI gave notice of public meetings and encouraged interested parties to become involved in the process. Five scoping meetings were held in southern Nevada in September 2002. Planning updates were also distributed throughout the planning process; details on these updates as well as other public, agency, and tribal correspondence are provided in Chapter 6 of the EIS. An interagency scoping meeting was held on August 28, 2002. Cooperating agencies and agencies with interests in and/or responsibilities for resources within the Desert Complex were invited to provide comments on issues that should be analyzed during development of the CCP and EIS. Interagency planning team meetings were held on March 11, 2003, July 10, 2003, and February 22, 2006, to solicit input and feedback on various aspects of the planning process, including alternatives development and reviewing early versions of the document. Tribal coordination meetings were held on April 7–8, 2004, June 18–19, 2005, and June 22–23, 2006.

On July 11, 2008, the Service published a Notice of Availability of the Draft Comprehensive Conservation Plan/Environmental Impact Statement (CCP/EIS) in the Federal Register. The draft CCP/EIS was available for public review for 60 days (July 11 – Sept 9 2008). A series of six public meetings were held August 6th – 9th 2008.

We received 41 comment letters with a total of 235 comments during the comment period. Nine of the comment letters address expansion. Of these comment letters, eight supported the expansion and one opposed it. Four letters requested that expansion include additional lands beyond what was proposed in the draft CCP/EIS:

- TNC and Clark County – both requested that TNC lands along Muddy River (72.9 acres) be included
- SNWA – requested all of Warm Springs Natural Area be included (150 additional acres) so the parcels are not split up
- Private landowner – requested that parcel adjacent to south east edge of proposed expansion be included (8.2 acres)

Based on these comments, and since the additional parcels are immediately adjacent to the proposed expansion area and support the same resources, the Service increased the expansion area by 223 acres to include a total of 1,765 acres.

The selection and approval of a project boundary only allows the Service to acquire lands or interest in lands from willing sellers at fair-market value or to enter into management agreements with interested landowners. An approved project boundary does not grant the Service jurisdiction or control over lands within the boundary, and it does not automatically make lands within the project boundary part of the National Wildlife Refuge System. Lands do not become part of the National Wildlife Refuge System unless they are acquired by the Service or are placed under an agreement that provides for management as part of the Refuge System.

No new or additional zoning laws would be imposed by the Service within the approved project boundary. Any landowner within an approved project boundary retains all existing rights, privileges, and responsibilities of private-land ownership as determined by local, city, or county jurisdictions. Again, lands remain under the control of the owner until management rights or title to the property have transferred to or have been acquired by the Service.

The Service land protection policy is to acquire land only when other protective means are not appropriate, available, or effective. The Service strives to obtain the minimum interest necessary to reach management objectives, once land is acquired or retained.

The acquisition and habitat protection program is expected to take several years. Initial acquisition efforts would focus primarily on protecting blocks of land having the highest biological values, and those where the landowner has expressed interest in immediate transfer. The Service recognizes that some lands identified within the approved project boundary may never become part of the National Wildlife Refuge System.

Willing Seller Policy

Service policy is to acquire lands or interest in lands only from willing participants under general authorities such as the Endangered Species Act, Fish and Wildlife Act of 1956, the Migratory Bird Conservation Act, and the Refuge Recreation Act. Landowners within the project boundary who do not wish to sell their property or any other interest in their property are under no obligation to enter into negotiations or to sell to the Service.

The Service, like other federal agencies, has been given the power of eminent domain, which allows the use of condemnation to acquire lands and other interest in land for the public good. This power, however, is seldom used and is not expected to be used in this project. The Service usually acquires land from willing participants and is not often compelled to buy specific habitats within a specific time frame.

In all cases the Service is required by law to offer 100 percent of fair-market value for lands to be purchased as determined by an approved appraisal that meets professional standards and federal requirements.

Under the Uniform Relocation Assistance and Real Property Acquisition Policies Act, landowners who sell their property to the Service are eligible for certain benefits and payments which include:

1. Reimbursement of reasonable moving and related expenses or certain substitute payments.
2. Replacement housing payments under certain conditions.
3. Relocation assistance services to help locate replacement housing/farm/or business.
4. Reimbursement of certain necessary and reasonable expenses incurred in selling real property to the federal government.

Land Protection Priorities within the Planning Area Boundary

The Service would seek cooperative agreements, memorandum of understanding, or fee title acquisition of all or part of the lands within the proposed Refuge boundary. The Service has prepared a table (Table 1) that lists assessor parcel numbers, acreages, protection method, and priority for acquisition should the property owner be willing to transfer, cooperatively manage, or sell, and funding become available. Acquisition priorities for lands within the proposed boundary can be difficult to calculate, as land uses and conditions can change rapidly. The Service has placed a priority on Moapa dace habitat, springheads and streams, including the Muddy River, and associated riparian habitat. Second in priority would be desert uplands retaining their characteristic vegetation.

In selecting the priorities for Table 1, it was determined that the first priority would be the Warm Springs Natural Area, because it contains 90 percent of Moapa dace habitat. Equal in priority are the BLM and TNC properties, as they contain a large portion of the Muddy River. Second in priority are the Premo, Nevada Power Company, LDS Church, and TNES, LLC properties. Final determination of priority lands would occur when final negotiations are made for the purchase of lands.

Social and Cultural Impacts

The current quality of life within communities around the proposed refuge is expected to remain the same or improve slightly as a result of the expansion of the Refuge. The expansion of the Refuge is not expected to change most land use activities or public use patterns in the vicinity of the project area.

Under provisions of the Refuge Revenue Sharing Act (Public Law 95-469), the Service would make an annual payment to the county to help offset revenue lost as a result of Federal acquisition. This law states that the Secretary of the Interior (Secretary) shall pay to each county in which any area acquired in fee title is situated, the greater of the following amounts:

- An amount equal to 75 cents per acre for the total acreage of that portion of the fee area which is located within each county.

- An amount equal to three-fourths of 1 percent of the fair market value, as determined by the Secretary, for that portion of the fee area which is located within each county.

- An amount equal to 25 percent of the net receipts collected by the Secretary in connection with the operation and management of such fee area during each fiscal year.

Congress may appropriate, through the budget process, supplemental funds to compensate local governments for any shortfall in revenue sharing payments. The Refuge Revenue Sharing Act also requires that Service lands be reappraised every five years to ensure that payments to local governments remain equitable. Payments under this Act would be made only on lands the Service acquires in fee title. On lands where the Service acquires only partial interest through easement, all taxes would remain the responsibility of the individual landowner. A summary of Refuge Revenue Sharing Act payments for the past 31 years is available at http://www.fws.gov/realty/pdf_files/RRS_31-year%20History.pdf. Recently, payments to the counties have been less than the legislated amounts because the receipts plus congressional appropriations have fallen short of the statutory entitlement. For example, during the past five years payments to the counties have been less than 50 percent of the entitlement.

Coordination and Consultation

The Service has worked with a variety of interested parties to identify issues and concerns associated with the proposed Refuge expansion. These interested parties include members of the public, interested private groups, elected officials, and federal, state and local government agencies. The Service's public involvement activities included hosting meetings, developing a mailing list, requesting information, undertaking consultations, and responding to inquiries. The Service has provided information about the proposal to the media and other interested or affected parties throughout the public scoping period.

The Service has invited and continues to encourage public participation through the public involvement program consisting of public notices, meetings with potential affected landowners, government agencies, and private organizations. The proposed acquisition is being presented in conjunction with the Desert Complex Comprehensive Conservation Plan (CCP). Planning updates have been prepared and sent to landowners and other interested parties. Additionally, public scoping meetings have been held.

Summary of Proposed Action

In light of the valuable resources in the proposed expansion area and continuing threats to these resources, the Service proposes to expand the Refuge boundary from 116 acres up to 1,765 acres. This proposed expansion would allow the Service to conserve, protect, and restore thermal springs, riparian corridors and desert uplands through fee-title acquisition. Protection of the lands considered would fulfill the habitat criterion of the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem (Recovery Plan) (USFWS 1995).

Our areas of emphasis are twofold: (1) the warm springs and their outflows, which provide the only habitat of the Moapa dace, and (2) riparian corridors and adjacent lands where land use directly affects water quality. Also important is the opportunity to improve riparian and mesquite bosque habitat conditions for the yellow-billed cuckoo, the southwestern willow flycatcher, and an exceptional diversity of other bird and bat species. The expansion of the Refuge is a crucial step toward recovery of the Moapa dace and would allow the Service to initiate habitat restoration and other important recovery actions on this land.

The Service has encouraged input from landowners, agencies, and conservation organizations, other Federal agencies, State and local governments, and individuals in the community to identify concerns and issues and to explore the alternatives. Additional public input was sought through the use of mailings, personal contacts, and news releases.

The EIS analyzes the potential effects to the human environment resulting from expanding the Refuge and managing the area under the Conceptual Management Plan (CMP). The EIS describes various alternatives that the Service could take to protect and manage an expanded refuge. Copies of the EIS, LPP, and CMP were distributed to Federal and State delegations, agencies, landowners, private groups, and interested individuals. The documents are also available on the Service's Region 8 Refuge Planning website at the following URL:

http://www.fws.gov/cno/refuges/planning.html.

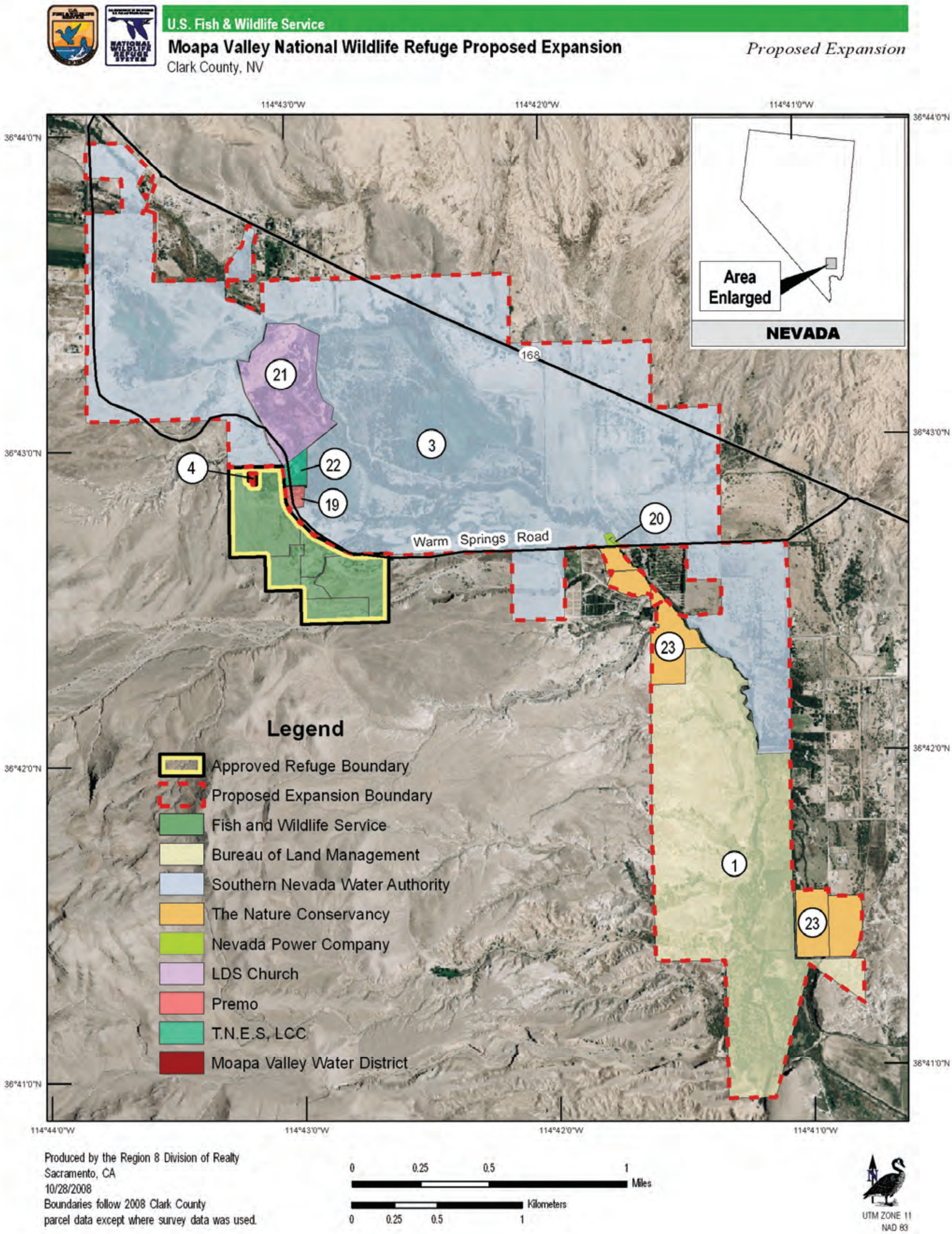
U.S. Fish & Wildlife Service
Moapa Valley National Wildlife Refuge Proposed Expansion
Clark County, NV
Proposed Expansion
Area Enlarged
NEVADA
168
Warm Springs Road
21
3
4
22
19
20
23
1
23
Legend
Approved Refuge Boundary
Proposed Expansion Boundary
Fish and Wildlife Service
Bureau of Land Management
Southern Nevada Water Authority
The Nature Conservancy
Nevada Power Company
LDS Church
Premo
T.N.E.S. LCC
Moapa Valley Water District
Produced by the Region 8 Division of Realty
Sacramento, CA
10/28/2008
Boundaries follow 2008 Clark County
parcel data except where survey data was used.
0 0.25 0.5 1 Miles
0 0.25 0.5 1 Kilometers
UTM ZONE 11
NAD 83

TABLE 1
Land Tracts and Acquisition Priorities for the Proposed Action:

Proposed Moapa Valley NWR Expansion – Tract Table

Tract #	Owner	APN	Acres	Protection Method	Priority
1	BLM	030-23-201-002	11.34	Agreement/Transfer	1
1	BLM	030-23-401-001	136.00	Agreement/Transfer	1
1	BLM	030-26-101-001	160.00	Agreement/Transfer	1
1	BLM	030-26-701-003	8.32	Agreement/Transfer	1
1	BLM	030-26-301-003	75.75	Agreement/Transfer	1
3	SNWA	030-16-101-001	243.90	Agreement/Transfer	1
3	SNWA	030-14-401-001	67.80	Agreement/Transfer	1
3	SNWA	030-15-301-001	325.06	Agreement/Transfer	1
3	SNWA	030-09-401-001	39.07	Agreement/Transfer	1
3	SNWA	030-16-701-004	65.89	Agreement/Transfer	1
3	SNWA	030-23-101-003	93.39	Agreement/Transfer	1
3	SNWA	030-15-201-001	152.71	Agreement/Transfer	1
3	SNWA	030-23-301-001	22.84	Agreement/Transfer	1
3	SNWA	030-14-301-001	11.59	Agreement/Transfer	1
3	SNWA	030-15-101-001	50.72	Agreement/Transfer	1
3	SNWA	030-15-601-001	47.17	Agreement/Transfer	1
3	SNWA	030-16-501-002	20.31	Agreement/Transfer	1
3	SNWA	030-16-701-001	16.79	Agreement/Transfer	1

Protection

Tract #	Owner	APN	Acres	Method	Priority
3	SNWA	030-22-501-001	30.89	Agreement/Transfer	1
3	SNWA	030-09-301-003	21.88	Agreement/Transfer	1
3	SNWA	030-09-301-007	0.21	Agreement/Transfer	1
3	SNWA	030-09-801-002	7.92	Agreement/Transfer	1
4	MVWD	030-16-701-002	0.65	Agreement/Transfer	1
19	Premo	030-16-801-009	3.3	Agreement/Fee	2
20	NPC	030-15-801-002	0.3	Agreement/Fee	2
20	NPC	030-15-801-001	0.9	Agreement/Fee	2
21	LDS	030-16-601-002	72.0	Agreement/Fee	2
22	TNES	030-16-701-005	6.0	Agreement/Fee	2
23	TNC	030-22-501-004	6.37	Agreement/Transfer	1
23	TNC	030-22-501-022	6.30	Agreement/Transfer	1
23	TNC	030-23-201-003	25.06	Agreement/Transfer	1
23	TNC	030-26-601-001	18.65	Agreement/Transfer	1
23	TNC	030-26-601-002	16.52	Agreement/Transfer	1
Total Acres			**1764.60**		

REFERENCES

Clark County. 2000. *Comprehensive Planning News*. Clark County Department of Comprehensive Planning, summer 2000.

U. S. Fish and Wildlife Service. 1995. Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem. Portland, Oregon. 60pp.

Waddell, R. 2002. Personal communication from Richard Waddell, hydrologist with GeoTrans, Inc., Westminster, Colorado.

CONCEPTUAL MANAGEMENT PLAN

Moapa Valley National Wildlife Refuge
Proposed Expansion

Clark County, Nevada

Prepared By:

U.S. Fish and Wildlife Service
Region 8
Sacramento, California 95825

December 2008

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CONCEPTUAL MANAGEMENT PLAN
MOAPA VALLEY NATIONAL WILDLIFE REFUGE
PROPOSED EXPANSION
Clark County, Nevada

INTRODUCTION

This draft conceptual management plan outlines resource protection needs, priorities, and habitat protection methods the U.S. Fish and Wildlife Service (Service) would use for the proposed Moapa Valley National Wildlife Refuge (Refuge) expansion in Clark County, Nevada. This plan proposes cooperative agreement, memorandum of understanding, and fee-title acquisition (transfer or purchase) as the primary protection tools needed to meet habitat and wildlife management goals for the project area. The Environmental Impact Statement/ Comprehensive Conservation Plan (CCP/EIS) for the Desert National Wildlife Refuge Complex evaluates the effects of expanding the approved refuge acquisition boundary to protect, conserve, and where appropriate, restore, thermal springs, riparian corridors, mesquite bosques and associated uplands totaling approximately 1,765 additional acres. Habitat management practices will be directed towards improving stream habitat and water quality for the endangered Moapa dace; these efforts will also have a direct and positive effect on use of the area by terrestrial and migratory wildlife.

This Conceptual Management Plan (CMP) is for the Service's proposed acquisition and management of the expanded Refuge and presents a general outline on how these new lands would be managed. As a conceptual plan, this CMP does not provide extensive detail or pinpoint exactly where long-term habitat improvements could be made or exactly where, if any, public use facilities would be ultimately constructed. Those details would normally be included in the Refuge's Comprehensive Conservation Plan (CCP), a long-term formal planning effort which is running concurrently with this land acquisition effort. During the CCP planning effort, goals, objectives, and strategies for public use as well as resource management are being developed for the existing 116-acre Refuge with input from the public, and in accordance with the National Environmental Policy Act. This CMP however, is for the proposed expansion acreage and presents a broad overview of the Service's proposed management approaches to wildlife, habitats, public uses, wildlife-dependent recreational activities, wildfire suppression, rights-of-way, easements, law enforcement, and facilities.

As part of the acquisition process, an environmental impact statement (EIS) evaluated the effects of expanding the approved refuge acquisition boundary to protect, conserve, and where appropriate, restore thermal springs, riparian corridors, mesquite bosques and associated uplands, totaling approximately 1,765 additional acres. Habitat management practices will be directed towards improving stream habitat and water quality for the endangered Moapa dace; these efforts will also have a direct and positive effect on use of the area by terrestrial and migratory wildlife.

Our areas of emphasis are twofold: (1) the warm springs and their outflows, which provide the essential habitat for the Moapa dace, and (2) riparian corridors and adjacent lands where land use directly affects water quality. Also important is the opportunity to improve riparian habitat conditions for the Yuma clapper rail, yellow-billed cuckoo, southwestern willow flycatcher, phainopepla and other migratory bird species. The Refuge expansion is a critical step toward recovery of the Moapa dace and would allow the Service to expand habitat restoration efforts and other important recovery actions. Additionally, habitat improvements and protection of this area could preclude the need to list other species in the future.

NATIONAL WILDLIFE REFUGE SYSTEM

The proposed expansion area would become part of the National Wildlife Refuge System (Refuge System) and would be managed to fulfill the Refuge System's mission and the specific purpose for which the Refuge was established. "The mission of the Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Improvement Act of 1997). The Refuge System is a network of protected lands and waters dedicated to fish and wildlife. Since the Refuge System's inception in 1903, with the establishment of the Pelican Island National Wildlife Refuge in Florida, the System has grown to 545 refuges, with at least one refuge in every state. The Desert National Wildlife Refuge complex consists of four refuges with a combined total of 1,634,306 acres.

Goals of the National Wildlife Refuge System

- To fulfill our statutory duty to achieve refuge purpose(s) and further the System mission.
- Conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.
- Perpetuate migratory bird, interjusisdictional fish, and marine mammal populations.
- Conserve a diversity of fish, wildlife, and plants.
- Conserve and restore, where appropriate, representative ecosystems of the United States, including the ecological processes characteristic of those ecosystems.
- To foster understanding and instill appreciation of fish, wildlife, and plants, and their conservation, by providing the public with safe, high-quality, and compatible wildlife-dependent public use. Such use includes hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

Purpose of the Moapa Valley National Wildlife Refuge

The Refuge was established on September 10, 1979, to secure and protect habitat for the endangered Moapa dace *(Moapa coriacea).* The purpose of the Refuge comes from the Endangered Species Act of 1973, as amended (Act):

"...to conserve (A) fish or wildlife which are listed as endangered species or threatened species...or (B) plants..." (16 USC §1534).

Goals of the Moapa Valley National Wildlife Refuge

The Service developed two goals for management of Moapa Valley NWR. These goals were used to identify appropriate objectives and strategies and develop alternatives.

- **Endemic and Special Status Species.** Protect and restore, when possible, healthy populations of endemic and special status species, such as the endangered Moapa dace, within the Muddy River headwaters.

- **Visitor Services.** Provide local communities and others with opportunities to enjoy and learn about the resources of Moapa Valley NWR and participate in its restoration.

REFUGE ADMINISTRATION

The Refuge would continue to be administered and supervised by the Desert National Wildlife Refuge Complex (Complex) in Las Vegas, Nevada. Currently, the Desert NWR Manager also serves as the Moapa Valley NWR Manager. However, acquisition of the expansion area would provide further justification for stand-alone staffing for the Refuge. The 2008 org chart shows a vacant GS-11 Refuge Manager and WG-8 Engineering Equipment Operator position. However, only the Refuge Manager position is currently funded. At present, the Desert NWR Equipment Operator assists, as needed, at the Moapa Valley NWR. This arrangement would be acceptable with supplemental funding provided, or alternatively, maintenance activities could be contracted. Eventually, a full-time maintenance position would be required. Visitor services and biologist support would be provided by the Complex, but an Environmental Education Specialist and Fish and Wildlife Biologist position would be desirable in the future. Administrative assistance would be provided through the Complex. Temporary or seasonal employees could include biological aides, tractor operators or Youth Conservation Corps (YCC) crews.

Two government quarters presently exist on the Refuge. It is conceivable that one employee could live in one of the homes, and the second be converted to office space. A small storage building is located on the existing Refuge; however, the Refuge does not have any heavy equipment. A larger building would be necessary in the future, to house and protect these items.

KEY AREAS OF MANAGEMENT FOCUS

The key areas of initial focus for the expanded area would be habitat and wildlife management, research, and wildlife-dependent recreational activities. The proposed new unit would operate under interim management until a formal habitat management plan or Comprehensive Conservation Plan is in place. Interim management would include non-native vegetation control using chemical and mechanical means, habitat restoration with native plant species, endangered species surveys, law enforcement patrols, and limited environmental education and interpretation.

Habitat and Wildlife Management

Native habitats and plant communities would generally be managed for the recovery of endangered, threatened, and rare species. Active modification and manipulation of intact native plant communities would be avoided. In disturbed areas, such as the pastures, along the roads and around buildings, there are non-native plant infestations. Mechanical and chemical means would be used to treat these species, as well as remove non-native trees. Areas that have undergone invasive/non-native species vegetation control would be re-planted with native species. Seeds from native plants would be collected locally and propagated in a greenhouse managed by the Moapa Band of Paiute Indians for future outplanting.

Research that may benefit the Refuge's endangered and threatened species or other natural resources may be permitted (see Compatibility Determination for Research, Appendix A). The Service may allow limited access for scientific research and for study groups on a case-by-case basis through a special-use permit process. Research that is nondisruptive to wildlife or archaeological resources, and compatible with refuge purposes and goals, are types that may be allowed.

Monitoring

Surveys of listed and sensitive species would occur semi-annually, as well as the continuation of scientific studies carried out within the Refuge through the special use permit program.

PUBLIC USE AND WILDLIFE-DEPENDENT RECREATIONAL ACTIVITIES

Refuges as Primary Use Areas

National wildlife refuges are managed first and foremost for the benefit of fish, wildlife, plants, and their habitats. In addition, refuges are closed to public uses unless specifically and formally opened. Other Federal land management systems are managed under a multiple-use mandate (e.g., national forests administered by the U.S. Forest Service and public lands administered by the U.S. Bureau of Land Management). Hunting, fishing, wildlife observation and photography, and environmental education and interpretation are priority public uses of the Refuge System. These uses must receive enhanced consideration over other general public uses in refuge planning and management.

As part of the National Wildlife Refuge System, the proposed Refuge expansion would provide opportunities for wildlife-dependent recreational uses that are compatible with the Refuge purpose. The Refuge can provide the people of the Las Vegas area and the nation with opportunities to gain better appreciation and understanding of the region's unique wildlife heritage.

The Compatibility Standard

Before any uses are allowed on a national wildlife refuge, Federal law requires a written compatibility determination be completed which states that the use is compatible. A compatible use is defined as a proposed or existing wildlife-dependent recreational use or any other use of a national wildlife refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purposes of the national wildlife refuge. Sound professional judgment is defined as a decision that is consistent with the principles of fish and wildlife management and administration, available science and resources (funding, personnel, facilities, and other infrastructure), and adherence to the requirements of the National Wildlife Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-668ee), and other applicable laws. If resources are not available to design, operate, and maintain priority public uses that are otherwise compatible, the refuge manager will take reasonable steps to obtain outside assistance from the state and other conservation interests. If adequate funding or staffing assistance cannot be identified, then the use is not compatible and cannot be allowed. High quality wildlife-dependent recreational opportunities are predicated on healthy habitats and healthy populations of endangered species, migratory birds, and other native species. Therefore, some constraints on public use and recreation are necessary. Unlimited public access and use of refuge lands could easily degrade the resources that make a visit to a national wildlife refuge so special.

Refuge Purpose(s)

The purpose(s) for which a refuge is established has special significance relating to compatible public uses. A refuge purpose may be specified in or derived from a Federal law or proclamation, an executive order, an agreement, a public land order, a donation document, or an administrative memorandum (Fish and Wildlife Service Manual, 602 FW 1.4M.). In addition to providing a basis for making compatibility determinations, a refuge=s purpose also serves as a vision or mission statement for refuge managers and the public. It provides a broad, long-term statement of management direction and priorities.

Pre-acquisition Compatibility Determinations

The Service is required to identify, prior to acquisition of new refuges or refuge additions, existing owner-authorized, wildlife-dependent public uses that would be allowed to continue on an interim basis during the time period following Service acquisition to the completion of a Comprehensive Conservation Plan (CCP). This is required by the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee). The referenced wildlife-dependent public uses are hunting, fishing, wildlife observation and photography, and environmental education and interpretation. These are the priority public uses of the National Wildlife Refuge System.

The Service is not required to complete pre-acquisition compatibility determinations for uses that did not previously exist and were not owner-authorized. Determination of what qualifies as an existing priority public use is a judgment call by the refuge manager. In general, occasional, personal use of property, such as allowing family or friends to hunt or photograph wildlife, would not be considered an existing public use. In contrast, properties that are generally open, such as a private hunt club or a military reservation that allows military personnel and their families to fish, would be considered to have an existing public use. The Warm Springs Ranch does not presently have any public uses. The Warm Springs Ranch is expected to have some public uses since the Southern Nevada Water Authority recently acquired the property through the Southern Nevada Public Land Management Act (SNPLMA). The SNPLMA funding source is the Parks, Trails, and Natural Areas (PTNA). As a PTNA, the SNWA is expected to provide public use and interpretation on the Warm Springs Ranch, once a management plan is written.

The Service, once they have acquired an interest in the Warm Springs Natural Area, is likely to continue wildlife dependent public uses that are compatible with the Refuge purpose. A pre-acquisition compatibility determination would have to be made by the Refuge manager. It is likely that some compatible public use opportunities would be available within the capabilities of allocated staff and budget.

Hunting and fishing do not currently occur on the Refuge. There are no game fish in the stream. The site does not provide good hunting opportunities due to the proximity of residences. There is no known demand for hunting on this site.

The Refuge expansion may eventually open to limited staff or volunteer-led public use, providing interpretative and educational opportunities. There would also be the opportunity for the public to enjoy wildlife observation and photography during these on-site visits. In order to protect endangered species and sensitive resources, the area would initially be open to the public only through Refuge staff-led tours and volunteer programs. Group size could be limited and may be supervised by Refuge staff or volunteers to ensure that resources are protected.

The Service may also allow limited access for scientific research and for study groups on a case-by-case basis through a special-use permit process. Research that is nondisruptive to wildlife or archaeological resources and compatible with refuge purposes and goals may be allowed. Any public use allowed would be in strict conformance with applicable Federal and State statutes.

RIGHTS-OF-WAY AND EASEMENTS

Lands for the Refuge would be acquired subject to existing rights-of-way and easements. The Service has an application process for granting new rights-of-way and easements across refuge lands. This process would also be used if holders of existing rights-of-way and easements on refuge lands want to expand or modify the terms and conditions of their rights. New rights-of-way and easements or modifications to existing rights-of-way and easements must be compatible with the purpose for which the Refuge was established.

LAW ENFORCEMENT

Enforcement of Federal, State, and County laws are critical to safeguard Refuge resources, visitors, and facilities. The Refuge Complex staff includes five law enforcement personnel. Refuge officers would work with Las Vegas Metropolitan Police Department, Clark County Sheriff's Office, and Bureau of Land Management Rangers to prevent trespass, vandalism, and violation of wildlife laws.

FACILITIES DEVELOPMENT AND MANAGEMENT

The Service is in the process of constructing visitor facilities on the existing Refuge property. These include a stream viewing chamber, an interpretive trail and kiosk, and an educational/group use shelter. Any additional facilities and management of those facilities cannot be projected at this time.

Boundaries of lands acquired by the Service are posted with refuge signs at regular intervals. Fencing or other types of barriers are often constructed to control trespassing that could damage habitat or endangered species.

FIRE MANAGEMENT

Wildfires are a threat to Refuge structures due to the number and flammability of dead palm tree fronds within the valley. If and when the Refuge is expanded, the Service would update the Moapa Valley National Wildlife Refuge Wildland Fire Management Plan (FMP) to include the new unit. The FMP addresses initial response, fire crew dispatch, wildfire suppression, cooperative agreements for firefighting support, and prescribed burning. Fire management planning would also include agreements with the Bureau of Land Management, and local fire departments for fire suppression support. The Refuge would maintain certain existing roads and trails as fire breaks and fire roads, and would evaluate needs for additional fire management facilities.

INTERAGENCY AND PUBLIC COORDINATION

The Service, Moapa Band of Paiutes, Southern Nevada Water Agency (SNWA), Moapa Valley Water District (MVWD), and Coyote Springs Investments, LLC (CSI) are signatories in a Memorandum of Agreement (MOA). In this MOA, the parties have identified certain conservation measures for the conservation and recovery of the Moapa dace, and have agreed to coordinate the monitoring, management and mitigation measures in their monitoring plans. The MOA establishes a Recovery Implementation Program (RIP) to outline and implement necessary protection and recovery activities for the Moapa dace. The MOA also provides for funding to develop the RIP, dedication of certain water rights to preserve in-stream flows, pumping restrictions whereby the parties agree to curtail pumping in the event spring flows in the Warm Springs area decline to specified "trigger levels." Any future production of groundwater by the parties would be subject to the terms of the MOA, including pumping that may occur after the two-year pump test or as a result of other groundwater development projects.

Recovery Implementation Team

The Service has established a Recovery Implementation Team for the Muddy River. The goal of the team is to develop an action plan, identify on-the-ground activities, and implement actions necessary for recovery and management of native and endangered species of the Muddy River watershed. Partners involved with this initiative include the Nevada Division of Wildlife, U. S. Geological Survey, The Nature Conservancy, University of Nevada, Reno, Clark County and the Southern Nevada Water Authority, and the Muddy River Regional Environmental Impact Alleviation Committee (MRREIAC).

Muddy River Regional Environmental Impact Alleviation Committee

The MRREIAC has begun an active program to enhance the Muddy River ecosystem. One aspect of the program is removing tamarisk and other weeds and restoring riparian habitat with native species. The communities of Moapa, Logandale, Glendale, and Overton support these activities. The program has received funding from the U.S. Environmental Protection Agency, the Service, and the Clark County MSHCP. If its conservation measures are determined to be effective, Clark County intends to continue to provide funding to assist MRREIAC.

The Service acknowledges the strong support of the Nevada Department of Wildlife and Clark County. The Service will continue to work with these agencies to maximize resource protection, enhancement, and public education for the expanded Refuge. The Service would seek partnerships with other agencies and neighboring landowners to meet mutual goals and objectives whenever possible. The Service would also pursue other partnerships to benefit resource management and public use, including interpretation and environmental education.

REFERENCES CITED

U. S. Fish and Wildlife Service. 1995. Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem. Portland, Oregon. 60pp.

Appendix M.
Response to Comments

SE ROA 13527

Appendix M. Responses to Comments

Introduction

The Draft Comprehensive Conservation Plan and Environmental Impact Statement (CCP/EIS) was available for public review and comment starting in July 2008. The comment period closed on September 9, 2008. Public meetings were held the week of August 4, 2008.

The following comment letters were received (in order of date received):

1. B. Sachau
2. Nevada Division of Water Resources
3. Wild Sheep Foundation
4. Lynn C. Miller
5. Jan Cameron
6. Larry Perkins Brundy
7. Hsiu Hui Lenford
8. Michael Lenford
9. Dot Astles
10. Lorraine Ealey
11. Sandra Kisner
12. Sheila J. Mason
13. Bruce Muise Jr.
14. Bruce Muise
15. Allan Pritcher
16. Marguerite Smallwood
17. Douglas Miller
18. Garry Scott McGuire
19. Clark County Department of Air Quality and Environmental Management
20. Bruce Burnett
21. Betty and Bob Davenport (and Kato)
22. The Nature Conservancy
23. Center for Biological Diversity
24. Ted Cassidy
25. Nevada Department of Cultural Affairs (Alice Baldrica)
26. Edward Wheeler
27. Nevada Department of Administration
28. Russell E. Waite
29. Clark County Department of Air Quality and Environmental Management
30. Brad Loveday
31. Red Rock Audubon Society (John E. Hiatt)
32. Nevada Power/Sierra Pacific Power (Eileen Wynkoop)
33. City of North Las Vegas (Gregory E. Rose)
34. Nevada Department of Wildlife (D. Bradford Hardenbrook)
35. Environmental Protection Agency
36. Defenders of Wildlife
37. Paul B. Aguirre
38. Southern Nevada Water Authority (John J. Entsminger)
39. Nellis Air Force Base (Sheryl K. Parker)
40. Gary and Darla Davis
41. Comments from Public Meetings

Letter 1

Bk1492@aol.com
07/13/2008 12:25 PM

To talktous@fws.gov
cc mark_pelz@fws.gov, americanvoices@mail.house.gov, comments@whitehouse.gov, foe@foe.org, information@sierraclub.org, today@nbc.com,
bcc
Subject re pahranagat and other plans for changing the 4 refuses in nevada 200 n 00064

For Follow Up: Normal Priority
History: This message has been forwarded.

ccp eis desert national wr

the scandal plagued us dept of interior has this plan to build up their administration building and visitor center, so they dont have to be outdoors i guess. now why would you work in this agency if you want to be ingovt concrete. i am very much opposed to more administration buildings that are huge cost expenses for taxpayers. what is simple is what should be used. not edifices like the pyramids which cost millions upon millions. 1-1

no action or decision on this plan should be made while bush cheney are in power in sin city washington dc - they are well known and notorious anti environmental and destroyers of the environment. put off any action until the new administration changes in jan 2009. crooked sin city washington dc only comes out with high destructive crooked, plans. is any friend of a politicians involved in this plan to make a killing for himself. 1-2

get sheep out of the refuge. they do not belong in the refuge. it should be for wildlife and wilde birds. national taxpayers sweated blood and tears to save that land. fws seems intent on destroying it--it is not managing for its purpose turning a refuge into a ranch for sheep. 1-3

b sachau
15 elm st
florham park nj 07932

SE ROA 13529

JA_6291

M.1 B. Sachau, July 13, 2008

Response 1-1: Comment acknowledged.

Response 1-2: Comment acknowledged.

Response 1-3: Comment acknowledged. Desert bighorn sheep, the primary management focus at Desert NWR, are native to the southwestern United States and northern Mexico. Domestic sheep are not allowed on the Refuge(s).

Letter 2

From: Nevada State Clearinghouse
Sent: Monday, July 14, 2008 9:47 AM
To: Robert K. Martinez
Subject: E2009-017 Desert National Wildlife Refuge Complex - US Fish & Wildlife Service

NEVADA STATE CLEARINGHOUSE
Department of Administration, Budget and Planning Division
209 East Musser Street, Room 200, Carson City, Nevada 89701-4298
(775) 684-0213 Fax (775) 684-0260

TRANSMISSION DATE: 7/14/2008

Division of Water Resources

Nevada SAI # E2009-017
Project: Desert National Wildlife Refuge Complex

Follow the link below to download an Adobe PDF document concerning the above-mentioned project
for your review and comment.
E2009-017

Please evaluate it with respect to its effect on your plans and programs; the importance of its contribution to state and/or local
areawide goals and objectives; and its accord with any applicable laws, orders or regulations with which you are familiar.

Please submit your comments no later than Wednesday, September 3, 2008.

Use the space below for short comments. If significant comments are provided, please use agency letterhead and include
the Nevada SAI number and comment due date for our reference.
Questions? Reese Tietje, (775) 684-0213 or clearinghouse@state.nv.us

____ No comment on this project __X__ Proposal supported as written

AGENCY COMMENTS:
All waters of the State belong to the public and may be appropriated for beneficial use pursuant 2-1

M.2 Nevada Division of Water Resources, July 14, 2008

Response 2-1: Comment acknowledged. We manage the surface and groundwater on the Refuges in accordance with applicable federal and state laws.

to the provisions of Chapters 533 and 534 of the Nevada Revised Statutes (NRS), and not
otherwise. Under all the proposed alternatives no use of surface water or groundwater is to occur 2-1
unless a permit or decreed water right is issued for such use under Nevada Water Law. Any
water or monitor wells, or boreholes that are proposed must be under a waiver and be drilled
within the described lands are the ultimate responsibility of the entity controlling the lands and 2-2
must be drilled, plugged and abandoned as required in Chapter 534 of the Nevada Administrative
Code (NAC). If artesian water is encountered in any well or borehole it shall be controlled as
required in NRS § 534.060(3). If any dam(s) are to be modified or removed under any of the
proposed action alternatives that action is to be done so in compliance with NRS Chapter 535 2-3
and NAC 535.

Signature: Robert K. Martinez, P.E.

Date: 7/16/2008

Response 2-2: Comment acknowledged. We will manage any wells or boreholes on the Desert Complex in accordance with applicable federal and state laws.

Response 2-3: Comment acknowledged. If we modify or remove any dam, such as the dam impounding Crystal Reservoir, the work will be completed in accordance with applicable federal and state laws.

Letter 3

WILD SHEEP Foundation

July 30, 2008

Cynthia Martinez
Desert National Wildlife Refuge Complex
4701 N. Torrey Pines Drive
Las Vegas, NV 89130

Re: CCP/EIS for the Desert National Wildlife Refuge Complex

Dear Ms. Martinez:

On behalf of the Wild Sheep Foundation (formerly FNAWS), I'd like to say thank you for allowing us the opportunity to comment on this very important issue. The Wild Sheep Foundation represents more than 10,000 wild sheep advocates worldwide and has generated more than $70 million for wild sheep conservation in North America.

The Foundation is in support of the U.S. Fish and Wildlife Services *proposed alternatives* in the Draft Comprehensive Conservation Plan and Environmental Impact Statement.

It appears to provide best management practices and safeguards the native wildlife resources; including bighorn sheep, and their habitats. 3-1

The Wild Sheep Foundation would also like to offer your agency additional assistance that may be needed to further educate the public and adjacent private landowners about the dangers that can be imposed on bighorn sheep if they are forced to share their habitats with domestic sheep and goats. 3-2

We applaud you in your attempt to sustain suitable habitat for the DNWR's wildlife resources. 3-3

Sincerely,

Neil Thagard
Director of Operations

720 Allen Ave. Cody, WY 82414 | tel: 1.307.527.6261 | fax: 1.307.527.7117 | e-mail: info@wildsheepfoundation.org | website: www.wildsheepfoundation.org

M.3 Wild Sheep Foundation, July 30, 2008

Response 3-1: Comment acknowledged.

Response 3-2: Comment acknowledged. We look forward to coordinating with the Wild Sheep Foundation for assistance with educational opportunities.

Response 3-3: Comment appreciated.

Letter 4

<landjmiller@sbcglobal .net>
08/04/2008 03:54 PM

To: <fw8plancomments@fws.gov>
cc:
Subject: Resident volunteers

Do you have a program for resident volunteers? My wife and I have volunteered at 3 National Wildlife Refuges for periods of 2 to 3 months and are looking for other interesting places to spend time volunteering. We are full-time RVer's. 4-1
Thanks,
Lynn C. Miller

M.4 Lynn C. Miller, August 4, 2008

Response 4-1: Ash Meadows, Desert, Moapa Valley, and Pahranagat NWRs have programs for resident volunteers. For more information, please contact the Desert NWR Complex headquarters at (702) 515-5450.

Letter 5

Public Input On
The Comprehensive Conservation Plan/
Environmental Impact Statement
Desert National Wildlife Refuge Complex

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT:

Page 5-14, Goal 4, second paragraph. Ash Meadows is located ~~so~~ not just "in the Amargosa Valley"; but "within the unincorporated township of Amargosa Valley". that is a very important difference to the local residents. 5-1

Figure 5 (after page 5-24), I cannot locate the area that is "modify/Remove Reservoir". This could be an important issue 5-2

NAME: Jan Cameron

AGENCY: Chair, Amargosa Valley Town Advisory Board

ADDRESS: HCR 69 Box 401-W
Amargosa Valley, NV 89020

PHONE: 775-372-1218

ASH

M.5 Jan Cameron, August 5, 2008

Response 5-1: Comment acknowledged. The CCP/EIS text has been revised to clarify that Ash Meadows NWR is located within the unincorporated township of Amargosa Valley.

Response 5-2: The legend for the map following page S-24 (Figure 6; also Figure 3.2-3 in the EIS) was revised to clarify that Crystal Reservoir is proposed for modification or removal, and the cross-hatch was shaded pink to make it more obvious.

Public Input On
The Comprehensive Conservation Plan/
Environmental Impact Statement
Desert National Wildlife Refuge Complex

Letter 6

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT:

I would like To See Alternative B at The moapa Valley NWR. 6-1

I am dif against Alternative C, I Cannot See any Perpose That would be Served by expansion. 6-2

NAME: Larry Perkins Brundy

AGENCY:

ADDRESS: P. O. Box 136
Moapa, Nevada 89025

PHONE:

MPV

M.6 Larry Perkins Brundy, August 6, 2008

Response 6-1: Comment acknowledged.

Response 6-2: Comment acknowledged. The primary purpose of the proposed expansion is the preservation of aquatic, wetland, and mesquite bosque habitats needed for the recovery and conservation of Moapa dace and other native wildlife species. Expansion of the Moapa Valley NWR boundary does not mean that any of the lands would automatically become part of the Refuge System, but would allow us to pursue management agreements, transfer, or purchase of land from willing sellers.

Letter 7

Public Input On
The Comprehensive Conservation Plan/
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Desert National Wildlife Refuge Complex

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COMMENT:

I'd be in Favor of plan C for the Moapa Valley area. 7-1

NAME: Hsiu Hui Lenford

AGENCY:

ADDRESS: PO Box 1248
Logandale NV 89021

PHONE: 702 398-7205

MPV

M.7 Hsiu Hui Lenford, August 6, 2008

Response 7-1: Comment appreciated.

Letter 8

Public Input On
The Comprehensive Conservation Plan/
Environmental Impact Statement
Desert National Wildlife Refuge Complex

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT:

I'd be in favor of plan C for the Moapa Valley area. 8-1

Also I'd be interested in having a property located at 750 N Saltbrush Ln include in any future aquisitions. 8-2

NAME: Michael Lenford

AGENCY:

ADDRESS: PO Box 1248
Logandale, NV 89021

PHONE: 702-398-7205

MPV

SE ROA 13545

JA_6307

M.8 Michael Lenford, August 6, 2008

Response 8-1: Comment appreciated.

Response 8-2: We appreciate your interest in having your property included in the Moapa Valley NWR acquisition boundary. Refuge staff will contact you to discuss this possibility.

Letter 9

Public Input On
The Comprehensive Conservation Plan/
Environmental Impact Statement
Desert National Wildlife Refuge Complex

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT:

We need the CAMP GROUND open.
We use it in FALL + SPRING on our way 9-1
home FROM AZ + on our way down to AZ.
THANK YOU
DOT ASTLES

NAME: DOT ASTLES

AGENCY:

ADDRESS: APT 230 - 5450 - 203 ST
LANGLEY BC V3A5V1

PHONE:

PHR

SE ROA 13547

JA_6309

M.9 Dot Astles, August 7, 2008

Response 9-1: We appreciate your input about the campground at Pahranagat NWR and its value to travelers. At this stage, our preferred alternative is to convert the campground to day-use only. Our primary reason for this position is that Pahranagat NWR lacks the staff and resources to effectively manage the campground in a manner that does not conflict with priorities for refuge management established by Congress in the National Wildlife Refuge System Improvement Act. Bureau of Land Management lands adjacent to Pahranagat NWR are open to camping.

Public Input On
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Letter 10

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT:

Please keep the campground open. The travelers leaving az + heading for the northern states + Canada need this stop over, + often times plan a 2 week stay here on their way home, and it should be a 2 week stay. I have seen this campground full in mar + april. The towns people + the business need the RVers. 10-1

I have 4 motor homes (friends) that stop every year for the last 4 years + spend 2 weeks here. Its a resting place before heading home.

NAME: Lorraine Exley
AGENCY: Volenteer at Pahranagat - and RKCR
ADDRESS: 4970 N Topeka Ave
CASCADE CO. 80809

PHONE: 610-216-6109

PHR

SE ROA 13549

JA_6311

M.10 Lorraine Ealey, August 7, 2008

Response 10-1: See Response 9-1.

Letter 11

Public Input On
The Comprehensive Conservation Plan/
Environmental Impact Statement
Desert National Wildlife Refuge Complex

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT: WE would like "OUR" Refuge BACK. 11-1

1. OPEN up CAmping like it WAS - 2WEEK - USE of GENERATORS + Etc

SAFety FActoR 2. move Rocks so people CAN pull off ROAD to look AT wildlife 11-2

3. UNlock gates At lower LAKE. So people CAN WATCH wildlife

4. Get Rid of Speed Bumps

5. Put TRASH CANS BAck AT EACH CAmp site + AT RESTROOMS

WHAT A WASTE of MONEY 6. GET Rid of SIGNS THERE IS NO ONE to EnforcE THEM. 11-3

7. Vistors Center (to be built) NEEDS to BE At lAKE not At headquarters 11-4

8. A small fee could BE CHARGED to CAmp. 11-5

9. Alot of talk About EDUCATION - if NO ONE CAN REAlly use it. 11-6

Dont close down to foot Traffic only, too MANY people CANT WAlk IN 11-7

NAME: SANDRA KISNER

AGENCY: Alamo USER

ADDRESS: P.O. Box 612
Alamo, NV 89001

PHONE: 775-725-3590

PHR

SE ROA 13551

JA_6313

M.11 Sandra Kisner, August 7, 2008

Response 11-1: Comment acknowledged.

Response 11-2: We appreciate your input about the Pahranagat NWR campground and your suggestions for changes to the area. At this stage, our preferred alternative is to convert the campground to day-use only. Our primary reason for this position is that Pahranagat NWR lacks the staff and resources to effectively manage the campground in a manner that does not conflict with priorities for refuge management established by Congress in the National Wildlife Refuge System Improvement Act. Bureau of Land Management lands adjacent to Pahranagat NWR are open to camping.

Response 11-3: Comment noted.

Response 11-4: The existing headquarters site was selected for the new visitor contact station for several reasons. First, the site is already disturbed and utilities are present so it would be most cost effective. Second, the location near Upper Pahranagat Lake would likely have a greater impact on wildlife due to the presence of sensitive riparian habitat.

Response 11-5: See Response 11-2.

Response 11-6: The preferred alternative was revised in the Final CCP/EIS to eliminate the foot access–only restriction in the day use area.

Response 11-7: See Response 11-6.

There are local families who take the family and camp out for the weekend and go fishing. Great place close to home. 11-8

The Snow Birds ("RV'ers") who USED TO stop and stay for 2 weeks. They were a big help to the Refuge. They went for walks and filled bags full of trash. Plus they spent money in Alamo (grocery - food - gas) 11-9 We need that. Now these people don't stop at all. They gas in Vegas and don't stop until Ely or Jackpot.

Response 11-8: See Response 11-2. Also note that Pahranagat NWR will continue to be open to fishing under the preferred alternative.

Response 11-9: Your comment regarding the benefit of "snowbirds" to the Refuge and local community is noted. We understand that converting the campground to a day use area may have an effect on the visitation by some user groups. We anticipate that any declines in visitation resulting from the campground closure will be at least partially offset by new visitors drawn by improvements to the visitor services program. For example, the preferred alternative includes development of new trails, interpretive panels, wildlife observation/photo blinds, and a new visitor contact station with interpretive exhibits.

Letter 12

Public Input On
The Comprehensive Conservation Plan/
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Desert National Wildlife Refuge Complex

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT:

PAHRANAGAT NWR

ALTERNATIVE D IS VERY COMPREHENSIVE AND I LIKE IT. 12-1

HOWEVER, I WOULD LIKE TO SEE MORE CONSIDERATION GIVEN TO:

(1) A DEFINITE SHORT TERM PLAN TO PROVIDE FISHING AT THE LAKE. LOCAL PEOPLE GET A LOT OF PLEASURE FROM THIS 12-2

(2) PROVIDE MORE ACCESSIBLE WALKING TRAILS 12-3

(3) PUT THE VISITORS CENTER AT THE UPPER LAKE 12-4

(4) RETAIN THE VEHICLE CAMPING AREAS 12-5

NAME: SHEILA J. MASON

AGENCY:

ADDRESS: P.O. BOX 600
ALAMO NV 89001

PHONE: 775/725-3504

PHR

SE ROA 13555

JA_6317

M.12 Sheila J. Mason, August 7, 2008

Response 12-1: Comment appreciated.

Response 12-2: Comment noted. Under the preferred alternative, Pahranagat NWR would continue to be open to fishing. However, until safety issues regarding the dam that impounds Upper Pahranagat Lake are resolved, opportunities will likely be limited.

Response 12-3: The CCP/EIS preferred alternative includes the development of new interpretive/wildlife observation trails on Pahranagat NWR.

Response 12-4: The existing headquarters site was selected for the new visitor contact station for several reasons. First, the site is already disturbed and utilities are present so it would be most cost effective. Second, the location near Upper Pahranagat Lake would likely have a greater impact on wildlife due to the presence of sensitive riparian habitat.

Response 12-5: See Response 11-2.

Public Input On
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Letter 13

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT:

Please don't close down the campground. we use it every year on our way home for 2 weeks. There are 3 units with me every year when we stop in. 13-1

Thank you

NAME: Bruce Muise JR

AGENCY:

ADDRESS: 9663 104th Ave
Grand Parrie
AB Canada T8BL9

PHONE:

PHR

M.13 Bruce Muise Jr., August 7, 2008

Response 13-1: Comment noted. See Response 9-1.

Letter 14

Public Input On
The Comprehensive Conservation Plan/
Environmental Impact Statement
Desert National Wildlife Refuge Complex

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT:

PLEASE KEEP THE CAMP GROUND OPEN FOR US RVERS. WE STOP IN EVERY YEAR ON OUR WAY HOME. 14-1

THANK YOU

NAME: BRUCE MUISE

AGENCY: c/o Jack Stobbert

ADDRESS: #6 Blane Rd
RR L Lone Butte, BC V0K 1X0

PHONE:

PHR

M.14 Bruce Muise, August 7, 2008

Response 14-1: Comment noted. See response to comment 9-1.

Public Input On
The Comprehensive Conservation Plan/
Environmental Impact Statement
Desert National Wildlife Refuge Complex

Letter 15

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT:

POSS. ESTABLISH A SEPERATE SWIMMING PROTECTED AREA (OR SMALL BEACH AREA). THE AREA COULD BE EASILY ESTABLISHED WITHOUT SPENDING VERY MUCH MONEY. 15-1

— — — —

OPEN UP ADDITIONAL CAMPING AREAS 15-2

— — — —

POSS - SET UP VENDOR STANDS FOR THE AREA 15-3

FLEXIBLE STAY TIMES 15-4

NAME:

AGENCY: Allan Pritcher FOR MAIL

ADDRESS: PO Box 251
Alamo, NV 89001-0251

PHONE: 775-725-3720 (MESSAGE)

PHR

M.15 Allan Pritcher, August 7, 2008

Response 15-1: Comment noted. Pahranagat NWR has been and will continue to be closed to swimming due to the potential for wildlife disturbance and conflicts with higher priority public uses.

Response 15-2: See Response 11-2.

Response 15-3: See Response 11-2. Vendors (concessionaires) on refuges are regulated according to U.S. Fish and Wildlife Service Policy 8, Refuge Manual 17. This policy prohibits us from allowing concessionaires on wildlife refuges such as Pahranagat Wildlife Refuge when commercial goods and services are available in close proximity (Alamo).

Response 15-4: See Response 11-2.

Letter 16

Public Input On
The Comprehensive Conservation Plan/
Environmental Impact Statement
Desert National Wildlife Refuge Complex

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Page 1

COMMENT:

1. Crop rotation = what ducks & geese ~~eat~~ to entise them to come back again & again. 16-1

2. Camping = set amount of time – supervised & control
Day use = same possibly reservations as by use progresses. 16-2

3. Fishing = only small paddle craft set amount of time in water & where = controlled & supervised 16-3

(2&3) (This is a wildlife Reserve for people to observe, learn, & enjoy. Period. (not to stay for whatever time, do their laundry, their dogs to run all over, and loud music & yelling.) 16-4

4. A/c Visitors Center Building enclosed observation area. Programs for schools, visitors, organizations etc. 16-5

Con'td 2

NAME: Marguerite Smallwood

AGENCY: (pg 1, 2 & 3,)

ADDRESS:

PHONE:

PHR

SE ROA 13563

JA_6325

M.16 Marguerite Smallwood, August 7, 2008

Response 16-1: Comment noted. The restoration planning effort for Pahranagat NWR has been initiated and will consider the best means for providing foraging habitat for sandhill cranes and other waterbirds.

Response 16-2: See Response 11-2.

Response 16-3: We appreciate your input regarding fishing at Pahranagat NWR. Your input will be considered as we develop a fisheries management plan.

Response 16-4: Comment acknowledged. See Responses 11-2 and 16-3.

Response 16-5: The preferred alternative includes construction of a new visitor contact station. The specific design of the visitor contact station will be addressed in a step-down NEPA document. Your input on its features is appreciated and will be considered.

Public Input On
The Comprehensive Conservation Plan/
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If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

Page 2 **COMMENT:**

Visitors store = books, mag, calendars, paintings, wildlife figures, art. (Not a convenient store or all items from China.!! 16-5

Employment & Volunteers 16-6

Good entrance - proper parking areas - some roads & areas black top. 16-7

Landscape = Replace trees, plant more trees & more trees!! 16-8

Meetings = need more meetings on progress of plans to keep & promote more interest for volunteers, donations, etc. to assist in making P.V. Lakes a beautiful assest to Nevada. 16-9

Cont'd 3

NAME:

AGENCY:

ADDRESS:

PHONE:

PHR

Response 16-6: Comment acknowledged.

Response 16-7: Comment acknowledged. The preferred alternative includes the development of additional parking as well as new turn lanes off the highway so visitors can more safely enter and exit Pahranagat NWR.

Response 16-8: Comment noted. The restoration planning effort has been initiated and will evaluate opportunities for restoring riparian habitat (such as willows and cottonwood trees) at Pahranagat NWR.

Response 16-9: Comment acknowledged. We plan to provide periodic updates to the local community as the restoration planning effort progresses.

Public Input On
The Comprehensive Conservation Plan/
Environmental Impact Statement
Desert National Wildlife Refuge Complex

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

Pg 3 **COMMENT:**

Nevada has not invested enough care, time, or money into the natural resources they have to entice visitors, only gambling, hotels, & such (commerical)! 16-10

Roadside rests in Nevada have always been few & far between. Just a fast bathroom stop for people & dogs. 16-11

There's probably more that could be said but that can be, hopefully, at another meeting.

This has been put together by surveying family members, friends, fellow workers, students & recreation club members that live in Clark Cty. and Pahranagat Valley - Nevada.

NAME: Marguerite Smallwood
AGENCY: Resident of Nevada since 1961 (Pahranagat Valley since 1966.)
ADDRESS: Box 479
Alamo, Nevada 89001

PHONE: 702-631-0048

PHR

Response 16-10: Comment acknowledged.

Response 16-11: Comment acknowledged.

Letter 17

Public Input On
The Comprehensive Conservation Plan/
Environmental Impact Statement
Desert National Wildlife Refuge Complex

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT:

WHY DON'T YOU GO BACK TO INVITING THE PUBLIC TO ENJOY THIS BEAUTIFUL NATURAL RESOURCE - PREVIOUS MANAGERS HAVE PLANNED FOR HIKING TRAILS YOUTH GROUP ACTIVITIES, CAMPING ETC ON THE REFUGE, I BELIEVE THAT THESE ACTIVITIES CAN PEACEFULLY CO EXIST WITH THE PRIMARY FUNCTION OF THE REFUGE, WILDLIFE MANAGEMENT. PUBLIC LANDS CAN AND SHOULD BE A REFUGE FOR BOTH MANKIND AND WILDLIFE. 17-1

NAME: DOUGLAS MILLER
AGENCY: ALAMO POWER DISTRICT
ADDRESS: 233 N. MAIN STREET
BOX 189, ALAMO 89001

PHONE: 725-3335

PHR

M.17 Douglas Miller, August 7, 2008

Response 17-1: Comment acknowledged. We agree that the primary function of Pahranagat NWR is wildlife management and that visitors should be allowed to enjoy Refuge resources. Congress has established clear priorities for public uses on refuges in the National Wildlife Refuge System Improvement Act of 1997: hunting, fishing, wildlife observation, photography, environmental education, and interpretation. The Improvement Act requires us to give these priority public uses enhanced consideration over other uses in planning and management. With this in mind, we developed plans in the preferred alternative to maximize opportunities for the priority public uses in a manner that is compatible with Refuge purposes and available staffing and funding.

Public Input On
The Comprehensive Conservation Plan/
Environmental Impact Statement
Desert National Wildlife Refuge Complex

Letter 18

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT:

from a former Volunteer at Pahranagat –
I should like to see the refuge achieve it's potential, this would be a real show place as Bosque Del Apache is in New Mexico – where I also Volunteered. The first and most important step has been taken, the long awaited departure of Mr. Merry Maxwell. The residents of Alamo have long waited for this day – Please do not Consider Closing the Campground – Many wonderful Visitors Come, Many dedicated birders, the majority from Canada, the refuge does not need law enforcement 18-1
however educational programs would be a necessary tool for the guest that fail to comply to rules and regulations 18-2

NAME: Harry Scott McDaniel

AGENCY: Retired – Volunteer for Various government agencies

ADDRESS: P.O Box 137
Alamo Nevada 8900

PHONE: 775 725 3201

PHR

SE ROA 13571

JA_6333

M.18 Garry Scott McGuire, August 7, 2008

Response 18-1: Comment noted. Please see Response 11-2.

Response 18-2: Please see Response 11-2. The preferred alternative does include expansion of environmental education and interpretative programs on Pahranagat NWR.

Public Input On
The Comprehensive Conservation Plan/
Environmental Impact Statement
Desert National Wildlife Refuge Complex

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT:

There is interest for the refuge here among the residents. However due to the fact of poor management at Pahranagat the town's people have withdrawn, many comment forms I passed out, yet only a few responded.
Time it will take to regain their support - it is here just needs to be cultivated. This can be achieved thru good site management. The support of the Vegas office and Mr. Jim Pedro are your greatest asset's - Thank you 18-3

NAME: Respectfully

AGENCY:

ADDRESS: Gary Scott McGuire

PHONE:

PHR

Response 18-3: Comment acknowledged. We look forward to working with the residents of Alamo in the future.

Letter 19

DAQEM

DEPARTMENT OF AIR QUALITY & ENVIRONMENTAL MANAGEMENT
500 S Grand Central Parkway 1st Fl · Box 555210 · Las Vegas, NV 89155-2510
(702) 455-5942 · Fax (702) 383-9994
Lewis Wallenmeyer Director · Alan Pinkerton Assistant Director · Tina Gingras Assistant Director

August 13, 2008

Cynthia Martinez
Desert National Wildlife Refuge Complex Manager
U.S. Fish and Wildlife Service
4701 N. Torrey Pines Drive
Las Vegas, NV 98130

RE: Request/comment to adjust the proposed boundary for the Desert National Wildlife Refuge Complex

Dear Ms. Martinez:

Thank you for the opportunity to review and comment on the Draft Comprehensive Conservation Plan/Environmental Impact Statement for the Desert National Wildlife Refuge Complex in southern Nevada. As you are aware, the Clark County Department of Air Quality and Environmental Quality, Desert Conservation Program administers the Clark County Multiple Species Habitat Conservation Plan (MSHCP) on behalf of the Nevada Department of Transportation, County and Cities of Boulder City, Henderson, Las Vegas, Mesquite and North Las Vegas (the Permittees) to maintain compliance with an Endangered Species Act Section 10(a)(1)(B) incidental take permit, # TE034927-0. Condition K.1 of that permit states that take is conditioned upon the acquisition of private lands in desert riparian habitats along the Muddy and Virgin rivers, and Meadow Valley Wash.

To meet this condition, we have funded the acquisition of several parcels from willing sellers in the upper Muddy River area. Specifically, Clark County provided funding and directed The Nature Conservancy to purchase five parcels within the 100-year floodplain of the Muddy River and adjacent to the Muddy River for the purpose of conservation of native species and their habitats.

These parcels are identified by the Clark County Assessor's office by parcel numbers: 19-1

030 225 01 004	6.30 acres	aka "Alamo" parcels
030 22 501 022	6.30 acres	aka "Alamo" parcels
030 23 201 003	25.06 acres	aka "Shirley Perkins" parcel
030 26 601 001	18.65 acres	aka "Henrie" parcels
030 26 601 002	16.52 acres	aka "Henrie" parcels

M.19 Clark County Department of Air Quality and Environmental Management, August 13, 2008

Response 19-1: We agree that addition of the referenced properties to the proposed Moapa Valley NWR expansion makes sense from a riparian landscape management perspective. The CCP/EIS and land protection plan have been revised to include these lands as requested.

We request that the proposed boundary for the Refuge be adjusted to include these parcels, as their inclusion would serve to keep these properties managed for the benefit of wildlife and conservation. The Nature Conservancy currently manages these parcels through funding from Clark County. While The Nature Conservancy of Nevada currently holds title to those parcels, the County retains first right of refusal on each of them. Potential inclusion of this property in the Refuge should be considered from a riparian landscape management perspective. 19-1

For additional information about these properties, or if you have any questions about this request, please contact Marci Henson at (702) 455-3118.

Sincerely,

L. Wallenmeyer

Lewis Wallenmeyer, Director
Clark County Department of Air Quality and Environmental Management

cc Marci Henson, Clark County Desert Conservation Program
Phil Rosenquist, Clark County
Kathryn Landreth, The Nature Conservancy

CLARK COUNTY NEVADA DAQEM

Letter 20

Cynthia Martinez/R8/FWS/DOI
08/14/2008 09:56 AM

To Mark Pelz/SAC/R1/FWS/DOI@FWS, "Leslie Wagner" <lwagner@swca.com>
cc
bcc
Subject Fw: Public comments re: Moapa Palms removal at Warm Springs

FYI

<><><><><><><><><><><><><><><><><>
Cynthia Martinez
Manager
Desert National Wildlife Refuge Complex
U.S. Fish and Wildlife Service
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
Phone: 702-515-5450
Fax: 702-515-5460
----- Forwarded by Cynthia Martinez/R8/FWS/DOI on 08/14/2008 09:55 AM -----

"Bruce Burnett" <utahbee@gmail.com>
08/13/2008 03:04 PM

To <Amy_Sprunger@fws.gov>, <Kevin_DesRoberts@fws.gov>, <Cynthia_Martinez@fws.gov>, <Shawn_Goodchild@fws.gov>
cc
Subject Public comments re: Moapa Palms removal at Warm Springs

I really do hope that we aren't paying to have these trees removed. I grew up near the springs and feel that the truth of matter is that the trees have always been there. Birds could easily have dropped seeds even before our Natives lived in the area. 20-1
Regards,

Bruce Burnett

SE ROA 13579

JA_6341

M.20 Bruce Burnett, August 13, 2008

Response 20-1: Moapa Valley NWR was established to protect the Moapa dace and its habitat. Our restoration and management is focused on achieving this Refuge purpose. Our policy regarding palm trees is to remove trees that are adversely affecting the hydrology of springs and channels on Moapa Valley NWR. We also remove and/or trim palm trees that could increase the risk of wildfire spreading on or off the Refuge.

Letter 21

Cynthia Martinez/R8/FWS/DOI
09/05/2008 10:34 AM

To Mark Pelz/SAC/R1/FWS/DOI@FWS, lwagner@swca.com
cc
bcc
Subject Fw: Comments on CCP?EIS for Pahranagat NWR

FYI

<><><><><><><><><><><><><><><><>
Cynthia Martinez
Manager
Desert National Wildlife Refuge Complex
U.S. Fish and Wildlife Service
4701 N. Torrey Pines Drive
Las Vegas, Nevada 89130
Phone: 702-515-5450
Fax: 702-515-5460
----- Forwarded by Cynthia Martinez/R8/FWS/DOI on 09/05/2008 10:32 AM -----

Betty <bettyplusbob@gmail.com>
08/22/2008 10:41 AM

To Merry_Maxwell@fws.gov, cynthia_martinez@fws.gov, Kevin_DesRoberts@fws.gov
cc
Subject Comments on CCP?EIS for Pahranagat NWR

Betty and myself have read The Desert National Wildlife Complex Draft (CCP?EIS). It looks like somebody has come up with some great ideas. 21-1
We found the draft easy to understand. We are mainly interested in The Pahranagat NWR portion. We hope the trail system will be built along with three observations sites and platforms. We know these will great benefit the public as they are at Bill Williams and Cibola NWRS where we have volunteer. 21-2
The plans to restore the Black canyon riparian corridor will be an asset as it is a important nesting area for waterfowl and shorebirds. The Sandhill Cranes use the Middle & North Marsh as resting areas. They are seldom there longer than overnight as their is no food for them on the refuge. 21-3

In converting the campground into a day park, where would the cars be parked? We disagree with no vehicles access allowed. Reason is because the distance to reach the Upper Lake will be difficult for the elderly, disabled small children (with their parents). 21-4
From past experience where fees are collected, ususally an use the iron range is used; someone with law enforcement powers to collect the fees and check the area for non compliance. Pahranagat' location along the major route from the Northwest to the southwest has the potential to be a show place for US Fish & Wildlife. 21-5

We have sold the motor home and our tow gear and moved into a senior citizen apartment house in Meridian, Idaho. Betty has to be near medial facilities which ends our traveling far and wide. However, we are planning on driving to Alamo and the refuge to see Jim, Joyce and our friends. We are now considering the first or second week in October.

M.21 Betty and Bob Davenport (and Kato), August 22, 2008

Response 21-1: Comment appreciated.

Response 21-2: Comment noted. The preferred alternative includes development of new trails and wildlife observation/photo blinds.

Response 21-3: Comment noted. The restoration planning effort, which has been initiated, is evaluating management options for sandhill cranes on Pahranagat NWR.

Response 21-4: Comment noted. The preferred alternative was revised in the Final CCP/EIS to eliminate the foot-access restriction in the day use area.

Response 21-5: Comment noted. We agree that Pahranagat NWR's strategic location and diversity of resources are a value to the public.

Letter 22

The Nature Conservancy

Protecting nature. Preserving life.™

THE NATURE CONSERVANCY

Northern Nevada Office
One East First Street, #1007
Reno, NV 89501

Tel 775-322-4990
Fax 775-322-5132

Southern Nevada Office
1771 East Flamingo Road, Ste. 104A
Las Vegas, NV 89119

Tel 702-737-8744
Fax 702-737-5787

August 25, 2008

Cynthia Martinez
Desert National Wildlife Refuge Complex Manager
U.S. Fish & Wildlife Service
4701 N. Torrey Pines Drive
Las Vegas, NV 98130

RE: Request / Comment pertaining to adjustment of the proposed boundary for the Desert National Wildlife Refuge Complex / Moapa Valley NWR

Dear Ms. Martinez,

Thank you for providing The Nature Conservancy (TNC) with an opportunity to review and comment on the Draft Comprehensive Conservation Plan / Environmental Impact Statement for the Desert National Wildlife Refuge Complex in southern Nevada (Draft CCC).

As you are aware, Clark County's Department of Air Quality and Environmental Quality, through its Desert Conservation Program and its administration of the Clark County Multiple Species Habitat Conservation Plan (MSHCP), has funded the acquisition by TNC of several parcels from willing sellers in the upper Muddy River area. Using this funding, TNC purchased a number of parcels within the 100-year floodplain of the Muddy River. These parcels were purchased in order to conserve and preserve native species and the habitat upon which those species depend. As noted in a previous letter from Clark County to you, dated August 13, 2008, the parcels relevant to the Draft CCC are identified by the Clark County Assessor's office by the following parcel numbers:

22-1

030 225 01 004	6.37 acres	aka "Alamo" parcels
030 22 501 022	6.30 acres	aka "Alamo" parcels
030 23 201 003	25.06 acres	aka "Shirley Perkins" parcel
030 26 601 001	18.65 acres	aka "Henrie" parcels
030 26 601 002	16.52 acres	aka "Henrie" parcels

The Conservancy holds title to these parcels, while Clark County holds the right of first refusal. Clark County has written in support of inclusion of these properties in the Moapa Valley NWR

SE ROA 13583

JA_6345

M.22 The Nature Conservancy, August 25, 2008

Response 22-1: Comment appreciated. See Response 19-1.

boundaries. TNC also supports the inclusion of these properties within the boundary of the Moapa Valley NWR. 22-1

Please do not hesitate to contact me at (702) 737-8977 x 12 if you have any further questions.

Sincerely,

Mauricia M.M. Baca
Southern Nevada Project Director
The Nature Conservancy

cc Lewis Wallenmeyer, Director, Clark County Department of Air Quality and Environmental Management
Marci Henson, Clark County Desert Conservation Program
Kathryn Landreth, Nevada State Director, The Nature Conservancy

Letter 23

CENTER *for* BIOLOGICAL DIVERSITY

Mr. Mark Pelz
Chief, Refuge Planning
Region 8
U.S. Fish and Wildlife Service
2800 Cottage Way, Room W-1832
Sacramento, CA 95825-1846

August 27, 2008

Re: Draft Comprehensive Conservation Plan and Environmental Impact Statement for the Desert National Wildlife Refuge Complex – Comments sent via e-mail and USPS

Dear Mr. Pelz:

Thank you for the opportunity to comment on the Draft Comprehensive Conservation Plan and Environmental Impact Statement for the Desert National Wildlife Refuge Complex . I am offering the following comments on behalf of the Center for Biological Diversity (Center).

The Center for Biological Diversity is a national nonprofit conservation organization with more than 180,000 members and online activists dedicated to the protection of endangered species and wild places, including members in the State of Nevada who recreate and care about the management of the Desert National Wildlife Complex of Refuges.

Our primary concern is that the Fish and Wildlife Service (Service) take all steps necessary to secure the water, both surface and ground water, required for the refuges to be able to fulfill their respective purposes under their enabling legislation. As you are well aware, there are intense battles now being fought in Nevada over the rights to water, and the Service must actively engage to protect the life blood of these refuges. We are equally concerned with the future sources of water, and how they may be impacted by up-stream and up-flow water developments and diversions. The Service has done an inadequate job of describing how water rights will be protected or acquired in the draft documents. 23-1

Another over-arching concern is that Appendix K does not provide an adequate analysis of the resources necessary for the refuges to fulfill their purposes and missions. While it does provide a project perspective, it fails to identify the base staffing and funding levels needed. For instance, while the Desert NWR was largely established to provide protection of the desert bighorn sheep, it currently does not employ a desert big horn biologist. The final plan and EIS for each refuge must identify the key skills needed for the successful stewardship of them, and the budget required to sustain this staffing. 23-2

Refuge specific comments now follow.

Ash Meadows NWR:

- The Center feels that Alternative C would best meet the refuge's purpose as it aggressively pursues habitat restoration and rehabilitation and an emphasis on the protection of rare endemic species. 23-3

Arizona . California . Nevada . New Mexico . Alaska . Oregon . Montana . Illinois . Minnesota . Vermont . Washington, DC
4261 Lily Glen Ct . Las Vegas, NV 89032 tel: (702) 249.5821 fax: (702) 638.4261 www.BiologicalDiversity.org

M.23 Center for Biological Diversity, August 27, 2008

Response 23-1: The preferred alternative for each refuge includes measures to protect water resources for the species that depend upon them. See Response 39-13. In addition, the preferred alternative for Pahranagat includes acquiring additional water rights from willing sellers.

Response 23-2: Please see Appendix K, Table 3 which includes the estimated salary and non-salary operation and maintenance cost to fully implement the CCP. This table identifies both existing and proposed staffing. The purpose of the CCP is to identify these needs over a 15-year span. New positions are subject to availability of funding.

Response 23-3: Comment appreciated.

- This refuge is critically important to many species of imperiled plants and animals, as the draft documents properly acknowledges. The protection and recovery of these species should be the driving criteria for any management. 23-4
- The plan and EIS should address the relationship between and any impacts to the Devils Hole component of Death Valley National Park, specifically any potential hydrologic impacts to desert pupfish habitat; 23-5
- The issue of water rights and mitigation and avoidance of future up-flow water developments is of critical importance. 23-6

Desert NWR:

- The Center believes that Alternative C would best meet the refuge's purpose. 23-7
- We would recommend adding fencing along the southern boundary of the refuge to provide needed protections from the population sprawl pushing up to the boundary. 23-8
- While in general the move to use of prescribed natural fire is to be lauded, it is not appropriate in all ecosystems. We would like to see the final plan and EIS specifically map areas on the NWR where natural fires would be consciously used as a management tool. 23-9

Moapa Valley NWR:

- The Center supports Alternative C, which would aggressively add lands to the refuge for the restoration and protection of species such as the Moapa dace and Southwestern willow-flycatcher. 23-10
- The issue of water rights and mitigation and avoidance of future up-flow water developments is of critical importance. 23-11

Pahranagat NWR:

- The Center supports Alternative D with its emphasis on restoration and species protection over recreational pursuits. 23-12
- As with the other refuges, the issue of water rights and the mitigation and avoidance of future up-flow and up-stream water developments is of critical importance. 23-13

After six years of effort, The Service has largely succeeded in meeting its responsibilities under the National Wildlife Refuge System Improvement Act of 1997. 23-14

Thank you again for this opportunity to provide input.

Sincerely yours in responsible stewardship,

Rob Mrowka

Rob Mrowka
Nevada Conservation Advocate

Response 23-4: Comment appreciated.

Response 23-5: Comment acknowledged. We have added a hydrology research strategy (2.2.10) to pursue funding and implement the Ash Meadows Embedded Model within the Death Valley Regional Flow Model to address these concerns and better understand these data gaps. Furthermore, whenever we plan restoration projects on the Refuge, our Section 7 consultation includes the Devils Hole pupfish.

Response 23-6: Comment acknowledged.

Response 23-7: Comment appreciated.

Response 23-8: Fencing the southern boundary is included in Alternative C.

Response 23-9: We agree that fire is not beneficial in all landscapes. The alternatives maps in the final CCP have been revised to show areas where fire may be managed for resource benefits. The text of the Final EIS has been changed to provide more clarity.

Response 23-10: Comment appreciated.

Response 23-11: Comment acknowledged.

Response 23-12: Comment appreciated.

Response 23-13: Comment acknowledged.

Response 23-14: Comment appreciated.

Letter 24

Ted.Cassidy@snwa.com
08/29/2008 09:43 AM

To: fw8plancomments@fws.gov
cc:
Subject: CCP/EIS comments

Dear Sir:

I would like to comment on the plans for the Pahranagat NWR. I am concerned with the plans to reduce the acreage open to hunting there. I am actually more concerned about the lack of consideration given to hunter's needs in management of the refuge. Specifically, the Middle Marsh has been allowed to be completely overgrown with reeds. I tried to hunt in the Marsh two seasons ago. I set out decoys in the small open water areas. My son and I knocked down eight ducks but we only found three despite hours of searching. I have not tried again since. Talking to other hunters, this is typical of the experience in the Marsh. This is very wasteful. Hunters need several open water areas large enough so that shot ducks will fall in open water. 24-1

I understand in the past the marsh was regularly burned off to maintain open water. It would be preferable to actually bulldoze out some open areas when the area is dry. This of course would benefit both the hunters and the ducks. 24-2

I know other hunters share my frustrations. Among them is Carl Dennison (702)308-1171 who does not have email access.

Sincerely,

Ted Cassidy
189 Kachina Drive
Henderson, NV 89074

M.24 Ted Cassidy, August 29, 2008

Response 24-1: We have modified the preferred alternative in the Final CCP/EIS to maintain the existing upland game hunting area.

Response 24-2: Your input on management of the marsh is appreciated. The restoration planning effort which has been initiated will explore options for improving marsh habitat.

STATE OF NEVADA
DEPARTMENT OF CULTURAL AFFAIRS
State Historic Preservation Office
100 N. Stewart Street
Carson City, Nevada 89701
(775) 684-3448 • Fax (775) 684-3442
www.nvshpo.org

Letter 25

JIM GIBBONS
Governor

MICHAEL E. FISCHER
Department Director

RONALD M. JAMES
State Historic Preservation Officer

September 2, 2008

MEMORANDUM

TO: Nevada State Clearinghouse

FROM: Alice Baldrica, Deputy SHPO Alice M Baldrica

SUBJECT: Desert National Wildlife Refuge Complex Comprehensive Conservation Plan and Environmental Impact Statement E 2009-017

Thank you for the opportunity to comment on the above referenced documents. The Nevada Historic Preservation office (SHPO) shares a programmatic agreement (PA) with the U.S. Fish and Wildlife Service regarding the management of cultural resources under Section 106 and 110 of the National Historic Preservation Act. Many routine undertakings are carried out without the involvement of the Nevada SHPO and are reported on annually. Preparation and implementation of a new plan falls outside the bounds of "routine undertaking" and the SHPO wishes to comment on alternatives that other than "no action" that require habitat modification and increased public visitation.

Although our two agencies agree that sponsoring public outreach activities is a means of educating the public about the need to care for cultural resources, we request that the U S Fish and Wildlife Service involve more than just the tribes in selecting cultural resources for further protection or interpretation. SHPO supports Goal 5 Objective 1 of the Goals, Objectives and Strategies for the Preferred Alternative (Appendix F) which recommends preparation of a cultural resources management plan. We request that data on archaeological resources be shared with SHPO within the State's NVCRIS database. 25-1

Regarding selecting sites for preservation and further protection, it would be appropriate to consult with more than just tribes and the public – the SHPO requests that the U. S. Fish and Wildlife Service consult with SHPO in the decision to interpret specific sites and recommends that organizations such as the Nevada Rock Art Foundation be involved in the process. 25-2

Last, the U. S. Fish and Wildlife Service does not need to create a site stewardship program as such a program is already in existence. George Phillips serves as the coordinator for Clark County and Sali Underwood serves the remainder of the state including Lincoln and Nye counties. We urge the agency to work with the site stewardship coordinators to organize volunteers to serve the refuge. 25-3

M.25 Nevada Department of Cultural Affairs (Alice Baldrica), September 2, 2008

Response 25-1: Comment acknowledged. We will coordinate with the SHPO during preparation of the cultural resources management plan and consider including others when identifying resources for interpretation opportunities. We will continue to submit our data findings to SHPO. The text of strategy 5.1.5 has been revised to clarify this ongoing practice.

Response 25-2: Comment acknowledged. The text has been revised to clarify that we will consult and coordinate with the SHPO for site selection and interpretation development of selected sites.

Response 25-3: Comment acknowledged. The strategies for all refuges have been revised to reflect that we will coordinate with the existing site stewardship programs.

Letter 26

Public Input On
The Comprehensive Conservation Plan/
Environmental Impact Statement
Desert National Wildlife Refuge Complex

If you would like to provide comments or input on the Draft CCP/EIS, please fill out this card and hand it to any of our staff or please mail it to us. You may also write us a letter or send e-mail to: fw8plancomments@fws.gov. Thank you!

COMMENT:

SEPT. 3, 2008

MR. MARK PELZ

THANK YOU FOR ACCEPT MY COMMENT UNDER THE N.E.P.A. 1969. IN ASH MEADOWS-REFUGE, PURPOSES 16 U.S.C. SEC. 460K-1 IN THE PREFERRED ALTERNATIVE.

"BOATS USED FOR WATER FOWL HUNTING WOULD BE RESTRICTED OR ELIMINATED"

PARKING, AND ACCESS TO CRYSTAL RESEVOIR AND SMALL BOATS WITHOUT MOTERS SHOULD NOT BE RESTRICTED FOR RECREATIONAL USE IN CRYSTAL RESEVOIR ASH MEADOWS NWR 26-1

THANK YOU
E.E. Wheeler

NAME: EDWARD WHEELER

AGENCY:

ADDRESS: PO. BOX 1194, PAHRUMP, NV. 89041

PHONE:

ASH

M.26 Edward Wheeler, September 3, 2008

Response 26-1: Comment acknowledged. Due to threats associated with spread of the invasive quagga mussel, it is imperative to restrict boat access to these waters in order to reduce the threat to the endemic aquatic species.

Letter 27

JIM GIBBONS
Governor

STATE OF NEVADA

ANDREW K. CLINGER
Director

DEPARTMENT OF ADMINISTRATION
209 E. Musser Street, Room 200
Carson City, Nevada 89701-4298
(775) 684-0222
Fax (775) 684-0260
http://www.budget.state.nv.us/

September 4, 2008

Mark Pelz
US Fish & Wildlife Service
Region 8
2800 Cottage Way, Room W-1832
Sacramento, CA 95825-1846

Re: SAI NV # **E2009-017** Reference:

Project: **Desert National Wildlife Refuge Complex**

Dear Mark Pelz:

Enclosed are comments from the agencies listed below regarding the above referenced document. Please address these comments or concerns in your final decision.

Division of Water Resources

State Historic Preservation Office 27-1

This constitutes the State Clearinghouse review of this proposal as per Executive Order 12372. If you have questions, please contact me at (775) 684-0213.

Sincerely,

R. Tietje
Nevada State Clearinghouse

SE ROA 13597

JA_6359

M.27 Nevada State Clearinghouse, September 4, 2008

Response 27-1: Thank you for forwarding the comments from the Division of Water Resources and SHPO.

Letter 28

Alamo Service Center Waite <alamoservicecenter@yahoo.com>

09/08/2008 12:32 PM
Please respond to alamoservicecenter

To: fw8plancomments@fws.gov
cc:
Subject: CCP/EIS Draft Comments

I would like to provide comment and input on what I would like to see done with the refuge in Pahranagat Valley. I have been the the valley since Aug 05 and the first couple of years greatly enjoyed seeing the waterfowl and critters that were in the refuge, but the last two years I have seen a big reduction of the wildlife in the refuge.

I know that this last summer they needed to drain the Upper Lake to check on a water leakage problem, but why is taking so long on corrective actions?

What I would like to see done on the refuge:

1. Expand the camping facilities to include more spaces and have water and dumpstation. 28-1

2. Once the problem with the Upper lake is corrected have the lake stocked with pan fish;
ie. crappies, bluegill, sunfish, bass and catfish. 28-2

3. Food plots planted for the waterfowl and deer. 28-3

I have talked with the long time valley people and when the lower valley was a working ranch it was full of wildlife and was an oasis in the desert. Since I have been here in the valley I have only noticed a degregation of the refuge area and attitude toward the refuge.
I would hate to see this trend continue as it would only hurt this beautiful valley that I have come to refer as my home. 28-4

Russell E. Waite
Owner, Alamo Service Center
PO Box 414 775-725-3298
or 702-292-4171
Alamo, NV 89001

SE ROA 13599

JA_6361

M.28 Russell E. Waite, September 8, 2008

Response 28-1: See response to comment 9-1.

Response 28-2: Once the restoration planning effort is completed, we will work with Nevada Department of Wildlife to prepare a revised fisheries management plan which will evaluate options for managing fisheries on Pahranagat Refuge.

Response 28-3: Your input on food plots for waterfowl and deer is appreciated and will be considered in the ongoing restoration planning effort.

Response 28-4: Comment acknowledged.

Letter 29

DAQEM

DEPARTMENT OF AIR QUALITY & ENVIRONMENTAL MANAGEMENT
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(702) 455-5942 · Fax (702) 383-9994
Lewis Wallenmeyer Director · Alan Pinkerton Assistant Director · Tina Gingras Assistant Director

September 8, 2008

Mr. Mark Pelz, Chief, Refuge Planning
Region 8
U.S. Fish and Wildlife Service
2800 Cottage Way, Room 1832
Sacramento, CA 95825-1846

Dear Mr. Pelz:

The Clark County Department of Air Quality and Environmental Management (DAQEM) understands that the U.S. Fish and Wildlife Service intends to manage the Desert National Wildlife Refuge (NWR) Complex according to the approved Comprehensive Conservation Plan (CCP). DAQEM reviewed the consolidated CCP and Environmental Impact Statement (CCP/EIS) for air quality and environmental compliance, and includes the following recommendations for your consideration.

The Air Quality Planning Section reviewed the project for adherence to the Clean Air Act and offers the following suggestions:

1. Continue to comply with all provisions of all applicable federal, state, and local permits. 29-1

2. Ensure that areas of the complex outside of Clark County comply with the regulatory requirements of the Nevada Division of Environmental Protection (NDEP). 29-2

3. Obtain a valid dust control permit for a site impacting an area within Clark County jurisdiction equal to or greater than 0.25 acre, and employ *Construction Activities Dust Control Handbook* best management practices at all times. 29-3

4. Comply with the procedures and criteria of the General Conformity regulations (Section 176(c)(1) of the Clean Air Act), which determine whether a proposed federal action conforms with Clean Air Act implementation plans. 29-4

M.29 Clark County Department of Air Quality and Environmental Management, September 8, 2008

Response 29-1: Comment acknowledged. We will comply with applicable permits.

Response 29-2: Comment acknowledged. Management of the Refuges outside Clark County will include compliance with NDEP requirements.

Response 29-3: Comment acknowledged. We will obtain dust control permits for applicable actions in Clark County.

Response 29-4: Comment acknowledged. We will comply with the Clean Air Act and its implementing regulations.

Mr. Mark Pelz,
September 8, 2008

Hydrographic Area (HA) 212 is in serious nonattainment for carbon monoxide and particulate matter with an aerodynamic diameter equal to or less than 10 micrometers. Since the Desert NWR is in HA 212, it must comply with Clark County air quality regulations. 29-5

In addition, the unclassified nonattainment area for ozone includes HAs 164A, 164B, 165, 166, 167, 212, 213, 214, 216, 217, and 218. Since both the Desert NWR and the Moapa NWR are located in the ozone nonattainment area, both are subject to Clark County air quality regulations. 29-6

The Water Quality Section reviewed the project areas within Clark County for adherence to the Clean Water Act and offers the following suggestion: obtain a Notice of Intent from NDEP under the National Pollution Discharge Elimination System Municipal Separate Storm Sewer Systems general stormwater permit if the project area to be disturbed is an acre or more, or a highly sensitive area. 29-7

DAQEM appreciates the opportunity to review the CCP/EIS. If you have any questions, please contact me at 702-455-1601.

Sincerely,

Alan Pinkerton
Assistant Director

Cc: Mr. Steve Swanton, City of Las Vegas

Response 29-5: Comment acknowledged. We will comply with Clark County air quality regulations for actions on the Desert NWR.

Response 29-6: Comment acknowledged. We will comply with Clark County air quality regulations for actions on the Desert and Moapa Valley NWRs.

Response 29-7: Comment acknowledged. We will comply with the Clean Water Act for applicable actions.

Letter 30

Pahranagat Valley WR,

I would like to give my opinion as to some possible changes to the wildlife refuge in Pahranagat Valley. It would be nice to see a more modern visitor center with an educational outreach center. It would be nice to see programs implemented that get the local school system involved in the refuge. 30-1

I would also like to see the lake become more fisherman friendly, maybe stocked more often and more fishing piers put in. 30-2

Thank you,

Brad Loveday
Science Teacher
Pahranagat Valley High School
775-725-3321 ex. 302
pvhssports@yahoo.com

M.30 Brad Loveday, September 8, 2008

Response 30-1: The preferred alternative includes development of a new visitor contact station on Pahranagat NWR.

Response 30-2: See response to comment 28-2.

Letter 31

September 9, 2009

Mark Pelz, Chief
Refuge Planning
2800 Cottage Way, W-1832
Sacramento, CA 95825-1846

RE: Desert National Wildlife Refuge Complex Draft Comprehensive Conservation Plan and Environmental Impact Statement

Dear Mr. Pelz,

Thank you for the opportunity to offer comments on the Desert National Wildlife Refuge Complex Draft CCP and EIS

We recognize the difficulties in trying to write a comprehensive plan for four quite different refuge areas is a single document but are still rather disappointed in the format of the document. It is not user friendly. A reader must spend a lot of time comparing the various chapters to understand what is proposed for a particular refuge. A better arrangement for the user would be to put all the details of the proposed alternative in one place and then describe the other alternatives in the appendices. It is unfortunate that perhaps the most telling part of the document, the financial section, is relegated to appendix K. This important section details how much money will be spent on which projects and activities. 31-1

A troubling aspect of the planning process is that implementation of the proposed action involves hiring people and paying for services which will not be funded by the Service, but will, hopefully, be funded by some other agency or source. The Southern Nevada Public Lands Management Act (SNPLMA) has provided funds for many projects on federal lands in Southern Nevada during the last decade. It needs to be pointed out, however, that SNPLMA funds cannot be used to fund personnel positions and that due to the collapse of the real estate market in Southern Nevada future funding from this source will not be nearly as generous as in the past 31-2

Reading through the alternatives one gets a sense of vagueness and generalities, although other parts of the document contain much useful information. To understand what is being proposed readers need a sufficient level of detail, in one place, to get a grasp on historical context, proposed actions, and obstacles to implementation to make sense of it all. 31-3

Something which is missing from the document is an up-front statement about the fact that three of these refuges are either former agricultural areas or sites of significant development activities and the challenge of restoring these areas to their previous status as important wildlife areas is a daunting one. The public is likely to be more supportive if it clearly understands the challenges posed by the soil disturbance and invasive plants common on former agricultural lands. 31-4

M.31 Red Rock Audubon Society (John E. Hiatt), September 9, 2008

Response 31-1: We appreciate your suggestions for organizing the CCP/EIS. The format and organization of the draft and final CCP/EIS follow the standard format for environmental impact statements. However, after the Record of Decision is signed, the document will be reformatted into a stand-alone CCP organized in a more user-friendly fashion similar to this suggestion.

Response 31-2: Comment acknowledged. Although SNPLMA funds may not be used to hire permanent personnel, they can and have been used to fund contract and term positions. We do recognize that SNPLMA funds have limitations and we continue to explore other funding options to bring the plan to fruition. Furthermore, we realistically acknowledge that if funds are unavailable, some aspects of the plan may not be implemented.

Response 31-3: Please see Response 31-1.

Response 31-4: Section 1.7 gives a concise description of the historic land uses of the different refuges and describes the impacts from pre-refuge development. In addition, we feel that existing and proposed refuge outreach and environmental education efforts are the best venues for informing the public of these challenges and issues.

Refuge specific comments:

A. Ash Meadows NWR: The Ash Meadows plan is probably the best written of the four individual unit plans with more detail and discussion than the other individual unit plans. Specific points are as follows: 31-5

1. p 3-19 (Visitor Services) states", no roadway or parking area improvements would be implemented." Yet on p 5-17 paragraph 3 states: "Additional improvements to roads as part of the re-surfacing plan under Alternative C would also benefit public access and improve Refuge road conditions." Which is it? 31-6
2. p 5-7 (Mitigation) last sentence: ", and stabilizing sloping surfaces using soil binders until vegetation or desert pavement (ground cover) can effectively stabilize the slope." Desert pavement generally takes hundreds or thousands of years to form and doesn't normally occur on slopes of greater than 3-5%. You may want to consider other alternatives. 31-7

B. Desert NWR:

1. Proposing to spend $10,000,000 on upgrading the Alamo and Mormon Well roads doesn't seem to be consistent with either the mission statement or the vision for the Refuge. The biggest single budget expenditure should be directed toward wildlife and habitat improvement or protection rather than visitor comfort. 31-8
2. The fire management plan doesn't seem to address the challenges posed by wildland or prescribed fire. An elevation of 5000 feet is not a point where fire effects on plant communities magically changes from bad to good. A major challenge posed by fire at all elevations less than about 9000 feet is type conversion to non-native annual grasslands with greatly increased fire frequency and much reduced value to native wildlife. Cheat grass and/or red brome thrive at elevations in excess of 8000 feet at this latitude and virtually all biotic communities are at risk of type conversion. 31-9
3. Bighorn sheep need safe, usable water sources. This means that water sources need to be free of encroaching vegetation that can shelter predators. This issue is just as important as protecting water sources from fire damage. 31-10
4. The proposal to use post and cable fencing to protect the eastern boundary may be a possible misuse of resources. Most of the vehicle trespass from U.S. Highway 93 occurs as a result of temporary fire access roads created during the fire season of 2005. Those access roads need to be decommissioned and re-habilitated at the point of departure from the highway. The BLM fire crews that fought those 2005 fires were supposed to re-hab those temporary access points before leaving the site. BLM managers need to be pressured to have their crews come back and do what they were supposed to do in 2005. This could save the Service a lot of money. 31-11

C. Moapa NWR:

1. The proposed expansion plan for the Moapa NWR is likely to attract some attention. Due to several strategic errors in the past the Service does not enjoy a high level of support from the local population, including many in Las 31-12

Response 31-5: Comment appreciated.

Response 31-6: The CCP/EIS text has been revised to reflect that road and parking area improvements may be made under Alternative C.

Response 31-7: The CCP/EIS has been revised to remove the reference to desert pavement as a means of soil stabilization. We will continue to research other soil stabilization techniques.

Response 31-8: The purpose of the proposed improvements to Alamo and Mormon Well Roads is to reduce visitor safety hazards and minimize resource impacts. Several miles of Alamo Road are located in the Desert Dry lake bed and become impassible during periods of rain. Likewise, several sections of Mormon Well Road are constructed in a wash and are subject to severe erosion during rainstorms. As a result, both roads can be hazardous to Refuge visitors and employees. The proposed improvements are aimed at stabilizing these sections of road.

Response 31-9: See Response 23-9.

Response 31-10: Comment acknowledged. CCP/EIS changed to reflect importance of vegetation maintenance for both reducing fire risk and limiting cover for bighorn sheep predators.

Response 31-11: Comment acknowledged. We will coordinate with BLM on decommissioning the fire roads. Fencing is proposed for sections of the eastern boundary due to the Coyote Springs development. As the population of Coyote Springs Valley increases, we anticipate an increase in inappropriate uses similar to our experience along the southern boundary. Fencing would be designed to protect Refuge resources while allowing the free movement of wildlife, especially desert bighorn sheep.

Response 31-12: Comment acknowledged.

Vegas. Prior to attempting acquisition of significant additional lands the Service would be wise to demonstrate that it can effectively manage the resources it now owns and complete the habitat improvement projects already underway and planned. 31-12

D. Pahranagat NWR:

1. At the present time the upper lake is the primary site of visitor interest and is likely to remain so as long as the lake is present. It might make more sense to locate the visitor center at the upper lake rather than at the present headquarters area as proposed. Even after the improvement projects at the headquarters area are completed the upper lake will still have more visible wildlife than the headquarters area. With the proposed closure of the camping area along the east side of the upper lake and the conversion to day use only it would make a lot of sense to locate the visitor center at the south end of the upper lake, which would provide glare free viewing of the lake and its waterfowl. 31-13 In any event, wherever the visitor center is located improvements to U.S. Highway 93 to allow safe entry and exit is essential and should be part of this plan. A safe and attractive ingress/egress point would help entice the public to stop at the visitor center. 31-14
2. p 3-53 (Wildlife Diversity): paragraph 2 states: "The service would also prepare a wilderness study report and NEPA document to evaluate options for preserving wilderness values of the three small wilderness study areas along the western boundary of the Refuge adjacent to the proposed Wilderness on Desert NWR." While being a strong supporter of Wilderness designation on appropriate federal lands we are unaware that there were any wilderness study areas adjacent to Pahranagat NWR on BLM lands prior to the 2004 expansion of Desert NWR along the western boundary of Pahranagat NWR. 31-15

Sincerely,

John E.Hiatt
Conservation Chair
Red Rock Audubon Society
8180 Placid Street
Las Vegas, NV 89123

Transmitted electronically via www.desertcomplex.fws.gov

Response 31-13: The existing headquarters site was selected for the new visitor contact station for several reasons. First, the site is already disturbed and utilities are present so it would be most cost effective. Second, the location near Upper Pahranagat Lake would likely have a greater impact on wildlife due to the presence of sensitive riparian habitat.

Response 31-14: The proposed alternative for Pahranagat Refuge includes the development of acceleration and deceleration lanes along U.S. 93 to improve the safety of visitors as they enter and exit the Refuge.

Response 31-15: The area west of Pahranagat NWR was included in the 1.4 million-acre Desert Wilderness proposal, which was forwarded to Congress in 1974. This area, which at the time was administered by BLM, was transferred to the Service by Public Law 108-424.

Letter 32

Nevada Power.
nevadapower.com

Sierra Pacific
sierrapacific.com

September 9, 2008

Mark Pelz
Chief, Refuge Planning
2800 Cottage Way, W-1832
Sacramento, CA 95825

Dear Mr. Pelz:

Nevada Power Company and Sierra Pacific Power Company (the Companies), subsidiaries of Sierra Pacific Resources serving communities of southern and northern Nevada and a portion of California, appreciate the opportunity to review and provide comments to the Draft Comprehensive Conservation Plan and Environmental Impact Statement (CCP/EIS) for the Desert National Wildlife Refuge Complex. The Companies understand the purpose of the CCP is "*to provide managers with a 15-year strategy for achieving refuge purposes and contributing toward the mission of the National Wildlife Refuge System (NWRS)*". The Companies appreciate this purpose and the opportunity to participate in the development of this CCP/EIS. The Companies hereby provide some comments and questions related to the CCP/EIS.

The Companies have a three-part energy strategy to meet an overall goal of providing clean, safe, reliable electricity to their customers at reasonable and predictable prices. This strategy includes increasing energy efficiency and conservation programs, expanding renewable energy initiatives and investments and also involves a diversified energy portfolio with a balanced mix of fuels for energy generation. This is in the best interest of their customers, shareholders, the communities they serve and the state.

Nevada is composed of over 85% federal lands, with over 50% of these federal lands managed for conservation of specific natural resources (DOE, 2007). The Companies understand that the Desert National Wildlife Refuge (Desert NWR) is the largest protected area in the state of Nevada, and is adjacent to some of the fastest growing urban areas in the United States. The Companies have a critical need to meet the energy demand requirements of its growing residential and commercial customer base. The Las Vegas Valley poses a critical bottleneck for transmission of electricity, particularly with the potential renewable energy resources (i.e., solar, wind, geothermal) that can be harnessed to deliver power to Las Vegas, other areas of the state and the region. This bottleneck exists because Las Vegas is surrounded by National Conservation Areas, an Instant Study Area, several Areas of Critical Environmental Concern, several wilderness and proposed wilderness areas, Nellis Air Force Base, Nevada Test Site and the Desert NWR. It should be noted that routes for new transmission lines to deliver electricity through and between southern and northern Nevada are critical to the Companies' planning to continue meeting this demand. 32-1

P.O. Box 98910, Las Vegas, Nevada 89151-0001 • 6226 West Sahara Avenue, Las Vegas, Nevada 89146
P.O. Box 10100, Reno, Nevada 89520-0024 • 6100 Neil Road, Reno, Nevada 89511

M.32 Nevada Power/Sierra Pacific Power (Eileen Wynkoop), September 9, 2008

Response 32-1: As described in the programmatic EIS for the West Wide Energy Corridor, "Although the Proposed Action identifies potential corridors crossing national wildlife refuge lands, the USFWS would not be amending plans designating these segments as energy transport corridors. Development on these refuges may only occur if the specific proposed project is determined to be compatible with the purposes of the refuges and the mission of the National Wildlife Refuge System (NWRS). Existing refuge Comprehensive Conservation Plans may require amendments, should a specific project be found compatible, and subsequent ROW permitting by the USFWS would occur."

This bottleneck could pose significant socioeconomic impacts to the delivery of electrical power to residential and commercial customers as the demand increases but land constraints remain the same and do not allow for the expansion of the electrical grid in the form of new transmission lines and transmission substations. This may become more critical as new electric generation facilities are constructed, particularly with the growing interest in renewable energy projects around the state. In order for these types of projects to go forward, they will need transmission line interconnections to the grid. With this critical issue in mind, the Companies support inclusion in the CCP/EIS any opportunity to allow for practical, common sense approaches to addressing and processing applications and proposals for future energy projects across the Desert NWR in relation to the proposed Westwide Energy Corridor Project (WWEC) currently in process under the Department of Energy and participating federal agencies. 32-1

To this end, however, the Companies are concerned about how the WWEC relates to, or conflicts with, the Desert NWR's compatibility policy, appropriateness finding guidelines and the Desert NWR's current proposed wilderness management status. The Companies request the CCP/EIS specifically address this issue with respect to any future energy project within the WWEC corridor through the refuge, should it be authorized. As described above, this could potentially pose a significant impact to the delivery of energy. 32-2

Alternatives B, C and D include new fencing along portions of the Desert NWR boundary. Some portions of the Desert NWR boundary are adjacent to existing and proposed utility corridors and proposed specific transmission line projects, so there's potential for safety hazards to the public from electrical shock should high voltage transmission lines and certain types of fencing materials be placed in proximity to each other. The Companies wish to bring this to your attention as this could be something our two organizations would need to coordinate on should this occur. The Companies understand that specific issues associated with such occurrence would be identified and discussed during early planning and coordination of future projects. 32-3

The Companies appreciate this opportunity to submit comments on the CCP/EIS and look forward to continuing to participate in this process.

Sincerely,

Eileen Wynkoop
Manager, Environmental Services

P.O. Box 98910, Las Vegas, Nevada 89151-0001 • 6226 West Sahara Avenue, Las Vegas, Nevada 89146
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Response 32-2: See Response 32-1.

Response 32-3: Comment noted. We will coordinate with the companies regarding construction of post and cable fencing along Refuge boundaries.

Citations

U.S. Department of Energy, Draft Programmatic Environmental Impact Statement, *Designation of Energy Corridors on Federal Land in the 11 Western States* (DOE/EIS-0386). October 2007.

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Letter 33

Mayor
Michael L. Montandon

Council Members
William E. Robinson
Stephanie S. Smith
Shari Buck
Robert L. Eliason

CITY OF
NORTH LAS VEGAS
Your Community of Choice

City Manager
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September 9, 2008

Mr. Mark Pelz
Chief, Refuge Planning
2800 Cottage Way
W-1832
Sacramento, California 95825

RE: Comments on the Draft Comprehensive Conservation Plan and Environmental Impact Statement (CCP/EIS) for the Desert National Refuge

Dear Mr. Pelz:

The City of North Las Vegas appreciates this opportunity to comment on the Draft Comprehensive Conservation Plan and Environmental Impact Statement (CCP/EIS) for the Desert National Wildlife Refuge Complex conducted by the U.S. Fish and Wildlife Service (USFW).

The CCP/EIS evaluated four options for managing Ash Meadows, Desert, Moapa Valley, and Pahranagat National Wildlife Refuges (NWRs) including, "No Action" and three alternatives. The Desert National Wildlife Refuge is the only Refuge that borders the City of North Las Vegas. The "Preferred Alternative", Alternative C, is described as the Moderate Improvement in Wildlife and Habitat Management and Minor Increase in Visitor Services. This plan will increase monitoring and habitat protection efforts; improve the development of a Sheep Management Plan; implement inventory and monitoring special-status species; consider reestablishing Pahrump; prescribe burns and naturally igniting fires above 5,000 feet to restore vegetation characteristics; include additional resource protection measures including fencing the eastern boundary where necessary, posting boundary signs along the entire southern, eastern, and northern boundaries, and expanding law enforcement presence and patrols throughout the Refuge; improve visitor services; provide educational materials; implementing additional cultural resource inventories and studies; and the Service would submit a request to the Service Director to de-designate the Papoose Lake Research Natural Area (RNA).

The City of North Las Vegas supports Alternative C and the USFW's plans to coordinate with the local jurisdictions, including the City of North Las Vegas, along the southern boundary to ensure compatible development occurs adjacent to the Refuge. Possible measures to ensure compatibility are outlined in Alternative C, including the establishment of a greenbelt or construction of walls along the north side of developments. The City also supports the Service's plans to rehabilitate and protect habitat along the 33-1

M.33 City of North Las Vegas (Gregory E. Rose), September 9, 2008

Response 33-1: Comment appreciated.

Page 2
September 9, 2008

southern boundary and the development and implementation of a plan to close illegal trails and rehabilitate damaged resources and is looking forward to working with the Service to coordinate future development opportunities. 33-1 However, the City wishes to continue in the future discussion of allowing access to the Desert Refuge between the southern boundary and the City. As a member of the Southern Nevada Regional Planning Coalition and outlined in the Southern Nevada Regional Policy Plan, within the Conservation, Open Space, and Natural Resource Element, the City wishes to encourage new development "to maintain historic access to adjacent public lands that will remain public, or provide new access". 33-2

Thank you for the opportunity to review and comment on the Draft Comprehensive Conservation Plan and Environmental Impact Statement (CCP/EIS) for the Desert National Wildlife Refuge Complex.

Sincerely,

Gregory E. Rose
City Manager

GER/
c: Maryann Ustick, Assistant City Manager, Development
Frank Fiori, Planning & Zoning Director

Response 33-2: We will continue to coordinate with the City of North Las Vegas regarding adjacent development and access to the Desert Wildlife Refuge along the southern boundary.

Letter 34

STATE OF NEVADA
DEPARTMENT OF WILDLIFE
1100 Valley Road
Reno, Nevada 89512
(775) 688-1500 • Fax (775) 688-1595

JIM GIBBONS
Governor

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September 9, 2008

NDOW-SR#: 09-017

Mr. Mark Pelz, Chief
Refuge Planning
U.S. Fish and Wildlife Service
2800 Cottage Way
W-1832
Sacramento, CA 95825

RE: Draft Comprehensive Conservation Plan/Environmental Impact Statement for the Desert National Wildlife Refuge Complex

Dear Mr. Pelz:

Thank you for review opportunity of the Draft Comprehensive Conservation Plan / Environmental Impact Statement for the Desert National Wildlife Refuge Complex (CCP). The Department overall is pleased as the CCP is much improved from previous versions. Many of the Department's observations and comments have been addressed during meetings and consultations and are reflected in the CCP. However, some observations and concerns remain outstanding and/or were recently detected in the present CCP. The Department provides the following as productive topical input and editorial critique.

<u>**Ash Meadows NWR**</u>

The Department supports Alternative C. This option offers the greatest habitat restoration benefit to wildlife all-inclusive. 34-1

- Ash Meadows NWR has limited information relative to management tools addressing decadent vegetation, which could lead to future large-scale fires. In particular, the Refuge has some fairly overgrown and decadent wetland vegetation that is in need of encouragement of new growth in terms of open areas and forage value for migratory and resident shorebirds. 34-2
- There is also no mention in the plan of how the Refuge will work with private landowners when conducting salt cedar control efforts. 34-3
- Past requests by the Department (Goals and Objectives comments in 2005 and Preliminary Draft comments in 2006) regarding the topic of accommodating bighorn sheep hunting on the Ash Meadows NWR remains unresolved. This topic was also not addressed in the recent compatibility determinations accomplished for the CCP. The Department is greatly disappointed in the Service's overlooking what has become issue. The points remain: 34-4

(NSPO Rev. 2-07) (O) 5396

09/09/2008 TUE 16:58 [TX/RX NO 6585] 002

M.34 Nevada Department of Wildlife (D. Bradford Hardenbrook), September 9, 2008

Response 34-1: Comment appreciated.

Response 34-2: Comment noted. The preferred alternative includes the use of prescribed fire and fuel treatments to maintain habitat and treat hazardous fuels. More specific information is contained in the fire management plan and the integrated pest management plan for Ash Meadows NWR.

Response 34-3: The preferred alternative for Ash Meadows was revised to include coordination with the Service's Private Lands Program, which is currently working with private landowners in the removal of salt cedar and the planting of native species.

Response 34-4: The preferred alternative in the Final CCP/EIS includes the preparation of a hunting step-down plan which will address all hunting opportunities on Ash Meadows NWR. We are currently collecting data that will inform the development of the hunting step-down plan.

- In light of the scope of issues discussed in the CCP, it is appropriate to address desert bighorn hunting.
- Certain, peripheral portions of the refuge are bighorn habitat and are adjacent to BLM lands where hunting is permitted.
- The vast majority of the refuge lands where bighorns could be hunted are BLM lands managed by the USFWS as part of the refuge.
  - East of Five Springs
  - Eastern Portion of the Warm Springs Unit
  - Point of Rocks Ridge
  - Two parcels on the eastern edge of the refuge, east of Point of Rocks Ridge.
- There has been no presentation that:
  1. Desert bighorn sheep hunting on portions of the refuge would conflict with the primary mission of the refuge;
  2. Public safety would be threatened; or,
  3. The hunting activity would increase the work load of refuge staff.

34-4

Desert NWR

The Department generally supports the Service's preferred Alternative C for Desert NWR while noting proactive attention to the following would firm up the Department's support. 34-5

- Note: the 8,503 acres transferred to the Service by the Lincoln County Conservation, Recreation and Development Act of 2004 is not shown on any of the maps of the Desert NWR. 34-6

- There is troubling discrepancy between the written narratives for Alternative's C and D on pages 3-31 and 3-35, respectively, and with Table 3.6-2 on page 3-82 relating to the Wildlife Diversity section and the topic regarding long-term permanent inventory plots above and below 5,000 feet elevation.

  1) The Department has twice previously pointed out that the preferred Alternative C indicates only establishing these plots below 5,000 feet, while the non-preferred Alternative D also includes plots above 5,000 feet. On this, the Department cannot concur with preferred alternative C based on biological merits. It would be remiss on the part of the Service to 'ignore' those habitats and vegetative and animal communities that occur above 5,000 feet due to a lack of permanent inventory plots. These plots are important not only to potential special status species or species of conservation concern that occur at higher elevations, but surveys are also necessary to begin documenting effects of climate change; the latter which the Service has repeatedly mentioned and expressed concern about throughout the CCP. 34-7

  2) While Alternative C in Table 3.6-2 on page 3-82 does state "Establish permanent plots...throughout the refuge...," Alternative D still indicates the addition of plots above 5,000 feet. NDOW recommends removing the Alternative D language in the Wildlife Diversity section of Table 3.6-2 *and* the written narrative pertaining to this issue in section 3.3.5 on page 3-35, and re-writing that same portion of section 3.3.4 on page 3-31 to clarify that plots well be established both above and below 5,000 feet, or throughout the refuge.

- The CCP should address the maintenance of both "guzzlers" and springs. Currently, many of the springs are in need of maintenance and repair, as they have mechanical fixtures (pipes, spring boxes, etc). The only mention of spring/water source maintenance is in regard to bighorn sheep habitat management (DEST, Table 3.6-2, page 3-81, and also in text). 34-8

Response 34-5: Comment appreciated.

Response 34-6: The 8,503 acres of BLM-administered land that were transferred to the Service to be managed as part of the Desert NWR are located at the northeastern boundary of the Desert NWR and the western boundary of Pahranagat NWR. This is shown on all EIS figures depicting the Desert NWR boundary.

Response 34-7: The CCP/EIS was revised to include monitoring permanent plots throughout Desert NWR for both Alternatives C and D.

Response 34-8: The CCP/EIS was revised to clarify that all springs and catchments on Desert NWR would be maintained. In addition, Alternative C was modified to include regular monitoring of flow rates of springs throughout Desert NWR.

The Department would be far more comfortable if the CCP commit refuge staff to regular inspection and maintenance of all water sources and developed springs, including higher elevation springs that may not be regularly used by bighorn sheep, but are of critical importance to other wildlife species (e.g. Sawmill, Wiregrass, and Perkins springs). Flow rate data should also be collected regularly and maintained for each spring. 34-8

- On page 3-21 in the second paragraph of the Wildlife Diversity Section, the plan states that bighorn sheep surveys could be utilized to collect raptor data. While recording raptor sightings incidental to bighorn sheep helicopter surveys have merit from a sight record database standpoint, there is little scientific value to this approach. Well thought out and executed raptor surveys during appropriate times of the year (i.e. spring or fall migration) would ultimately provide more useful information on raptor usage of the area. 34-9
- On page 3-31 the first sentence of the Wildlife Diversity Section would read better by inserting *and wildlife*, such that it would read: "In order to track long-term trends in vegetation *and wildlife* communities on the Refuge..." 34-10
- In the first full paragraph regarding fire and fire suppression on page 3-32 (as well as Page 3-84 Wildlife and Habitat Management issue area, Alternative C), the first bullet statement mentions using prescribed burns and allowing natural fires throughout the refuge to restore vegetation without reference to elevations. The second bullet deals with fires above 5000 feet, but the specifics of the first bullet are unclear. The Department recommends that wording be added to clarify that this will not apply to Mojave scrub and Joshua tree habitats. 34-11
- Under the Affected Environment Section for DNWR on page 4-51, the fire history should be updated with information from the 2005 and 2006 fires, due to their size and the apparent change in the fire regime being observed in the Mojave Desert. 34-12
- For a large refuge primarily created for the management of desert bighorn sheep it seems incongruous that the mammals section on Page 4-59 begins discussion with bats. Was this in keeping with traditional taxonomic order? As an aside, O'Farrell and Bradley's 1970 bat work was done at White Blotch Spring, not White Hot Spring. 34-13
- On page 4-59, desert bighorns are identified in the third paragraph as a subspecies of bighorn sheep (*Ovis canadensis*), but the subspecies is not identified until the following paragraph.(*Ovis canadensis nelsoni*). 34-14
- Figure 4.3-3 shows a spring on the northeast end of the Las Vegas Range, almost directly west of the junction of SR-168 and US-95. This is a test well site, not a spring. It should be deleted from all maps. There is also a spring shown on the north tip of the East Desert Range. This is an old cattle pond, dug on the edge of the playa. It should be deleted from all maps. 34-15
- On page 4-59, the plan cites the Air Warfare Center. This not an appropriate, credible source of information about desert bighorns movements on the refuge. McQuivey (NDOW 1978) quotes several sources on seasonal movements. The best of which are probably those by Charles Hansen and Gayle Monson since they relate specifically to the Desert Game Range. 34-16

Response 34-9:	Comment acknowledged. We will consider raptor-specific surveys.
Response 34-10:	The CCP/EIS has been revised as suggested.
Response 34-11:	The CCP/EIS has been revised as suggested.
Response 34-12:	The final CCP/EIS has been updated to reflect the 2005 and 2006 fire occurrences. In addition, text has been added to address the impact of invasive, non-native vegetation on fire management decisions.
Response 34-13:	The order of the discussion is consistent with other refuge descriptions. White Hot Spring was changed to White Spot Spring, which is consistent with the cited reference.
Response 34-14:	The scientific name for the desert bighorn sheep was moved to the correct location.
Response 34-15:	The CCP/EIS maps have been revised as suggested.
Response 34-16:	The CCP/EIS has been revised to include a more appropriate reference for desert bighorn sheep movements.

- On page 5-31, under 5.3.2 Biological Resources, Vegetation, there is no mitigation suggested with regard to allowing prescribed and naturally ignited fires to burn. Mitigation should include post-fire habitat monitoring and actions to prevent spread of invasive exotic vegetation in addition to re-seeding with native species where appropriate. In addition, the Department believes that close coordination should be maintained between our agencies relative prescribed burns and natural fires above 5,000 feet. 34-17

- The third full paragraph on page 5-32, pertaining to habitat above 5000' and fires, should mention the Hidden Forest Uinta Chipmunk (*Tamias umbrinus nevadensis*), which is a Nevada Department of Wildlife Species of Conservation Priority as well as Protected Sensitive under NAC 503.030. Until the status of this species can be determined it should be assumed that is still exists in the habitat above 5000' as an endemic species. As such, this species may be negatively impacted by prescribed and natural fires and subsequent loss of downed woody debris. Mitigation measure should be added to address these possible impacts. 34-18

- On page 5-31, fifth paragraph, third sentence reads, "The Service would coordinate with the Nevada Fish and Wildlife Office……" This should be changed to the "Nevada Department of Wildlife". 34-19

<u>Moapa NWR</u>:
The Department supports alternative C, with the notations below. This Alternative has the greatest benefit to all wildlife species from habitat restoration to Refuge expansion and there is the greatest long-term benefit to desert tortoise, Gila monster and other wildlife from Refuge expansion. 34-20

- It is indicated under 'Features common to all alternatives' (page 3-40), that the Service will remove palm tress associated with riparian areas and conduct periodic palm tree maintenance for fire protection. Further, Alternative C (page 3-48, 2nd paragraph) states the Service will coordinate with NDOW to conduct surveys of palm tree habitat for their use by bats.

  The document should specify that removal or thinning occur only in locations essential for aquatic critical habitat restoration or where necessary for fire fuel reduction until said coordination, surveys and research are conducted. The western yellow bat (*Lasiurus xanthinus*) is listed as a Species of Conservation Priority in the Nevada Wildlife Action Plan, and can be negatively affected by the trimming of dead leaf skirts, removal of palms, etc. Close coordination with NDOW must occur prior to fan palm habitat modification. 34-21

- Current yellow bat mitigation is limited only to "bats would be flushed from palm trees prior to removal to minimize harm of individuals". The Department suggests the following mitigation measures should be identified in this document for the yellow bat (page 5-50) and incorporated into future Refuge restoration planning efforts. Additional mitigation could include, but is not be limited to: replace removed palms with native vegetation known to be used by yellow bats (i.e. cottonwood); minimize palm removal away from areas where palms directly affect aquatic habitat quality and retain some higher density palm habitat in less sensitive areas; conduct thinning and removals during winter months (although yellow bats have been documented year-round in Nevada and do not hibernate, a major portion of the breeding population may migrate south during the winter). 34-22

Response 34-17: The CCP/EIS has been revised as suggested.

Response 34-18: The CCP/EIS has been revised as suggested.

Response 34-19: The CCP/EIS has been revised as suggested

Response 34-20: Comment appreciated.

Response 34-21: Comment noted. We will coordinate with NDOW regarding future removal and thinning efforts.

Response 34-22: The CCP/EIS has been revised as suggested

Pahranagat NWR
The Department supports Alternative D. This option offers the greatest long-term benefits to common wildlife species and offers the highest protection to the desert tortoise. 34-23

- On Figure 3.5-4 (Figure 9 in the CCP Summary), the central portion of the refuge is identified as an area where the Service would, "Modify Upland Game Hunt Area to Reduce Crane Disturbance." Although there is mention of improving habitat for sandhill cranes in Alternatives B, C and D, we are unable to find any discussion of how modifying the area open to upland gamebird hunting might be accomplished. 34-24

- Page 4-113, second line, Should read: "A handicapped accessible hunting blind ..." 34-25

Appendix G
On Page G-88, Compatibility Determination: Recreational Use of Pack and Saddle Stock, This compatibility determination must prohibit the use of pack goats or llamas. These animals can carry diseases which are devastating to bighorn sheep populations. Recent Nevada BLM wilderness plans in areas with desert bighorn sheep prohibit the use of these animals for pack stock (South McCullough/Wee Thump Wilderness Management Plan, Muddy Mountains Wilderness Plan, Sloan Canyon Resource Management Plan). 34-26

Appendix H
- The phase 'special status species' is used many times throughout the documents in reference to various plant and animal species. Should it be assumed that 'Special Status Species' is synonymous with 'Sensitive Wildlife Species...' as in the title of Table 4 in appendix H?

  In dealing with multiple agencies, all of whom use their own vernacular when describing species (i.e. endangered, listed, species of concern, sensitive species, special status, etc), these situations can be confusing. For example, in Table 3 (appendix H) the Hidden Forest Chipmunk is listed as "*FWS NS=no status, these species previously considered species of concern*, and *NV SCP=Species of Conservation Priority*." Is this species still considered a 'special status species.'? We recommend including a section to define 'special status species' and 'sensitive wildlife', and/or clarify the text and table titles. 34-27

- Adding to the above confusion is the fact that the text narratives beginning on page H-19 in Appendix H under the heading 'Sensitive Species Accounts' are not inclusive of all the species listed in the 'Sensitive Wildlife Species...' Table 3.

- We recommend the following changes to Table 3 in Appendix H:
  - Hoary bat (*Lasiurus cinereus*) NV SCP, Mova
  - Western red bat (*Lasiurus blossevillii*) NV SCP, Mova
  - Western yellow bat (*Lasiurus xanthinus*) NV SCP, Mova
  - Pallid bat (*Antrozous pallidus*) NV S, all refuges 34-28
  - Brazilian free-tailed bat (*Tadarida brasiliensis*) NV S, all refuges
  - California leaf-nosed bat (*Macrotus californicus*) NV S, Mova
  - Western mastiff bat (*Eumops perotis*) NV S
  - Status[1] for Table 3, on pages H 8-11, indicates the possibility of inclusion of Stewardship Species (SS). Please refer to the Nevada Wildlife Action Plan for a list of identified Nevada Stewardship Species, which are too numerous to list here.

Response 34-23: Comment appreciated.

Response 34-24: The CCP/EIS has been revised to remove the proposed modification of the upland game hunt area from the preferred alternative for Pahranagat.

Response 34-25: Comment noted. The referenced text has been changed to “A wheelchair accessible hunting blind . . .”

Response 34-26: The referenced Compatibility Determination has been revised to include the stipulation prohibiting pack goats and llamas.

Response 34-27: Comment acknowledged. Text within the document and table title has been changed to define the meaning of special status species and use it consistently throughout the document.

Response 34-28: The CCP/EIS has been revised as suggested

- Many of the species in Table 3 are recognized as having NV Status[1] of 'SCP' (species of conservation priority). It may be important to note that many species are also afforded additional protection under NAC 503 and as such should also be noted with 'S' for Nevada Special Status Species. 34-29
- On page H-7, the last sentence of the first paragraph indicates "Lists of common wildlife species are also provided for each of the refuges at the end of this appendix." Are these lists at the end meant to be inclusive or exclusive of the species already identified in Tables 3 and 4? If they are meant to be inclusive of all species then the lists should be reviewed and revised to include those species listed above and possibly others. If the lists are meant to be exclusive, they should also be revised to include only the most common species (example: the list for Ash Meadows includes the Ash Meadows montane vole, which is by no means common (possibly extinct) and already addressed in Table 3). These lists need to be reviewed and/or revised to clarify their purpose. 34-30

- In Table 4, Page H-14, what is the reason for the "?" after the NV WAP Priority heading? 34-31
  - On page H-20, under desert tortoise, first paragraph:
    - The Upper Sonoran life zone should be changed to lower Sonoran life zone. C.H. Merriam's lower and upper life zones described below identify the Mojave Desert as a lower Sonoran life zone.
    - <u>Lower Sonoran Life Zone:</u> The vegetation of this life zone corresponds with the hot deserts of the southwestern United States and northwest Mexico (the Mojave, Sonoran, and Chihuahuan deserts). Creosote (*Larrea tridentata*) and other desert shrubs and succulents occur at elevations from 100 ft to 3,500-4,000 ft above sea level. Total annual precipitation averages 10 inches or less. 34-32
    - <u>Upper Sonoran Life Zone:</u> A number of communities are characteristic of this zone that ranges from 3,500-4,000 ft to about 7,000 ft in elevation. These include a woodlands of evergreen oaks (*Quercus* spp.), pinyon pine (*Pinus cembroides*), and/or juniper (*Juniperus* spp.); the Arizona chaparral of leathery-leaved scrub oaks (*e.g., Quercus emoryi*), manzanita (*Arctostaphylos* spp.), buckthorn (*Rhamnus* spp.) and mountain mahogany (*Cercocarpus* spp.); grassland; and Great Basin desertscrub with its dominant sagebrush (*Artemsia tridentata*). Total annual precipitation varies from 8 to slightly more than 20 inches.
    - The last sentence should be deleted. Tortoise burrows are found in many other places other than washes and arroyos in the Mojave Desert. 34-33

  - On page H-20, desert tortoise, second paragraph:
    - Change the first sentence to, "Tortoises *utilize their underground burrows* to escape the heat…" Otherwise it sounds as though they spontaneously dig burrows only to escape heat, rest and find warmth in winter, rather than retreating to existing burrows for these purposes. 34-34
    - Change the third sentence to, "…can *sometimes* be found under bushes at night." Otherwise, it sounds as though tortoises don't use their burrows at night, which they often do. 34-35

  - On page H-21, desert tortoise, second paragraph:
    - Delete the first sentence, as it is redundant. The range of the desert tortoise was already described earlier in this section on p H-20. 34-36

Response 34-29: The CCP/EIS has been revised as suggested.

Response 34-30: Tables in Appendix H have been reviewed and updated, as appropriate.

Response 34-31: The referenced question mark has been removed from Table 4.

Response 34-32: The CCP/EIS has been revised as suggested.

Response 34-33: The CCP/EIS has been revised as suggested.

Response 34-34: The CCP/EIS has been revised as suggested.

Response 34-35: The CCP/EIS has been revised as suggested.

Response 34-36: The CCP/EIS has been revised as suggested.

- On page H-21, desert tortoise, third paragraph:
  - At the end of this paragraph, add, "The Moapa Valley and Ash Meadows NWRs are located within desert tortoise habitat and it is likely that tortoises occupy lands on or around these Refuges." 34-37

- Please make the following changes to the reptile lists for each of the Refuges.
  - H-37: Reptile List for Ash Meadows NWR
  - *Cnemidophorus* should be *Aspidoscelis*.
  - Desert spiny lizard (*Sceloporus magister*) should be yellow-backed spiny lizard (*Sceloporus uniformis*).
  - Speckled rattlesnake (*Crotalus mitchellii*) should be Panamint rattlesnake (*Crotalus stephensi*).
  - Coachwhip should be *Coluber flagellum*.
  - Delete gopher snake *Pituophis melanoleuces*.
  - Add:
    - Desert tortoise (*Gopherus agassizii*)
    - Western lyresnake (*Trimorphodon biscutatus*)
    - Smith's black-headed snake (*Tantilla hobartsmithi*)
    - Desert night snake (*Hypsiglena chlorophaea*)
    - Western shovel-nosed snake (*Chionactis occipitalis*)
    - Long-nosed snake (*Rhinocheilus lecontei*)
    - Glossy snake (*Arizona elegans*)
    - Western patch-nosed snake (*Salvadora hexalepis*) 34-38
    - Striped whipsnake (*Coluber taeniatus*)

  - Page H-51: Change '*Plecotus*' to '*Corynorhinus*'.

  - H-52: Reptile List for Desert NWR
    - *Cnemidophorus* should be *Aspidoscelis*.
    - "*Genus Phrynosoma*" should be "*Phrynosoma platyrhinos*"
    - Gila should be capitalized. The subspecies of the banded Gila monster is *cinctum*, not *suspectum*.
    - Chuckwalla should be *Sauromalus ater*.
    - Desert spiny lizard (*Sceloporus magister*) should be yellow-backed spiny lizard (*Sceloporus uniformis*).
    - Coachwhip should be *Coluber flagellum*.
    - Gopher snake should be *Pituophis catenifer*
    - Add:
      - Banded gecko (*Coleonyx variegatus*)
      - Desert night lizard (*Xantusia vigilis*)
      - Desert iguana (*Dipsosaurus dorsalis*)
      - Western fenced lizard (*Sceloporus occidentalis*)
      - Sagebrush lizard (*Sceloporus graciosus*)
      - Long-tailed brush lizard (*Urosaurus graciosus*)
      - Gilbert's skink (*Plestiodon gilberti*)
      - Western skink (*Plestiodon skiltonianus*)
      - Western thread snake (*Leptotyphlops humilis*)

Response 34-37: The requested change has been made in the CCP/EIS, as appropriate.

Response 34-38: The requested changes have been made in the CCP/EIS, as appropriate.

- H-52: Reptile List for Desert NWR, cont.
  - Spotted leaf-nosed snake (*Phyllorhyncus ecurtatus*)
  - Striped whipsnake (*Coluber taeniatus*)
  - Western patch-nosed snake (*Salvadora hexalepis*)
  - Glossy snake (*Arizona elegans*)
  - Common kingsnake (*Lampropeltis getula*)
  - Long-nosed snake (*Rhinocheilus lecontei*)
  - Western ground snake (*Sonora semiannulata*)
  - Western shovel-nosed snake (*Chionactis occipitalis*)
  - Desert night snake (*Hypsiglena chlorophaea*)
  - Western lyresnake (*Trimorphodon biscutatus*)
  - Sidewinder (*Crotalus cerastes*)
  - Panamint rattlesnake (*Crotalus stephensi*)
  - Southwestern speckled rattlesnake (*Crotalus mitchellii*)
  - Mohave rattlesnake (*Crotalus scutulatus*)

- H-59: Reptile list for Moapa Valley NWR
  - Desert collared lizard *Crotaphytus collaris* should be Great Basin collared lizard *Crotaphytus bicinctores*
  - Add:
    - Banded gecko (*Coleonyx variegatus*)
    - Desert night lizard (*Xantusia vigilis*)
    - Desert iguana (*Dipsosaurus dorsalis*)
    - Zebra-tailed lizard (*Callisaurus draconoides*)
    - Long-nosed leopard lizard (*Gambelia wislizenii*)
    - Yellow-backed spiny lizard (*Sceloporus uniformis*)
    - Western fenced lizard (*Sceloporus occidentalis*)
    - Sagebrush lizard (*Sceloporus graciosus*)
    - Ornate tree lizard (*Urosaurus ornatus*)
    - Long-tailed brush lizard (*Urosaurus graciosus*)
    - Side-blotched lizard (*Uta stansburiana*)
    - Desert horned lizard (*Phrynosoma platyrhinos*)
    - Western whiptail (*Aspidoscelis tigris*)
    - Western thread snake (*Leptotyphlops humilis*)
    - Spotted leaf-nosed snake (*Phyllorhyncus ecurtatus*)
    - Coachwhip (*Coluber flagellum*)
    - Striped whipsnake (*Coluber taeniatus*)
    - Western patch-nosed snake (*Salvadora hexalepis*)
    - Gopher snake (*Pituophis catenifer*)
    - Glossy snake (*Arizona elegans*)
    - Common kingsnake (*Lampropeltis getula*)
    - Long-nosed snake (*Rhinocheilus lecontei*)
    - Western ground snake (*Sonora semiannulata*)
    - Desert night snake (*Hypsiglena chlorophaea*)
    - Western lyresnake (*Trimorphodon biscutatus*)
    - Sidewinder (*Crotalus cerastes*)
    - Southwestern speckled rattlesnake (*Crotalus mitchellii*)
    - Mohave rattlesnake (*Crotalus scutulatus*)

34-38

- <u>H-71: Reptile List for Pahranagat NWR</u>
  - Unsure as to why the ground snake is categorized with rattlesnakes.
    - *Cnemidophorus* should be *Aspidoscelis*.
    - Desert collared lizard *Crotaphytus collaris* should be Great Basin collared lizard *Crotaphytus bicinctores*.
    - *Eumeces* should be *Plestiodon*
    - Desert spiny lizard (*Sceloporus magister*) should be yellow-backed spiny lizard (*Sceloporus uniformis*). 34-38
    - *torquata* should be *chlorophaea*.
    - *Masticophis* should be *Coluber*
    - Add:
      - Western fenced lizard (*Sceloporus occidentalis*)
      - Sagebrush lizard (*Sceloporus graciosus*)
      - Western thread snake (*Leptotyphlops humilis*)
      - Ring-necked snake (*Diadophis punctatus*)
      - Delete Gila monster (*Heloderma suspectum*)

Thank you for the opportunity to work with the Service on this plan. Please contact Habitat Biologist Craig Stevenson concerning this review at 702-486-5127 x3614 or cstevenson@ndow.org

Sincerely,

D. Bradford Hardenbrook,
Supervising Habitat Biologist

CS:cs/dbh

cc: NDOW, Files

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Letter 35

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

September 9, 2008

Cynthia T. Martinez
Complex Manager
Desert National Wildlife Refuge Complex
4701 N. Torrey Pines Drive
Las Vegas, NV 89130-5450

Subject: Draft Environmental Impact Statement for the Desert National Wildlife Refuge Complex Comprehensive Conservation Plan, Clark, Lincoln, and Nye Counties, Nevada (CEQ #20080262)

Dear Ms. Martinez:

The Environmental Protection Agency (EPA) has reviewed the above-referenced document pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508), and Section 309 of the Clean Air Act.

EPA supports the purpose and goals of the Comprehensive Conservation Plan and the preferred alternatives for each of the four refuges. We believe that the more extensive efforts to improve and protect habitat for plants and wildlife included in the preferred alternatives will be most beneficial to those species that depend upon the refuge habitats. We also support adaptive management in efforts to minimize temporary adverse impacts to listed species during activities such as eradication of invasive species. We have, therefore, rated this Draft Environmental Impact Statement (DEIS) as LO, *Lack of Objections*. Please see the enclosed *Summary of EPA Rating Definitions* for a description of our rating system. 35-1

There are a few items that EPA recommends be clarified in the Final Environmental Impact Statement (FEIS):

- The Nevada Department of Transportation and the Federal Highway Administration (FHWA) have initiated an environmental review process for the Sheep Mountain Parkway, a proposed transportation corridor that may be located near the southern border of the Desert National Wildlife Refuge (DNWR). This project should be included in the cumulative impact discussion, and its potential impacts considered in planning for the DNWR. We also encourage DNWR staff to participate in the Sheep 35-2

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M.35 Environmental Protection Agency, September 9, 2008

Response 35-1: Comment appreciated.

Response 35-2: The referenced project has been added to the cumulative impacts section. Desert NWR Complex staff have been and will continue to coordinate with FHWA and other stakeholders involved with this project.

Mountain Parkway planning process. Information about this project can be obtained from Abdelmoez Abdalla of FHWA at 775-687-1231. 35-2

- The DEIS states that the Las Vegas Valley Airshed is considered nonattainment for carbon monoxide and particulate matter less than 10 microns. The Las Vegas Valley airshed is also in nonattainment with the 8-hour ozone standard. Please contact the Clark County Department of Air Quality Management for current information on attainment status and state implementation plans for these pollutants and include this information in the FEIS. 35-3
- The DEIS states that "[e]ach of the refuges in the Desert Complex has potential to contain paleontological resources based on the geologic units that have been mapped." However, the *Environmental Consequences* chapter states that paleontological resources would not be affected by the Proposed Action, and no discussion of potential impacts is included. Please clarify why these potential resources would not be impacted by activities such as earthmoving associated with habitat restoration and facility construction. 35-4

We appreciate the opportunity to review this DEIS, and request a copy of the FEIS when it is officially filed with our Washington, D.C., office. If you have any questions, please contact Carolyn Mulvihill of my staff at 415-947-3554 or mulvihill.carolyn@epa.gov.

Sincerely,

Kathleen M. Goforth

Kathleen M. Goforth, Manager
Environmental Review Office (CED-2)

Enclosure: Summary of EPA Rating Definitions

cc: Abdelmoez Abdalla, Federal Highway Administration

Response 35-3: The CCP/EIS air quality discussion within section 4.1.1 has been revised to reflect that the Las Vegas Valley airshed is in nonattainment for the 8-hour ozone standard.

Response 35-4: The CCP/EIS text has been changed to explain that no known resources are present but that ground disturbing activities may result in the finding of such resources.

Sep. 9. 2008 4:19PM DEF OF WILDLIFE No. 1043 P. 2

Letter 36

National Headquarters
1130 17th Street, N.W. | Washington, D.C. 20036-4604 | tel 202.682.9400 | fax 202.682.1331
www.defenders.org

September 9, 2008

Ms. Cynthia Martinez, Project Leader
U.S. Fish and Wildlife Service
Desert National Wildlife Refuge Complex
4701 North Torrey Pines
Las Vegas, NV 89130

Sent via Fax to 702-515-5460, Hard Copy to Follow

RE: DRAFT COMPREHENSIVE CONSERVATION PLAN FOR THE DESERT NATIONAL WILDLIFE REFUGE COMPLEX

Dear Ms. Martinez:

Thank you for the opportunity to provide comments as you develop the Comprehensive Conservation Plan ("CCP") for the Desert National Wildlife Refuge Complex. Defenders of Wildlife ("Defenders") is a non-profit, public interest institution with over 530,000 members nationwide, including more than 1,000 living in Nevada.

Defenders has long been an advocate for the Refuge System and takes a special interest in the Refuge System planning process. We published the *Citizen's Wildlife Refuge Planning Handbook* to encourage the public to become more involved in refuge planning. We have been actively involved in issues facing the refuges in the Desert Complex. We featured the refuges in the Complex in our report, *Gambling on the Water Table*, which described in detail the threat of large-scale groundwater withdrawals on the species in the southern Nevada refuges. Defenders also publishes an annual report on the state of the Refuge System, *Refuges at Risk*. The 2006 report featured the impacts that water withdrawals would have the Desert Complex.

Overall, Defenders is supportive of the draft CCP including the habitat restoration and invasive species control planned. Of particular concern to Defenders in the development of this CCP, however, is how the Fish and Wildlife Service ("FWS") proposes to address the two most significant threats to refuge resources over the planning horizon: large-scale groundwater withdrawals and climate change. 36-1

CLIMATE CHANGE

The National Wildlife Refuge System Improvement Act of 1997 ("Refuge Improvement Act") has been called "the most important statute Congress has passed for the Refuge System."[1] Prior to its enactment, the Refuge System was the lone remaining system of federal public lands without an "organic" statute.[2] Congress intended the Refuge Improvement Act to fill this void, by directing that the primary mission of the Refuge System is "to administer a national network of lands for the conservation . . . of the fish, wildlife, and plant resources and their habitats within the United States

1

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M.36 Defenders of Wildlife, September 9, 2008

Response 36-1: We agree that existing and proposed groundwater withdrawals and the potential effects of climate change are significant issues on all four Refuges. As a part of water resources management, the Service would continue to monitor water parameters at springs and wells, compare water quality and quantity with past measurements on a biannual basis, and implement measures in coordination with the State Engineer to defend water rights and mitigate substantial changes in water flow or temperature and maintain constant water parameters. The Service will also monitor changes in the environment, such as changes in vegetation communities, wildlife trends, and surface and groundwater levels, to assess the effects of climate change on the Refuges. Climate change impacts will be further analyzed in project-specific NEPA documents, as appropriate.

for the benefit of present and future generations of Americans."[3]

The CCP process is the primary vehicle for ensuring that the Refuge System conservation mission is met. Under section 7 of the Improvement Act, FWS must issue a CCP for every refuge at least once every 15 years. Among many other things including evaluating existing or proposed public or economic uses for compatibility, the CCP must identify and describe the "significant problems that may adversely affect the populations and habitats of fish, wildlife, and plants" within the Refuge and identify "the actions necessary to correct or mitigate such problems."[4]

Defenders believes that climate change is clearly a "significant problem" affecting plant communities, wildlife, habitat and variables such as rainfall and snowpack. Therefore, the impacts of climate change should be a central consideration in the development of refuge CCPs.[a] As highlighted in Defenders' *Refuges at Risk 2006* report, such consideration is especially critical for refuges that are particularly susceptible to a rapidly changing climate, including refuges in arid regions. Indeed, Congress in May 2006 specifically directed that FWS "should incorporate consideration of global warming and sea-level rise into the comprehensive conservation plans for coastal national wildlife refuges, and for other purposes."[b] 36-2

Though Defenders supports the draft CCP's inclusion of climate change into the "Affected Environment" and other sections, the draft CCPs coverage of climate change should be greatly expanded given the enormity and complexity of the problem.

The effects of climate change on the Desert Complex are provided a total of three paragraphs (CCP at 163). The description of the impacts of climate change on southern Nevada provided in the CCP include a documented increase in air temperatures, a documented increase in precipitation at Ash Meadows refuge, and potential future conversion of forests to grasslands and arid lands. The CCP 36-3

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[a] In addition, Department of the Interior Secretarial Order 3226, issued January 19, 2001, states that: "Each bureau and office of the Department will consider and analyze potential climate change impacts when undertaking long-range planning exercises, when setting priorities for scientific research and investigations, when developing multi-year management plans, and/or when making major decisions regarding the potential utilization of resources under the Department's purview. Departmental activities covered by this Order include, but are not limited to…management plans and activities developed for public lands."

[b] House Concurrent Resolution 398. The resolution states that: (1) the United States Fish and Wildlife Service should incorporate consideration of the effects of global warming and sea-level rise into the comprehensive conservation plan for each coastal national wildlife refuge; (2) each such comprehensive conservation plan should address, with respect to the refuge concerned, how global warming and sea-level rise will affect--(A) the ecological integrity of the refuge; (B) the distribution, migration patterns, and abundance of fish, wildlife, and plant populations and related habitats of the refuge; (C) the archaeological and cultural values of the refuge; (D) such areas within the refuge that are suitable for use as administrative sites or visitor facilities; and (E) opportunities for compatible wildlife-dependent recreational uses of the refuge; and (3) the Director of the United Fish and Wildlife Service, in consultation with the United States Geological Survey, should conduct an assessment of the potential impacts of global warming and sea-level rise on coastal national wildlife refuges.

Response 36-2: We agree that climate change and its potential effects on fish, wildlife, and plants and their habitats is a significant problem on all refuges. The discussion of climate change in chapter 4 has been substantially expanded. In addition, the preferred alternatives for each Refuge have been revised to include modeling of climate change and its effects on refuge resources. We currently have a proposal with NDOW and several other partners to implement such a project on Desert and Pahranagat Wildlife Refuges, pending available funding. Climate change impacts will be further analyzed in project-specific NEPA documents, as appropriate.

Response 36-3: See response to comment 36-2.

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fails to further explore these and other impacts. For example, there is widespread scientific agreement that there will be significant further warming globally, and in the Western United States specifically. This will in turn lead to earlier spring snow melting, reducing summer riparian flows. Though the magnitude and timing of these changes are difficult to predict, a thorough discussion of these effects on refuge fish and wildlife is needed to explore management options. 36-3

In addition, many of the threatened, endangered, and endemic species found within the Desert Complex have narrow temperatures tolerances, particularly water temperature for some of the desert fish species. How will global warming affect these species? Though the CCP does state that inventory and monitoring programs will be established to monitor these types of environmental changes, much more detail needs to be included. 36-4

A more thorough discussion of climate change's effects on wildfire is also needed in the CCP. A shorter and earlier spring snowmelt means that drier conditions will come earlier in the season, making for a longer fire season. Given the history of fire suppression in Nevada, forests are already overgrown and have a heavy fuel load. With the potential for a longer fire season, Nevada forests will be at higher risk of more frequent and intense forest fires due to climate change (Nevada Climate Change Advisory Committee 2008). Additionally, less cold winters could mean that bark beetles are better able to survive through the winter, leading to a more wide-spread infestation. This infestation would make trees even more vulnerable to burning (Nevada Climate Change Advisory Committee 2008). The CCP should include these changes in the fire regime in the CCP and adjust, if necessary, proposed fire management. 36-5

Climate change will necessitate more landscale-level and regional-scale analysis and partnerships to solve the conservation problems of the future. There are many scientific questions that may need to be answered that the FWS lacks the capacity to address. Though the CCP contains lists of existing partnerships, additional partnerships should be established specifically to address complex climate change issues. In particular, we are surprised that the Nevada Desert Research Center (NDRC), which has facilities at the Nevada Test Site, and thus on the Desert Range, was not listed as a partner. The NDRC is currently conducting ecological experiments and other studies relating to the effects of climate change and would seem a natural partner both in the development of this CCP and in future research for the refuge complex. 36-6

Defenders is pleased to see that the Nevada State Wildlife Action Plan was consulted in the development of the draft CCP. We understand that the Nevada Division of Wildlife is planning a revision of their state wildlife action plan by 2010 to include more detailed description of the effects of climate change and strategies to address these. Many of these effects and strategies will likely be applicable to the Desert Complex. The FWS should work closely with NDOW and partners to ensure that information developed during the state plan revision process is incorporated into the final CCP. 36-7

Water Rights and Associated Issues

Like global warming, proposed groundwater and surface water development and withdrawals adjacent to the four Refuges comprising the Desert Refuge complex is without question a "significant problem that may adversely affect the populations and habitats of fish, wildlife, and plants" within the Refuge and thus, FWS is required during this CCP process to identify "the actions necessary to correct or mitigate such problems." Indeed, the issue of ensuring adequate water 36-8

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Response 36-4: Currently, little or no information exists on how climate change may affect the many special status and endemic species which occur on the Desert Refuge Complex. The preferred alternative for each refuge includes expansion of inventory and monitoring which is a key part of detecting climate change impacts. In addition, we have revised the preferred alternative for each refuge to include modeling of climate change impact scenarios and development of adaptation strategies.

Response 36-5: Section 4.1.1 in the CCP/EIS has been revised to include more information on the potential influence of climate change on wildfires.

Response 36-6: The Nevada Test Site, and thus the Nevada Desert Research Center (NDRC), are adjacent to but not within the boundaries of the Desert Wildlife Refuge. However, we will explore opportunities for collaboration with the NDRC.

Response 36-7: Comment acknowledged. See response to comment 36-2.

Response 36-8: We agree that groundwater development on is a significant concern for the Refuges. Section 2.3 of the CCP/EIS has been revised to include the impacts of potential groundwater development as a planning issue for each refuge. Furthermore, the alternatives for each refuge include an action to work with the State Engineer's office to defend existing water rights. In addition, the water resources section (4.1.1) in the affected environment has been expanded with a discussion of some of the potential options for defending refuge water rights.

quantity and quality has arguably always been *the* central challenge facing the Desert Refuge complex and as the Service is well aware, was a primary catalyst for protecting these unique and irreplaceable National Wildlife Refuges. 36-8

Defenders is thus pleased to see that FWS has recognized the threats that water development poses to the future integrity and biological diversity of the Desert Complex, and identified some specific measures that the agency intends to take to address those threats.

For example, with respect to Ash Meadows, the draft CCP states at p. 72:

> As a part of water resources management, the Service would continue to monitor water parameters (flow, levels, and temperature) at springs and wells identified in the Water Monitoring Plan (Mayer 2003), compare water quality and quantity with past measurements on a biannual basis, and *implement measures in coordination with the State Engineer to defend water rights and mitigate substantial changes in water flow or temperature and maintain constant water parameters*.

Similarly, with respect to Pahranagat, the draft CCP states at p. 121:

> The Service would restore and manage 40 acres of native forage for migrating sandhill cranes between the Headquarters Unit and Lower Pahranagat Lake. Sandhill crane usage of the Refuge would be monitored. The Service would *acquire additional water rights from willing sellers and explore opportunities for additional water supplies* through coordination with the Alamo, Richardville, and Hiko Water Boards, Lincoln County, and the U.S. Bureau of Reclamation.

And finally, the draft CCP at p. 87 states with respect to Desert Refuge:

> Wild horses or burros that occur on the Refuge would be removed as soon as possible to protect Refuge resources and minimize competition with wildlife. Well water use and discharge at Corn Creek would continue to be monitored, and the Service would *work with the State Engineer to defend water rights and mitigate substantial changes in temperature or flow*. (P87)

Defenders notes, however, that the draft CCP does not appear to make similar statements with respect to the Moapa Valley National Wildlife Refuge, and thus requests FWS to ensure that the final CCP makes clear that FWS will vigorously defend water rights at not only Moapa Valley, but *all* four of the Refuges comprising the Desert Refuge Complex. 36-9

Specific to Moapa Valley, Defenders also requests that the final CCP address the future inclusion of the Warm Springs Ranch (currently owned by SNWA) into the Refuge, and the preferred alternative for that Refuge include a boundary adjustment that would authorize and facilitate this 36-10

Response 36-9: The CCP/EIS has been revised to include an action to defend water rights for each Refuge, including Moapa Valley.

Response 36-10: Comment acknowledged. The preferred alternative for Moapa Valley Refuge in the final CCP/EIS includes expansion of the acquisition boundary by 1,765 acres, including the former Warm Springs Ranch.

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expansion. Defenders believes that expanding Moapa Valley to include the Warm Springs Ranch is both a natural and logical step to take in ensuring the continued existence and recovery of the Moapa dace and other endemic and imperiled species that the Refuge is intended to protect. 36-10

In addition, Defenders believes that despite FWS's effort to specifically address water issues, the draft CCP as a whole fails to adequately highlight its central importance, and indeed, water and the potential effect on Refuge water resources from groundwater development is not even identified as one of the CCP's major issues, or as an "area of controversy." *See* CCP at S-17, S-18. These shortcomings must be remedied in the final CCP. In general, as is the case with the discussion of global warming, the final CCP's discussion of water issues must be greatly expanded given the enormity and complexity of the problem. 36-11

Specifically, Defenders recommends that the final CCP include detailed information on *all* pending water proposals (groundwater and surface) that have the potential to impact any water resources within any of the four Refuges. Defenders further recommends that the issue of *protecting Refuge water resources* actually be incorporated into the final CCP's preferred alternative for *each* Refuge. This course of action is clearly justified—and is in fact compelled—by FWS's duties under the Improvement Act, as the development of water resources is the most pressing challenge facing the agency, the Refuges, and the many imperiled and endemic species that depend upon the Refuge's habitat, and will likely remain so for the approximate 15-year period that this CCP will govern management of the Desert Complex. 36-12

CONCLUSION

We appreciate this opportunity to comment, and again stress the importance of better addressing climate change and water issues in the final CCP. We hope our comments have been helpful in the development of the Desert National Wildlife Refuge Complex final CCP.

Sincerely,

Noah Matson

Noah Matson
Vice President for Land Conservation

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[1] Fischman, Robert L. The National Wildlife Refuge System and the Hallmarks of Organic Legislation, 29 Ecology L.Q. 457, 501 (2002).
[2] See H. Rep. No. 105-106 at 3 (1997).
[3] 16 U.S.C. § 668dd(e)(1)(A).
[4] 16 U.S.C. § 668dd(e)(2)(E).

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Response 36-11: The CCP/EIS Summary has been revised to include potential impacts resulting from existing and proposed groundwater development as both a major issue and an area of controversy. We have also expanded the water resources discussion in the Final CCP/EIS to reflect groundwater concerns potentially affecting the refuges and actions we have taken to address these concerns.

Response 36-12: See response to comments 38-9 and 38-11. The CCP/EIS has been revised to include more information on pending groundwater development proposals, including SNWA's proposed Groundwater Development Project.

September 9, 2008

Letter 37

Mark Pelz
Chief, Refuge Planning
2800 Cottage Way, W-1832
Sacramento, CA 95825

Dear Mr. Pelz,

I am a member of the public who resides in Las Vegas, Nevada. I am a wildlife biologist and an avid recreational user of federal public lands managed by the National Park Service, Bureau of Land Management, U.S. Forest Service and the U.S. Fish and Wildlife Service (Service). I enjoy backcountry driving, viewing wildlife, hiking, photography (scenery and wildlife), camping, picnicking, and learning about our public lands. With respect to the Desert National Wildlife Refuge Complex (Complex), I have a keen interest in the development of the Comprehensive Conservation Plan and Environmental Impact Statement (CCP/EIS) as I visit the Desert National Wildlife Refuge (DNWR) on occasion and is one of the places I enjoy taking visitors from out-of-town to show them what else southern Nevada has to offer besides "the Strip". Without fail, everyone is amazed by the beauty of the landscape and the remoteness and isolation of the area in such proximity to the zaniness of Las Vegas.

I commend the Service in its efforts on the Complex to enhance visitor services and maintain the roadways many of us enjoy driving. I fully support the Service's efforts that include reopening the Alamo Road and maintaining it and the Mormon Well Road as "open" on the DNWR. These two roads provide great backcountry driving opportunities that allow the public to appreciate and enjoy our public lands. I realize, however, that there are instances where members of the public do not realize or understand the remoteness, length or condition of these roads, especially after significant rain events and may experience unpleasant driving conditions or worse, become stranded. This is unfortunate for the health and safety of those individuals, but also for those of us who are responsible, experienced and properly outfitted drivers of the backcountry when it leads the Service to close roads. I would support some sort of responsible and fair system, be it a toll or permit of some sort, which would allow responsible, experienced and properly outfitted drivers to continue to be able to use the backcountry roads of the Complex when otherwise they would temporarily be designated "closed". 37-1

I also support efforts to deter unauthorized uses of the Complex, such as increased law enforcement and boundary fencing; although I imagine that will become increasingly difficult as development within the Cities of Las Vegas and North Las Vegas advance north to the southern boundary of the DNWR. 37-2

Thank you for the opportunity to review and comment on the CCP/EIS.

Sincerely,

Paul B. Aguirre

M.37 Paul B. Aguirre, September 9, 2008

Response 37-1: Comment appreciated. We plan to continue to keep Mormon Well and the portion of Alamo Road south and north of the Desert Dry Lake open to the public. Furthermore, we are evaluating options for reopening the portion of Alamo Road which traverses the Desert Dry Lake, if feasible.

Response 37-2: Comment appreciated.

Letter 38

SOUTHERN NEVADA WATER AUTHORITY
1001 South Valley View Boulevard • Las Vegas, NV 89153
(702) 258-3939 • snwa.com

September 9, 2008

Mark Pelz
Chief, Refuge Planning
2800 Cottage Way, W–1832
Sacramento, CA 95825-1846

Re: Comments on Draft Comprehensive Conservation Plan/Environmental Impact Statement for the Desert National Wildlife Refuge Complex, 73 Fed. Reg. 39979 (July 11, 2008)

Dear Mr. Pelz:

The Southern Nevada Water Authority (SNWA) submits the enclosed comments in response to the above-referenced notice by the U.S. Fish and Wildlife Service (Service) regarding the availability of the Draft Comprehensive Conservation Plan/Environmental Impact Statement (draft CCP/EIS) for the Desert National Wildlife Refuge Complex. SNWA is a cooperative agency formed in 1991 to address Southern Nevada's unique water needs on a regional basis. SNWA officials are charged with managing the region's water resources and providing for Las Vegas Valley area residents' and businesses' present and future water needs.

In fulfilling this mission, SNWA has obtained and is in the process of applying for water rights in and near the four refuges in the Desert National Wildlife Refuge Complex. SNWA has also entered into numerous agreements and stipulations with the Service to protect the natural resources in and around the refuges. Thus, SNWA has a significant interest in the draft CCP/EIS for the Desert National Wildlife Refuge Complex. Please consider and include these comments in the administrative record for the Desert National Wildlife Refuge Complex draft CCP/EIS.

Sincerely,

John J. Entsminger
Deputy General Counsel

Enclosures

Cc: Kay Brothers, Deputy General Manager, Engineering/Operations
Ken Albright, Director, Groundwater Resources
Bill Rinne, Director, Surface Water Resources
Robert Williams, Field Supervisor, U.S. Fish & Wildlife Service
Cynthia Martinez, Complex Manager, Desert National Wildlife Refuge Complex
Michael Brennan, Esq., Holland and Hart LLP

SNWA MEMBER AGENCIES
Big Bend Water District • Boulder City • Clark County Water Reclamation District • City of Henderson • City of Las Vegas • City of North Las Vegas • Las Vegas Valley Water District

Southern Nevada Water Authority's Comments on the Draft Comprehensive Conservation Plan/Environmental Impact Statement for the Desert National Wildlife Refuge Complex

On July 11, 2008, the U.S. Fish and Wildlife Service (Service) made available for public comment the draft Comprehensive Conservation Plan/Environmental Impact Statement (CCP/EIS) for the Desert National Wildlife Refuge Complex, which encompasses the Ash Meadows, Desert, Moapa Valley, and Pahranagat national wildlife refuges. *See* 73 Fed. Reg. 39979 (July 11, 2008). The draft CCP/EIS describes how the Service will manage each National Wildlife Refuge (NWR) over the next 15 years, assesses the environmental impacts of such management, and includes draft compatibility determinations for several existing and proposed public uses. The following are the comments of the Southern Nevada Water Authority (SNWA) on the draft CCP/EIS.

I. Compatible Use Determinations

The Refuge Improvement Act (16 U.S.C. §§ 668dd-668ee) requires that the Service prepare a comprehensive conservation plan (CCP) for each refuge or refuge complex (i.e., planning unit) that provides management direction for such planning unit for a 15-year period. 16 U.S.C. § 668dd(e)(1). More specifically, a CCP

> describes the desired future conditions of a refuge or planning unit and provides long-range guidance and management direction to achieve the purposes of the refuge; helps fulfill the mission of the Refuge System; maintains and, where appropriate, restores the ecological integrity of each refuge and the Refuge System; helps achieve the goals of the National Wilderness Preservation System; and meets other mandates.

50 C.F.R. § 25.12(a).

The Refuge Improvement Act authorizes the Service to permit the use of any area within the Refuge System whenever it determines that such use is compatible with the major purposes for which such area was established and is not inconsistent with public safety. 16 U.S.C. §§ 668dd(d)(1), (d)(3). A compatible use is "a wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge." *Id.* § 668ee(1). As part of the CCP planning process, the Service provides "a forum for the public to comment on the type, extent, and compatibility of uses on refuges[.]" Refuge Manual, 602 FW 3.3(F).

A. Applying a Two-Tier Screening Process for Evaluating Proposed Refuge Uses is Improper

The draft CCP/EIS describes the process for approving proposed uses of refuge lands as follows:

> The first step in determining if a use is compatible is to determine if the use is appropriate (called an appropriateness finding). The Service evaluates each use to determine if it is appropriate based on the NWRS [National Wildlife Refuge System] mission and refuge purpose(s). If a use is not appropriate, the use is not further considered, and a compatibility determination is not required. If a use is determined to be appropriate, the Service must prepare a compatibility determination. When a determination is made as to whether a proposed use is compatible or not, this determination is provided in writing and is referred to as a compatibility determination.

Draft CCP/EIS at 1-7. This process is based on Service policy in general, and is not specific to the Desert National Wildlife Refuge Complex.

This two-tier process established by Service national policy–i.e., the use of an initial appropriateness finding followed by a compatibility determination, if the use is deemed appropriate–is not contemplated by the Refuge Improvement Act or its implementing regulations (50 C.F.R. parts 25 and 26), but instead is wholly a creation of Service policy. The only criteria authorized by the statute and its implementing regulations for considering proposed uses of refuge system lands is the requirement that a proposed use be a "compatible use" and that it is not inconsistent with public safety. 16 U.S.C. § 668dd(d)(3)(A); 50 C.F.R. § 26.41. As noted above, a "compatible use" is one that "will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge." 16 U.S.C. § 668ee(1); 50 C.F.R. § 25.12(a). Neither the Act nor Service regulations discuss an appropriate-use standard or define what uses may be considered "appropriate."

The compatibility finding requires a determination of whether a use would physically conflict with management of the refuge to meet refuge purposes. See Refuge Manual, 603 FW 2.11(B) (the threshold requirement is that the proposed use "not degrad[e] the ecological integrity of the refuge"; "refuge managers should be looking for tangible impacts"). The Service's use of an "appropriateness" determination means that a use could be denied without ever reaching the congressionally mandated determination that the activity would be incompatible. The appropriate-use test thus allows a refuge manager to reject a proposed use based on a more stringent and more ambiguous standard for approval than the compatibility requirement established by the statute or regulations.

For example, for a nonwildlife-dependent use to be deemed compatible under the Act, it must not materially interfere with or detract from the mission of the System or purposes of the refuge. But under Service policy, as set forth in the Refuge Manual, for such a use to be appropriate, it generally must, among other things, "contribute to the public's understanding and appreciation of the refuge's natural and cultural resources" or be "beneficial to the refuge's natural or cultural resources." 603 FW 1.11(A)(3)(i). This is a higher standard, which is not consistent with the Act's requirements and is improper for the Service to propose. *See Wilderness Society v. U.S. Fish & Wildlife Serv.*, 316 F.3d 913, 926 (9th Cir. 2003) ("a use need not *support* Refuge purposes in order to be compatible, as the definition clearly provides. In order to be 'compatible,' a use simply must not 'materially interfere' with stated Refuge purposes") (emphasis in original).

Other criteria in the appropriate-use test are sufficiently lacking in detail that they provide almost unfettered authority for a refuge manager to deny a proposed use on wholly subjective and unsubstantiated grounds. For instance, the refuge manager may reject a use as not appropriate if he or she finds that such use is not consistent with refuge goals and objectives. Unlike the term "compatible use," there is no definition of "consistent with" in the Act, regulations, or policies. The Refuge Manual section on appropriate use indicates that if a use conflicts with the goals and objectives of the refuge, it generally is not appropriate. 603 FW 1.11(A)(e). But "conflicts with" is no more self-explanatory than "consistent with." And to the extent that the Service interprets "consistent with" as synonymous to "compatible with," such an interpretation would allow the refuge manager to determine that a use is not compatible outside the normal constraints of the compatibility determination process (i.e., public involvement and Regional Chief concurrence).

This lack of clarity is compounded by the fact that the goals of a refuge are often broadly worded, which renders them susceptible to subjective (and inconsistent) interpretation and application in the appropriate-use test. For instance, in the draft CCP/EIS, one of the proposed goals for the Ash Meadows National Wildlife Refuge is to "[r]estore and maintain the ecological integrity of natural communities within the Ash Meadows NWR." Worded this way, different refuge managers could easily reach different conclusions regarding whether a proposed use is "consistent with" this goal.

In addition, the refuge manager is able to reject proposed uses through the appropriate-use test with little to no oversight. For compatibility determinations, the refuge manager must obtain the Regional Chief's concurrence. 50 C.F.R. § 26.41(a)(14). But when the refuge manager determines that a use is not appropriate, no concurrence by the Regional Chief or even the refuge supervisor is required. 603 FW 1.11(C). Moreover, with compatibility determinations, the refuge manager solicits public review and comments on the proposed refuge use before issuing the final compatibility determination. 603 FW 2.12(A)(9). By contrast, for appropriateness findings outside the comprehensive conservation plan process, the appropriateness finding is made without public review and comment. 603 FW 1.9(B). This is contrary to the Act, which directs the Service to provide an opportunity for public review and comment on each evaluation of a use. 16 U.S.C. § 668ddd(d)(3)(B)(ix). Thus, the

refuge manager may unilaterally deny a proposed use based on his or her subjective opinion as to the "appropriateness" of the use without input or oversight by other Service personnel or the public. The Service should not employ the "appropriateness" test in evaluating potential uses of the National Wildlife Refuge System, either at the Desert National Wildlife Refuge Complex or elsewhere. 38-1

B. Draft Compatibility Determinations for the Desert National Wildlife Refuge Complex

1. Water Resource Monitoring

Appendix G to the draft CCP/EIS lists water monitoring on the Moapa Valley NWR as both an appropriate and a compatible use. See Draft CCP/EIS at G-2. However, the specific compatibility determination for these water monitoring activities is not included in Appendix G. The Service should make this compatibility determination available for public review and comment. 38-2

More importantly, however, the Service should recognize that water resource monitoring is a refuge-management activity that does not require a compatible use determination. The Refuge Manual recognizes that the Service does not need to prepare compatibility determinations for refuge management activities. 603 FW 2.10(A). The regulations define "refuge management activity" as "an activity conducted by the Service or a Service-authorized agent to fulfill one or more purposes of the national wildlife refuge, or the National Wildlife Refuge System mission. Service-authorized agents include contractors, cooperating agencies, cooperating associations, refuge support groups, and volunteers." 50 C.F.R. § 25.12(a). 38-3

Water resource monitoring qualifies as a refuge management activity because it helps fulfill the purposes of the four refuges. The purposes of the Ash Meadows, Desert, and Moapa Valley NWRs include the conservation of species listed as threatened or endangered under the Endangered Species Act. Draft CCP/EIS at 1-25, 1-33, 1-38. The vision statement for the Ash Meadows NWR recognizes the manner in which water monitoring contributes to such species conservation:

> Researchers are drawn to the Refuge where science-based management and *monitoring* is used to guide habitat restoration and endangered species recovery efforts and, in the process, further scientific knowledge of fields such as species genetics, *regional water flow*, geology and even the cultural and historical significance of this long inhabited area.

Id. at 1-25 (emphasis added).

In addition, the purpose of the Pahranagat NWR is to serve as a sanctuary for migratory birds. *Id.* at 1-43. The vision statement for the Pahranagat NWR recognizes that "researchers focus on understanding the role of southwestern wetlands and

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M.38 Southern Nevada Water Authority (John J. Entsminger), September 9, 2008

Response 38-1: This Appropriate Refuge Uses Policy was promulgated under the authority of the National Wildlife Refuge System Administration Act of 1966, as amended (16 USC 668dd–668ee) and the Refuge Recreation Act of 1962 (16 USC 460k). The draft policy was made available for public comment in the Federal Register on January 16, 2001 (66 FR 3673). The initial public comment period closed March 19, 2001. However, the comment period was extended several times, and eventually ended June 30, 2001. The Notice of Availability of the final policy, which included a response to comments on the draft, was published in the Federal Register on June 26, 2006 (71 FR 36408). The final Appropriate Refuge Uses Policy took effect on July, 26, 2006. This policy is currently in effect and applies to all existing and proposed uses of the Desert National Wildlife Refuge Complex.

Response 38-2: The references to water monitoring in Appendix G, Table 1 were included in error. No compatibility determinations (CDs) exist for this specific use because in this particular instance, it was determined to be a refuge management activity and thus did not require a compatibility determination. These references were removed in the final CCP/EIS.

Response 38-3: Water monitoring is not always considered a refuge management activity. Any such activity will be evaluated on a case-by-case basis pursuant to Service policy diversity in the regional and national refuge system . . . This ever expanding understanding contributes to conservation and management of Mojave Desert environments important to southern Nevada, the southwest, and the United States." *Id.* at 1-44. Groundwater and surface-water monitoring provides information that is essential to the Service's management of the refuges, and which thus helps advance the Refuge's purpose.

Moreover, the Service has previously recognized that groundwater monitoring activities undertaken by SNWA on the Desert NWR qualify as refuge management activities. In the 2004 stipulation between Las Vegas Valley Water District (LVVWD), SNWA, and the Service regarding applications for water rights in the North and South Tikaboo Valleys and the Three Lakes North and South Valleys (attached as Attachment 1), the parties agreed to develop and implement a groundwater monitoring study on the Desert NWR. 2004 Tikaboo/Three Lakes Stipulation ¶ 4. The Service determined that the study fulfilled one or more of the purposes of the Desert NWR or the System and that LVVWD/SNWA was a Service-authorized agent. *Id.* ¶ 3. Thus, the Service concluded that the groundwater monitoring on the Refuge was a "refuge management activity" that did not require a compatibility determination. *Id.* The Service should similarly regard any future water resource monitoring on the refuges as a refuge management activity that does not require a compatible-use determination. 38-3

2. Mitigation Activities on Refuge Lands

The regulations state that that the Service will not allow compensatory mitigation to make a proposed refuge use compatible. 50 C.F.R. § 26.14(b). But if SNWA were to propose to conduct activities on the refuge that would mitigate and compensate for *offsite* impacts, the Service should consider such mitigation measures to be refuge management activities that do not require a compatibility determination. For instance, in the Memorandum of Agreement (MOA) that the Service, SNWA, and other parties entered into with respect to SNWA's application for water rights in the Coyote Spring Valley hydrographic basin (Muddy River MOA) (attached as Attachment 2), SNWA agreed to provide funding in the amount of $750,000 for the restoration of Moapa dace habitat under the direction of the Service on the Apcar Unit of the Moapa NWR. Similar to water resource monitoring activities, mitigation measures such as those contemplated in the Muddy River MOA that are undertaken to improve refuge resources help fulfill one or more of the purposes of the refuge and the System, and should be considered refuge management activities. Therefore, mitigation activities that the Service authorizes SNWA to undertake on the Refuges to compensate for offsite impacts should be exempt from the compatible use determination. 38-4

3. Water Development Activities

SNWA has the following water rights for groundwater withdrawals with points of diversion on the Desert NWR: (1) Permits 53950 and 53951 for a combined duty of 1,700 acre-feet per year (afy); (2) Permit 54060 for 1,700 afy; and (3) Permits 54068 and 54069 for a combined duty of 2,000 afy. In addition, SNWA has eight water rights applications for groundwater withdrawals pending before the State Engineer that have

Response 38-4: We will make a case-by-case determination whether proposed mitigation or other activities on refuge lands are considered a refuge management activity or are subject to an appropriateness finding and compatibility determination, in accordance with 603 FW 1 and 2 of the Fish and Wildlife Service Manual. According to this policy, a refuge management activity is "an activity conducted by the Service or a Service-authorized agent to fulfill one or more purposes of the national wildlife refuge, or the National Wildlife Refuge System Mission. . ."

points of diversion on the Desert NWR: (1) application 53952 for 10 cubic feet/second (cfs); (2) application 54056 for 6 cfs; (3) application 54061 for 10 cfs; (4) application 54065 for 10 cfs; (5) application 54070 for 10 cfs; (6) application 54071 for 10 cfs; (7) application 54072 for 10 cfs; and (8) application 54106 for 10 cfs.

Development of SNWA's existing water rights should be deemed a compatible use of the Desert NWR in light of the various stipulations SNWA has entered into with the Service regarding such water rights to ensure they would have no adverse effects on refuge resources. For instance, in the 2005 Tikaboo/Three Lakes Stipulation (attached as Attachment 3), the Service and SNWA agreed to a monitoring, management, and mitigation plan to protect federal water-related resources, including those on the Desert NWR. The monitoring requirements of the plan include monitoring wells, spring flow 38-5
measurements, water quality analyses, quality control procedures, and reporting requirements. The management requirements include the creation of a Technical Review Panel to review information collected under the plan, use of a numerical groundwater flow model to predict the impacts of pumping, and the establishment of a decision-making process. The mitigation plan involves the modification of the location and quantity of pumping, if necessary to avoid unreasonable adverse effects to federal water rights and resources or to rehabilitate, repair, or replace resources affected by pumping. With these protections in place, the development of these existing water rights is a compatible use of the Desert NWR.

SNWA is supportive of the Service's management goals and objectives for the 38-6
Desert NWR. With respect to future efforts by SNWA to develop its pending water rights applications (once acted on by the State Engineer), SNWA will endeavor to propose development in a manner that does not impair refuge resources and can be determined to be compatible for the purposes of the Service's regulations. Furthermore, it is possible that SNWA and the Service would enter into similar protective stipulations regarding the development of those water rights to protect refuge resources. 38-7
It is similarly possible that the State Engineer would impose conditions on the approval of such water rights that protect refuge resources. Accordingly, SNWA believes that development by SNWA of future water rights on the refuge can be done in a manner that will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge, and which can thus be determined to be a compatible use.

As a related matter, the final CCP/EIS should recognize that the Service has been coordinating and will continue to coordinate with local agencies, such as SNWA, with respect to activities on- as well as off-refuge lands. In its discussion of the Desert NWR preferred alternative, the draft CCP/EIS states: "[t]he FWS would coordinate with local jurisdictions along the southern boundary to ensure compatible development 38-8
occurs adjacent to the Refuge." Draft CCP/EIS at 3-32. This statement, while beneficial, appears to be limited to areas outside of the Refuge; it should be expanded to include and provide for coordination with local jurisdictions for compatible development within the boundaries of the refuges that comprise the Desert National Wildlife Refuge Complex.

Response 38-5: See response to comment 39-5. Furthermore, as pointed out in the SNWA comments, the Service's compatibility policy (603 FW 2) states that "We will not allow compensatory mitigation to make a proposed refuge use compatible." Our determination on whether or not a proposed use is compatible will be based entirely on its potential impacts and any avoidance or minimization measures. The foundation of the Monitoring, Management, and Mitigation (3-M) plan developed as part of the November 2005 Tikaboo/Three Lakes Stipulation was that all groundwater development by SNWA would be off refuge lands and would be located south of the refuge in the Three Lakes South Hydrographic Basin. There was never any consideration of groundwater development on the refuge in the plan. This stipulation only considered the change applications proposed by SNWA in Three Lakes South.

Furthermore, all the parties to the Stipulation agreed to implement the Monitoring, Management, and Mitigation Plan "…if and only if the Nevada State Engineer grants SNWA's Applications for changes in points of diversion for permits 53950, 53951, 54060, 54068, and 54069, in total or in part. In the event the Nevada State Engineer only grants SNWA's Applications for changes in points of diversion for permits 54062 and 54066, in total or in part, SNWA agrees that it shall negotiate in good faith with the federal agencies to develop 'sufficient monitoring and plans for mitigation of impacts, including cessation of pumping, if necessary'." In the ruling on these change applications, the State Engineer did not grant any of the change applications for permits 53950, 53951, 54060, 54068, and 54069, in total or in part. According to the stipulation, this means the 3-M plan originally negotiated by the parties terminated by its own terms.

Response 38-6: Comment appreciated.

Response 38-7: While we are skeptical that any such use on the Desert NWR would be considered compatible, we will determine compatibility of proposed uses on a case-by-case basis in accordance with our Appropriateness and Compatibility Policies (603 FW 1 and 2). Evidence suggests that groundwater development on Desert NWR would impact Service water rights and trust resources at Desert NWR, Ash Meadows NWR, and Devils Hole (see State Engineer Rulings from the Amargosa Basin and the Three Lakes/Tikaboo Basins).

Response 38-8: The statement regarding development adjacent to the southern boundary refers to residential and related development proposed by the City of North Las Vegas and the City of Las Vegas. The purpose of this statement was to express our desire to work with city governments and other stakeholders to ensure that refuge purposes are taken into consideration in any development plans near our boundaries. Any proposed uses within the refuge boundaries will be evaluated on a case-by-case basis in accordance with the Service's compatibility and appropriateness policies.

4. Pipeline Rights-of-Way

The draft CCP/EIS does not address potential rights-of-way (ROWs) across any of the refuges, such as for water pipelines. For future proposed ROWs, the Service would need to determine that the specific proposed use is compatible with the purpose of the refuge and the mission of the System. The Service would make this compatibility determination once a ROW application has been filed and an additional project-specific NEPA analysis has been prepared, as contemplated by the draft CCP/EIS. *Id.* at 1-45. However, these proposed uses should not be evaluated under the appropriate-use test.

The Refuge Improvement Act specifically recognizes the authority of the Service to grant the use of or easements across refuges for purposes such as powerlines, telephone lines, canals, ditches, pipelines, and roads, when they are compatible uses. 16 U.S.C. § 668dd(d)(1)(B). Through this provision, Congress implicitly recognized that it is appropriate to allow use of a refuge for pipelines and the like, so long as they are compatible with the purposes of the refuge.

In addition, unlike other proposed uses of refuge lands, ROWs requests are governed by their own regulations, 50 C.F.R. §§ 29.21-29.22, and Service policy, 340 FW 3, where they are subject to different evaluation procedures than other proposed uses. *See, e.g.*, 50 C.F.R. § 29.21-1(a) (requiring the *Regional Director* to determine whether the use is compatible); *id.* § 29.21-4 (outlining specific terms and conditions for a ROW easement or permit). In light of the other regulations and policy, the Service expressly recognized in the preamble to its appropriate-use policy that "[r]ights-of-way will continue to be handled through the compatibility and right-of-way permit processes, not this policy." 71 Fed. Reg. 36408, 36415 (June 26, 2006). Thus, if SNWA were to request a ROW across any of the refuges in the Desert National Wildlife Refuge Complex, the Service must evaluate the compatibility of such ROW request, but should not subject the request to the appropriate-use test. 38-9

Likewise, by specifically authorizing the Service to permit rights-of-way across refuges for pipelines, powerlines, and the like, Congress anticipated that such ROWs can be found compatible. This statutory provision renders any argument that these types of uses are per se incompatible with the System mission or individual refuge purposes unsupportable. Instead, it demonstrates Congress's continuing intent that such uses can be allowed if they do not physically jeopardize the purposes of the refuge in question. Thus, absent a demonstration that a particular ROW will have tangible, negative impacts on refuge wildlife resources or the ability to manage the refuge for refuge purposes, a ROW should be found compatible.

II. Draft Wilderness Policy

In its section on the legal mandates and Service policies that govern the Service's planning and management of the National Wildlife Refuge System, the draft CCP/EIS discusses the Draft Wilderness Stewardship Policy Pursuant to the Wilderness Act of 1964 (Draft Wilderness Policy). Draft CCP/EIS at 1-9. The Draft Wilderness 38-10

Response 38-9: Requests for water pipeline rights-of-way or other proposed uses will be evaluated on a case-by-case basis in accordance with our Appropriateness and Compatibility Policies (603 FW 1 and 2).

Response 38-10: Comment noted. Subsequent to the release of the Draft CCP/EIS, the Service's Final Policy on Wilderness Stewardship was published in the Federal Register (see 73 FR 67876).

Policy was circulated for public comment on January 16, 2001. *See* 66 Fed. Reg. 3708 (Jan. 16, 2001). Since that time, it does not appear that the Service has taken steps to finalize the draft policy. In light of the time that has passed since it was originally issued, the Service should recirculate the Draft Wilderness Policy for additional public comment and finalize the policy before relying on its content to support the CCP/EIS. 38-10

III. Affected Environment

A. Effects Across Flow Systems

Several statements in the draft CCP/EIS regarding adverse impacts from groundwater pumping propagating within and across regional flow systems are inaccurate. For instance, the document states that "surface water resources within each of the four refuges can be affected by uses elsewhere within the same flow systems" *Id.* at 4-8. It also states that "[b]ecause the springs at Ash Meadows NWR are derived from the regional flow system, groundwater use in other, more distant basins is also a concern, including as far as Pahranagat Valley and the Spring Mountains." *Id.* at 4-25. Furthermore, the draft CCP/EIS claims that "[t]he groundwater aquifer within each Refuge connects to other aquifers in southern Nevada; therefore, impacts at Coyote Springs, for example, could have adverse impacts at Ash Meadows NWR." *Id.* at 5-77.

Blanket statements such as these oversimplify the physical characteristics of the hydrologic system of the regional carbonate aquifer, and disregard the administrative processes established to protect such systems. First, the statements in the draft CCP/EIS do not reflect the complexity of the region's groundwater hydrology. The importance of major structures in compartmentalizing the carbonate aquifer system has been described by several researchers including Winograd (1963), Winograd and Thordarson (1968 and 1975) and Rowley and Dixon (2000) among others.[1] This compartmentalization will in effect isolate or at the least attenuate the effects resulting from groundwater production. Hydraulic barriers that may disrupt flow continuity include fault zones and the juxtaposition of confining units with aquifers. These barriers occur throughout the carbonate rock province, so it is improper simply to assume that effects will propagate long distances within a flow system or across flow systems. 38-11

[1] See Rowley, P.D., and G.L. Dixon, 2000, Cenozoic Evolution of the Great Basin Area, USA, - New Interpretations Based on Long-term Field Studies, Geological Society of America Abstracts with Programs, V. 32, No. 7, at A461; Winograd, I.J., 1963, A Summary of the Ground-water Hydrology of the Area between the Las Vegas Valley and the Amargosa Desert, Nevada: U.S. Geological Survey, Report TEI-840, at 79; Winograd, I.J., and W. Thordarson, 1968, Structural Control of Ground-Water Movement in Miogeosynclinal Rocks of South-Central Nevada, in Eckel, E.B., ed., Nevada Test Site: Geological Society of America Memoir 110, at 35-48; Winograd, I.J., and W. Thordarson, 1975, Hydrogeologic and Hydrogeochemical framework, south-central Great Basin, Nevada-California, with Special Reference to the Nevada Test Site: U.S. Geological Survey, Professional Paper 712-C, at 126.

Response 38-11: The referenced sections have been revised to include additional discussion about groundwater hydrology, including the complexity of the regional carbonate aquifer. This discussion also recognizes that there are different interpretations of the data used to characterize the groundwater system and its susceptibility to stressors.

Second, Nevada has a well-developed process for the administration of water rights in which rights to groundwater are granted by the State Engineer based upon perennial yield. Perennial yield is defined as

> The amount of usable water of a ground water reservoir that can be withdrawn and consumed economically each year for an indefinite period of time. It cannot exceed the sum of the Natural Recharge, the Artificial (or Induced) Recharge, and the Incidental Recharge without causing depletion of the groundwater reservoir.

Nevada Division of Water Planning, Water Words Dictionary at 236.[2]

In addition, when evaluating water-rights applications the State Engineer must consider (1) whether there is unappropriated water at the source; (2) whether use of the water would conflict with existing rights; (3) whether use of the water would be detrimental to the public interest; and (4) whether use of the water would adversely impact domestic wells. This administrative process provides a safeguard against adverse impacts within and across regional flow systems.

Furthermore, and directly relevant to the Service's draft EIS, prior to the State Engineer's evaluation of a water right application, the applicant and interested parties often enter into stipulations to protect groundwater resources. This is a process which the Service has engaged specifically to protect various of the Nevada refuges which are the subject of the DEIS, and the DEIS should be revised to recognize the role that such stipulations play with respect to resource management and protection. 38-12

In January 2008, the Service and other agencies of the United States Department of the Interior agreed to withdraw their protests to SNWA's applications for groundwater withdrawals in the Delamar, Dry Lake, and Cave Valley hydrographic basins, based on the terms and conditions set forth in the Delamar, Dry Lake, and Cave Valley Stipulation (attached as Attachment 4), which is primarily applicable to the Pahranagat NWR with minor application to Moapa NWR. A common goal of the parties to the Delamar, Dry Lake, and Cave Valley Stipulation was to manage the development of groundwater by SNWA in Delamar, Dry Lake, and Cave Valley hydrographic basins without causing unreasonable adverse effects to special status species within the area of interest through the implementation of monitoring, management, and mitigation plans.

The management plan required the creation of a Biologic Resources Team ("BRT") to review biological information collected pursuant to the plan and advise the Executive Committee (created under a previous stipulation); the expansion of the duties of the Technical Review Panel (established under a previous stipulation) to review information collected under the plan and advise the Executive Committee; the use of an agreed upon transient groundwater flow system numerical model to help predict effects

[2] Available at http://water.nv.gov/WaterPlanning/dict-1/ww-index.cfm.

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Response 38-12: The water resources discussion in section 4.1.1 of the CCP/EIS has been revised to include a description of some of the options we have to protect refuge water resources of groundwater withdrawals by SNWA in the subject hydrographic basins; and the use of the consensus-based decision making process.

The monitoring plan requirements included, but were not limited to, existing wells, new monitoring wells, water chemistry analyses, spring discharge measurements, quality control procedures, and reporting requirements. The mitigation plan included, but was not limited to, (1) modification, relocation, or reduction in points of diversion and/or rates and quantities of groundwater withdrawals; (2) the augmentation of federal water rights, federal resources, and/or water-dependent ecosystems; (3) acquisition of real property and/or water rights dedicated to the protection of special status species; and (4) measures designed and calculated to rehabilitate, repair, or replace any and all federal water rights, federal resources, and water-dependent ecosystems, if necessary to achieve the common goals set forth in stipulation.

The stipulation also included a hydrologic plan, which established a process for conducting biological monitoring to further the common goals of the parties and focus on special status species and their habitats within the area of interest that are most likely to be affected by any hydrologic changes that may result from SNWA's groundwater withdrawals in the hydrographic basins. The TRP was directed to determine the areas most likely to be affected by any hydrologic changes that may result from SNWA's groundwater withdrawals in the hydrographic basins. The BRT was directed to develop and implement a biological monitoring program in coordination with the Nevada Department of Wildlife.

SNWA entered into similar protective stipulations with the Service in the Muddy River MOA (applicable to the Moapa Valley NWR; mentioned above in Section I.B.2 and described further below in Section III.F.2), and the Authority's Three Lakes/Tikaboo Valleys groundwater rights (described above in Section I.B.3). Each of these stipulations serves to protect refuge resources from the impacts of regional groundwater development.

The draft CCP/EIS should be revised to reflect the complex groundwater hydrology of the regional and surface flow systems which underlie the refuges, and to consider the role that the State Engineer's thorough evaluation of water rights applications plays in protecting refuge resources. Finally, the CCP/EIS should further reflect the existence and significance of the stipulations entered into by the Service, the Department of the Interior, and the Authority to protect such resources. 38-13

B. Monitoring of Existing Wells on Desert NWR

The draft CCP/EIS states that a "few groundwater monitoring wells exist on the Refuge in the Corn Creek Springs area and on the east side of the Sheep Mountains, but not all have data collected from them. The Southern Nevada Water Authority (SNWA) and Las Vegas Valley Water District (LVVWD) have proposed to install new wells and use existing wells to monitor groundwater on the Refuge." Draft CCP/EIS at 4-47. This statement is not entirely accurate. 38-14

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SE ROA 13677

JA_6439

Response 38-13: See response to comments 39-11 and 39-12.

Response 38-14: Section 4.3.1 (water resources) of the CCP/EIS has been revised to more accurately reflect the existing monitoring wells on Desert NWR.

There are, in fact, six existing monitoring wells located on or near the Desert NWR that are part of a long-term groundwater monitoring program conducted by the U.S. Geological Survey (USGS) through a joint funding agreement with SNWA, Nevada Division of Water Resources, and USGS. The monitoring wells with quarterly data collection intervals are USBLM Corn Creek, USGS Cow Camp, USFWS DR-1, USFWS SBH-1, and USAF 2372-1. In addition, the Creech near field monitoring well has continuous data collection. SNWA also maintains an extensive groundwater monitoring network in Coyote Spring Valley, which monitors groundwater levels on a continuous basis. This network includes CSVM-5, which is located within the Desert NWR. 38-14

C. Moapa Valley NWR Groundwater Issues

1. Muddy River

The draft CCP/EIS makes the following statement regarding the Muddy River:

> Flow in the Muddy River has been declining since the early 1960s. The decline is attributed to surface water diversions and nearby groundwater pumping. The direct relationship is unclear, as is whether pumping from regional carbonate aquifers or from the local alluvial aquifers has the primary effect on the springs.

Draft CCP/EIS at 4-74.

It is important to note that this decline is being analyzed by members of the Muddy River Hydrologic Review Team (HRT), which was formed as a result of a Muddy River MOA. In October 2007, a Baseline Pumping Report was issued by the HRT to summarize its findings regarding spring discharge and water level changes in the Muddy River Springs Area and nearby basins. 38-15

In its discussion of the Muddy River, the CCP/EIS should include the following information from the HRT's Baseline Pumping Report regarding the debate over the causes of the observed water level changes:

> Researchers have debated the cause of the water level declines/rises, but generally attribute them to groundwater production in Muddy River Springs area by MVWD [Moapa Valley Water District] (Arrow Canyon production wells), climate effects including drought, changes in Lake Mead elevations, or some combination thereof. The degree to which each of these factors is individually or cumulatively responsible for observed declines/rises has been substantially debated.

HRT Baseline Pumping Report at 16.

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JA_6441

Response 38-15: See response to Comment 39-17.

2. Declining Water Levels

The draft CCP/EIS includes the following statement regarding aquifer water levels in the Moapa Valley NWR:

> Water levels appear to be declining slightly in the alluvial and carbonate aquifers in the vicinity of the Refuge. Based on monitoring data, this declining trend began in the late 1990s, approximately the same time that groundwater withdrawals began rising in the vicinity of the Refuge.

Draft CCP/EIS at 4-77.

While it is true that the declining trend began approximately the same time that groundwater withdrawals increased, during this same time period, the region experienced a significant drought that most likely contributed to the declining trend. The final CCP/EIS should acknowledge this contemporaneous drought event in addition to the increased groundwater withdrawals. 38-16

Furthermore, the HRT Baseline Pumping Report concluded that pumping is not the only factor that may affect groundwater levels:

> Two important multi-year fluctuations and trends include the 1998 to 2004 decline and the 2005 -06 recovery. These have been attributed to climate, groundwater pumping, and/or base level changes (water levels in recharge areas and in Lake Mead) in the various analyses.

HRT Baseline Report at 21. The final CCP/EIS should similarly acknowledge these alternate causes of declining groundwater levels.

D. Moapa Valley NWR Surface Water Issues

1. Muddy River Mapping

Figures 4.4-1 and 4.4-2 of the draft CCP/EIS erroneously depict the Muddy River, which is also known as the Moapa River, as a perennial stream above the Muddy River Springs area. As accurately described in the text of the draft CCP/EIS, the Muddy River does not receive any of its perennial flow until the Muddy Springs area. Draft CCP/EIS at 4-79. The figures should be revised to reflect this fact. 38-17

2. Spring Flow Monitoring

The draft CCP/EIS includes the following statement regarding spring flow measurements: 38-18

> The USGS, in cooperation with the SNWA, currently collects data from a number of gauges on streams fed by

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Response 38-16: The information in the HRT Baseline Report, completed in 2007, was compiled from data generally through 2006. Some of this information has already been updated by more recent work (such as Mayer and Congdon 2008). All of it will likely continue to be updated and changed through the additional study and work products of the HRT members. The CCP/EIS summarizes the issues leading to the establishment of the MOA (existing declines in water levels and springs; a Biological Opinion for a pipeline enabling additional carbonate pumping) and briefly mentions the current status of water monitoring sites and water level/spring discharge trends within this context. Readers can refer to ancillary documents for more specific information. The text of the CCP/EIS has been revised to more fully discuss the monitoring, activities, data collection, and water level decline trends.

We recognize that climate affects ground water levels in the Muddy River Area. In a peer-reviewed article in the journal *Ground Water*, Mayer and Congdon (2008) showed that the response of groundwater levels to climate in this area is limited to very wet years, and that there was no response to dry or average years. This analysis also demonstrated that the decline in groundwater levels that began in 1998 was not caused by drought. The decline began in 1998, which was a very wet year. Groundwater levels did not decline during similar droughts that preceded 1998, the year that groundwater pumping increased so significantly. Local climate records do not show a consistent drought from 1998 to 2004, the period of groundwater level declines. Finally, wells outside of the Muddy River/Coyote Springs/CA Wash area do not show a similar response to what is claimed to be a regional drought.

The draft Consensus Statement by the HRT acknowledges that the trends in groundwater levels cannot be explained with climate alone; rather, it is necessary to add pumping or some other parameter as an explanatory variable (page 4 in consensus statement).

Response 38-17: Figures 4.4-1 and 4.4-2 have been revised to show the correct extent of the Muddy River perennial flow.

Response 38-18: The referenced section of the CCP/EIS has been revised to reflect the issues with data quality at these sites prior to 1998. Groundwater monitoring data quality is a dynamic issue and one that is continually being addressed and resolved through the work of the HRT, the USGS, and others. Past flow records have been “cleaned up” or significantly improved at sites such as Pedersen Spring and Corn Creek Springs. We know a great deal more about what data are regarded as poor quality than we did when we first started evaluating these records. We anticipate that this will continue to be an area of further refinement and improvement. The need for a precise statement on the quality of spring discharge data is one of the points the Service has been making in the HRT meetings. It is more appropriately addressed in the HRT documents rather than in the CCP. This comment clearly calls attention to the need for such a statement. Also, see Response 38-16.

> spring complexes. Jones and Baldwin Springs are monitored by the Moapa Valley Water District (MVWD). Since 1998, Pedersen Spring has exhibited a downward trend, and from 1998 to 2004, a gauge at Warm Springs West, which measures collective discharge from the Pedersen spring complex, has shown a significant declining trend. In addition to questions over what pumping might be responsible for this decline, some controversy exists whether pumping or some other factor has been affecting spring flow.

Draft CCP/EIS at 4-77.

While it is true that these spring gauge records exhibited downward trends, it is not clear that if these gauges were accurately recording the discharge of the springs themselves, due to a couple of issues with the monitoring station. The HRT Baseline Pumping Report discusses these issues:

> The record for Warm Springs West has much greater variability and a slight increasing trend in the discharge prior to 1998. There were unmeasured irrigation diversions above the gage during this time. The post-1998 spring discharge record at Warm Springs West shows a multi-year decline from 1998 to 2004 and an increase in 2005. The trends are similar to those observed in the carbonate water levels in EH-5B and EH-4. 38-18
>
> The monitoring record of spring discharge from Pedersen Spring has been the subject of much debate. The discovery of a slight warp in the weir in 2002, along with independent flow measurements at the site led the USGS to adjust the rating curve and recalculate a period of the historical flow back to 1994. The USGS speculated that warped weir was a result of the fire on the Refuge in 1994, but there is no direct evidence that the fire caused the warp or that the warp affected the accuracy of the weir.
>
> In addition, a leak underneath the weir, first noted in December 2003, led to a large decrease in flow over the following months and the weir was replaced cooperatively between FWS, USGS, NDWR, and SNWA in April 2004 to the same elevation. It is not known if the pre-2003 and post-2004 data are directly comparable. Since 2004, the new gage seems to be functioning well and coincides well with the Pedersen East gage. Individual interpretations of the data from this site vary by agency.

HRT Baseline Pumping Report at 23. The final CCP/EIS should recognize the questionable reliability of these monitoring results.

Also, the last sentence of the quoted paragraph implies that there may be only one factor that is affecting spring flow. As noted above, the HRT concluded in 2007 that a combination of factors can influence spring discharge, such as climate effects, changes in Lake Mead elevations, and groundwater production, although the degree of influence of each factor has not been conclusively determined. *Id.* at 16. 38-18

E. Moapa Valley NWR Water Use

1. Groundwater Use

The draft CCP/EIS makes the following statement regarding use of groundwater at the Moapa Valley NWR:

> Water from the local alluvial aquifer has been developed in the Muddy River Springs area for some time, for both irrigation and domestic uses and later by Nevada Power Company by the late 1940s. Water from the regional carbonate aquifer was developed by the MVWD beginning in 1986. The MVWD and SNWA have developed and plan to develop within the next five years several groundwater monitoring and extraction wells to the northwest of the Refuge. 38-19

Draft CCP/EIS at 4-77.

While the MVWD has utilized spring discharge from the Jones Spring since 1959 and Baldwin Spring since the 1975, groundwater development did not occur until 1986. In fact, the use of groundwater did not exceed the use of spring flows until 1999. These data are graphically represented in Figure 5-9 of the report "Water Resources and Ground-Water Modeling in the White River and Meadow Valley Flow Systems, Clark, Lincoln, Nye, and White Pine Counties, Nevada" submitted by SNWA during the Coyote Spring groundwater hearing in support of ground water applications 54055 through 54059. The CCP/EIS should reflect the fact that groundwater did not exceed the use of spring flows until 1999.

In addition, the CCP/EIS should clarify that the wells the SNWA plans to develop are approximately 15 miles to the northwest of the Refuge in another groundwater basin (Coyote Spring Valley). The uncertainty regarding the potential effects of pumping at a location several miles away in another groundwater basin were described in the HRT Baseline Pumping Report as follows: 38-20

> It is well understood that structural geologic faulting can have an affect on groundwater movement and also influence the propagation of groundwater pumping effects. The central question is whether or not the existence of geologic

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Response 38-19: While we agree that the volume of water pumped from the carbonate aquifer did not exceed the volume of water diverted from springs until 1999, we do not believe this information is relevant to the existing discussion referenced in the comment.

Response 38-20: The CCP/EIS text in section 4.4.1 has been revised to clarify that SNWA's existing and proposed groundwater wells are in Coyote Springs Valley. Redistributing pumping to move groundwater withdrawals further from the Moapa Valley NWR is certainly a strategy to consider. However, the information available to date suggests that this strategy may only delay impacts to the springs and potentially make any impacts more difficult to mitigate. Future data collection and analysis such as that being done through the HRT may enable us to better understand whether the proposed strategy will effectively protect the springs from upgradient pumping.

> structures and heterogeneities will function to impede, completely stop, or have no affect on the propagation of pumping impacts to the Muddy River Springs area.

HRT Baseline Pumping Report at 23.

In addition, in 2002, the State Engineer issued Order No. 1169 in connection with various applications for groundwater rights in Coyote Spring Valley. The order requires a minimum five-year pump test to determine the impacts of groundwater withdrawals on the groundwater or surface water resources of the carbonate rock aquifer or the alluvial aquifer systems. In the event that spring flows decline at the Warm Springs West gauge during the test required by State Engineer's Order No. 1169, SNWA and Coyote Springs Investment LLC (CSI), a private landowner with water rights in the Coyote Spring Valley hydrographic basin, will work together to geographically redistribute pumping in the Coyote Spring Valley. The specific flow decline "trigger" volumes and the redistribution of pumping were agreed upon in Section 5 of the Muddy River MOA, of which MVWD, CSI, the Service, and SNWA are signatories. Redistributing pumping will move the groundwater withdrawals even further from the Moapa NWR. In addition, the State Engineer's Order No. 1169 and the Muddy River HRT's data collection and analyses, which are forthcoming, will provide clearer information as to the potential impacts of these wells on springs in the Muddy Springs groundwater basin. 38-20

2. Consumptive Use Information

The draft CCP/EIS states that "[a] number of nonnative palm trees were planted by Moapa Valley settlers and resort owners over the last century. These trees can each consume up to 300 gallons of water per day during summer months." Draft CCP/EIS at 4-78. The rate of 300 gallons, per day per tree is very high. Please provide a source for these data. 38-21

F. Moapa Valley NWR Water Rights

1. Muddy Springs and Coyote Spring Valley Water Rights

The draft CCP/EIS describes the water rights in the Muddy Springs and Coyote Spring Valley area as follows:

> In the Muddy Springs area, most of the water rights are actively developed and in use in varying amounts. However, most of the water rights in Coyote Spring Valley, hydraulically upgradient in the flow system, are permitted but as yet are undeveloped (NDWR 2003). Issuance of additional groundwater rights from the regional carbonate aquifer in the southern portions of the White River Flow System were being held in abeyance for five years (2002–2007) while aquifer studies are conducted (NDWR 2002). 38-22

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SE ROA 13687

JA_6449

Response 38-21: The reference to palm trees in this section was removed from the CCP/EIS.

Response 38-22: Section 4.4.1 has been updated to more accurately reflect the status of water rights within the vicinity of Moapa Valley NWR.

Draft CCP/EIS at 4-78.

To be more accurate, the CCP/EIS should note that NDWR has held in abeyance the granting of additional water rights within six hydrographic basins, including the basin in which the Moapa Valley NWR is located. In addition, the five-year study, which now has been initiated, will not be complete until at least 2012 to fully comply with NDWR's Order 1169.

38-22

It is also important to note that the vast majority of the water rights on the Muddy River (including some rights from local springs being developed by the SNWA) are utilized farther downstream from the Refuge on the Muddy River, and thus their use will not impact the refuge. The Muddy Valley Irrigation Company controls about 80% of the rights on the Muddy River, which flow from the headwaters to the about 15 miles downstream of the Refuge and remain in the natural channel(s). In addition, the spring rights that SNWA is leasing are being developed to allow the water to flow to Lake Mead – thus leaving the water in the natural channels.

2. Muddy River Memorandum of Agreement

The Service, SNWA, and other parties to the Muddy River MOA agreed that they share a common interest in the conservation and recovery of the Moapa dace and its habitat. Each party also had an interest in the protection, use, and enjoyment of its water rights and entitlements.

To serve these interests, the parties identified certain conservation measures with the objective of making measurable progress toward the conservation and recovery of the Moapa dace, and agreed to coordinate monitoring, management, and mitigation measures. These measures include the following:

- <u>Establishment of Recovery Implementation Program.</u> To effectuate the goals of the Muddy River MOA, the parties agreed to establish a Recovery Implementation Program ("RIP") whereby measures necessary to accomplish protection and recovery of the Moapa dace, the operation and development of regional water facilities, and the inclusion of necessary and interested third parties are outlined and implemented.

- <u>Dedication of Jones Water Right</u>. The parties agreed that the recovery of the Moapa dace would be enhanced by the guarantee of additional in-stream flows in areas of historical Moapa dace habitat. Once such area was the Apcar Stream down gradient of the Jones Spring. To effectuate the dedication of the Jones Water Right to the provision of in-stream flows in the Apcar Stream, the parties agreed to dedicate and transfer certain water rights as described in the Muddy River MOA.

- <u>Habitat Restoration and Recovery Measures.</u> To restore habitat necessary for the Moapa dace and take other steps to protect and recover the species, the parties agreed to provide funding and other contributions, including: (1) SNWA agreed to provide funding for the restoration of Moapa dace

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habitat under the direction of the Service on the Apcar Unit of the Moapa Valley NWR or otherwise; (2) the Service and SNWA agreed to provide funding to develop an ecological model designed to investigate the effects of habitat change on the ecology of the Moapa dace; (3) SNWA agreed to provide funding to construct fish barriers to help eliminate the predacious tilapia from areas of Moapa dace habitat; and (4) SNWA agreed to provide funding to implement programs related to the eradication of non-native fish species, including predacious tilapia, in the Warm Springs area.

- Protection of In-Stream Flows. The parties recognized that the maintenance of minimum in-stream flows in the Warm Springs area was essential for the protection and recovery of the Moapa dace. Although those flows were unknown at the time, the parties agreed to maintain certain average flow levels as described in the Muddy River MOA.

- Acquisition of Additional Land and Water Rights. As a potential conservation measure, the parties agreed to work cooperatively to identify both land and water rights that, if acquired and dedicated to the recovery of the Moapa dace, would assist in making measurable progress towards the recovery of the Moapa dace. SNWA agreed to make a good faith effort to acquire land and water rights identified by the parties. When such land or water rights were acquired by SNWA, SNWA would cooperate with the Service in establishing restrictions upon the use of such lands and water rights consistent with existing law so as to effectuate the conservation of those resources and the recovery of the Moapa dace.

- Adaptive Management Measures. The parties agreed to carry out additional conservation measures to protect and recover the Moapa dace following the initiation of the RIP and as more data became available regarding the biology of the Moapa dace and regional hydrology. These measures are more fully described in the Muddy River MOA.

The CCP/EIS should fully describe the Muddy River MOA and its conservation measures and commitments, and consider the relevance of such measures to the management of the Refuge and its resources, particularly to the conservation of the Moapa dace. Furthermore, to the extent that such measures are performed on refuge lands, they should be identified as refuge management activities for which no compatibility determination is required. 38-23

3. Refuge Water Rights

The draft CCP/EIS notes that:

> The Service has two water rights for the Refuge that have been certified by the Nevada State Engineer. One of these is for approximately 2,500 afy of spring flow. The other is for

38-24

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Response 38-23: The Final CCP/EIS Section 4.4.1 has been revised to include a summary of the Muddy River MOA. More details on the MOA are included in the Management Considerations section of the Land Protection Plan.

Response 38-24: The Final CCP/EIS Section 4.4.1 has been revised to accurately describe the Service's water rights for Moapa Valley NWR.

> approximately 1.4 afy of well water. Water from the springs is also adjudicated to downstream landowners.

Draft CCP/EIS at 4-78. The first water right is an instream flow right with no consumptive use. Quantifying this right in acre-feet could be misleading, as flow rights are usually listed in cubic-feet/second (cfs). The Service's instream flow right is for 3.5 cfs and is subject to the agreed upon terms in the Muddy River MOA. 38-24

G. Pahranagat NWR Biological Resources

The draft CCP/EIS's discussion of the occurrence of amphibians, fish, and small mammals on the Pahranagat NWR contains inaccuracies. Draft CCP/EIS at 4-104 to 4-107, and Appendix H, Table 3. Relict leopard frog (*Rana onca*), plains leopard frog (*Rana blairi*), Desert Valley kangaroo mouse (*Microdipodops megacephalus albiventer*), and pygmy rabbit (*Brachylagus idahoensis*) do not occur on the Pahranagat NWR or Pahranagat Valley.[3] Furthermore, the CCP/EIS should clarify that Pahranagat roundtail chub (*Gila jordani*), White River springfish (*Crenichthys baileyi baileyi*), and Hiko White River springfish (*Crenichthys baileyi grandis*) occur in Pahranagat Valley, but do not occur on the Pahranagat NWR.[4] 38-25

IV. Environmental Consequences

A. Cumulative Impacts

Regarding potential cumulative impacts, the draft CCP/EIS makes the following statement:

> Groundwater in the vicinity of each refuge would also be adversely affected by expanded urban developments that use groundwater wells for water supply. The groundwater aquifer within each Refuge connects to other aquifers in southern Nevada; therefore, impacts at Coyote Springs, for example, could have adverse impacts at Ash Meadows NWR. Cumulative impacts on the groundwater aquifer would be significant because groundwater impacts could affect the entire region. 38-26

Draft CCP/EIS at 5-77.

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[3] *See* Raymond Hall, Mammals of Nevada at 387, 615 (1995); Conservation Agreement and Rangewide Conservation Assessment and Strategy for the Relict Leopard Frog (*Rana Onca*), Relict Leopard Frog Conservation Team at 21, 22 (2005); T. Kuhrt, 2000. "Rana blairi" (On-line), Animal Diversity Web. Accessed August 29, 2008 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Rana_blairi.html.

[4] *See* Recovery Plan for the Aquatic and Riparian Species of Pahranagat Valley, U.S. Fish and Wildlife Service at 3 (1998).

Response 38-25: Comment noted. The referenced statements have been changed to reflect that the species mentioned do not occur on the Refuge.

Response 38-26: Comment noted. The referenced paragraph has been revised to more accurately reflect potential cumulative impacts of groundwater development.

As previously discussed, blanket statements such as these oversimplify the hydrologic system of the regional carbonate aquifer. Moreover, the language quoted above is inconsistent with other statements in the draft CCP/EIS, such as "pumping is not expected to adversely affect private groundwater wells in the nearby communities because they are located upgradient and far enough away that impacts are unlikely." *Id.* at 5-59. Consistent with this latter statement, pumping activities within Coyote Spring Valley would have no hydrologic influence on the Ash Meadows NWR because the Ash Meadows NWR is located in the Ash Meadows Regional Flow System, while Coyote Spring Valley is located in the southern end of the White River Regional Flow System. 38-26

B. Effects on Water Resources at Pahranagat NWR

With respect to the effects on water resources at the Pahranagat NWR, the draft CCP/EIS makes the following statements:

> More open water habitat may be created, and hydrology of some springs would be returned to historic conditions. To supplement existing flows from Upper Pahranagat Lake, groundwater wells on the Refuge would be pumped to increase flows to Middle Marsh. . . .
>
> During this time, pumping could cause the groundwater table to lower. . . .
>
> New visitor use facilities under Alternatives B, C, and D would increase the water demand from the domestic well on the refuge. Changes in the groundwater table, however, with additional demand, could be significant.

Draft CCP/EIS at 5-59.

The Delamar, Dry Lake, and Cave Valleys stipulated agreement for hydrologic monitoring includes an evaluation of data collected from Cottonwood and Maynard springs located within the Pahranagat NWR. It is important for the CCP/EIS to acknowledge that spring discharge and pumping activities within the Refuge will be monitored and analyzed to evaluate influences, if any, on the spring discharges relative to pumping activities outside of and within the Pahranagat Wildlife Refuge. 38-27

V. Warm Springs Natural Area near Moapa Valley NWR

A. General Comments on the Warm Springs Natural Area

SNWA acquired 1,218 acres of privately held property adjacent to the Moapa Valley NWR in September 2007. This property was previously known as the Warm Springs Ranch and has now been renamed the Warm Springs Natural Area. The draft CCP/EIS references to the Warm Springs Ranch should be revised to reflect the area's current name of Warm Springs Natural Area. 38-28

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Response 38-27: Comment noted. Text within the referenced section was revised to clarify that we will monitor spring discharge on the Refuge to determine if pumping activities within and outside the Refuge may be affecting it. In addition, we also included a summary of the Delamar, Dry Lake, and Cave Valleys stipulated agreement in 3.1.1.

Response 38-28: The CCP/EIS and Land Protection Plan have been revised to reflect the current name for the property.

In the Preferred Alternative, the draft CCP/EIS identifies about 987 acres of the Warm Springs Natural Area as part of the Service's plans for future boundary expansion of the Refuge. The document does not include the following information regarding the important steps that SNWA has already taken in the conservation of the threatened, endangered, and sensitive species and their habitat in the region through private property acquisition and management to protect and achieve the goals identified for the Refuge as important for management.

Since the Warm Springs Natural Area was purchased with Southern Nevada Public Lands Management Act (SNPLMA) funds under the category of "Parks, Trails, and Natural Areas," SNWA committed to manage all 1,218 acres as a "natural area." Three spring complexes that originate on the Moapa Valley NWR and flow onto the Warm Springs Natural Area provide crucial habitat for the endangered Moapa dace (*Moapa coriacea*).

The *Clark County Multiple Species Habitat Conservation Plan* and the *Integrated Science Assessment for the Upper Muddy River* focus extensively on the species and habitat values present in the Warm Springs Natural Area, and discuss potential threats to the resource and recommendations for management action. Acquisition of privately held land along the Muddy River is identified as a high priority conservation action in both planning documents. The acquisition of private lands along the Muddy River is considered among the most important steps necessary to ensure the long-term viability of the endangered Moapa dace and other important plant and animal species. The Warm Springs Natural Area includes habitat for southwestern willow flycatcher, yellow-billed cuckoo, and Nevada's largest breeding population of vermillion flycatcher. SNWA's acquisition of the Warm Springs Natural Area affords protection to numerous species.

As a commitment of the SNPLMA Financial Agreement between the U.S. Bureau of Land Management (BLM) and SNWA, SNWA agreed to work cooperatively with adjacent land owners – the Service and The Nature Conservancy (TNC) – to develop a long-term management plan to cooperatively manage the Warm Springs Natural Area in concert with Moapa Valley NWR and the TNC's Muddy River property.

Types of potential management actions under discussion include:

- Development of educational and recreational areas/trails emphasizing the natural resources for public use consistent with the Moapa National Wildlife Refuge and other adjacent lands;
- Management of invasive plant species;
- Management of invasive fish and invertebrate species;
- Bank and channel stabilization activities;
- Construction and/or enhancement of wetlands;
- Restoration and/or enhancement of riparian and upland habitat; and
- Spring pool restoration/enhancement.

SNWA is also responsible for the operation, maintenance, and management of the property over the long-term as a natural area under the "parks, trails, and natural areas" category. However, SNWA plans to work cooperatively with other stakeholders with a vested interest in the long-term health of the Muddy River. Management of the property will be conducted cooperatively with the signatories to the Muddy River MOA, including the Service, Clark County, and TNC, with the SNWA serving as lead agency in coordinating activities.

Although this property holds significant ecological value at present, there are a number of challenges in managing and improving the health of these resources. Historically, the Warm Springs Ranch was intensively farmed and ranched, and many of the associated adverse impacts of these activities still persist. More recently, the fields have been left to go fallow, resulting in the invasion of non-native terrestrial plants such as saltcedar and Russian knapweed. Introduction of non-native fish, such as blue tilapia, need management to alleviate the threat to the existing population of Moapa dace and White River springfish. SNWA is currently working to control invasive species and manage the resource.

Long-term management of the Warm Springs Natural Area will undoubtedly generate numerous partnerships, allowing stakeholders to leverage significant funding in efforts to protect and restore this important resource. During the past several years, numerous entities, including Clark County, TNC, and the SNWA have invested significant funding in a variety of research, monitoring, and restoration activities in the area in an effort to protect the resources present. SNWA's acquisition of the Warm Springs Natural Area has increased the opportunities to acquire funding and engage in collaborative joint management of the property. The CCP/EIS should include an informed discussion of the current protections and management actions in progress since SNWA took possession of the property in September of 2007, as well as an evaluation of whether the Refuge's goals could likewise be achieved under SNWA ownership. 38-29

B. Proposed Moapa Valley National Wildlife Refuge Boundary Expansion

The CCP/EIS's Preferred Alternative evaluates the proposal to expand the Moapa Valley NWR by 1,503 acres, which would include a little over 987 acres of the Warm Springs Natural Area. A total of 1,218 acres make up the Warm Springs Natural Area, leaving a difference of 231 acres excluded without explanation from the proposed boundary expansion. For planning and NEPA purposes, SNWA recommends the Service include the entire 1,218 acres in the planning boundary. 38-30

In concept, SNWA does not oppose the proposal to expand the Moapa Valley NWR planning boundary. However, active consideration of any future acquisition of the property by the Service is premature until certain commitments are agreed to by the Service and SNWA. These commitments include: (1) the development of a Long-term Management Plan for the Warm Springs Natural Area in coordination with stakeholders, 38-31

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Response 38-29: The Management Considerations section in the Land Protection Plan describes the conservation measures that SNWA and other signatories have committed to in the Memorandum of Understanding. Both the Land Protection Plan and the EIS have been updated to show cooperative agreement, memorandum of understanding, and/or transfer as the preferred protection method for the Warm Springs Natural Area.

Response 38-30: The Land Protection Plan and CCP/EIS have been revised to include the entire Warm Springs Natural Area within the proposed expansion area.

Response 38-31: Comment acknowledged.

such as TNC, and signatories to the April 2006 MOA, which include the Service, the Moapa Band of Paiutes, CSI, and Moapa Valley Water District; (2) SNWA's management of the property as a Natural Area as part of SNWA's commitment in the SNPLMA Financial Assistance agreement; and (3) commitments by the Service necessary for attaining reasonable certainty regarding the development and continued use of regional municipal water supplies. 38-31

Although the CCP/EIS evaluates the expansion of the Moapa Valley NWR as the Preferred Alternative, it should also include an alternative evaluating whether the Refuge's goals could be achieved under cooperative agreements with SNWA's ownership of the Warm Springs Natural Area. Also helpful would be an informed discussion of the current protections and management actions in progress since SNWA took possession of the property in September of 2007. These are outlined in detail below. 38-32

SNWA has committed significant financial and personnel resources to care for and manage the property. SNWA management also has included (1) the hiring of two fulltime employees – the Warm Springs Natural Area Manager to reside on site, and a property caretaker; (2) routine maintenance of the property; (3) arranging for security on the property; (4) completing a baseline resource inventory of the property as the basis for developing the management plan; and (5) development of key purposes for management of the Warm Springs Natural Area, including protection of the Moapa dace and its habitat. Under SNPLMA's "Parks, Trails and Natural Areas" category that governs the property, a limited public access component needs to be developed that includes an interpretive/visitor component. SNWA has also committed time and staffing to foster stakeholder and community relations important to management of the property. Continuation of these commitments is important to continuing the current level of management of this key Muddy River property.

C. Identification of SNWA as a Partner

Several times throughout the draft CCP/EIS, the Service identifies entities with which it has a partnership. SNWA should be included in these lists of partners. SNWA partners at many levels with the Service both by virtue of the SNPLMA-funded acquisition of the Warm Springs Natural Area, as well as the Muddy River MOA and Recovery Implementation Program. SNWA is signatory to the MOA and committed to cooperate extensively with the Service to work toward recovery of the Moapa dace. SNWA is currently developing goals in a Long-term Management Plan for the Warm Springs Natural Area consistent with Service goals. 38-33

D. Fee-title Acquisition of Warm Springs Natural Area

The Service identifies three mechanisms in the Preferred Alternative to increase its property boundaries: purchase, transfer, and/or agreement. Draft CCP/EIS at 3-48. The boundary expansion would increase the Moapa Valley NWR to 1,503 acres, within which habitat would be protected by working with partners. The Land Protection Plan (Appendix L) lays out the framework of accomplishing the preferred alternative.

Response 38-32: See response to comment 39-30.

Response 38-33: The Final CCP/EIS Section 1.7.3 Refuge Partnerships has been revised to include SNWA as a Refuge partner.

Though the Service acknowledges that its acquisition options include fee-title acquisition, conservation and agricultural easements, cooperative agreements, or memorandum of understanding, *id.*, App. L at 7, the Land Protection Plan "proposes fee-title acquisition as the primary level of protection needed to meet habitat and wildlife management goals for the project area." *Id.*, App. L at 1; *see also id.*, App. L at 7 ("the Service believes fee title acquisition represent [*sic*] the minimum possible interest or rights in land and waters which would need to be acquired to meet the habitat protection objectives for the Warm Springs Ranch"). The Conceptual Management Plan also recognizes fee-title acquisition as the primary level of protection needed to meet habitat and wildlife management goals for the project area. *Id.*, App. L-2 at 1.

Due to SNWA's use of SNPLMA funds to purchase the Warm Springs Natural Area, the majority of the property identified in the boundary expansion is currently under a conservation commitment to manage of the property as a natural area. *See* SNWA's Sept. 13, 2007 SNPLMA funding application. The fact that SNWA has acquired and is managing as a natural area 987 acres out of the 1503 acres proposed for the refuge boundary expansion strengthens the argument for a cooperative agreement and lessens the need for fee-title acquisition of this area by the Service. In fact, the existing SNPLMA agreement already requires a coordinated management effort with the Service. Thus, the CCP/EIS should recognize that SNWA's management of the Warm Springs Natural Area under SNPLMA offers an alternative to fee-title acquisition that will be equally protective of wildlife and its habitat. 38-34

The draft CCP/EIS includes a number of situations in which outright purchase (fee-title acquisition) is justified, none of which is applicable to the Warm Springs Natural Area. The first situation is when "the land's fish and wildlife resources require permanent protection that is not otherwise available". Draft CCP/EIS, App. L at 8. This justification does not support fee-title acquisition of the Warm Springs Natural Area because such area is already guaranteed permanent protection under SNWA's SNPLMA purchase. Second, outright purchase is appropriate when "the land is needed for development associated with public use". *Id.* Again, this does not apply to the Warm Springs Natural Area because SNWA's management plans entail cooperative development of the area for public use.

The third situation is when "a pending land use could otherwise harm fish and wildlife resources". *Id.* With respect to the Warm Springs Natural Area, the pending land use is designed to enhance fish and wildlife resources. Finally, the Service asserts that fee-title acquisition is appropriate when "purchase is the most practical and economical way to assemble small tracts into a manageable unit." *Id.* This does not apply to the Warm Springs Natural Area because the current property is not subdivided into small tracts; it is a single contiguous property that is already protected with commitments to cooperatively manage restoration activities and public use with the Service.

In sum, fee-title acquisition of the Warm Springs Natural Area is neither necessary nor appropriate, particularly while other high-value properties exist which could be better utilized to support dace conservation. Thus, the Land Protection Plan 38-35

Response 38-34: Both the Land Protection Plan and the EIS have been updated to show cooperative agreement, memorandum of understanding, and/or transfer as the preferred protection method for the Warm Springs Natural Area.

Response 38-35: See Response 39-35.

should not identify such area states as a first priority for fee-title acquisition. *Id.*, App. L at 12. Instead, the CCP/EIS should use the following approach described in the Land Protection Plan: "[o]n lands owned and managed by public agencies, cooperative agreements and coordinated planning/management efforts, including shared resources, could be used to conserve natural resources within the proposed refuge boundary." *Id.*, App. L at 7. This would also have the benefit of utilizing a consistent approach to the Warm Springs Natural Area and the TNC property that includes Muddy River, which is not currently proposed for fee-title acquisition. 38-35

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Letter 39

Review Comments: Desert Natural Wildlife Refuge Complex, Draft Comprehensive Conservation Plan and EIS

Reviewer: Nellis AFB 9/9/2008

#	Page/ Line	Comment	
1.	Vol 1, General Comment	Throughout the documents, there is general discussion on access and uses of the lands. An important point is the withdrawn lands are closed to public access. This should be up front. As you read the sections such as 3.3, it discusses volunteers, and research. I drew the conclussion that volunteers and reachers were accessing all portions of the DNWR. Recommend a general discussion that clarifies access.	39-1
2.	Vol. 1, General	Document does not reference USAF INRMP. Recommend including short paragraph discussing the Nellis INRMP.	39-2
3.	Vol. 1, General	When fire is discussed, this document states to "consider resource values". Recommend expanding this discussion to include AF assets in fire planning.	39-3
4.	Vol 1, Summary, Fig. 1, p. 1-3, Fig. 1.1-1 and throughout document	Map does not accurately depict the NTTR or designate Nellis AFB Small Arms Range. Recommend showing the withdrawn DoD lands that overlap the DNWR. This map does not show those lands. Leads the read to think there are no DoD lands within the DNWR, only the NTTR overlays. The NTTR is a complex that includes withdrawn lands for DoD use and the accompaning airspace. It would be more accurate to change the "DOD" lands and "NTTR" to a single graphical depiction of lands withdrawn for DoD use.	39-4
5.	Summary, p. S-1, line 4	"DNWR is located 10 miles north" this does not match Pg 1-26, section 1.7.2, 1st para, line 1.	39-5
6.	Summary, p. S-27, Fig. 7	Locations of springs on this figure does not match locations shown on Figure 3.3-2 or Figure 4.3.-3.	39-6
7.	Summary, p. S-27, Fig. 7	See comment 1. The hatched line (NTTR) is incorrect.	39-7
8.	Summary, Fig. 3	See comment 1. Also recommend consistency in colors used on maps. Figure 7 shows NTTR as black cross hatched and figure 3 shows as a pink cross hatch.	39-8
9.	Summary, Fig. 3	Footnote discusses "secondary jurisdiction". This document incorrectly states the USFWS has primary jurisdiction of the co-withdrawn lands. Some of the DNWR lands were assiged to DoD subsequent to the initial EO establishing the Game Range and PL 106-65, which specifically assigns secondary jurisdiction of "conservation matters in the impact areas" to USFWS. DoD has primary jurisdiction for all activites except conservation. Please provide the EO or PLO or PL that confirms the assumption that USFWS has primary jurisdiction. Recommend including the document that assigns primary and secondary juridiction in this CCP.	39-9
10.	Vol 1, p. 1-7, ¶4; Vol 2, Appendix G	Paragraph 4 states that a compatibility determination is not required where other Federal Agencies have primary jurisdiction. Appendix G does not discuss DoD mission/use in the compatibility determination. USFWS determined that no compatibility determination is required, therefore DOD has primary jurisdiction except for the impact areas mentioned in PL 106-65. Recommend the Service clarify this issue by providing the EO, PLO, or PL that confirms the assumption that USFWS has primary jurisdiction.	39-10
11.	Vol 1, p. 1-29, ¶2	This paragraph states that the Executive Order that established the Bombing Range took precedence over the EO that established the Game Range, however, the USFWS maintained primary jurisdiction. If the order took precedence, how did USFWS maintain primary jurisdiction when it is not discussed in the EO? Since the EO establishing the Bombing Range took precedence over the EO for the Game Range, what documents give primary jurisdiction back to USFWS? Please provide the EO or PLO or PL that confirms the assumption that USFWS has primary jurisdiction over the co-managed lands. Recommend including the document that assigns primary and secondary juridiction in this CCP.	39-11

M.39 Nellis Air Force Base (Sheryl K. Parker), September 10, 2008

Response 39-1: Sections 1.7.2, 3.3.1, and Table 3.6-2 have been revised to clarify access restrictions that apply to the DOD-withdrawn lands.

Response 39-2: The U.S. Air Force Integrated Natural Resources Management Plan (INRMP) is described in Section 1.5, Relationship to Regional Goals.

Response 39-3: Sections 3.3.1 and Table 3.6-2 have been revised to include consideration of Fish and Wildlife Service and Air Force assets in wildfire management.

Response 39-4: The Final EIS Figures 1.1-1, 1.7-2, 3.3-1, 3.3-2, 3.3-3, 3.3-4, and 4.3-5, and Summary Figures 1, 3, and 7, have been revised to clarify DOD-withdrawn lands.

Response 39-5: Both sections referenced were revised to reflect Desert NWR is located immediately north of the cities of Las Vegas and North Las Vegas.

Response 39-6: The referenced figures have been revised to show the correct locations of springs.

Response 39-7: See Response 39-4. Figure 3 (Summary) and 1.7-2 (FEIS) have been revised to use the same symbol to designate DOD-withdrawn lands as other maps.

Response 39-8: This figure and others showing DOD's withdrawn lands have been corrected in the final CCP/EIS.

Response 39-9: The footnote on Figure 3 in the Summary has been deleted to avoid confusion.

Response 39-10: The compatibility policy discussion in Section 1.4 Legal and Policy Guidance correctly states that compatibility determinations are not required when other federal agencies have primary jurisdiction and the activity is in accordance with a Memorandum of Understanding (MOU) governing use of the land. Our compatibility policy (603 FW 2, Section 2.10[B][1]) further states that "where reserved rights or legal mandates provide that we must allow certain activities, we should not prepare a compatibility determination." Based on our interpretation of the most recent Nellis Air Force Range withdrawal (Public Law [PL] 106-65), Air Force activities on Desert NWR that are in accordance with the existing Air Force/Fish and Wildlife Service MOU are considered legal mandates and are not subject to compatibility determinations. Conversely, activities not covered in the existing MOU are subject to the compatibility policy and regulations.

Response 39-11: Section 1.7.2 History of Establishment and Acquisition has been revised to clarify that we have administrative jurisdiction over the Desert Refuge pursuant to PL 106-65. We also included further clarification that PL 106-65 transferred primary jurisdiction of 112,000 acres of bombing impact areas on Desert Refuge from the Service to DOD, and that we retained secondary jurisdiction over these lands.

12.	Vol 1, p. 1-33	DNWR Vision states "… The vast, rugged wild spaces provide wildlife and people a refuge and a place for harmonious recreational opportunities." The statement is misleading in that recreational opportunities are severely limited due to military restrictions and operations. Access to roughly 50% of the DNWR is restricted by the military, thus no recreational opportunities exist except for the few people fortunate enough to obtain a sheep tag. The remaining 50% is overflown by aircraft as low as 100 feet above the ground. Individuals might argue this impacts the "harmonious recreational opportunities" of this area. These points are ignored in the discussion and vision statement. Recommend a discussion of this impact so readers understand that the recreation oppurtunities exist on only 50% of the DNWR except for a once a year Big Horn Sheep hunt on the military portion of the DNWR.	39-12
13.	Vol 1, p. 3-22, ¶2; Appendix I	This mentions 1974 wilderness stipulations. They are not included in Appendix I. Please include them in the CCP document.	39-13
14.	Vol 1, p. 3-29, ¶3	Recommend including DOD in the Outreach program.	39-14
15.	Vol 1, chapter 4 or 5	Why no discussion in chapters 4 or 5 on wilderness, yet it's included in table 5.3-1 Summary of Consequences? Recommend adding discussion.	39-15
16.	Appendix F, ¶3.1.2	Remove word "Environmental" and "regular".	39-16
17.	Appendix F, ¶3.3	Request verbiage be added to this section to state that any wilderness revisions/updates on the co-withdrawn lands will be in full coordination with the USAF.	39-17
18.	Appendix I	Please include the winderness proposal to Congress rather than the summary brochure.	39-18
19.	Appendix I	Wilderness Review: This section addressed Wilderness designations for Ash Meadows, Moapa Valley, and Pahranagat and concluded the lands within Ash Meadows or Moapa Valley did not meet the criteria for wilderness designation. The Service is recommending continuing protecting the 1.37 million acre DWNR wilderness study area until such time as Congress acts upon their wilderness proposal. Recommendation One: The Service withdraw the proposal or re-evaluate designating portions of the 845,787 acres of co-withdrawn lands within the DNWR as wilderness. Designating the DOD lands as wilderness appears to usurp the intent of Executive Order 8578, and subsequent legislation, granting the Department of the Air Force exclusive use of these lands. If enacted, wilderness designation would permanently restrict military use of over 730,000 acres of land, directly impacting our ability to meet current and future National Defense objectives. Recommendation Two: The Service does suggest submitting technical corrections to the wilderness proposal to correct overlap with bombing ranges and to relocate hazardous sections of roads. The Service should identify and discuss the military and DOE impacts within these co-managed lands and the affect these impacts have to any potential wilderness designation. As with the de-designation language in Alternative C for the Papoose Lake RNA due to the military overlay, that portion of the DNWR designated as a WSA affected by the military overlay should also be identified as not meeting wilderness criteria. Request the wilderness designation for that portion of the DNWR affected by the military overlay also be considered as not suitable for wilderness designation.	39-19
20.	Appendix J	Why no sheep data since 2003 included? Recommend including current data.	39-20

Response 39-12: We disagree that the sentence regarding recreational opportunities in the vision statement is misleading. Vision statements are broad characterizations of what we hope a refuge will be based on Desert NWR purposes and the Refuge System mission. Not all elements of the vision statement need apply to every unit of a refuge. Many refuges have units that are seasonally or completely closed to the public and address recreational opportunities in their vision statements. Nevertheless, we have added additional text to the CCP/EIS to clarify that the western half of Desert NWR is closed to the general public (see section 1.7.2 and Figure 4.3-5).

Response 39-13: Wilderness stipulations are located on pages 25 and 26 of the 1974 wilderness proposal, which is found in Appendix I-2 of the CCP/EIS.

Response 39-14: Comment noted. We would be happy to include DOD in the outreach program for Desert Refuge.

Response 39-15: The proposed wilderness was not discussed in Chapters 4 or 5 because it is treated the same in all the alternatives. In other words, the treatment of wilderness in the action alternatives is the same as the no-action alternative. Nevertheless, we have revised section 1.7.2, Special Designations, to include more information about the proposed wilderness.

Response 39-16: Desert NWR Strategy 3.1.2 has been revised as suggested.

Response 39-17: Desert NWR Objective 3.3 has been revised to reflect that we will prepare a revised wilderness proposal in coordination with the DOD.

Response 39-18: To the best of our knowledge, the document contained within Appendix I is the proposal that was submitted to Congress. In the Final CCP/EIS, we have included a separate document that accompanied the proposal to Congress: "Changes as a result of the public hearing."

Response 39-19: Comment acknowledged. See response to comment 39-17. We plan to coordinate with the DOD when preparing the revised wilderness proposal for Desert NWR. The issues raised by the commenter can be addressed at that time.

Response 39-20: Appendix J was prepared in 2003 by Bruce Zeller, the former Refuge wildlife biologist. The purpose of this document was to explain the basis for bighorn sheep population objectives on Desert NWR. Section 4.3.2 Wildlife has more recent sheep population data, based on NDOW surveys.

Letter 40

August 18, 2008

1) We have lived in Pahranagat Valley pretty much our entire lives. The P.V. Wildlife Refuge/Lake is one of the most beautiful places in the valley enjoyed by many. We have seen the lake drained for one reason or another through the years , but never to the point that the trees around the edge appeared to be dying like they are now. We hope that the problem there now can be resolved, and that it can be restored to its original beauty so it can continue to be a place of enjoyment for all of us as well as the wildlife. 40-1

2) **HELP**

Within the last 3-4 years it seems the Buzzards have changed the area in which they roost. **We have been invaded by Buzzards** sometimes 50-100 birds flock to roost in the big cottonwood tree behind our house here in Alamo. **They are a real gross nuisance and concern for us**. They cough up hair balls and poop all over our garden area making it impossible to grow vegetables and the place smells like dead cows or animals. We are also concerned for the safety of our little grandchildren who play in our back yard. This doesn't seem like a very healthy environment-possible disease, etc. ?? We have tried to scare them off, but nothing seems to work. We told Merri Maxwell from the Wildlife Refuge about our problem and asked if there was something we could do about it. Merri said she would check into it and later told us that the Buzzard waste was sterile and they shouldn't be a threat to the children. That was all we heard from her. We understand that Buzzards serve their purpose (but not in our backyard). There must be some reason why they have come into town to roost. There are a couple of other people that have also complained that the Buzzards roost in their trees here in town. Why?? There has got to be a reason why they have changed their pattern. 40-2

This can't possibly be a healthy environment - pooping in our garden! We are really tired of them! We would really appreciate any help in solving this problem.

Thank-You

Gary and Darla Davis

M.40 Gary and Darla Davis, received September 11, 2008

Response 40-1: The reservoir was drained to address safety issues regarding the outlet structure of the dam. We plan to repair the outlet structure this summer. In addition, we are exploring options for future management of the Upper Pahranagat Lake/North Marsh in the ongoing restoration planning process.

Response 40-2: We suggest you contact the Nevada Department of Wildlife (702-486-5127) to address this concern. Alternatively, the U.S. Department of Agriculture Wildlife Services office in Reno may be able to assist you. Their phone number is (775) 851-4848.

M.41 Comments from Public Meetings

Letter 41

Desert National Wildlife Refuge Complex Draft CCP/EIS
Comments from Public Meetings

This file provides a list of the comments received during the public meetings conducted the week of August 4, 2008 for the Draft CCP/EIS. Meetings were held at the following places/dates/times:

- **Desert Complex Office** at 4701 N. Torrey Pines Dr., Las Vegas; Monday, August 4, 6-8 pm
- **Amargosa Valley Multipurpose Building** at 821 E. Farm Rd., Amargosa Valley; Tuesday, August 5, 1130 am-130 pm
- **Bob Ruud Community Center**, B Room at 150 N. Highway 160, Pahrump; Tuesday, August 5, 6-8 pm
- **Clark County Government Center**, Training Room 1 at 500 S. Grand Central Pkwy, Las Vegas; Wednesday, August 6, 130-330 pm
- **Overton Community Center** at 320 N. Moapa Valley Blvd., Overton; Wednesday, August 6, 6-8 pm
- **Alamo Annex Building** at 100 South 1st West, Alamo; Thursday, August 7, 6-8 pm

M-41 Comments from Public Meetings

Letter 41

Desert NWR Meeting in Las Vegas
Desert Complex Office
August 4, 2008, 6-8 pm

Desert NWR Comments:

- Where will kiosk/signs be located off the 93? 41-1
- Road improvements will help visitors. 41-2
- What type of fencing will be used on southern border? Concern with metal fencing and power lines in the utility corridor that follows the southern border. 41-3

Moapa Valley NWR Comments:

- Why was The Nature Conservancy property not included in the proposed Refuge expansion under Alternative C? 41-4
- Have SNWA lands been considered in the Refuge expansion? 41-5

M.41 Comments from Public Meetings

Response 41-1: See Section 3.3. A new entrance sign and information kiosk will be located at the Mormon Well Road entrance under Alternative B, C, and D.

Response 41-2: Comment appreciated.

Response 41-3: We are currently planning to use post and cable fencing along the southern boundary.

Response 41-4: See Response 19-1.

Response 41-5: Yes. See Response 38-30.

Letter 41

Ash Meadows NWR Meeting in Amargosa Valley
Amargosa Valley Multipurpose Building
August 5, 2008, 1130-130 pm

Ash Meadows NWR Comments:

- What part of Refuge is open to hunting and what is allowed to be hunted? | 41-6
- Do bighorn sheep use the Refuge? | 41-7
- Do mountain lions use the Refuge? | 41-8

M.41 Comments from Public Meetings

Response 41-6: See Sections 3.2 and 4.2.2. Until a hunt plan is completed, hunting for waterfowl and upland game would continue to be allowed on most of the Refuge, consistent with Service and State of Nevada policies and regulations. In general, the current hunt area includes the entire Refuge except for the area around the current Refuge headquarters.

Response 41-7: See Section 4.2.2. Bighorn sheep are occasionally observed at Point of Rocks and the steep terrain on the northeast portion of the Refuge.

Response 41-8: Mountain lions have been sighted infrequently on the Refuge.

Letter 41

Ash Meadows NWR Meeting in Pahrump
Bob Ruud Community Center

August 5, 2008, 6-8 pm

Ash Meadows NWR Comments:

- What is the Service's knowledge of the historic system based on and what features is the Service attempting to restore to historic conditions? 41-9
- Who manages Devils Hole pupfish and is it considered a Service-managed species? 41-10
- What fish does the Service manage the Refuge for? 41-11
- Do burros occur on the Refuge? 41-12
- What are current visitor numbers and how are they estimated? 41-13
- What are the current Refuge budget and the project budget for the restoration activities under Alternative C? 41-14
- What is the purpose of restoration activities- will they expand or increase endemic species populations? 41-15
- What do the shaded areas mean on the alternative maps? 41-16
- Information is available dating back to 1958 on water quality and plants at the Refuge and in the local area, from people who used to work at the Nevada Test Site or for DOE. 41-17
- Does Pahrump buckwheat occur at the Refuge? 41-18
- Are ash trees present? 41-19
- How will noxious or invasive species be managed? Concern with species such as Russian knapweed. 41-20

M.41 Comments from Public Meetings

Response 41-9: See Section 4.2.1. The Service is currently engaged in restoration activities in attempt to restore the area to its natural historic condition. The overall goal of the Refuge is to re-direct spring outflows back into former natural channels, restore native riparian and upland vegetation, and remove unnecessary structures such as roads, fences, dams, levees, and power lines.

Response 41-10: See Section 4.2.2. Devils hole is a 40-acre inholding within Ash Meadows NWR, which is managed by Death Valley National Park. The Service has a responsibility to jointly manage threatened and endangered species, including Devils Hole pupfish.

Response 41-11: See Section 4.2.2. We manage Ash Meadows Refuge for Ash Meadows Amargosa pupfish, Warm Springs pupfish, Devils Hole pupfish, Ash Meadows speckled dace, and a wide variety of other wildlife and plants.

Response 41-12: See Section 4.3.2. Burros do not currently occur on the Refuge because the boundary is completely fenced.

Response 41-13: See Section 4.2.4. The number of visitors annually to the Refuge is estimated by traffic counters that count the number of cars entering the Refuge. Based on recent estimates, Ash Meadows NWR receives approximately 65,000 visitors annually.

Response 41-14: Information about the existing and proposed budgets for Ash Meadows NWR and the other refuges is contained in Appendix K.

Response 41-15: See Sections 3.2.1 and 1.5.4. Restoration activities on the Refuge attempt to restore species to the their historic ranges, establish self-sustaining populations, remove threats from their habitats, restore historic water flows in historic channels, and restore plant and aquatic communities to historic structure and composition. By restoring natural habitat, endemic species are expected to expand their range and increase in population.

Response 41-16: The shading represents various vegetation control and/or restoration alternatives as described in the Alternative Highlights legends.

Response 41-17: Comment appreciated.

Response 41-18: Pahrump buckwheat has not been observed on Ash Meadows NWR.

Response 41-19: Leather-leaf ash trees are present throughout the Ash Meadows Refuge.

Response 41-20: See Section 5.2.2. The Service prepared an Integrated Pest Management (IPM) Plan in 2006 and is beginning to implement strategies to manage invasive species. A more active invasive species removal program would be implemented under Alternatives B and C to control non-native and invasive plants throughout the Refuge. Specifically, the Service would remove 50 to 75 percent of salt cedar and Russian knapweed populations under Alternative B and 75 to 95 percent of their populations under Alternative C.

Letter 41

Desert NWR Complex Meeting in Las Vegas
Clark County Government Building
August 6, 2008, 130-330 pm

General Comments/Questions:

- Define purpose and need for CCP. 41-21
- Make the connection between planning/expansion of services and staffing levels. 41-22

Ash Meadows NWR Comments:

- Coordinate with NPS to ensure joint planning with NPS for Devils Hole. 41-23

Desert NWR Comments:

- Where will prescribed fire be used? This should be identified in a step-down plan. 41-24

Moapa Valley NWR Comments:

- What factors determined the proposed boundary expansion? 41-25
    - Actual boundary lines?
    - Why does it not include other private properties?
- Why is SNWA not "called out" as a partner regarding Refuge involvement? 41-26

Pahranagat NWR Comments:

- Capture planning for cultural resources and include management of "Black Canyon" in the preferred alternative. 41-27
- Recommend interpreting cultural resources on the Refuge to benefit the public. 41-28

M.41 Comments from Public Meetings

Response 41-21: Section 1.3 describes the purpose and need for a CCP. A CCP provides long-range guidance on refuge management through its vision, goals, objectives, and strategies. The CCP also provides a basis for a long-term adaptive management process that will include monitoring the progress of management actions, evaluating and adjusting management actions based on new information or techniques, and revising management and monitoring plans accordingly.

Response 41-22: Appendix K contains a list of projects proposed in the CCP and their cost. This appendix also describes the existing and proposed staffing levels needed to implement these projects. CCPs provide long-term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the Service's best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

Response 41-23: Comment acknowledged.

Response 41-24: See Section 5.3.1. Prescribed fire will be used to restore vegetation characteristics representative of a natural fire regime under Alternatives C and D.

Response 41-25: See Section 3.4.4, and response 6-2. The primary management objective of the Moapa NWR is to protect and restore habitat for the Moapa dace and contribute to its recovery. This was the primary factor in determining what properties to include in the proposed expansion area.

Response 41-26: See Response 38-33

Response 41-27: Comment acknowledged. The preferred alternative does include management of cultural resources, including Black Canyon.

Response 41-28: Comment acknowledged. The preferred alternative does include cultural resource interpretation, in coordination with culturally affiliated tribes.

Letter 41

Moapa Valley NWR Meeting in Overton
Moapa Valley Community Center
August 6, 2008, 6-8 pm

Moapa Valley NWR Comments Overview:

- Status of Moapa dace population 41-29
- Tilapia removal and description 41-30
- Restoration of Apcar springs/streams 41-31
    - Removal of shade for fish
    - Flooding concerns
- Use of soil/gravel for restoration 41-32
    - Concern with bringing in nonnative soil
- Fire impacts on dace population on Refuge 41-33
    - Reintroduce dace after fire
- Differences between dace species 41-34
- Joint management of dace population with SNWA 41-35
- Management of expansion area 41-36
    - Water rights and use
    - Palm tree removal
- Fencing constraints for wildlife access to springs 41-37
    - Bighorn sheep
    - Location/extent of fencing
- Spring location 41-38
- Dace survival 41-39
    - Length of time during restoration that dace are at risk
- Odors during restoration of Plummer 41-40
    - What is source?
- How can people volunteer? 41-41
- How will the Service open expansion area to public? 41-42
    - What access will be open?
    - Need to clean up certain areas
    - Allowed uses
- Status of soft-shell (aka snapping) turtles 41-43
- Effects of raccoons on fish (particularly dace) 41-44

M.41 Comments from Public Meetings

Response 41-29: Though the Moapa dace population went through a period of decline until 2007, it has stabilized in the last two years.

Response 41-30: See Section 4.2.2. Blue tilapia were illegally introduced into the upper Muddy River and tributaries. The Service, NDOW, and other collaborators have been conducting a program to eradicate blue tilapia from the Muddy River system and control other non-native populations in order to facilitate recovery of Moapa dace and restore Moapa White River springfish to historic population levels.

Response 41-31: Comment acknowledged. Moapa dace were not present on the property prior to restoration. The Service is working with partners to address potential flooding concerns of downstream property owners.

Response 41-32: Soil and gravel used in all restoration projects come from local sources.

Response 41-33: The 1994 fire devastated the Moapa dace population on the Pederson unit of the Refuge and required reintroduction efforts.

Response 41-34: See Appendix H, Biological Resources.

Response 41-35: Per the requirements of the SNPLMA funds used to purchase the Warm Springs Ranch, SNWA is required to coordinate with the Service in management of the property.

Response 41-36: Appendix L contains a conceptual management plan for the proposed expansion area. More detailed planning for the area will be completed if and when the Service acquires the lands (through agreement, transfer, or purchase).

Response 41-37: The southwest side of Moapa Refuge is not fenced and allows wildlife access to springs. Bighorn sheep have recently been sighted on the Pederson Unit of the Refuge.

Response 41-38: During the restoration efforts, the modified spring sources are excavated to reveal the original spring heads.

Response 41-39: During previous restoration projects, dace have been observed moving into newly restored habitat almost immediately after construction if access is available.

Response 41-40: We suspect that the odors are from the breakdown of organic materials.

Response 41-41: See Section 4.4.4. The Service works with the other public land agencies in southern Nevada to coordinate volunteer work through the Southern Nevada Interagency Volunteer Program–Get Outdoors Nevada. For more information, please contact the Desert NWR Complex headquarters at (702) 515-5450 or www.getoutdoorsnevada.org.

Response 41-42: See Appendix L for more information on how the Service proposes to manage properties that are acquired or transferred.

Response 41-43: The soft-shell turtle is known to occur in Moapa Valley NWR; however, the species is not considered a species of special concern.

Response 41-44: Raccoons are known to occur at Moapa Valley NWR and within the proposed expansion area. The effects of raccoons on dace are not currently known.

Pahranagat NWR Meeting in Alamo
Alamo Annex Building
August 7, 2008, 6-8 pm

Pahranagat NWR Comments Overview:

- Goals/purpose of Refuge 41-45
- Use water from outside state 41-46
- Why convert campground to day use?
  - Campground benefits local community/visitors
  - Used by Boy Scouts and locals
  - Removing/restricting camping forces people to go elsewhere (e.g., Eagle Lake) 41-47
  - Locals willing to volunteer
  - Campground has been working fine
- Will fishing remain?
  - Need fish for waterfowl/wildlife 41-48
  - Secondary use should be for fishing
- Clean water for swimming to be safe 41-49
- Who stocks fish? 41-50
- Where will the visitor center be located? 41-51
- Need new trails that are accessible 41-52
- Status of sandhill crane
  - Historic use/mitigation route 41-53
- Why restore drainage through Black Canyon?
  - Consider alternative routes
  - Construction concerns 41-54
  - Concern with petroglyphs and public
- Can drainage restoration at Black Canyon be done without impacts to cultural resources? 41-55
- Visitor center design and appearance
  - Who will be able to use (e.g., school groups)?
  - Could it be expanded in the future? 41-56
  - Would trees be affected or new trees planted?
  - Restoration plans, especially for old trees 41-57
- Status of Ducks Unlimited project 41-58
- Could gift shop be included at visitor center? 41-59
- Consider visitor center location at Upper Lake 41-60
- Does visitor center funding include restoration, trails, etc? 41-61

M.41 Comments from Public Meetings

Response 41-45: See Section 1.7.4.

Response 41-46: Comment acknowledged.

Response 41-47: Comment acknowledged. Our primary reason for proposing to convert the campground to a day use area is that it requires significant staff and funding to operate, which detracts from other refuge management activities.

Response 41-48: See Section 3.5.1. Under the preferred alternative, Pahranagat NWR would continue to be open to fishing. However, until safety issues regarding the dam that impounds Upper Pahranagat Lake are resolved, opportunities will likely be limited.

Response 41-49: The Refuge policy to prohibit swimming would be enforced and regulatory signs at the open water areas maintained. Swimming poses a public health and safety concern and can adversely affect fish, wildlife, and their habitats.

Response 41-50: NDOW has stocked fish on the Refuge in the past but not in recent history.

Response 41-51: Comment acknowledged. The Service is currently proposing to locate the new visitor contact station at the current headquarters site.

Response 41-52: The preferred alternative for Pahranagat NWR includes construction of new interpretive trails on the Refuge. New trails will be wheelchair accessible where feasible.

Response 41-53: See Section 3.5.1. Pahranagat Refuge is an important stopover location for migrating sandhill cranes. The cranes that use the Refuge are part of the lower Colorado River population of greater sandhill cranes, which is a species of high concern in the Intermountain West Waterbird Conservation Plan.

Response 41-54: We propose to restore the historic drainage through the Black Canyon to diversify habitat on the Refuge, in particular riparian areas.

Response 41-55: Potential impacts to cultural will be analyzed further in project-specific NEPA documents to be prepared for Refuge actions. To prevent adverse impacts on cultural resources during restoration and construction activities, professional archaeologists would survey the Refuge for cultural resources and record the information and locations prior to project implementation. This project will be fully coordinated with culturally affiliated tribes.

Response 41-56: See response 41-52. A step-down plan and NEPA analysis will address the purpose (use), impacts, and mitigations associated with the proposed visitor contact station development. The design of the visitor contact station has not been initiated but we hope to include space for appropriate uses such as school groups.

Response 41-57: The health of the riparian habitat is being addressed in the restoration planning effort which is in progress.

Response 41-58: The Ducks Unlimited project has been completed.

Response 41-59: We will consider including a gift shop at the visitor contact station.

Response 41-60: See Responses 41-52 and 41-56. We are not currently proposing to locate the visitor contact station near Upper Lake due to the sensitivity of the habitat and lack of utilities. However, we may consider alternative locations when we prepare the NEPA document for the project.

Response 41-61: Funding for the visitor contact station does not include restoration or construction of other visitor facilities such as trails.

- When did BLM take over management of Maynard Lake? 41-62
- What is timetable for outlet structure repair? 41-63
- Campground use/staffing issues need to be addressed 41-64

Response 41-62: Jurisdiction of the Maynard Lake area was transferred to BLM by Public Law 108-424, which became law on November 30, 2004.

Response 41-63: We plan to complete the repairs of the outlet structure after the lake is drawn down again in the summer of 2009. The lake will refill again as we begin to receive our water allocation in November.

Response 41-64: Comment acknowledged.

Responses to Comments on Tetra Tech's

Groundwater Flow Model of Part of the

Colorado Regional Groundwater Flow System, Southeastern Nevada

(Version 1.0)

December 13, 2013

Prepared by:

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TETRA TECH

Responses to Comments on Tetra Tech's

Groundwater Flow Model of Part of the Colorado Regional Groundwater Flow System, Southeastern Nevada (Version 1.0)

EXECUTIVE SUMMARY

On behalf of several agencies of the Department of the Interior, Tetra Tech developed and calibrated a model describing groundwater flow in Southeastern Nevada, an area where future groundwater development may impact resources under the protection of the Department of the Interior. Parties with interest in the groundwater have been provided an opportunity to review the reports describing the development of the model and predictions of the effects of future pumping using different pumping scenarios that were developed by the National Park Service. Many excellent and useful comments were provided which may result in improvements to future versions of the model. The most important of these comments are discussed in this current document.

In the cover letter that transmitted their review comments on the Tetra Tech reports, the Southern Nevada Water Authority (SNWA) stated '… *Without a good calibration to predevelopment conditions, the model is not ready for transient calibration or to be used to predict the "magnitude and timing of changes" due to future groundwater pumping. Deficiencies in the conceptualization and representation in the numerical model of springs and evapotranspiration are the main causes of the inadequate model calibration. These deficiencies, coupled with many others described in the enclosed report, yield a model that, in its current state, in unusable for its intended purpose*.' Vidler Water Company concurred with SNWA's statement that the "Tetra Tech Model is "unusable for its intended purpose." Tetra Tech strongly disagrees with these statements.

First, we disagree with SNWA's representation of the springs in the Muddy River Springs area as having conduits feeding water to the springs that extend to the bottom of the carbonate-rock aquifer, as represented in their models. The temperature of the water discharging from the springs is best explained by conduits that extend through the younger sediments (primarily Muddy Creek) and perhaps a short distance into the upper portion of the carbonate-rock aquifer. Water temperatures measured in upgradient wells screened near the top of the carbonate-rock aquifer are slightly warmer than measured in the spring discharge. There is no evidence that the water is derived deeper in the carbonate aquifers. The concept of extending the spring conduits to the bottom of the carbonate aquifer as done by SNWA modelers is not supported by any data and is not necessary to explain the temperature of the spring discharge.

Second, we agree that the ET estimates used in the model do not represent the conditions during the period when agricultural irrigation was occurring and as a result, the simulated flow in the Muddy River as it flows past the Lewis Avenue stream gage is too high. The ET estimate developed by DeMeo and others (2008) was intended to represent natural groundwater discharge and not the additional amount caused by diversions from the Muddy River and subsequent ET loss from irrigated fields. The SNWA estimate, on the other hand, includes the effects of diversions and irrigations. We could have incorporated the diversion from the Muddy River, added the ET due to irrigation in the Lower Moapa Valley, and attempted to estimate irrigation return flows into the river to improve the match with the Lewis gage measurements. We made a decision that this would not result in an improved groundwater model and was therefore not worthy of the effort. We also notified the reader of the calibration report that the Lewis gage mismatch was present. The use of the model for predicting groundwater-use effects in places other than along the Muddy River in Lower Moapa Valley is not affected by this simplification.

SNWA also criticized the model's under-simulation of stream flow at the Muddy River at Moapa gage. The mismatch occurs primarily as a result in the location of the simulated discharge, not the volume of discharge. Additional discharge into the stream occurs in the model between the Moapa gage and White Narrows, a short distance downstream. This mismatch at the gage does not affect the usability of the model to make predictions, although a better measure of the impact of pumping would be obtained at the White Narrows rather than at the Moapa gage.

The post-audit evaluation of the model, in which predictions made with the model were compared with observations made during 2012, indicated that the model under-simulates the effects of pumping in Coyote Spring Valley. This is likely the result of ignoring the effects of earlier Arrow Canyon and Arrow Canyon 2 pumping in the Order 1169 calibration model, and by using specific-storage values for the carbonate aquifer that were too high. Until additional calibration work can be performed, predictions of drawdown resulting from pumping in Coyote Spring Valley can be improved by calculating location-specific compensation factors based on observed and simulated drawdowns, and multiplying long-term predicted drawdowns by these factors.

The greatest source of uncertainty in predictions in locations other than Coyote Spring Valley and the Muddy River Springs area is likely to be the absence of information on the response of the groundwater system to long-term pumping. This model, as well as other models of these areas, is only calibrated to non-transient conditions. The uncertainty created by the lack of long-term observation of the effects of pumping should be explicitly recognized, but this does not make the model unusable for making preliminary predictions. To claim that this uncertainty does not exist would be a disservice to water-resource managers, decision makers, and the public. Because of the size and characteristics of the groundwater system, the effects of groundwater use on other users may occur slowly, especially if the other users are in basins different from where the pumping occurs. Recovery from the impacts is also likely to occur slowly. Before decisions that may have long-term impacts are made using this or other models, the effects of this uncertainty should be determined through numerous modeling simulations in which model parameters are varied within reasonable limits. With additional information on the effects of pumping, the uncertainty will be reduced. The State Engineer's Office has been wise in their approach to require slow groundwater development coupled with an adequate monitoring system to collect this missing response information in these areas.

Responses to Comments on Tetra Tech's

Groundwater Flow Model of Part of the Colorado Regional Groundwater Flow System, Southeastern Nevada (Version 1.0)

In 2012, Tetra Tech prepared a report (Tetra Tech, 2012a) which described a newly developed groundwater flow model in Southeastern Nevada, and a second report (Tetra Tech, 2012b) which described predictive simulations developed with the new model. The model was developed using MODFLOW-2000, and the geologic framework for the model was based on a geologic map compiled by Page and others (2005), structural interpretations developed by Page and others (2011) and available drillhole and geophysical control. The model was calibrated using water-level and streamflow data available through December, 2011, approximately half-way through the Order 1169 testing in Coyote Spring Valley, and is the only model currently available that uses these data to constrain its calibration.

The model was developed on behalf of three Department of the Interior (DOI) agencies (U.S. National Park Service, U.S. Fish and Wildlife Service, and the Bureau of Land Management). While primarily intended for use by the DOI agencies as a resource to use in making decisions about how best to protect groundwater-dependent environments within public lands in their trust, the model also has secondary uses in improving the understanding of the groundwater system and in identifying types of information which may decrease the uncertainty of predictions of the effects of groundwater use. There is also a potential use of the model related to water-rights applications in submittals to the Office of the State Engineer. The model was calibrated to observations of water levels and flows collected over decades, with special attention paid to the first year of the Order 1169 pumping in Coyote Spring Valley.

The model was released as Version 1.0, in recognition of the likelihood that additional information would become available in the future which would improve the model. Additionally, interested parties were encouraged to provide comments on the model, so that future versions could benefit from their comments and interpretations. Three groups have provided written comments to date: Southern Nevada Water Authority (SNWA), Vidler Water Company, and Mifflin & Associates (Attachment A). The comments were submitted in different formats. SNWA prepared a 24-page written report which provided general and specific comments on Tetra Tech's two model reports. Peter Mock/PMGC, Inc. prepared a 6-page memo for Vidler Water Company which provided a summary of the model for Vidler Water Company as well as providing comments about the model, and areas where there is disagreement. Mifflin & Associates developed a 30-slide PowerPoint presentation that provides information gleaned from the modeling datasets for the areas around the Muddy River Springs area and Coyote Spring Valley. The presentation also presents results from a simplified model based on the Tetra Tech model.

On the whole, the comments are quite useful in pointing out areas where there is uncertainty and disagreement, and many will be particularly helpful in improving the model. However, SNWA and Vidler Water Company questioned the usability of the model in its present state of calibration. As with any groundwater flow model, the Tetra Tech model can be improved with additional data and effort.

For example, the recently performed post-audit analysis of the Version 1 model (Tetra Tech, 2013) using an additional year of data on the effects of Order 1169 pumping demonstrated that the model under-predicts the effects of the pumping in Coyote Spring Valley. Observed drawdown was greater and more widespread than simulated. Nonetheless, the observed changes were similar to those simulated, just of greater magnitude. In our opinion, this model is useable in predicting the effects of pumping, but the decision makers need to understand its limitations, and to use the modeling results in conjunction with and not in place of hydrologic data. For example, if both the Tetra Tech model results and the actual measurements indicate that pumping is causing declines in spring discharge, and the model predicts that additional pumping will cause further declines in spring discharge, the decision maker can be confident that additional pumping will cause further declines.

The following responses to the comments address the most salient comments. The efforts of the commenters are appreciated, and these comments will be considered in future revisions of the model. Many of the more general comments will not be addressed in this present response, but will also be considered in future revisions.

There are similarities between some of the comments by different reviewers. To avoid repetition, these comments will be addressed together the first time the comment is discussed, with a reference in later similar comments. Because SNWA had the greatest number of comments, this response will first address SNWA's comments, followed by Vidler Water Company's comments, and then those comments by Mifflin & Associates.

SNWA Comments

1. There is a mismatch between simulated and measured flows in the Muddy River – The model's simulated flow at the Moapa gage is about 30% lower than the target, and the flow at the Glendale gage is approximately 50% higher than the target. Mifflin & Associates also noted this issue. SNWA suggests that the mismatch at the Moapa gage is caused by the stream segments used to simulate the springs not being assigned throughout the thickness of the PC4 HGU. However, the model matches the spring discharge quite well. The mismatch is caused by inadequate discharge into the Muddy River downstream of the springs and upstream of the Moapa gage. Much of the calibration effort attempted to address this problem, but a solution was not found. One possibility is that there may be a zone of high vertical hydraulic conductivity underlying the alluvium that is not currently incorporated in the model. Also, see the response to Mifflin & Associates comment about this issue (#2). Another possibility is that the structural barrier which causes the discharge to occur in this part of the Muddy River is located too far downstream in the model.

   The model simulates about 60% of the streamflow at this gage that the streamflow data indicate. A short distance downstream from the Moapa gage, additional groundwater discharge is simulated to nearly make up the mismatch. At the White Narrows, a short distance downstream from the gage, the simulated flow in the river is approximately 83% of the measured value at the gage. The issue in the model is not the volume of simulated discharge, but where it occurs. Movement of our White Narrows HFB a short distance to the west, as SNWA did, would very likely resolve this issue. We based the location of our HFB on geologic mapping and locations of paleospring deposits observable on aerial photos.

SNWA has stated that the model cannot be used for predictive purposes because of these differences between observed and simulated stream flows. We agree that additional calibration effort would benefit the model in this area, but disagree with SNWA's statement. With the current model, use of the simulated streamflow at White Narrow would provide a better measure of the effects of pumping than the simulated flow at the Moapa gage.

2. There are differences in the estimated evapotranspiration (ET) rate for California Wash and Lower Moapa Valley between the DeMeo and others (2008) and earlier USGS and SNWA estimates - We used the recent DeMeo and others (2008) measurements of ET, which are lower than estimates published in the earlier USGS reconnaissance reports and those developed by SNWA. SNWA asserts that the rate of ET along the Muddy River downstream of the Glendale gage has decreased as a result of the diminished flows in the Muddy River (p. 19), partially explaining the difference between the earlier USGS estimates (24,000 af/y) and the DeMeo and others estimate (11,500 af/y). They also suggest that the model over-simulates the flow rate in the Muddy River at Overton because the wrong ET rate was used. They indicate that use of a higher ET rate along this stretch of the Muddy River would reduce the flow in the river.

   The DeMeo and others (2008) estimate, which is based on classification of satellite spectral data and measurements of ET rates in Nevada (including the study area) and nearby states, is an estimate of the natural ET prior to agricultural irrigation. This (not a reduction in ET caused by reduced flow in the Muddy River) is the primary reason for the difference between the DeMeo and others ET value, and the estimates developed earlier by the USGS and by SNWA. The earlier USGS estimate for non-agricultural ET (11,000 af/y), was developed by D.O. Moore and published in a Reconnaissance Series report by Rush (1968). Moore used an ET rate of 2 ft/y for a plant community described as "Mostly saltbrush and saltgrass; some saltcedar, mesquite, cottonwood, and tules" for Lower Moapa Valley (Rush, 1968, Table 11). However, Moore used a value of 1 ft/y for a nearly identical collection of plants in California Wash, indicating the presence of significant uncertainty in the annual ET rate. DeMeo and others mapped the distributions of different plant communities and applied measured annual ET rates to each. They estimated that the non-agricultural ET was 11,500 af/y, which is very similar to Moore's estimate. We consider the more recent work to be a much more reliable estimate of discharge from the groundwater system, with much less uncertainty than Moore's estimate.

   Agriculture in Lower Moapa Valley is based on irrigation, which is supported by diversions from the Muddy River, primarily at Wells Siding into Bowman Reservoir. Moore had estimated the ET from agricultural areas at 13,000 af/y, for a total ET estimate of 24,000 af/y. SNWA's estimate (25,000 af/y) also includes ET from agriculture. This is illustrated on Figure 1, in which the much larger area of ET delineated by SNWA compared with that of DeMeo and others is shown. Aerial photographs taken at the approximate time of the Thematic Mapper data used by DeMeo and others (June 2003) show that there are large irrigated areas on the west side of the Muddy River that DeMeo and others did not delineate.

We considered including the effects of agricultural ET in the transient simulations. This would have meant including (1) the diversion at Wells Siding into Bowman Reservoir and other diversions, (2) the systems for delivering the water to the numerous irrigated fields, and (3) infiltration and return flows from the irrigation. This effort would have been outside the scope of our contract and, besides improving the match at the Lewis Avenue gage, would have little benefit with respect to the intended uses of the model. It would not have affected the ability of the model to make predictions, except for the Muddy River flow at the Lewis gage. Thus, we decided to accept the mismatch at Lewis Avenue gage. Similarly, there is agricultural ET in lower Meadow Valley Wash that is not addressed in this model, and an unknown portion of the mismatch at the Glendale gage is likely caused by not including this irrigation.

3. SNWA disagrees with the method of simulating ET in the model – The model uses Modflow's Well Package to simulate ET rates in order for the seasonally variable ET to be a driving function (in conjunction with seasonal pumping) to cause the seasonal variations in water levels observed over large areas. SNWA commented that Modflow's ET Package should have been used instead of the Well Package. They also express the opinion that annual stress periods and annual ET rates should be used in the model. We chose the Well-Package method to simulate the seasonally varying stresses on the groundwater system, as measured water levels respond to these stresses. The seasonal ET is caused by changes in plant growth throughout the year, and the shallow water levels vary in response. As ET increases during the growing season, water levels decline. The ET Package bases the ET rate on the maximum ET rate specified in the data set, and the depth of groundwater. ET-package simulated ET increases in response to <u>increases</u> in water levels. This is the reverse of what actually occurs. An approach that could have been used during calibration would have been to use the ET Package and monthly stress periods, with the maximum ET rate changed monthly based on data obtained by DeMeo and others. We considered this approach, and decided not to use it during the model calibration because of concerns about model and PEST stability during the calibration process. Use of the ET Package with annual stress periods during the <u>predictive</u> runs would have been beneficial and may be invoked during the next revision of the model, allowing the capture of groundwater discharge from ET to be estimated.

4. It is not clear that recharge rates match discharge estimates – SNWA commented that the Maxey-Eakin coefficients needed to be adjusted so that recharge matched discharge estimates. Vidler Water Company also provided a similar comment. The recharge was adjusted to match discharge and boundary flux estimates, but the model development report discusses the recharge dataset in two different areas of the report, so that this is unclear. The first discussion of the recharge data set is on pages 28 and 29. The last sentence of this discussion states "The basin water budget information was used to estimate a factor by which to reduce the calculated

recharge rates to be consistent with discharge rates." Information on this factor was provided on page 48, in the 4th complete paragraph: "…, the recharge rates calculated by the modified Maxey-Eakin approach were reduced by 35% to be consistent with the overall water balance estimates based on more recent studies."

5. The Order 1169 calibration model should have begun using simulated values for 2008, rather than 1987 – Pages 34 – 36 of the model development report describe the three different temporal modeling periods used during model calibration. SNWA commented that the Order 1169 calibration model used initial heads representing water levels calculated by the pre-production calibration model for 1987, and that using heads for 2008 calculated from the long-term calibration model would have been a better choice. In concept, we agree. However, the long-term calibration model takes approximately 12 hours to run, which would be added to the time for the pre-production calibration model to run (approximately 1 ½ hours). We tried to set up modeling so that PEST ran overnight estimating hydraulic conductivity and storage parameters for the PC4 carbonate sheet using Order 1169 data, and using the daytime work hours to evaluate the results and make PEST dataset and MODLOW model adjustments prior to starting another PEST run. The effort during the day also included updating modeling parameters and re-running the pre-production model, so that the Order 1169 model could start with updated initial conditions. If we had run the long-term model to get initial conditions for 2008, this daily cycle would have become a two-day cycle. Interspersed with the Order 1169 PEST runs were PEST runs to estimate other modeling parameters using the pre-production model. We recognized that while this approach was less than optimal, it did make the calibration feasible. To minimize the impact of this time gap, the Order 1169 calibration model was run to match drawdown, based on simulated and observed hydraulic heads at the beginning of the Order 1169 runs.

   The effect of this necessary simplification is shown on Figure 2. The drawdown simulated in the long-term model run is shown by blue diamonds, and drawdown for the Order 1169 model run is shown by green triangles. The most notable difference between the two simulation periods is that the Order 1169 calibration model simulates greater drawdown during its simulation period than does the long-term calibration model, for many of the wells in the vicinity of the Muddy River Springs area. This is likely the result of the absence of the simulated effects of pumping of the Arrow Canyon and Arrow Canyon 2 wells during the period 1993 through 2008. When pumping of a well begins, drawdown occurs more rapidly at first than it does at later times. This is what the Order 1169 calibration model is simulating, as the 1987 initial head dataset does not reflect any pumping of the Arrow Canyon wells. The long-term calibration model, on the other hand, included pumping of these wells beginning in 1992. Thus, during the Order 1169 modeling period, the long-term calibration model simulates a slower rate of drawdown. The differences in the modeling results indicate that the model simulates effects of pumping from these carbonate aquifer wells throughout the Muddy River Springs area into eastern Coyote Spring Valley, near MX-5.

What are the effects of our using the shorter time frame model for calibration of the PC4 parameters based on the Order 1169 test, and what are the effects on the predictions? It is likely that estimated values for the transmissivity in this area are too low and/or the storage parameter values are too high, as the long-term calibration model, which includes the effects of Arrow Canyon wells during the time gap, simulates less drawdown than the Order 1169 calibration model used to estimate these parameters. As a result, the predicted drawdowns made with the long-term model are likely to be too low. [Note: the predictive runs were made using the output from the long-term calibration model, as were the simulations performed for the post-audit evaluation.] The approach we used may partially explain the under-estimation of drawdown that we found in our post-audit study. This issue could be resolved in future improvement to the model, if the schedule will accommodate the longer run times for the long-term calibration model.

6. The depths of spring sources in the model are too shallow based on temperatures of water discharging from springs – It has long been recognized that the warm temperatures of water discharging from the large regional springs indicate that the water has had a relatively deep flow path, based on geothermal gradients. SNWA has used this to justify placing spring sources at the base of the carbonate aquifer. They have used geothermal gradient information to estimate the depth of the source, based on the temperature of the water. We agree with SNWA's interpretation that the water has been to depths of several thousand feet. However, their methodology for estimating the source of the spring does not take into account that the temperature of the water reflects thermal transport processes of conduction and advection. The rate of advection affects the water temperature in upward moving water. If the rate is high, the time for conductive loss of heat is reduced, and the water remains warm. However, slowly moving water has more time to equilibrate with the conductive geothermal gradient, and the water becomes cooler. This needs to be considered in interpreting the temperature data of springs and the "sources" of the springs. Simulating this would require development of a heat transport model, which has not been done for this area, and is rarely done. However, there is information available which casts doubt on SNWA's method of determining the depth of the spring source (and the way that the spring should be represented in a model). The springs in the Muddy River Springs area have temperatures of approximately 32° Celsius (~ 90° Fahrenheit). Based on SNWA's Figure 7-8 in their report "Conceptual Model of Groundwater Flow for the Central Carbonate-Rock Province", the source of these springs should be at depth of 2000 to 4000 feet. They argue that models should have springs "plumbed" to these depths. Interestingly, MX-5, with a total depth of 628 feet, had temperatures in 2003 of approximately 35° Celsius (~ 95° Fahrenheit), and, according to SNWA's approach, the source of this water should be "plumbed" to depths greater than 2000 to 4000 feet, not 628 feet or less. Another nearby well, completed to 669 feet, also has water with a temperature of approximately 35° Celsius measured in 1980 and 1981. These temperatures were measured prior to the beginning of the Order 1169 test and should not be affected by long-term pumping which might pull water up from greater depths. This warm water was sampled from the top of the carbonate aquifer,

not at depths of several thousand feet. The temperature of the water provides information on the depth to which the water has travelled, but not depth of spring conduits.

In the Tetra Tech model, the SFR package was used, with stream segments extending down to layer 8, which has a depth range of 1510 to 1,860 feet below the water table. The spring conduits are simulated as passing through approximately 700 to 800 feet of younger deposits, and a similar thickness of the upper PC4 HGU. The PC4 is simulated as being approximately 14,000 to 15,000 feet thick at the location of the springs. The SNWA models have the conduits extending through the entire thickness of the aquifer, based on an interpretation which is not supported by data.

In summary, the temperature data for relatively shallow groundwater samples indicate that water in the upper part of the PC4 carbonates sheet in the vicinity of MX-5 and near the Muddy River Springs is warm, and therefore an interpretation that spring conduits extending thousands of feet into the carbonate aquifer is not supported by the temperature data. The Tetra Tech model simulated conduits extending only through several hundred feet of the 14,000 to 15,000 foot thick aquifer, in contrast to SNWA models which have the conduits extending through the entire thickness of the aquifer.

7. The transmissivity values for the PC4 carbonate sheet are too high in some areas – The pilot point approach calculated large hydraulic conductivities in an area bounded on the east by the wells Paiutes M1, EH-4 and CSV-2, westward beneath the Muddy River into Coyote Spring Valley to the area of MX-5 Within this area, hydraulic conductivities ranged from 20 to nearly 20,000 ft/d. At MX-5, the model-estimated value was approximately 4,500 ft/d. SNWA suggests that calculations of transmissivity using analytical solutions to the MX-5 drawdown produce lower values than was produced by our modeling calibration, and that we should have used the values determined by analytical solutions. Vidler Water Company also commented that the values in the model are too high. SNWA suggested that the high values in our model resulted from the lack of connection between the Muddy River springs and the deep carbonate aquifer. [As discussed above, we do not interpret the warm temperature data to indicate a deep plumbing system, but that deep movement has occurred. In the future, we may test SNWA's idea of extending these "conduits" deeper to determine whether the model-estimated hydraulic conductivities are sensitive to the depth of the conduits, but do not expect deeper connections to significantly affect the model.]

   While aquifer tests are useful for characterizing a groundwater system, they must be used wisely. In fractured rock, such as the carbonate-rock aquifer, water will enter a production well in significant quantities where the borehole penetrates permeable fractures that are connected to other permeable fractures. Because of the limited proportion of the borehole that is actually producing a significant quantity of water (probably less than 1% of the length of the borehole), the velocity of water moving in the fractures will be quite high, causing significant head losses in the fractures near the production well because of non-Darcian flow. Most analytic solutions do not take this into account, and thus yield permeability values that are too low in fractured rock, even with little drawdown in the production well. Still, it can be constructive to compare the data from MX-5 with another permeable well completed in the carbonate-rock aquifer. MX-5 was pumped at approximately 3,500 gpm, and experienced approximately 6 to 7 feet of drawdown. In Yucca Flat, well ER-6-1#2 was pumped at 275 gpm, with 8 to 9 feet drawdown (Ruskauff, 2005). Drawdown was detected in ER-7-1, approximately 7 miles away, in less than a day. A multi-well analytic solution of the Yucca Flat test produced hydraulic conductivity values of approximately 250 ft/d. The MX-5 pumping rate was more than 10 times higher than the pumping rate in ER-6-1#2, with approximately the same amount of drawdown over a longer period of time. Assuming that the flow law in the nearby fractures was linear (Darcy's Law applies), MX-5 would be approximately 13 times more permeable than ER-6-1#2. As the flow law is likely not linear in the fractures close to the pumped well, the permeability near MX-5 is likely even higher. Assuming a linear flow law applies in these fractures, the hydraulic conductivity at MX-5 would be in the neighborhood of 3,200 ft/d. The model estimated a value of approximately 4,500 ft/d at land surface, and lower values at depth. There clearly are many assumptions in this brief evaluation, but it appears that the hydraulic conductivity estimated in the model for the area near MX-5 is in the right ballpark.

The highest hydraulic conductivity estimated by the model was for the pilot point located in the Muddy River Springs area. The value at this location was nearly 20,000 ft/d. Vidler Water Company commented that this value is outside the range of values that would be reasonable for the carbonate-rock aquifer. We agree that it is a large number, and the sensitivity of the model to this parameter should be further examined. However, we think that the value suggested by Vidler Water Company (3 ft/day) is not reasonable for this area of the model. This pilot point is the one where SNWA suggests that the high value is being driven by using a shallow source for the springs in the model. Our view is that the high value determined by the model calibration results from the high discharge in the Muddy River Springs area, coupled with the low gradient present upgradient of the springs. The Ash Meadows area, in the Death Valley Flow System, is similar in that the hydraulic gradient is low upgradient of the discharge area, there is significant discharge of regional groundwater at the location, and discharge occurs from shallow carbonate rock upgradient of less permeable rocks or sediments. However, there are some differences that affect the estimated hydraulic conductivity. First, the discharge at the Muddy River Springs is approximately 50% higher than at Ash Meadows (approximately 29,000 af/y versus 18,000 af/y). Second, the width of the discharge area is considerably smaller (4,000 ft versus 50,000 ft). Third, the hydraulic gradient is approximately half that upgradient of Ash Meadows. These three observations suggest that the transmissivity should be considerably higher near the Muddy River Springs than at Ash Meadows, by a factor of approximately 30. It is difficult to determine the thickness of the carbonate aquifer used in the DVRFS model upgradient of Ash Meadows, but 1,000 m (~3,200 feet) is a reasonable estimate. Winograd and Thordarson (USGS Professional Paper 712-C) show a thickness of about 4,000 ft on their Plate I. Using a thickness value of 1,000 m and the calibrated value of 200 m/d for the carbonates upgradient of Ash Meadows in the DVRFS model yields an estimate of 200,000 m^2/d for the transmissivity, or 2.1 x

10^6 ft^2/d. Considering that the width of the discharge area is an order of magnitude smaller than at Ash Meadows, the discharge is 50% higher than at Ash Meadows, and the gradient is half that at Ash Meadows, the value used in our model for transmissivity (9.3 x 10^6 ft^2/d) is consistent with value used in the DVRFS model near Ash Meadows. The value estimated in our model appears to be driven by the discharge rate and small discharge area, not the way that the springs were modeled. SNWA (2009, p. 4-4) has postulated a structural zone running from the spring area northwestward into Coyote Spring Valley that may be responsible for this high permeability.

Vidler Water Company Comments

Vidler Water Company's comments were compiled by Peter Mock of PMGC, Inc. He combined his comments on our model with a description of the modeling approach. The following discussion addresses his main criticisms of the model.

1. References not provided for the two reports on the previous model developed by Tetra Tech (GeoTrans, 2001 and 2003) – These references are:

   GeoTrans, July 2001, Ground-Water Modeling of the Muddy River Springs Area and Surrounding Basins with Emphasis on Evaluating Pending Water Rights Applications in Coyote Springs Valley

   GeoTrans, November 2003, Addendum to Ground-Water Modeling of the Muddy River Springs Area and Surrounding Basins with Emphasis on Evaluating Pending Water Rights Applications in Coyote Springs Valley.

2. The geologic model does not portray a major boundary in the carbonate aquifer that Vidler Water Company interprets to be present near the Mormon and East Mormon Mountains – It is not entirely clear to what boundary this comment is referring. The East Mormon Mountains are located south of the Tule Desert basin. We cut some sections through our geologic model to determine the extent of the shallow crystalline basement in this area, and found that it is likely to serve as a barrier to flow in this area. The extent is observable in the maps provided in Attachment I of the modeling report, especially the map at the end of Attachment I which shows the elevation of the top of the XLB (crystalline rocks). The reddish orange area to the southeast of the intersection of section B-B' (the second section down from the north) and J-J' (the approximately north-south section east of the Mormon Mountains) represents an uplift of the crystalline basement in this area. The carbonate rocks thin significantly over this crystalline high. This crystalline high extends a short distance into southern Tule Desert. The outcrops of Bonanza King and Nopah present in southern Tule Desert are probably associated with upper plate carbonate rocks present in the hills to the south, according to the compiled map developed by SNWA and the USGS (Page and others, 2005), not a horst block as depicted in section B-B' of Bushner and Feast (2008). Further to the north, we used a horizontal flow boundary (HFB) in the model to represent the range front fault (East Tule Desert fault) on the

east side of the Tule Desert. Thus, our model does include features that create a partial barrier between the Tule Desert and Virgin River Valley basins, but it is not clear that such a barrier truly exists. We agree that more detailed work could be done in this area, but it is unlikely that significant improvements to the model can be made without measurement of the effects of pumping as was done in Coyote Spring Valley and the Muddy River Springs area.

3. Jim Harrill's report on the boundary flux estimates was not provided – The report is attached to these comments as Attachment B.

4. More information is needed on the recharge model – The recharge model was discussed in the above response (#4) to SNWA's comments. The recharge was developed to match discharge information. With respect to the concern about why we applied recharge in the Muddy Mountains, geochemical evidence based on data from the water discharging from Rogers and Blue Point springs, and the presence of small local springs in the Muddy Mountains, indicated a small amount of local recharge was occurring in these mountains that was not suggested by the modified Maxey-Eakin analysis.

5. Vidler Water Company believes that the hydraulic conductivities for the pilot points are unrealistically high – This was discussed in SNWA response #7.

6. Vidler Water Company does not believe that hydraulic conductivity for the carbonate rock decreases with depth of burial. Figure 3 below illustrates aquifer test data collected from many lithologies, including carbonate rocks, in the Death Valley Region. This figure is from WRIR 01-4210 (Belcher and others, 2002), prepared for the DVRFS model. It clearly shows decreases in hydraulic conductivity with increasing depth, which is expected because of increasing overburden stresses. [See also SNWA, 2009, Figure C-7, which also shows decreasing conductivity with depth.] The carbonate rocks are represented by the horizontal dash marks. While their hydraulic conductivities decrease more slowly with increasing depth than other lithologies, they clearly decrease. There is considerable scatter in the data points, making estimation of the depth-decay coefficient uncertain. The scatter is great enough that statistical testing of the slope of a regression line indicates that one interpretation of the testing could be that the slope is not significantly different from zero (no decrease with depth) and therefore the null hypothesis should be accepted. Another test could also be done to test whether the slope is significantly different from -0.005, and it would also fail. Therefore, the null hypothesis (that the slope is -0.005) should be accepted. Clearly, statistical testing cannot be used to determine permeability decreases with depth. But, a reasonable person would look at the data presented in Figure 3 and determine that it does decrease with depth. This conclusion is consistent with laboratory testing of permeability under different confining pressures that are reported by the oil industry, where understanding of reservoir permeability at depth is very important. In models where the total thickness of the groundwater system being evaluated is a few hundreds of feet, this is not an issue. However, when the aquifer rocks can be present at depths of thousands of feet, it is.

Mifflin & Associates Comments

1. The specific yield for the PC4 carbonate HGU is too high – The Tetra Tech model used a specific yield for the PC4 HGU of 0.02. This value, in combination with other model-parameter values, produced a reasonable agreement with observed drawdown data available at the time. Because of Mifflin & Associates' comment, we ran a sensitivity analysis of the model using the value selected by Mifflin & Associates based on their simplified model. When we changed the specific yield (which is applied only to the uppermost layer) from 0.02 to 0.003, there was virtually no change in the simulated drawdown. The results are shown in Figure 4. Figure 6.2-5 from our model development report is also provided for reference. [These results are for the Order 1169 calibration model.] The very small change occurs because there are storage contributions from compressibility of the rock and water (described by specific storage) in the underlying layers that then become greater than the specific yield. The change in the storage coefficient, which incorporates both the specific storage and specific yield, was from approximately 0.026 down to 0.009, or about a factor of 1/3. Within this range of the storage coefficient, there is very little sensitivity to the storage parameters. We then reduced the specific storage to a value of 1.0E-8/ft, and the specific yield to 0.003. The change in the storage coefficient, from approximately 0.026 for our calibrated model to approximately 0.0031, caused an increase in simulated drawdown in Coyote Spring Valley and in the Muddy River Springs area (Figure 5). These wells extend in a band from EH-4 to CSI-4. Because of the very limited sensitivity at the higher storage values, we believe that PEST did not have the information needed to cause it to lower storage values in order to improve the matches to observed drawdowns. In hindsight, we should have tried lower specific storage values which would have resulted in better matches. The efforts and comments of the Mifflin & Associates hydrologists are greatly appreciated. With the determination that our model under-predicts the longer term Order 1169 drawdown in our post-audit study, the specific yield and specific storage of the carbonates deserves a second look.

2. The simulated discharge at the stream gage at Moapa is too low, and the simulated discharge at the Glendale gage is too high. Fixing this should be a priority. Changing the location of recharge in the model may help. – We agree that a better match at these two gages is important to achieve. There may be several different approaches to improving the matches, including those suggested by Mifflin & Associates. We were unsuccessful in improving the agreement through changes in material properties. However, we did not try changes in the depth-decay parameter which may affect locations of the simulated discharge or changing the location of the White Narrows HFB. The high flow at Glendale results from discharge along lower Meadow Valley Wash, and this needs to be reduced. One way to increase the discharge at the Moapa gage, besides changing the location of recharge from precipitation, might be to increase the boundary flux into the model across the Pahranagat Shear Zone or from Tikaboo Valley. The widespread

> effects of the MX-5 pumping on water levels and the under-simulation of the model of these effects suggest that transmissivities should be increased in areas away from the Muddy River Springs area, which would be consistent with increasing the inflow along the model boundaries into Coyote Spring Valley.   In addition, simulating agricultural ET would decrease flow at the Glendale gage. The suggestion is appreciated.

Summary

The efforts of the reviewers are greatly appreciated, and there were many helpful suggestions. Several of the comments are of great value. We will evaluate the comments further, and try to implement them as appropriate during future efforts to improve the model, and the documentation.

Some the comments offer the opinion that the current version of the model cannot be used to evaluate the effects of future pumping. We disagree, and restate the caution provided at the conclusion of the modeling report:

> Predictions made using the model will be approximate, but can be used to guide decisions about management of the groundwater resource and to determine whether there will be impacts on sensitive environments and on other users of the water. The uncertainty in the predictions will primarily affect the timing of when impacts become significant, not whether there will be impacts.

We still believe these statements to be true. We had identified the mismatches in the simulated and observed flows in the Muddy River at Moapa and at Glendale, and agree that future work should be performed to improve these matches. Evaluating the simulated streamflow at White Narrows on the Muddy River will be a better indicator of the effects of pumping than at the Moapa gage location. The post-audit analysis of the model, using Order 1169 pumping test water-level data collected through 2012, indicated that the model is under-simulating the impact of the pumping near in Coyote Spring Valley and the Muddy River Springs. The observed effects were also more widespread than simulated. Thus, with respect to the impacts of pumping in Coyote Spring Valley, the data show that the model is conservative.

The under estimation of drawdown caused by pumping in Coyote Spring Valley is likely caused by not including the effects of pumping in the Arrow Canyon wells prior to 2008 in the Order 1169 calibration model, and the use of a specific storage value for the carbonate rocks that was too high. The mismatch between simulated and observed streamflow at the Moapa gage on the Muddy River is primarily one of location, not discharge rate, and will not make the model unusable for predictive purposes. In hindsight, the mismatch is probably easy to resolve. Similarly, the decision not to simulate the effects of diversion of water for irrigation in Lower Moapa Valley affects streamflow calculations between the Glendale and Lewis Avenue gages, but not other parts of the model. Accordingly, the model can be used to predict pumping effects elsewhere, but should not be used to estimate the effects of changes in water use or of pumping on streamflow in Lower Moapa Valley.

Given that the model simulated less drawdown than was observed from the Order 1169 test, a method for incorporating the difference could be applied to the predictions made with the model pertaining to pumping near MX-5 in Coyote Spring Valley. Using the observed and simulated drawdowns from the Order 1169 pumping, a factor could be calculated by which the simulated drawdown would be multiplied to best match the observed drawdown. This factor could then be applied to predicted drawdown to develop an improved prediction of the drawdown. This could be done, for example, to predict if resource-management triggers based on drawdown might be exceeded.

In areas outside of the Muddy River Springs area and Coyote Spring Valley, there are not sufficient pumping-related data to constrain the transient calibration and as a result, there will be greater uncertainty in the predicted effects. This statement is true for the Tetra Tech model, and other models that have been developed of these areas. The resulting uncertainty in our model and these other models should be considered in using modeling results. Additional data on the groundwater system's response to pumping, followed by recalibration of the models, will reduce this uncertainty. Thus, the approach that has been taken by the State Engineers Office of proceeding slowly and using a good monitoring program to collect sufficient data is a very appropriate and wise approach.

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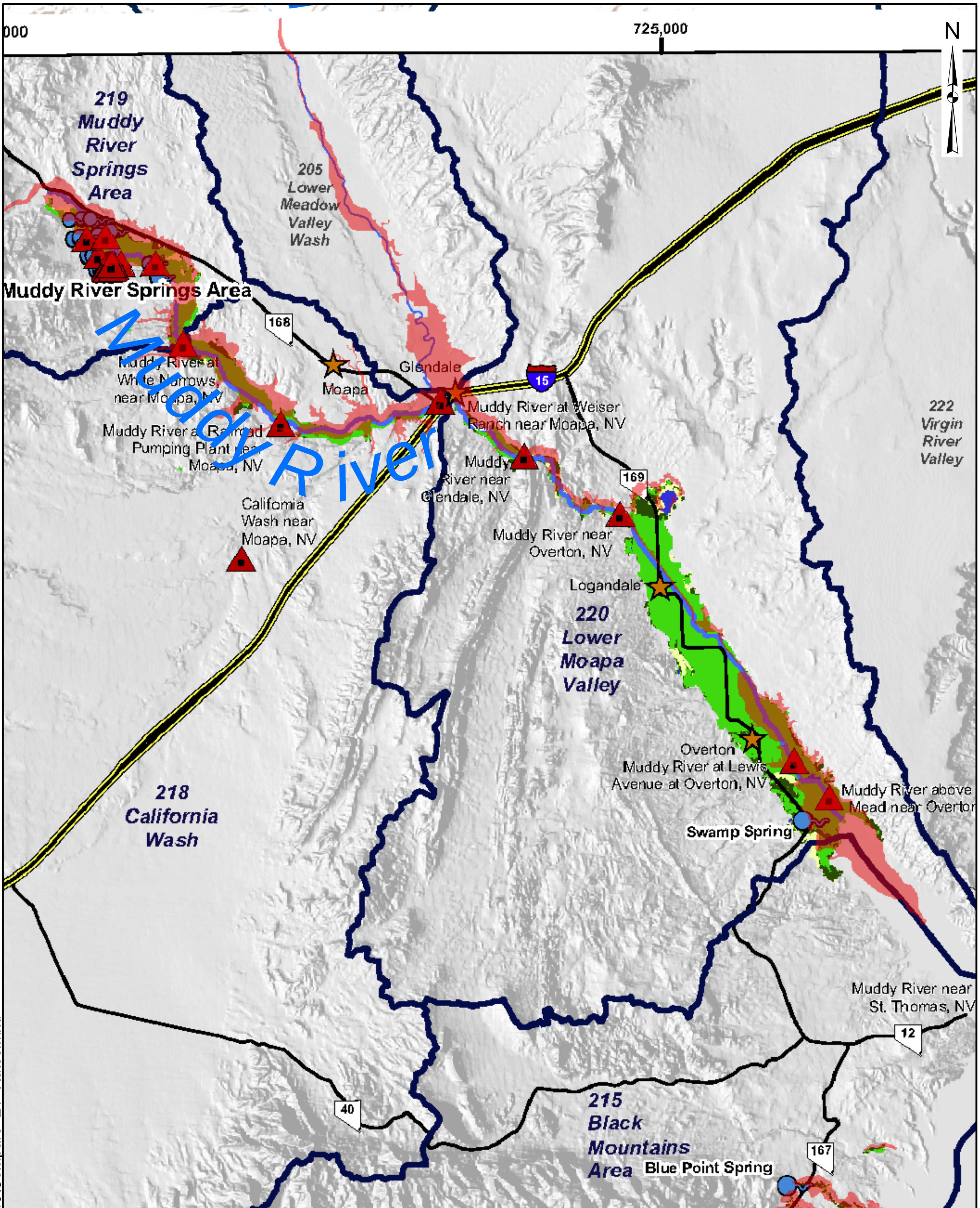
Winograd, I.J. and Thordarson, Wm., 1975, Hydrogeologic and hydrochemical framework, South-Central Great Basin, Nevada-California, with special reference to the Nevada Test Site: U.S. Geological Survey Professional Paper 712-C.

FIGURES



Legend

DeMeo and others

SNWA

Hydrographic Region

TITLE: Comparison of ET Areas Designated by SNWA and DeMeo and others

LOCATION: **Colorado Regional Groundwater Flow System Southeastern Nevada**

TETRA TECH

FIGURE 1

T:\MuddyRiver\GIS\mxd\2013\Compare_ET_Rates.mxd

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Figure _2_. Comparison of drawdown simulated in the long-term and Order 1169 simulations in selected wells, 2010-2012

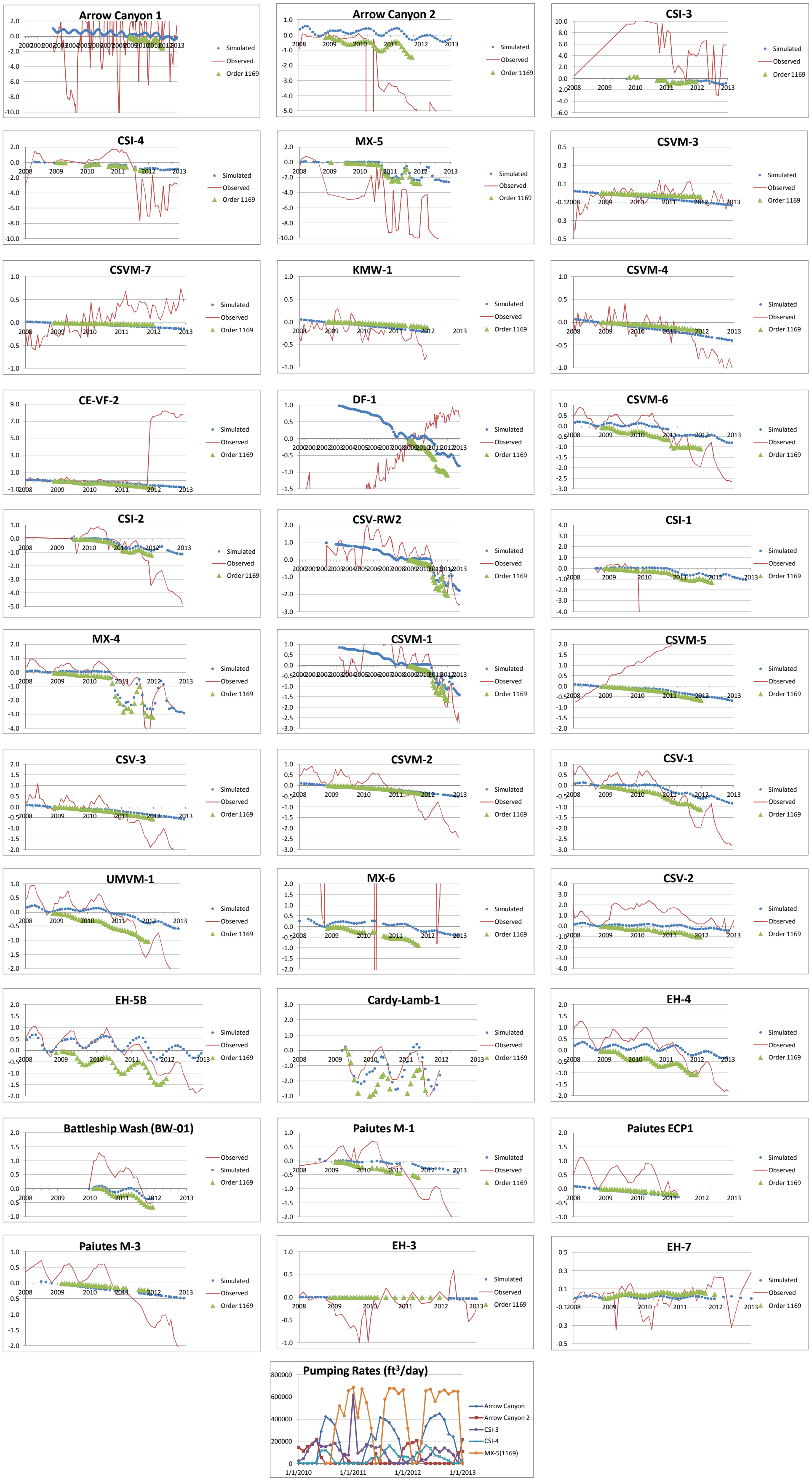

Figure 3. Decrease in measured hydraulic conductivity with increasing depth.

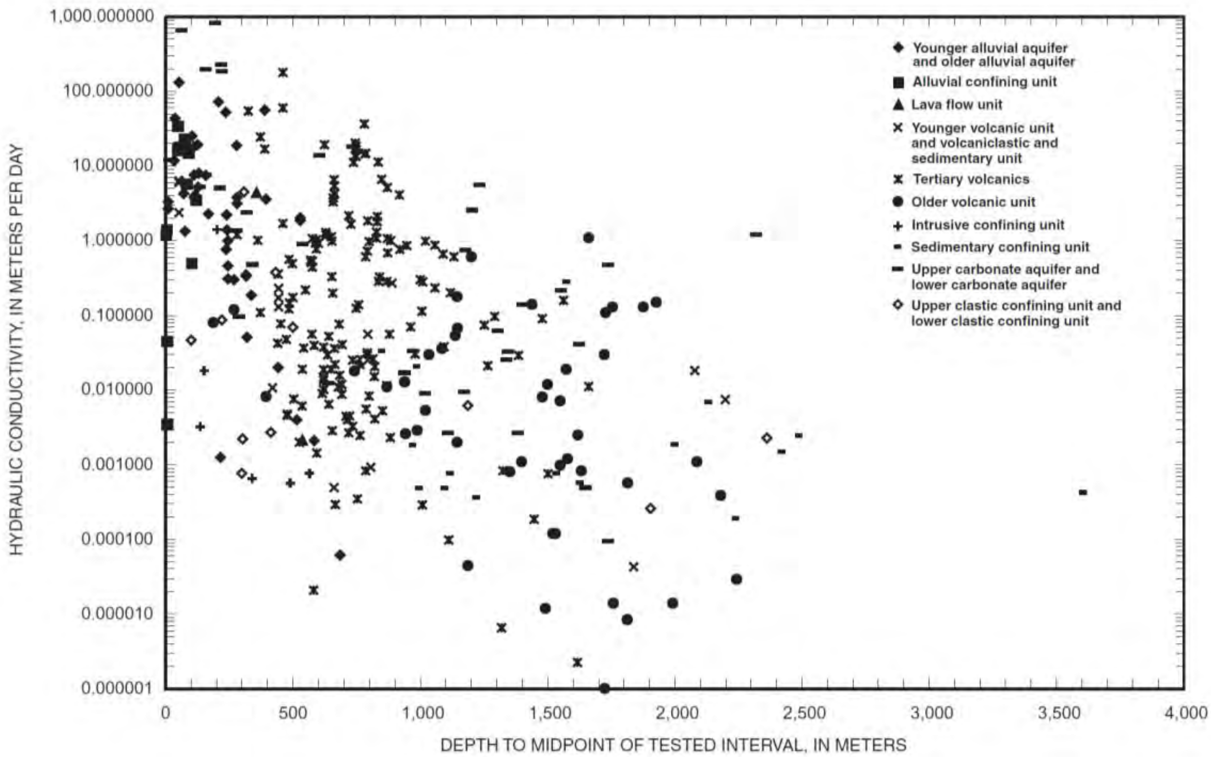

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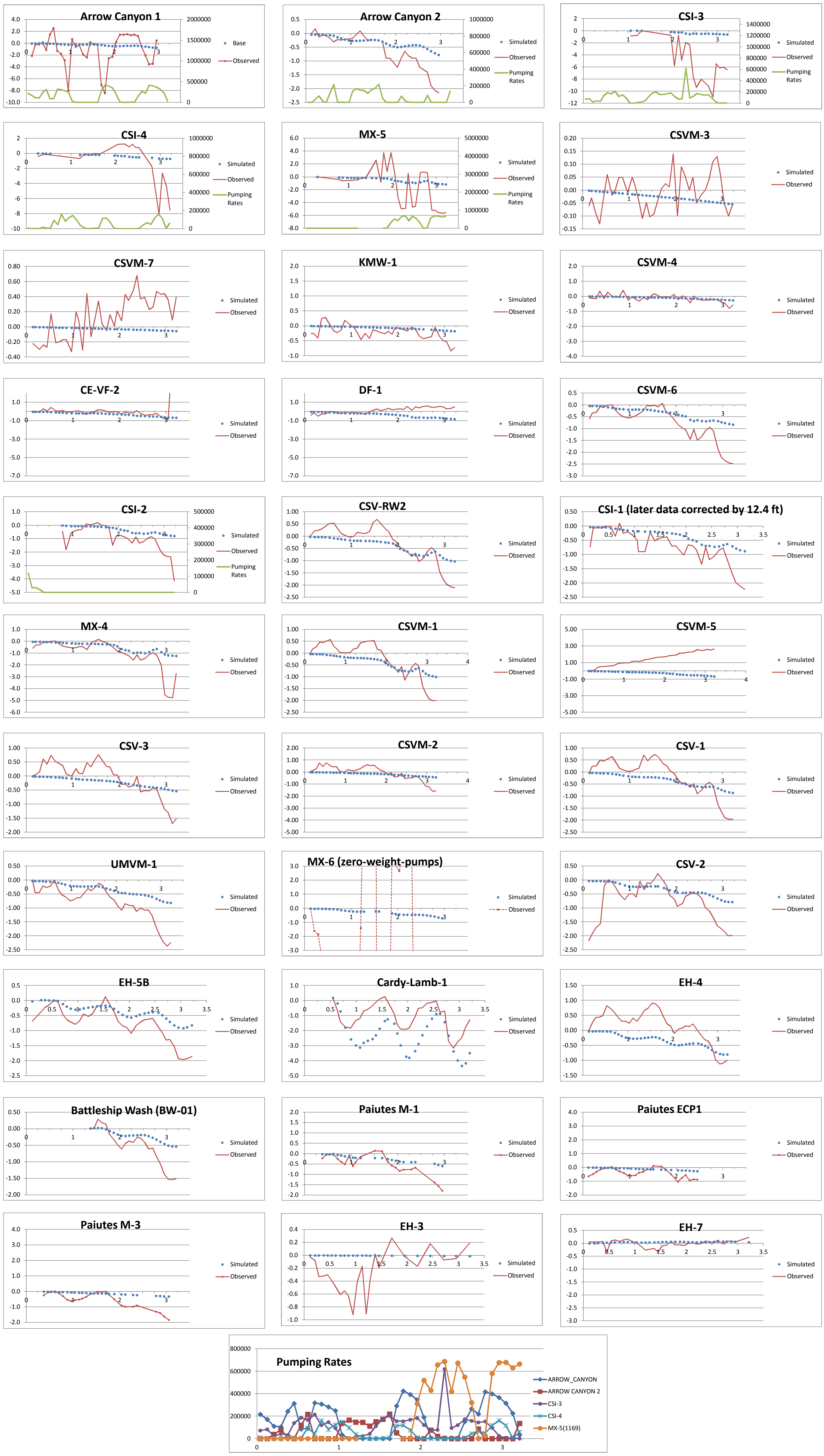
Figure 4. Simulated drawdown with calibrated model parameters, but with Sy of PC4 changed to 0.003



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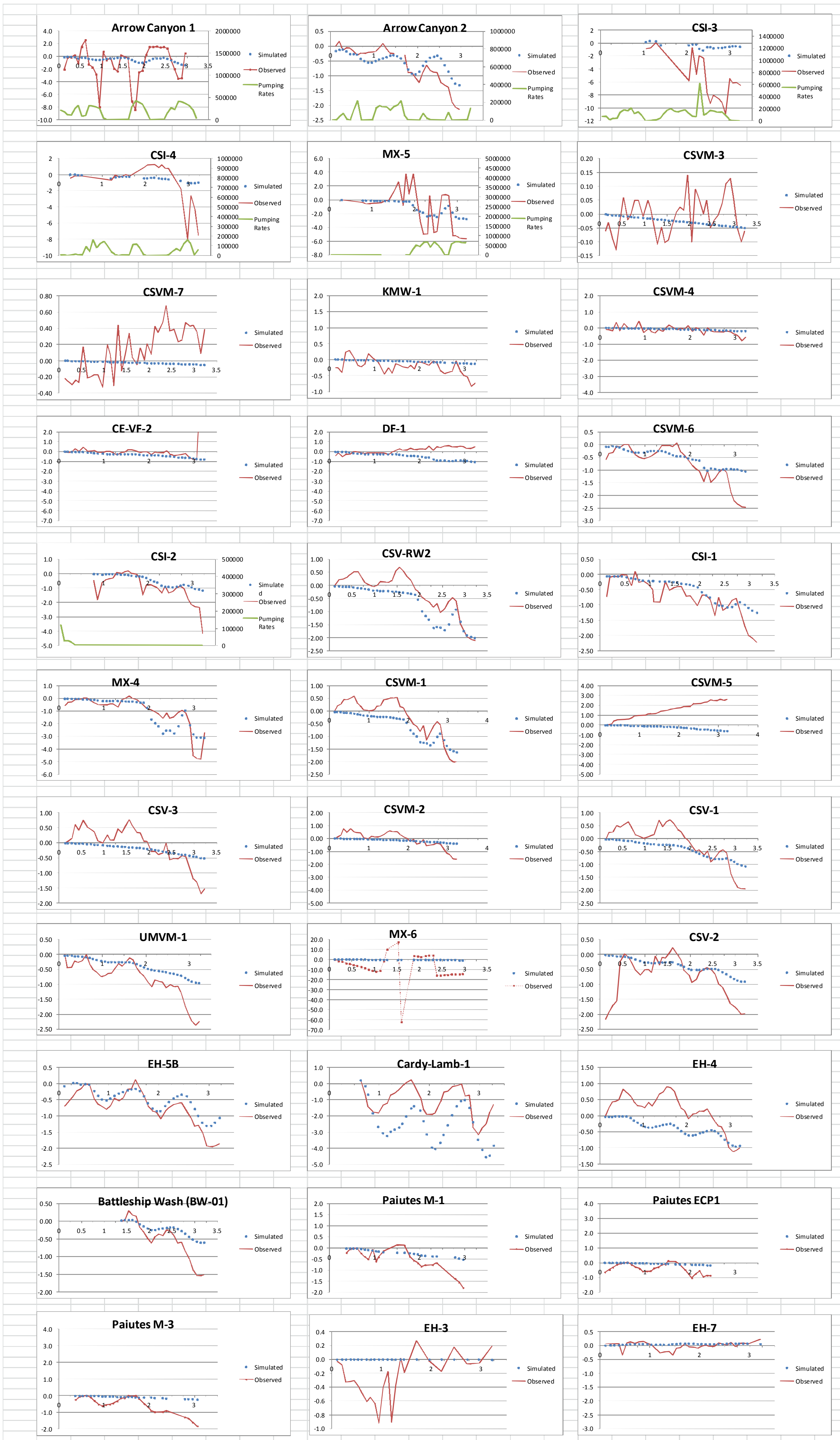
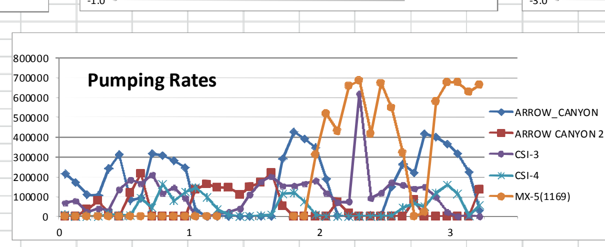


Note: Arrow Canyon 2 water level measurements corrected by 2.51 feet from 7/1/10 to end.
CSI-1 water level measurements corrected by 12.4 feet from 12/1/09 to end.



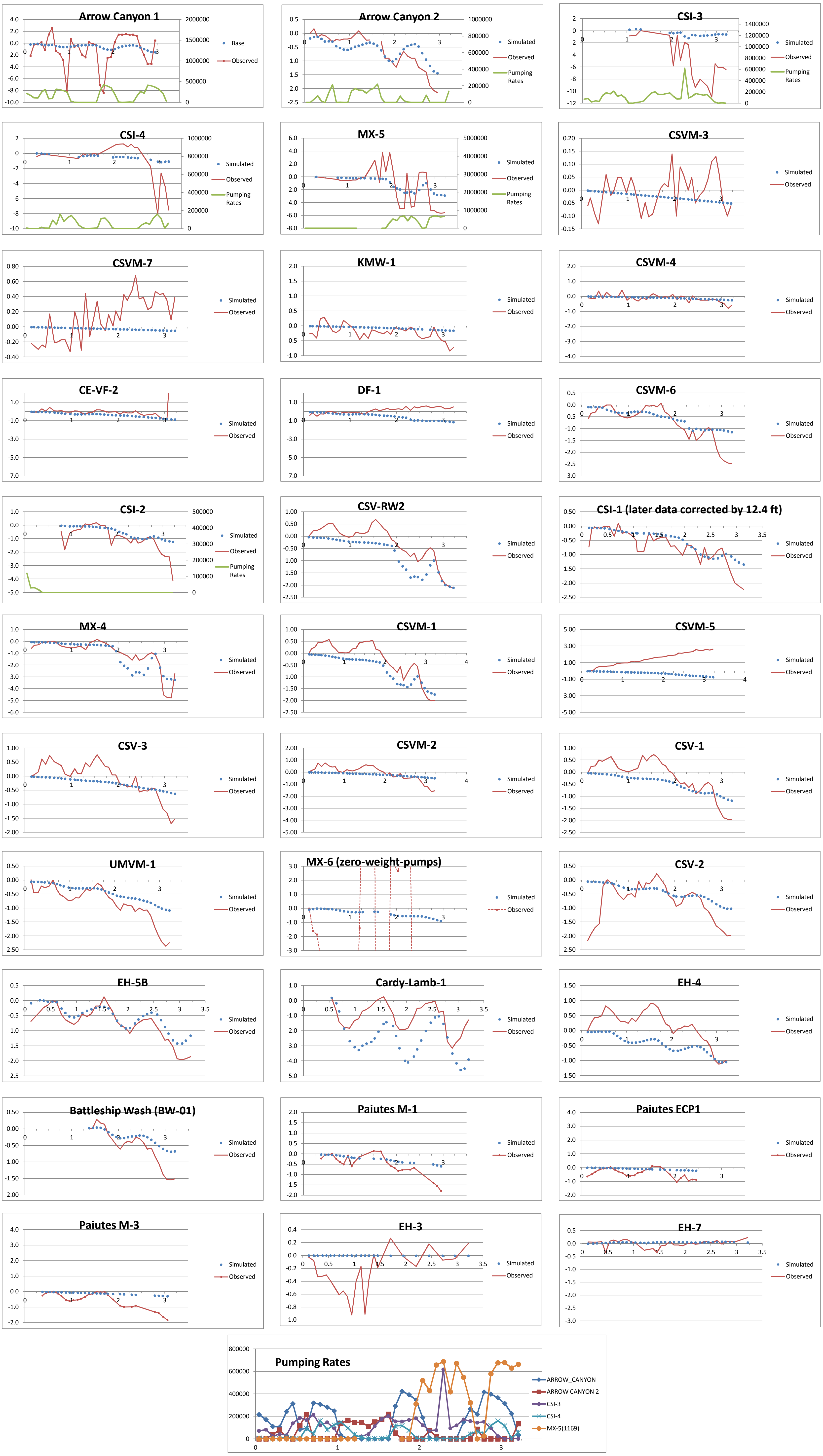
Comparison of Observed and Simulated Drawdown
Order 1169 Simulation

Lower Colorado River Flow System

TETRA TECH GEO

Figure 6.2-5

Figure 5. Simulated drawdown with carbonate Sy changed to 0.003 and Ss changed to 1E-8/ft



ATTACHMENT A

SOUTHERN NEVADA WATER AUTHORITY
100 City Parkway, Suite 700 • Las Vegas, NV 89106
MAILING ADDRESS: P.O. Box 99956 • Las Vegas, NV 89193-9956
(702) 862-3400 • snwa.com

June 13, 2013

Mr. Bill Van Liew
National Park Service
Water Resources Division
1201 Oak Ridge Drive, Suite 250
Fort Collins, Colorado 80525-5596

Dear Mr. Van Liew:

SUBJECT: TRANSMITTAL OF SNWA COMMENTS ON THE NUMERICAL GROUNDWATER FLOW MODEL OF SELECTED BASINS WITHIN THE COLORADO REGIONAL GROUNDWATER FLOW SYSTEM, SOUTHEASTERN NEVADA, VERSION 1.0

Per our conversation at the 2013 Nevada Water Resources Annual Conference, please find enclosed a report containing technical review comments prepared by the Southern Nevada Water Authority (SNWA) regarding the *Numerical Groundwater Flow Model of Selected Basins within the Colorado Regional Groundwater Flow System, Southeastern Nevada, Version 1.0* prepared by Tetra Tech, Inc. for the National Park Service, U.S. Fish and Wildlife Service, and Bureau of Land Management (September 28, 2012). A technical review of the following products was performed:

- Report titled *Development of a Numerical Groundwater Flow Model of Selected Basins within the Colorado Regional Groundwater Flow System, Southeastern Nevada - Version 1.0*
- Report titled *Predictions of the Effects of Groundwater Pumping in the Colorado Regional Groundwater Flow System Southeastern Nevada*
- Modeling files provided in electronic form in folder named *Modeling Datasets.*

It is apparent from these products that significant efforts were expended to develop the subject model and, given the complexity of the area, the work accomplished by the authors thus far is recognized. However, given the broad purpose of the model ("...to evaluate the cumulative effects of pumping...and to estimate the magnitude and timing of changes that will occur as a result of use of the groundwater"), SNWA has serious doubts that the model can accomplish this goal. After review, it is apparent that the documentation of the conceptual and numerical models is incomplete and the calibration of the numerical model is inadequate. For example, the steady-state model (pre-pumping) simulates flow in the Muddy River at about 20,000 acre-feet per year (afy). This simulated flow is a poor match to the Tetra Tech calibration target of 32,000 afy or the 33,700 afy reported by Eakin (1964)[1]. Without a good calibration to predevelopment conditions, the model is not ready for transient calibration or to be used to predict the "magnitude and timing of changes" due to future groundwater pumping. Deficiencies in the conceptualization and representation in the numerical model of springs and evapotranspiration are the main causes of the inadequate model calibration. These deficiencies, coupled with many others described in the enclosed report, yield a model that, in its current state, is unusable for its intended purpose.

SNWA appreciates the opportunity to provide these comments and recommends appropriate corrections to the model and documentation. If you have any questions regarding the enclosed report, please contact Andrew Burns at (702) 862-3772 or me at (702) 862-3713.

Sincerely,

Zane Marshall, Director
Water and Environmental Resources Department

ZM:AB:clw

Enclosure

c: Rick Felling, NDWR

[1] Eakin, T.E., 1964, Ground-water appraisal of Coyote Spring and Kane Spring Valleys and Muddy River Springs area, Lincoln and Clark Counties, Nevada: Nevada Department of Conservation and Natural Resources, Ground-Water Resources Reconnaissance Series, Report 25, 40 p.

Doc No. WRD-ED-0020

SOUTHERN NEVADA
WATER AUTHORITY

Water and Environmental Resources Department
Water Resources Division

Technical Review of Numerical Groundwater Flow Model of Selected Basins within the Colorado Regional Groundwater Flow System, Southeastern Nevada, Version 1.0 - A Model Prepared by Tetra Tech for the National Park Service, U.S. Fish and Wildlife Service and Bureau of Land Management

June 2013

Suggested citation: Southern Nevada Water Authority, 2013, Technical Review of Numerical Groundwater Flow Model of Selected Basins within the Colorado Regional Groundwater Flow System, Southeastern Nevada, Version 1.0 - A Model Prepared by Tetra Tech for the National Park Service, U.S. Fish and Wildlife Service and Bureau of Land Management: Southern Nevada Water Authority, Las Vegas, NV, Doc. No. WRD-ED-0020, 30 p.

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CONTENTS

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FIGURES

TABLES

ACRONYMS

COV	Coefficient of variation
CCRP	Central Carbonate-Rock Province
DRN	Drain Package (MODFLOW)
DRT	Drain Return Package (MODFLOW)
ET	Evapotranspiration
HGU	Hydrogeologic Unit
HUF	Hydrogeologic Unit Flow Package (MODFLOW)
K	Hydraulic conductivity
LVVWD	Las Vegas Valley Water District
NPS	National Park Service
PC4	Paleozoic carbonate unit 4
PRISM	Parameter-elevation Regressions on Independent Slopes Model
SFR2	Streamflow Routing Package 2 (MODFLOW)
SNWA	Southern Nevada Water Authority
T	Transmissivity
U.S.	United States
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator

ABBREVIATIONS

afy	acre-feet per year
cfs	cubic feet per second
ft/yr	feet per year
ft^2/d	square feet per day

INTRODUCTION

This document contains a technical review of a numerical groundwater flow model of selected basins of the Colorado Regional Groundwater Flow System, located in southeastern Nevada. The model was developed by Tetra Tech for the National Park Service, U.S. Fish and Wildlife Service, and Bureau of Land Management, collectively referred to as the Department of Interior Bureaus. This review covers the following products dated September 28, 2012:

- Report titled “Development of a Numerical Groundwater Flow Model of Selected Basins within the Colorado Regional Groundwater Flow System, Southeastern Nevada - Version 1.0” (referred to herein as the "Model Development Report")

- Report titled “Predictions of the Effects of Groundwater Pumping in the Colorado Regional Groundwater Flow System Southeastern Nevada” (referred to herein as the "Model Prediction Report")

- Modeling files provided in electronic form in folder named “*Modeling Datasets*”

It is apparent from these products that significant efforts were expended to develop the subject model and, given the complexity of the area, the work accomplished by the authors thus far is recognized. As stated on page 63 of the Model Development Report, the purpose of the model is "…to evaluate the cumulative effects of pumping in different areas within the model, and to estimate the magnitude and timing of changes that will occur as a result of use of the groundwater." However, as explained in this document, both the model and the corresponding reports have a number of serious defects that render the model unusable for its intended purpose. This review focusses on the predevelopment model, which represents the system under natural conditions before significant development by man, and is modeled in the first 2 stress periods in the "pre-production" simulation of the Tetra Tech model. Only a limited review of the transient and predictive simulations was performed because the defects that render the predevelopment model unusable, as it does not represent the natural system, also render all subsequent model simulations unreliable and therefore unusable too.

Extensive revisions to the model and associated reports are necessary to resolve the defects identified in this review. These revisions would need to be performed prior to using the model for any predictive simulations and are described in the following text:

1. Preparation of a complete and well-documented conceptual model based on all available and relevant old and new information. This conceptual model would preferably be documented and peer-reviewed prior to the development of the numerical model.

2. Revision of the construction of the numerical model so that important features such as faults, springs, evapotranspiration, and boundary conditions are represented as accurately as possible.

3. Refinement of the model construction through calibration of the revised numerical model to more accurately represent the natural conditions of the system being modeled (approximate predevelopment conditions).

4. Calibration of the numerical model to transient conditions, using all available and relevant hydraulic head, spring discharge, and stream flow data.

5. Preparation of a complete and well-documented numerical model report that would include a detailed analysis of the model fit, including comparisons of simulated targets to actual observations; and a robust comparison between the final calibrated parameters and the observed ranges. This report should also be peer reviewed prior to its use for predictive simulations.

GENERAL COMMENTS - PREDEVELOPMENT MODEL

This section contains descriptions of the major issues identified in the predevelopment model. Remedies are suggested where possible.

Predevelopment Model Calibration

The main issue is that the numerical model is not properly calibrated for predevelopment conditions under natural conditions (stress periods 1 and 2), as exhibited by (1) large residuals for major discharge calibration targets (e.g. Muddy springs discharge); (2) the large magnitude and inappropriate distributions of the head residuals; and (3) hydraulic parameter estimates well outside of the observed ranges, particularly the hydraulic conductivity (K) and transmissivity (T) of the Paleozoic Carbonate unit 4 (PC4). Without a good calibration to predevelopment conditions, the model is not yet ready for the transient calibration or predictive runs.

Discharge Calibration Targets

As reported by the authors of the Tetra Tech model, the measured stream flow in the Muddy River at the Moapa gage is about 32,000 afy under pre-development conditions [Eakin (1964) reports 33,700 afy]. The Tetra Tech model only simulates a flow of about 20,000 afy, or only 63 percent of the assumed value (32,000 afy). This target represents the largest and most reliable of all targets in the White River Flow System portion of the model domain. SNWA (2009a) assumed that the predevelopment stream flow at the Muddy River near Moapa gage to be equal to the average annual flow of 33,700 afy (adjusted for precipitation runoff events), estimated by Eakin (1964). SNWA (2009a) derived an estimate of the variability of this estimate from the historical record up to 1962. The coefficient of variation (COV) of stream flow at that location prior to 1962 was about 0.13 for the raw record (unadjusted) and about 0.02 for the adjusted record, not including suspect measurements. Therefore, stream base flow at this location is known within 4 percent (2 standard deviations). Allowing for model error in addition to the observation error, one should be able to match this target to within 5 or even 10 percent maximum of the observed value.

The authors did not report the simulated flows at other gages located downstream from the Moapa gage on the Muddy River but an examination of the model files reveals that these are also not well matched (Table 1). For example, the simulated streamflow in the Muddy River at Lake Mead is more than 40,000 afy. This is at least 4 times larger than ever reported. SNWA (2009a) estimated a base flow of 7,000 afy based on unadjusted measurements taken in 1914 at the St. Thomas gaging station. The St Thomas gage was located on the Muddy River at its confluence with the Colorado River and was destroyed when Lake Mead was created. Rush (1968) in Reconnaissance Report No. 50, reports an estimate of 10,000 afy based on data collected in 1967.

Table 1
Comparison of Simulated and Observed Streamflow Rates at Gages Located along the Muddy River, under Predevelopment Conditions

Gage	Simulated Value (afy)	Observed		
		Observed Value (afy)	Time Observed	Source
Moapa	20,300	33,700	1914 to 1962	Eakin (1964)
Glendale	48,000	33,600	1951 to 1960	LVVWD (2001)
St Thomas (Lake Mead)	46,600	7,000	1914	SNWA (2009a) based on Wells (1954)

LVVWD: Las Vegas Valley Water District
SNWA: Southern Nevada Water Authority

Head Residuals

In theory and in a well-calibrated model, residuals should vary randomly about a mean value of zero. Table 2 lists the statistics for the head residuals (calculated as simulated minus observed values) at the end of stress period 2. These statistics indicate that the probability distribution of the heads is not normal and has a large mean value of -49 feet. Furthermore, a plot of the same head residuals versus the observed values (Figure 1) confirms that the distribution of the residual is biased. At head elevations lower than about 3,000 ft amsl, most points fall above the zero line, whereas most points at head elevations larger than 3,000 ft fall below the zero line. Figure 6.2-2 of the Tetra Tech report also shows that the spatial distribution of the head residuals is biased. Residuals are mostly positive in the southern part of the model area, and negative in the northern part. These are indications that the model solution is not a good fit to the real system and additional work on the conceptual model and calibration are required.

Hydraulic Parameter Estimates

The values of transmissivity derived by Tetra Tech are inconsistent with the existing data (provided in Table 3-1 of Tetra Tech's report) and with preliminary estimates derived by SNWA based on the Order-1169 aquifer test. The spatial distribution of the total transmissivity is shown in Figure 2 for reference.

Table 2
Pre Production Model, Stress Period 2
Head Residual Statistics

Statistic	Value
Mean	-49
Standard Error	43
Median	6
Standard Deviation	266
Sample Variance	70,747
Kurtosis	5
Skewness	-2
Range	1,526
Minimum	-963
Maximum	562
Sum	-1870
Count	38

In the Tetra Tech model, the total transmissivity in the Muddy River Springs area and a portion of Coyote Springs Valley exceeds 1,000,000 ft^2/day, whereas the highest reported for aquifer test values as summarized in the Tetra Tech Table 3-1 are 530,000 ft^2/day for Well RW-1 in Coyote Spring Valley, and 92,940 to 360,000 ft^2/day for wells proximal to the Muddy River Springs. Within the immediate vicinity of the Muddy River Springs, simulated transmissivities exceed 9,000,000 ft^2/d (Figure 2). These values are significantly greater than those reported in the current literature. One possible solution would be to analyze the Order-1169 aquifer test data and constrain the model by those results.

The large hydraulic conductivity values derived by PEST for the PC4 unit in the Muddy River Springs Area are likely caused by the faulty model representation of the springs (seeps) that occur between the main springs and the Moapa gage. In an attempt to match the streamflow in the Muddy River at Moapa, PEST is forced to calculate extremely large Ks for the PC4 unit in that area.

The issue is likely the result of the plumbing depths of these springs (seeps) being too shallow. Also, as a result of this issue, the water is by-passing the Moapa gage, discharging into the Muddy River downgradient from the Moapa gage, as exhibited by the over-simulated amount of streamflow at gages located below Moapa. This issue is further discussed in a later comment.

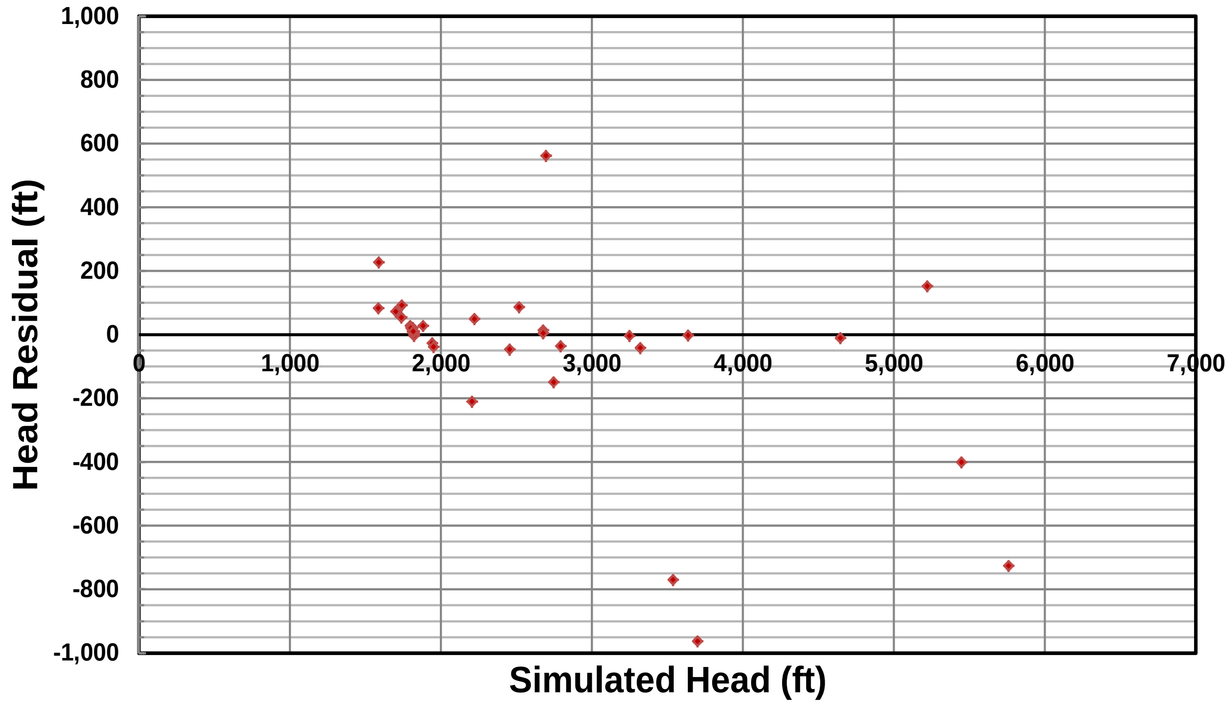

Figure 1
Head Residuals versus Simulated Heads for Predevelopment Conditions, Stress Period 2

Conceptual Model

Missing Faults in the Hydrogeologic Framework

Some major structures have been identified in the basins comprising the Tetra Tech model area, based on photogeologic interpretations and field work (Page et al., 2005; Scheirer et al., 2006; Scheirer and Andreasen, 2008). These structures which include faults located along the Muddy River from Coyote Spring Valley all the way to Lake Mead are not included in the Tetra Tech model. Two SNWA reports (SNWA, 2009a and b) describe how these structures were included into the conceptual and numerical model developed by SNWA. The omission of these faults acting as conduits, leads to simulated subsurface flow to Lake Mead that may be underestimated, for example.

The following is an excerpt from SNWA (2009a, page 4-4) describing these faults; for more details and maps, see SNWA (2009a and b):

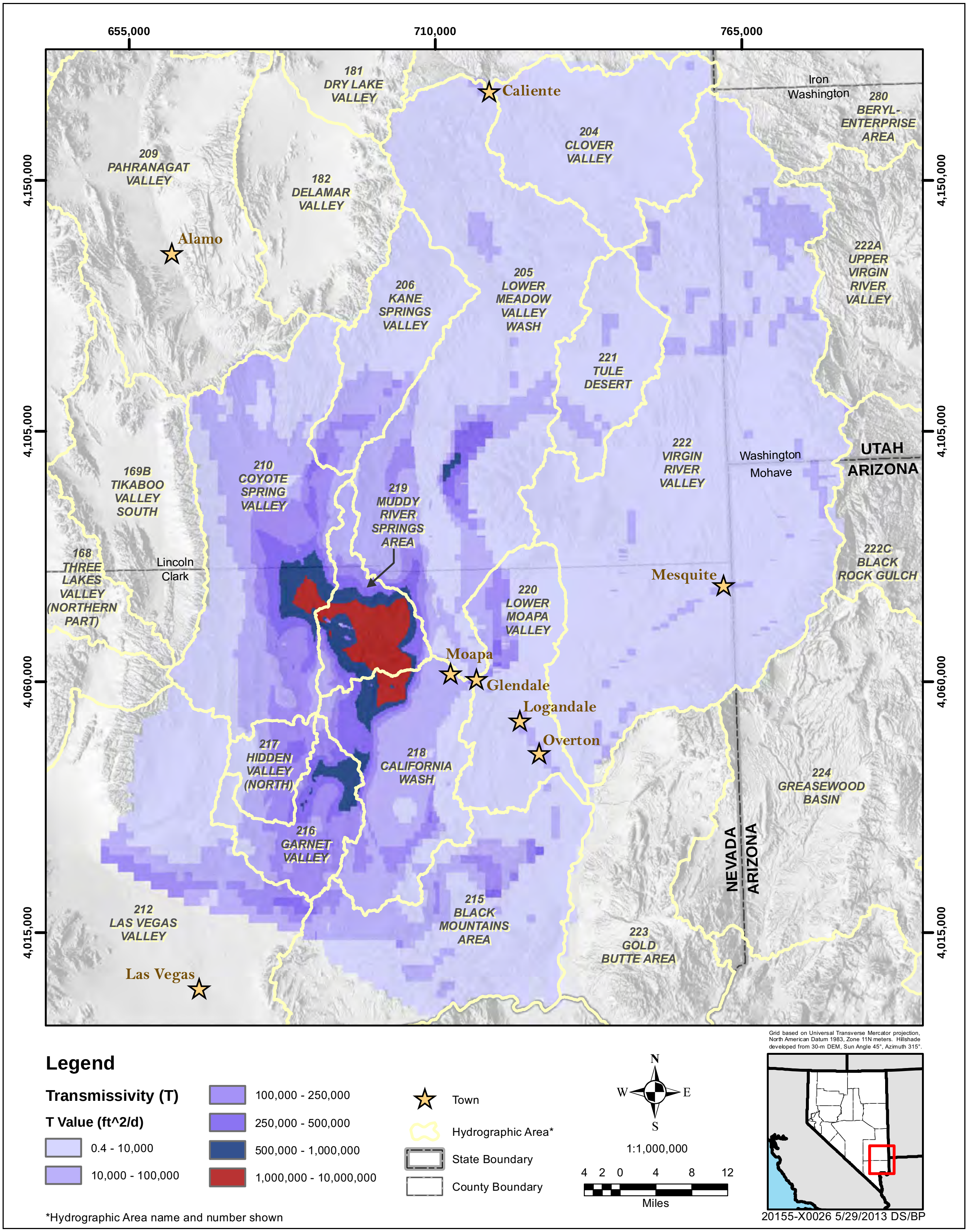

Figure 2
Total Transmissivity Distribution in the Tetra Tech Model

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> "Recent photogeologic interpretations and limited field work (Page et al., 2005; Scheirer et al., 2006; Scheirer and Andreasen, 2008) have provided insight into the hydrogeology of the southern part of the area. Based on this work, selected structural features were reinterpreted as significant to groundwater flow in the southern part of the study area. These features consist of middle Miocene to Holocene basin-range faults of north, east, and northwest trends. These faults are interpreted to be connected and to form a path for groundwater flow from southern Coyote Spring Valley to the Muddy River Springs Area and eventually to Lake Mead. These faults are also interpreted to have hydraulic conductivities large enough to move groundwater through this area as evidenced by the spring and stream flow in the Muddy River Springs Area. These faults constitute a structural zone from Coyote Spring Valley to Lake Mead (Scheirer and Andreasen, 2008). These faults were directly added to the simplified hydrogeologic model that is discussed in Sections 4.3 and 4.4."

See the following documents for further information on the missing faults.

Scheirer, D.S., Page, W.R., and Miller, J.J., 2006, Geophysical studies based on gravity and seismic data of Tule Desert, Meadow Valley Wash, and California Wash basins, southern Nevada. U.S. Geological Survey Open-File Report 2006-1396, 44 p.

Scheirer, D.S., and Andreasen, A.D., 2008, Results of gravity fieldwork conducted in March 2008 in the Moapa Valley region of Clark County, Nevada: U.S. Geological Survey Open-File Report 2008-1300, 40 p.

Southern Nevada Water Authority, 2009a, Conceptual model of groundwater flow for the Central Carbonate-Rock Province-Clark, Lincoln, and White Pine Counties Groundwater Development Project: Southern Nevada Water Authority, Las Vegas, Nevada, 416 p.

Southern Nevada Water Authority, 2009b, Transient numerical model of groundwater flow for the Central Carbonate-Rock Province-Clark, Lincoln, and White Pine Counties Groundwater Development Project: Prepared in cooperation with the Bureau of Land Management. Southern Nevada Water Authority, Las Vegas, Nevada, 394 p.

Missing Analytical Solutions Based on Order-1169 Test

The Order-1169 aquifer test data should have been analyzed (at least for some portions of the test) to derive estimates of aquifer properties for the carbonate aquifer in that area, before using the information in the numerical model. Such analysis would have provided mean values and ranges of aquifer properties, in addition to the ones you list in Table 3-1 on page 11 of the Tetra Tech report. The Order-1169 test provides more reliable initial estimates and ranges of hydraulic properties, particularly for the PC4 unit, for use during model calibration. SNWA conducted preliminary analyses of the Order-1169 data and derived ranges of hydraulic conductivities for the PC4 unit that are much lower than the ones used in this model.

Hydraulic Properties by Hydrogeologic Unit

Aquifer-property data are provided in Table 3-1 of the Tetra Tech model report, but the authors did not analyze these data to clearly identify observed mean values and ranges of hydraulic properties for the hydrogeologic units composing the framework of the aquifer system. The mean values serve as the initial estimates of the parameters and the ranges may serve as constraints during model calibration and/or provide comparative measures for the calibrated values to evaluate their appropriateness and gage the model's representativeness of the real system. This information is also critical to the modeler whether the calibration is done by trial and error or using automatic techniques such as PEST. The PEST information and files are lacking from the report and the modeling files. Providing the PEST files would have at least revealed the ranges used in the model, if the modeler chose to include them in the input PEST file. Although it is clear that constraints on hydraulic conductivity were not used during the PEST optimization process, as some of the pilot point values are well outside of the observed ranges. A summary table of aquifer-property data containing means and ranges derived from all available data should be developed, used by the modeler(s) during model development, and included in the report. The PEST files should be included along with the MODFLOW files in future publications of the model.

Springs

Springs that are located within the model domain should be properly identified, their characteristics including their source depth listed, and classified as to whether they should or should not be included in the numerical model. The spring sources or plumbing depths of regional and sub-regional springs are particularly important because they identify which layers of the numerical model should supply their discharge water. References containing important information to help identify the depth of the spring sources based on water chemistry (Pohlmann et al., 1998) and relationships between spring water temperatures and the geothermal gradient such as Mifflin (1968), must be considered. For example, using water temperature data and Mifflin's (1968) relationship, SNWA (2009a) estimated the plumbing depth of the Muddy springs to be between 2,500 and 3,100 feet below ground surface. Since this information was not considered in the Tetra Tech model, the source of water to the Muddy River springs was placed at a much shallower depth. As a result, the vertical hydraulic gradient in the numerical model was too small and as a consequence simulated discharge does not match the observed total spring discharge as observed at the Moapa gage on the Muddy River. More information may be found in the following reports:

Mifflin, M.D., 1968, Delineation of ground-water flow systems in Nevada: Desert Research Institute, Water Resources Center, Technical Report Series H-W, Publication No. 4, 115 p.

Pohlmann, K.F., Campagna, D.J., Chapman, J.B., and Earman, S., 1998, Investigation of the origin of springs in the Lake Mead National Recreation Area: Desert Research Institute, Water Resources Center, Publication No. 41161, 94 p.

Recharge

Initial recharge estimates are based on the Maxey-Eakin (ME) method and 800-meter normal Parameter-elevation Regressions on Independent Slopes Model (PRISM) of precipitation. The ME efficiencies were adjusted during model calibration. As concluded by the Nevada State Engineer (NSE, 2007, p. 12 and 13), the standard Maxey-Eakin recharge efficiencies should only be applied to the Hardman precipitation maps (Hardman, 1936). Also, the standard Maxey-Eakin recharge efficiencies only apply to the 13 basins and the estimates of groundwater discharge estimates that Maxey and Eakin (1949) used at that time. If new recharge estimates are to be derived based on updated precipitation maps and/or updated groundwater discharge estimates, as is the case for the Tetra Tech model, the appropriate recharge efficiencies should be recalculated using the groundwater-balance method.

Estimates of recharge efficiencies could be derived by balancing recharge to estimates of discharge, prior to input in the model to reduce the number of calibration parameters and present a complete conceptual model prior to numerical model construction and calibration.

Discharge

The omission of existing and available information on groundwater discharge and streamflow under predevelopment conditions may have led to fatal flaws in the conceptual model, which were then represented in the numerical model. Estimates of predevelopment groundwater discharge from springs and especially by evapotranspiration (ET) in some basins are incorrect. For groundwater ET, recent measurements (DeMeo et al., 2008) that are not representative of predevelopment conditions were used in the model. The authors should have considered older reports giving information of what conditions were before significant development started (Glancy and Van Denburgh, 1969; Rush, 1968; LVVWD, 1992), and fully utilized references that are included in their report (Eakin, 1964 and Rush, 1964).

The underestimation of the value of predevelopment ET in Lower Moapa, in particular, causes major problems during model calibration. Predevelopment conditions were much different than when DeMeo et al. (2008) conducted his study. Although the estimates in DeMeo et al. (2008) are reasonable for the time they represent, they are not appropriate for predevelopment conditions everywhere in the model domain. For instance, while SNWA (2009) and reconnaissance estimates for groundwater ET in Lower Moapa Valley are 25,000 and 24,000 afy, respectively, DeMeo et al. (2008) report only 11,500 afy. The difference of 13,000 to 14,000 afy of unaccounted for groundwater loss manifests itself as extra flow in the Muddy River (see Overton target). This also contributes to an outflow from the Muddy River to Lake Mead of more than 40,000 afy, a flow that is at least 4 times larger than historical measurements and estimates indicate. SNWA (2009) estimated 7,000 afy of base flow at the St Thomas gage based on gage records available for Water Years (WY) 1913 through 1916 (Wells, 1954), while Eakin (1968b) estimated flow to Lake Mead to be about 10,000 afy. See excerpt from SNWA (2009a, Section 7.3.1.1.3 , page 7-46) below:

> "The Muddy River near the St. Thomas gaging station was located just upstream from the confluence of the Muddy and Virgin rivers (Figure 7-9). This gaging station was flooded and destroyed when Lake Mead was created. Because of its early record and

location with respect to the Colorado River, the gage records for this station were most representative of predevelopment conditions of flow from the Muddy River to the Colorado River. Gage records are available for Water Years (WY) 1913 through 1916 (Wells, 1954).

The gage records began in June of WY 1913 and ended in September of WY 1916, during which time there was a 7-month period of missing records from June of WY 1915 to December of WY 1916 (Wells, 1954). The mean annual flow for the only complete year (WY 1914) was 19.3 cfs, or about 14,000 afy (Wells, 1954). This measurement includes contributions from both groundwater and storm runoff. The period of record mean annual flow was calculated to be 19.6 cfs based on the mean monthly values; however, this value reflects large flood events during February of WY 1914 (136 cfs). Given the limitations of the available records, it is impossible to determine the magnitude of the groundwater component. Rush (1968b) estimated this flow to be 10,000 afy but qualified the estimate as a rough approximation based on few data gathered in 1967. This flow most likely represented agricultural return flows.

For this analysis, it is estimated that about half of the stream flow measured in WY 1914 was groundwater discharge, or 7,000 afy. Furthermore, this value is assumed to represent the portion of stream flow of groundwater origin reaching the Colorado River (pre-lake) or Lake Mead under predevelopment conditions. No data are available to derive COVs for this gage; however, they can be assumed to be at least as large as the COV estimated for the other two gages. Considering the lack of information, they are probably larger.

Stream flow in the Muddy River between the Glendale gage and the St. Thomas gage (Figure 7-9) decreases from 31,500 afy to 7,000 afy, or a difference of about 24,500 afy. This amount is very close to the annual volume of groundwater ET estimated by Method 1 for Lower Moapa Valley. This amount, when reduced by the amount of ET located above the gage near Glendale (2,200 afy), is equal to about 23,100 afy. Therefore, stream flow between the two gages is most probably infiltrating into the groundwater flow system and sustaining the riparian vegetation located along the banks of the Muddy River in Lower Moapa Valley."

For more information spring and stream discharge before significant development by man, see the following documents:

Glancy, P.A. and A.S. Van Denburgh, 1969, Water-resources appraisal of the Lower Virgin River Valley Area, Nevada, Arizona, and Utah: Nevada Department of Conservation and Natural Resources, Water Resources Reconnaissance Series Report 51, 94 p.

Rush, F.E., 1968, Water-resources appraisal of the Lower Moapa-Lake Mead area, Clark County, Nevada: Nevada Department of Conservation and Natural Resources, Water Resources Reconnaissance Series Report 50, 75 p.

LVVWD and the MARK Group, 1992, Hydrology and Interactive Computer Modeling of Ground and Surface-Water in the Lower Virgin River Valley, Primarily in Clark County, Nevada, Cooperative Water Project - Water for Nevada's Future- Hydrologic Report. Las Vegas Valley Water District, Las Vegas. NV

Eakin, T.E., 1964, Ground-water appraisal of Coyote Spring and Kane Spring Valleys and Muddy River Springs area, Lincoln and Clark Counties, Nevada: Nevada Department of Conservation and Natural Resources, Ground-Water Resources Reconnaissance Series, Report 25, 40 p.

Maxey, G.B., and Eakin, T.E., 1949, Ground water in White River Valley, White Pine, Nye, and Lincoln Counties, Nevada: Nevada State Engineer, Water Resources Bulletin 8, 59 p.

Rush, E.F., 1964, Ground-water appraisal of the Meadow Valley area, Lincoln and Clark Counties, Nevada: Nevada Department of Conservation and Natural Resources, Groundwater resources - Reconnaissance Report 27, 43 p.

Numerical Model

Spring Representation

Major springs in the Muddy River Spring Area forming the head waters of the Muddy River are not properly represented in the numerical model. The Muddy River Springs are represented in the model using the Stream Flow Routing (SFR2) package of MODFLOW in which the discharge from the springs originates only from the uppermost layers of the model. This representation is conceptually at odds with the physical reality of the spring complex. As discussed in a previous comment, the Muddy River Springs derive their flow from deeper portions of the flow system, rather than from the shallow model layers. Springflow discharges in the stream which loses water to the alluvium where a portion of the water is consumed by ET.

This physical process can be represented in MODFLOW in several manners. To preserve the dynamics of deep sourced spring discharge supplying water to the river, a preferred option would be to use the DRT (Drain Return) package in MODFLOW to represent the springs forming the headwaters of the river and keeping the SFR2 package to represent the river. An alternative option would be to keep using the SFR2 package only but adding vertical "stream" reaches at the location of the springs with their first segment located in the layer corresponding to the deepest part of the aquifer system supplying water to the spring. For an example of this setup, see the Central Carbonate-Rock Province (CCRP) numerical model report prepared by SNWA (2009b). This option was utilized in the CCRP model to represent the Muddy River Springs and other springs. These alternative solutions may help you achieve a better match to discharge using more realistic values of hydraulic conductivity.

Evapotranspiration Representation

The ET process is represented using the well package and seasonal changes in ET are simulated in the model. It does not make sense to calibrate the model to seasonal variations of ET when the objective of the model is to serve as a predictive tool for effects of potential pumping in the long term. Also ET, which is a head-dependent process, is simulated using the WELL package, which only allows specified fluxes as inputs. It is extremely inappropriate to use the well package to represent groundwater ET in a transient model, particularly in the predictive simulations far into the future with potentially significant withdrawals of groundwater. As groundwater is pumped, heads in the ET areas may decrease, thereby decreasing the ET rates. This is a major issue for the predictive runs. The ET process should be simulated using the ET package or the Drain Package (DRN) package so that calibrated estimates of the parameters controlling the ET process can be derived and used in the transient simulations. This is an absolute necessity if the model is meant to be a tool to predict what may happen to ET if and when potential future pumping is imposed on the system and the water table is lowered. The observed ET rates and/or volumes should be used as targets during model calibration.

Calibration Targets

The observation weights are not explicitly provided in the report. Whether calibration is performed by trial and error or automatically, the observations used as targets, their measurement errors, and their ranges need to be clearly identified in the description of the conceptual model and all modeling files containing the related information included in the review package.

From the MODFLOW observation process file, it appears that all head values were assigned weights of 1 and the Rogers and Blue Point spring discharge was assigned a weight of 3, but no explanation is provided as to how or why such weights were used. The weights used in the PEST input file are unknown as the PEST files were not part of the model documentation.

Observation weights should be based on data accuracy and dependent on the errors associated with the observations. In addition, if several types of observations are used, relative weighing is required as to not favor one type of measurement over another. Such information is not presented in detail in the report. From the MODFLOW files, it appears that observation weights for all observations other than the gages are equal to 1. However, on p. 34, the report states: "As a result, the simulated streamflow at Lewis Avenue was many-fold larger than measured, and a low weighting factor was applied at the Lewis Gage to minimize the impact on the PEST estimation process." No PEST files were provided to check the weights used in the PEST input file.

Calibration Process

The following are recommendations to help resolve some of issues identified in the model calibration process:

It is not apparent from the reports that a systematic approach for developing numerical groundwater flow models was followed. Model calibrations could benefit from following standards such as the 14 guidelines for effective model calibration documented by Hill (1998) and later updated by Hill and Tiedeman (2007), cited as follows:

Hill, M.C., 1998, Methods and guidelines for effective model calibration: U.S. Geological Survey Water-Resources Investigations Report 98-4005, 90 p.

Hill, M.C., and Tiedeman, C.R., 2007, Effective groundwater model calibration-With analysis of data, sensitivities, predictions, and uncertainty: Hoboken, New Jersey, John Wiley and Sons, Inc.

The initial recharge distribution should be estimated independent of the numerical model and adjusted, if necessary, during model calibration.

Evapotranspiration should be simulated as a head-dependent boundary condition as described earlier, and the observed discharge rates/volumes should be used as calibration targets. The model should be calibrated to mean annual observations rather than seasonal values. The principal of parsimony should be applied here as the seasonal values only add additional complexity that is not required for the stated purpose of the model.

The time discretization should be changed. Typically, if sufficient historical data are available, the historical period may be subdivided into sequential periods for purposes of steady-state and transient calibration and verification/validation. The heads simulated at the end of each time period are used as initial conditions for the next time period. In this case, model calibration is performed using 2 disconnected time periods: prior to 1949 (predevelopment) to 1987 and 2008 to 2011. The verification/validation (called confirmation here) period spans the whole historical period, from 1949 to 2011.

The initial heads used in the Order 1169 model, which covers a time period ranging from 2008 to 2011, are those simulated for the end of the predevelopment model i.e. 1987. According to Figure 3.6-2 in the Model Development Report, significant pumping occurred within the model domain between 1987 and 2008. This means that the heads in 2008 must not be the same as in 1987. It is, therefore, wrong to use the 1987 heads as initial heads in the Order 1169 model. Changing the time discretization to properly cover the entire period of record would resolve this issue and improve your calibration.

Information Presentation

Report

In addition to the defects identified in the model, another major weakness in this effort is in the documentation. In its current state, the model is provided without presenting a separate and comprehensive description of the conceptual model including the details of the available data, the data analyses, and interpretations. The available information should be based on a comprehensive literature review of past studies, including field and modeling studies.

It is extremely important to formulate a conceptual model of the aquifer system being modeled before constructing the numerical model. An adequate description of the conceptual model has many advantages. It allows the modeler to clearly formulate and perhaps deepen his or her understanding of the system based on the available information. It allows others to review the conceptual model before even starting the construction of the numerical model and provide valuable feedback to the modeling team.

Standard methods could be used to develop the conceptual model. Even the most seasoned modeler could benefit from following standard methods because such methods provide a systematic roadmap to complete the task and ensure that all components have been accounted for. In addition, standard methods, when properly applied, give more credence to the work. Examples of standards for groundwater flow modeling include those designed by the American Society for Testing and Materials (ASTM, 1996) and by the Environmental Protection Agency in a manual titled "Guidance on the Development, Evaluation, and Application of Environmental Models" (EPA, 2009). Note that the modeling process used for environmental models is applicable to hydrologic models as the latter are a subset of the former.

The model construction and calibration process should also be documented in detail. Detailed cross sections of the model represented framework should be prepared so that the Hydrogeologic Unit Flow Package (HUF) assignments may be reviewed in relation to the hydrogeologic framework model. All parameters, their initial values, and their ranges should be listed. Estimates of hydraulic properties by hydrogeologic unit (HGU) should be provided. All targets, their mean values, their error measures and their range of values should be listed, including their weights and how they were derived.

The documentation of the Tetra Tech model results is inadequate. As described by Halford (2013), "a groundwater-flow model must be comprehensible in order to assure stakeholders that the model approximates reality and can be used to accurately assess the effects of groundwater development." In order to achieve this goal, clear documentation with simple maps are required to allow comparisons between model simulations and observed conditions. This includes the development of maps and tables of transmissivity and storage-coefficient distributions as it is generally not possible to reject alternative conceptual models with just water-level and drawdown observations (Halford, 2013).

More specifically, a comprehensive evaluation of the model results should also be provided, including model fit and evaluation of parameters. The following lists several of the items required to accomplish this task:

- Figure 6.2-3 should show the observed and simulation values relative to the 1:1 line, rather than the correlation between the two.

- Graphs or tables of simulated and observed stream flow at gages along the Muddy and Virgin rivers should be provided.

- Simulated water budget component estimates should be provided by hydrographic area (use ZONEBUD), as these components are generally published by hydrographic area. This will allow comparison of calibration results to reported values.

- The estimated parameters should be compared to literature ranges using graphs or tables.

- An evaluation of whether the residuals are normally distributed and uncorrelated should be provided.

For a comprehensive description of model result evaluation methods, see Hill and Tiedeman (2007) described in an earlier comment.

Electronic Files and Documentation

The model documentation is also insufficient. It is apparent that changes were made to the source code used for this model. However, the exact changes to the source code are not documented. These modifications should be provided by listing the portions of changed code (original code and new code) in some form, even if the modified source code is not included in the submittal. Not all modeling files are provided, for example the PEST files were not provided. Providing this information would assist the reviewers in performing a more thorough and complete review of the model and allow them to make better recommendations for improvements.

GENERAL COMMENTS - PREDICTIONS REPORT

Given the issues identified in the review of the numerical model and the fact that the model is not calibrated, this review of the predictive simulations and associated report is limited. As stated in the review of the numerical model, some of the identified issues render the numerical model unusable as a predictive tool in its current state. Once the issues identified in the numerical model are addressed, predictive simulations can be performed. Such simulations should, however, take the following comments into account.

- Simulations 3-7 contain pumping of water rights that are still in application status. These scenarios were not conceived with any thought as to what portion of the pumping in each valley may actually be permitted but are rather done by year of the application. Therefore, they are all very unrealistic. More realistic scenarios are necessary.

- The simulations assume pumping 24 hours per day, 7 days per week, 365 days per year for 1,000 years without regards to well-maintenance down time or management strategies involving alternative pumping distributions, or cessation of pumping by any user. While this is typical of models, this limitation needs to be presented to the reader. The simulations do not account for triggers that have been established that would limit drawdowns or changes in discharge at specific locations. This assumption must be explicitly stated in the descriptions of the scenarios and their limitations.

- ET in the simulations is represented as wells pumping at the annual ET rate of the area. As such, there is no reduction in ET throughout the simulation as would be the case if the ET were captured by pumping. As a result, drawdowns would be over-simulated in these areas. A switch to the MODFLOW ET package for a better representation of ET is necessary, as already stated in the review comments on the numerical model.

- In the simulations, there is a substantial amount of time between when the upper springs in the Muddy River System are impacted by pumping and those that are lower. If this were the case, the upper springs would provide significant advanced warning to allow for the management or curtailment of pumping that would avoid the effects to the lower springs and the Muddy River.

- There were no attempts to perform any management scenarios such as the cessation of pumping to determine how quickly the system might recover. Given the triggers that are established, this sort of run on a well-calibrated model, may be very informative.

- The model documentation is very poor. However it does contain some caveats including that the model may be useful if improved with the addition of future pumping and monitoring data. Additional work on the model construction and calibration would also vastly improve the model.

SPECIFIC COMMENTS - MODEL DEVELOPMENT REPORT

Page 1, Section 1.0, 2nd paragraph: In this paragraph, a previous model built by GeoTrans for the study area is described, but no references to documents describing this model are provided. Please refer to and provide appropriate documentation.

Section 1.2, 1st paragraph, last sentence: The stated objective is to improve the previous model in terms of predictive capabilities. Although this new model covers a larger area, apparently has a better representation of the hydrogeologic framework, and uses more sophisticated analysis tools, it does not fulfill this objective, at least not yet given the model's current state of calibration.

Section 1.3: Given that (1) the previous versions of this model were not documented in detail (GeoTrans 2001 and 2003); (2) this new model covers a larger area; and (3) a significant period of time has elapsed since the last model revision in 2003; the approach should include all steps needed to develop this model. This would include:

A clear statement of the modeling objectives.

A three-dimensional conceptual model for the aquifer system of the study area, based on a comprehensive literature review of old and new information and including detailed descriptions of:

- The hydrogeologic framework and how it was simplified into HGUs
- Aquifer-property data and how they were summarized by HGU
- Hydrologic features
- Water budget

The estimates of the water-budget components (recharge, ET, interbasin flow, springflow and streamflow) should be provided for predevelopment conditions and times for which information is available for transient conditions. Summary water budget tables should be included.

A numerical model for the flow systems of the study area, including:

- Construction of the numerical model based on the conceptual model

- Identification of all parameters and calibration targets
- Calibration of the numerical model to predevelopment conditions
- Calibration of the numerical model to transient conditions
- Verification of the numerical model using transient data, if such data are sufficiently available

Page 3, Section 1.3-Item no. 3: New data are great but careful consideration of the time the data were collected versus the time they are represented in the model is necessary. For example, ET rates measured recently may be similar to those prevailing under predevelopment conditions, but the ET areas may be different.

Page 5, Section 2.2, 1st paragraph: The sources of information cited for spring and stream locations and flows are incomplete. Older reports such as the Reconnaissance reports should be added to your list, as they provide the best information of approximate predevelopment conditions.

Page 5, Section 2.2, 2nd paragraph: When selecting small springs from topographic maps and/or Google Earth, was consideration given as to whether these springs discharge from the regional aquifer system that is being simulated? Is it possible that some of these springs are perched? What were the spring selection criteria for inclusion in the model?

Page 5, Section 2.3: It is stated that the spatial and temporal distributions of ET were based on recent studies by DeMeo et al. (2008). The estimates derived by DeMeo et al. (2008) do not represent the mean pre-development ET for all basins in the study area. In particular, the DeMeo et al. (2008) estimate of ET for Lower Moapa Valley (11,500 afy) is less than half of what ET was when Rush (1968) conducted his reconnaissance study (24,000 afy). The difference in the annual volumes is mostly due to a change in the phreatophyte and irrigation acreages. See Table 3 for details. In addition, estimates made by LVVWD (2001) and SNWA (2009a), using different methods, also yielded average annual ET volumes of 26,500 afy and 25,000 afy, respectively, for Lower Moapa, or more than twice the estimate derived by DeMeo et al. (2008). Thus, in addition to the new studies, other references describing and/or estimating historical conditions including predevelopment conditions should have been considered. Please consult all relevant Reconnaissance Reports, LVVWD and SNWA reports, Cole and Katzer (2000); Dixon and Katzer (2002), etc...

Table 3
Comparison of Evapotranspiration Estimates for Lower Moapa Valley

Source	ET Type	Acreage	ET Rate (ft/yr)	ET Volume (afy)
De Meo et al. (2008)	Phreatophytes	3,550	2.2	7,880
Rush (1968)	Phreatophytes	5,600	2.0	11,200
De Meo et al. (2008)	Agriculture	700	5.2	3,640
Rush (1968)	Agriculture	3,400	3.9	13,200

Page 10: After the stratigraphy and the structural features are described, it would be useful to add a Section 3.1.3 titled "hydrogelogic framework" or "hydrogeologic units" and describe how the stratigraphic units were grouped into hydrogeologic units (HGUs). Relevant information from Section 3.1.1 could be moved into this new subsection.

Page 11, Section 3.2 Aquifer Parameters, Table 3-1: First, many more data are available for the study area and should be included in this table or in an appendix. Second, the numerical model requires hydraulic conductivity (K) as the input, not transmissivity. The data in this table are missing information about the tested aquifer interval to derive hydraulic conductivity (K) values. As stated previously, the final model calibrated values should be compared to these ranges at some point to ensure they are reasonable.

Page 12: If the HGUs in the previous section are defined as recommended above, the hydraulic properties could be defined for each of them at the end of Section 3.2 (Aquifer Parameters), after the available data are presented. This aquifer property table by HGU should include means and ranges for hydraulic conductivity and storage coefficients. Later this information can be used to derive initial estimates and constraints for the HGUs K and S parameters.

Page 12, Section 3.3, 1st paragraph., 1st sentence: Considering that Harrill (2007) is an unpublished report, the methods by which Harrill (2007) derived the estimates of inflow and outflow along the boundary of the study area should be summarized; or the report provided in the appendix. Second, it states that the Harrill (2007) estimates were modified. An explanation is needed as to how the estimates were modified, and why. Also, a comparison of the Harrill (2007) estimates to those derived by others should be provided since there is uncertainty in all estimates of interbasin flow.

Page 12, Section 3.3, 1st paragraph., 3rd sentence: It states that "There is a net inflow into the area, most water coming into Coyote Spring Valley from Tikapoo Valley on the west side of the Sheep Range (CSV-2) and from Pahranagat Valley (CSV-3)". This sentence is misleading, it is true that most water comes from Pahranagat Valley but not from Tikapoo Valley. At least list Pahranagat Valley first in the sentence.

Page 13, Table 3-2: The comments provided in this table hint that the authors of this report, rather than Harrill (2007) estimated some of the boundary fluxes. Details on how this was accomplished should be provided in the report or its appendix. Table 3-2 should also include estimates by others for comparison.

Page 13, Section 3.4: The method used to derive estimates of recharge for the model area is incomplete. The recharge efficiencies were not adjusted so that recharge balances discharge. Although the efficiencies (referred to as “Maxey-Eakin coefficients” in report) were adjusted to estimates of discharge later during model calibration, a complete and balanced initial estimate of the recharge distribution should have been derived first, at least for the long-term average recharge you use to represent predevelopment natural conditions (steady-state model). This would help define the water budget for a complete conceptual model, prior to the numerical model construction. Furthermore, recharge and all other water budget components by basin should have been provided to enable comparisons with previous estimates of others. Note that resultant recharge efficiencies should not be called Maxey-Eakin efficiencies as they are substantively different by their method of derivation and magnitude.

Page 14, Section 3.5.1: This section does not include any references to spring discharge data, temperatures, or other information to identify the plumbing depths of the modeled springs.

Page 14, Section 3.5.1, 1st paragraph, 4th sentence: The total predevelopment discharge from the Muddy River springs, as measured at the Moapa gage, was correctly cited (34,000 afy), yet a smaller value (32,000 afy) was used in the numerical model. Why?

Page 15, 3rd paragraph: Perched springs should not be represented in the numerical model. Yet Section 5.2.2 (Springs) states:"Numerous small springs in the Clover and Delamar Mountains were also simulated using a DRAIN cell only in layer 1."

Page 15, Section 3.5.2, 1st paragraph, sentences 1 and 2: The general definition of ET is correct but the statement that "ET, for the purposes of this model, includes evaporation from open water and soils, and transpiration from plants," is not. The numerical model only simulates ET from groundwater and surface-water sourced by groundwater, i.e. phreatophyte transpiration, evaporation from shallow groundwater, and evaporation from open water fed by groundwater. Transpiration of plants sustained by soil moisture from precipitation, evaporation from soils and open water fed by precipitation cannot be simulated by MODFLOW.

Page 15, Section 3.5.2, 1st paragraph, 3rd sentence: Specify that the National Park Service (NPS) funded the USGS to delineate the distribution of and to quantify the amount of annual discharge of ET *from groundwater and surface water*, as the the report prepared by DeMeo et al. (2008) indicates. Although De Meo et al. (2008) had to measure total ET rates in the field, their estimates of ET from each basin did not include ET from precipitation (see previous comment).

Page 15, Section 3.5.2, Table 3-4: Specify when these measurements were made, because the groundwater ET value in Lower Moapa Valley reported by DeMeo et al. (2008) is less than half of previously reported estimates (see general comments). Although the ET rates used by DeMeo et al. (2008) may represent averages over time, the ET areas were delineated using satellite imagery from a single year, 2003. Section 3.5.1, end of 1st paragraph, states that "with development, pumping had decreased the discharge [of the Muddy River springs] to approximately 22,000 afy in 2004. Furthermore, Figure 3.6-2 shows that pumping in the Muddy River Springs Area was maintained at relatively high rates starting in 1987 and pumping rates were similar in 2003 and 2004. The Muddy River flow at Moapa decreased by about 12,000 afy, from 34,000 afy in 1967 (approximate predevelopment conditions) to 22,000 afy in 2004. Thus, the difference in the estimate of ET in Lower Moapa Valley between 24,000 afy (Rush, 1968) and 11,500 afy (DeMeo et al., 2008) is partially due to the reduction in river flow upstream of Lower Moapa Valley. The reduction in river flow is due to pumping and stream water diversions. Other factors contributing to the difference between the estimates of ET include changes in land use along the Muddy River and estimates of ET rates.

Page 20, Section 4.1 and 4.2: The approach seems reasonable and appears to yield a hydrogeologic framework that is consistent with the conceptual rendition as exhibited by the cross-section comparisons. However, as described in the general comments, there are additional faults that may act as conduits for flow in this area (see SNWA 2009a and b).

Page 27, paragraph 2 (Section 5.1.4): The depth-decay equation is missing a parenthesis.

Page 30, 1st paragraph, 3rd complete sentence: These "numerous" springs located on the mountains should not be simulated in this MODFLOW-based model.

Page 30, Section 5.2.3: In the previous model (Geo Trans 2001 and 2003, ET was simulated using the ET package. This version of the model uses the well package. The use of the ET package is superior because it allows ET to be represented as a head-dependent discharge process (which it is), use of ET estimates as targets to adjust the parameters, and how the ET rates may change under the various scenarios to be simulated. This is obviously important given the differences in predevelopment ET estimates and those developed by DeMeo et al. (2008).

Page 32, Section 5.3, 1st paragraph: The description of model calibration is lacking essential elements. The description should include a list of the model parameters, their initial estimates and constraints.

Page 32, Section 5.3, second paragraph: The discussion on model uncertainty is better suited in the discussion of the results. This discussion should be replaced with estimates of the measurement errors on the observed values. Such errors could be used to define weights for the targets and gage whether the calibration is reasonable or not.

Page 32, Section 5.3.1 Calibration Approach: This section would be clearer if each model was discussed separately: steady-state model first, then transient, etc..

Page 33, Section 5.3.2, 1st paragraph: Simply listing how many targets were used is inadequate; the data and the analysis of the data including the statistical analyses should also be presented. Measurement errors should be used to derive variances which can form the basis of weights for the targets. Adjusting the weights of targets based on the magnitudes of their values should be considered.

Page 34, 1st paragraph: The steady-state data set and the source data from which it was derived should be described. How were the original data processed and reduced?

Page 34, last paragraph, 1st sentence: Some information exists, a complete literature review should be performed (see general comments).

Page 35, last paragraph: The use of the pilot points and automatic calibration is not warranted at this point, considering the model may still have some construction issues and is poorly calibrated. As long as a connection between the deep carbonate aquifer and the Muddy River above or at Moapa is not represented in the model, and the river flows downgradient from Moapa under predevelopment conditions do not match, this automatic calibration or any transient calibration will not substantively improve the model.

Page 36, 2nd paragraph, 1st sentence: The potentiometric heads simulated for the end of the pre-production model, i.e. 1987, should not be used as the initial heads for the Order 1169 model, which starts in 2008. Stresses that occurred between 1987 and 2008 must certainly have altered the heads to some degree.

Page 37, Section 6.0: The presentation of the calibrated model does not appropriately describe the fit of the model to the observed data and does not demonstrate that the estimated parameters fall within observed, reasonable, and/or reported ranges.

Page 39, Table 6-2: As discussed under the general comments, the estimates of K in the Muddy River Springs Area are far outside the observed range of values. This is likely a result of an unconstrained PEST attempting to match flow to the Muddy Springs.

Page 40, Table 6-4: The estimates of storage parameters provided in this table fall within the range of observed values. The authors, however, should (1) document the observed values as a part of the description of the conceptual model, (2) present the initial parameter values used in the model, and (3) compare the final estimates to reported ranges.

Page 47, 2nd and 3rd full paragraphs: The mismatches described are not due to uncertainty in pumping and diversion information. They are due to faulty model construction and usage of transient observations to represent predevelopment conditions (ET for Lower Moapa Valley for example). Please see earlier comments.

Page 49, Table 6-5: Streamflow in the Muddy River at Lake Mead is simulated at more than 40,000 afy. This is at least 4 times larger than ever reported. SNWA (2009a) estimated a base flow of 7,000 afy based on unadjusted measurements taken in 1914 at the St. Thomas gaging station. Rush (1968) in Recon Report 50, reports an estimate of 10,000 afy based on data collected in 1967.

Page 64, Section 8.0: Among others, references to the previous GeoTrans model are missing.

GeoTrans, Inc. 2001. Groundwater modeling of the Muddy River Area and surrounding basins with an emphasis on evaluating pending groundwater applications in Coyote Spring Valley. A Report prepared by GeoTrans, Inc. for the U. S. Fish and Wildlife Service, Portland, OR.

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Las Vegas Valley Water District, 2001, Water resources and ground-water modeling in the White River and Meadow Valley flow systems, Clark, Lincoln, Nye, and White Pine counties, Nevada: Las Vegas Valley Water District, Las Vegas, Nevada, 285 p.

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Memorandum

To: Greg Bushner/Vidler Water Company

From: Peter Mock/PMGC, Inc.

Date: November 7, 2012

Subject: A Brief Overview of and Two Simulations using the Model Described in: "Development of a Numerical Groundwater Flow Model of Selected Basins within the Colorado Regional Groundwater Flow System, Southeastern Nevada, Version 1.0, prepared for the National Park Service, U.S. Fish & Wildlife Service and Bureau of Land Management, by TetraTech, Inc. of Louisville, Colorado, dated September 28, 2012.

The report referenced above is one of two that you provided me in October of 2012. The other is a predictive simulations report. The MODFLOW input files for both reports were provided as well. The reports and MODFLOW input files arrived on one CD. I have not conducted a detailed, that is, sentence by sentence, review. I selected what I thought were key highlights and potential concerns with respect to evaluations of Tule Desert (and Clover, while we're at it) groundwater development.

This report describes the current status of what is now a decades-long effort in groundwater flow model construction. The Nevada State Engineer's deliberations early in the 1990s concerning proposed pumping from Coyote Springs Valley drew the attention of three bureaus within the U.S. Department of the Interior: the National Park Service, the U.S. Fish & Wildlife Service, and the Bureau of Land Management. After initial funding by the NPS alone, the three DOI Bureaus joined to share in the cost of this model. We have known this effort for the last decade as that of Geotrans, Inc., working for the National Park Service. They give references for two reports on that modeling with dates of 2001 and 2003, but curiously these two references are not given in the reference section. They make no mention of other model efforts in the region, except a notation late in the text that they are conducting one part of the work in a manner similar to that of SNWA.

Geotrans, Inc. has been a part of TetraTech since 1988 according to their website, but evidently only recently has the TetraTech name taken precedence on this project. The authors of the report are not given. I assume that Rick Waddell and Guy Romer are still the principal "architects" of this model.

Brief Overview

The model is a large one, encompassing the following Hydrographic Areas:

- Clover Valley - #204
- Lower Meadow Valley Wash - #205
- Kane Springs Valley - #206
- Coyote Spring Valley - #210
- Garnet Valley - #216
- Hidden Valley (North) - #217
- California Wash - #218
- Muddy River Springs Area - #219
- Lower Moapa Valley - #220
- Tule Desert - #221
- Virgin Valley - #222
- part of Black Mountains Area #215) north and east of the Las Vegas Valley Shear Zone
- part of Las Vegas Valley (#212) north of the Las Vegas Valley Shear Zone and east of the crest of the Sheep Range.

The report lists the following as the effort accomplished since the last model (Geotrans, Inc., 2003):

1. Added lower Virgin Valley and Clover Valley
2. New 3-D geologic framework model (still based on - and the reason for - Page's (USGS) work in 2005, 2006 and 2011, also funded by NPS)
3. Incorporation of recent USGS ET studies (funded by NPS – DeMeo and others, 2008)
4. Incorporation of geologic, hydrologic and geochemical data from SNWA/LVVWD, Vidler and others
5. Calibration to observed water levels, stream flow and spring discharge and responses to evaporation and pumping rates varying over time

The model and efforts are consistent with what we thought they had been doing to date.

The geology is based on the work of Page (USGS) from 2005-2006, though they now note an update to Page's cross sections published in 2011 (OFR 2006-1040). Here's the summary of changes quoted from Page (2011):

- *Cross section C–C' includes revisions in the east Mormon Mountains in the east part of the section;*
- *D–D' includes revisions in the Mormon Mesa area in the east part of the section;*
- *E–E' includes revisions in the Muddy Mountains in the east part of the section;*
- *F–F' includes revisions from the Muddy Mountains to the south Virgin Mountains in the east part of the section; and*
- *J–J' includes some revisions from the east Mormon Mountains to the Virgin Mountains.*
- *The east end of G–G' was extended about 16 km from the Black Mountains to the southern Virgin Mountains, and*
- *the northern end of I–I' was extended about 45 km from the Muddy Mountains to the Mormon Mountains, and revisions were made in the Muddy Mountains part of the original section.*

I extracted the geologic layer tops and thicknesses from the MODFLOW HUF files, imported and georeferenced them in GIS, and reviewed the units that occur under Tule Desert in a cursory fashion. In general, the units defined beneath Tule Desert are what are shown on the Page cross sections in this area, but that we may want to at some point check the distributions of contact elevations against cross-sections and structural geology interpretations developed to date by Vidler. I would note at this point that the regional carbonate aquifer as input to the HUF package of this model thins along the boundary between Tule Desert and Virgin Valley, but that thinning is modest: from 3,000-3,400 meters down to 2,700-3,000 meters in crossing that boundary from either side. This is a major boundary, as expressed at the surface by the East Mormon Mountains, but the model makes this a short, limited island breaking up only a short distance of the regional carbonate aquifer – only where it is present at the surface. With 9,000 to 10,000 feet of saturated thickness, there is essentially no barrier to flow (or propagating drawdowns) between the Tule Desert and Virgin Valley Hydrographic Areas, even when taking into consideration the strong decline in hydraulic conductivity with depth that they apply in this model. To my way of looking at the structural geology, this representation of this boundary is completely incorrect.

In general, the model is bounded around its edges by large fault alignments. They conclude that flow is low across most of their model boundaries due to a work by Harrill (2007), which I located only in their reference list: "Evaluation of Boundary Fluxes for the Ground-Water Flow Model being prepared as part of the SNPLMA-5 Project, unpublished consultant report, December 2007, 17 pages". That this is J.R. Harrill of the USGS, now retired, is encouraging (though I still may or may not agree with what he has written in this undisclosed report), but an unpublished consulting report is not an acceptable reference unless it is attached.

Recharge was estimated using the famous Maxey-Eakin recharge factors (converted from discrete steps to a continuous cubic equation) and PRISM 800-meter resolution 1971-2007 mean monthly precipitation. They do not explain how they go from monthly values to annual values so that Maxey-Eakin can be applied, though I would hope they just added the monthly values before applying the Maxey-Eakin factors. No recharge is calculated for precipitation values less than 7 inches. No reason is given for extending the lower limit for recharge downward from 8 inches to 7 inches. The exception is that recharge was added at 0.5 in/yr in the Muddy Mountains area above 3,000 feet, despite the precipitation being less than 7 inches there. Recharge was later adjusted overall during calibration to match their assumed discharge rates. In fact, the adjustment was a decrease of 35%.

They used the DRAIN package in all 18 model layers in one horizontal cell location to simulate Rogers and Blue Point Springs. The combined discharge of all 18 nodes is used to track this discharge and to serve as a calibration target. Many other springs were simulated with the DRAIN package. The springs in the Muddy River area were simulated with the stream flow routing (SFR) package.

Evapotranspiration was estimated from DeMeo (2008) and simulated as a constant withdrawal using the WELL package.

Pumping was simulated with the first multi-node well (MNW1) package, which apportions flow over multiple layers based on current water-level and hydraulic conductivity along the well.

The Horizontal Flow Barrier (HFB) package was used to simulate a few selected fault alignments, including the Tule Desert Fault System. A hydraulic characteristic (transmissivity or hydraulic conductivity divided by barrier width –"TDW") of 1×10^{-6} ft/d was used for all but the Tule Desert (1.31×10^{-6} ft/d) and Kane Springs Wash ($4.74. \times 10^{-6}$) Faults

Although a large number and variety of calibration targets were used, they are largely clustered in a fraction of the model area. Tule Desert and Clover Valley are not well represented in the calibration data set. Also, there are no data on the propagation of drawdowns in or out of Tule Desert or Clover Valley.

An important (to the authors) part of the calibration process was simulation of test pumping of Coyote Spring Valley under Order 1169 during the period August 2010 to December 2011. I don't think the simulated drawdowns matched the measured drawdowns well in this exercise of the model. Calibration of the carbonate system hydraulic conductivity using pilot points resulted in isolated unique values in a circle around each pilot point, which is not realistic. This is not a fault of pilot points, but of their application here. One pilot point value was 19,500 ft/d; another was 4,560 ft/d; six more were larger than 1,000 ft/d. The hydraulic conductivity value used in most of the model (which does not contain pilot points) for the carbonate unit ranges from 1,000 to 10,000 ft/day. These are not realistic values for regional simulation of the carbonate unit. I think the regional value should be approximately 3 ft/d as we used in our Tule Desert Model.

They also caused the hydraulic conductivity to decline exponentially with depth using a modification made by these authors to the modification made by the USGS to the HUF package.

The authors' change was to put a limit (floor) on the minimum value that could be reached at depth. The carbonate unit was simulated to decline by an order of magnitude for every 1,333 feet of depth, limited to a minimum of .0003 ft/d. We (i.e., me, Vidler, Wayne Belcher, and Keith Halford) disagree that the hydraulic conductivity of the carbonate unit declines significantly with depth. This feature is reasonable for representing Tertiary sedimentary basin fill, but not for the regional carbonate unit.

The extremely large hydraulic conductivity values obtained from pilot point calibration and the extremely strong decline function with depth lead to flow in and between basins being funneled through the top of the model, which I do not think is representative of this system. I think flow circulates to depths of tens of thousands of feet in the regional carbonate system.

The specific yield of the carbonate system is 0.02, which I agree with. The specific storage is 1×10^{-6} ft^{-1}, which I also agree with.

Overall in this model, prior to large-scale pumping, 50% of discharge is to streams, 40% of discharge is to evapotranspiration, and the remainder is a combination of springs and Lake Mead discharge. They make a point of describing pre-Dam observations (but don't provide a reference) that indicated few and minor discharges of groundwater to what would become the bed of Lake Mead. In this model, they simulate 4,500 ac-ft/yr discharge to Lake Mead. Overall in this model, 38,000 ac-ft/yr comes in through the boundaries and 6,500 ac-ft/yr leaves the boundaries. As I made abundantly clear in discussions of our Tule Desert model, I disagree that flow across this tremendous thickness of carbonates comes essentially to a stop at these boundaries.

This quote from the summary at Page 61 will be of interest to Vidler:

> *"The largest model residuals [mismatch between simulation and measurement] are in high gradient areas, where model errors can result in large differences, in the Clover Mountains where the volcanic stratigraphy is greatly simplified, and in the Tule Desert where some of the structural complexity may not be incorporated in the geologic model and the model grid is relatively coarse."*

Indeed the errors range from 560 feet too low to 149 feet too high in Tule Desert and from 150 feet too low to 730 feet too high in Clover Valley. Also of interest is a quote from Page 62:

> *"Cross sections developed in the Tule Desert by consultants for Vidler Water Company were not used in the construction of the geologic model. There are differences between the interpretations presented in these cross sections and other cross sections developed by Page and others (2011). Given the scale of the modeling and the use of the sections by Page and others in the remainder of the model, some of the information contained in the sections developed by Vidler Water Company was not incorporated. In future work, evaluation and*

incorporation of some of the more detailed information might improve the model in the Tule Desert."

One additional quote related to Vidler's interests, on Page 63:

> *"There are aquifer-testing data available in the Tule Desert, but no long-term pumping has yet occurred, and thus there is no information on long-term productivity or on response to pumping in areas distant from wells. Thus, there is substantial uncertainty on the magnitude and timing of drawdown in the Tule Desert. The most uncertainty is in the Clover and Delaware Mountains. The drawdown that will occur will be very dependent on local conditions and rock properties because of the complex volcanic stratigraphy, which has been generalized."*

Finally, I note that the recently available hydrogeochemistry or geochemistry information described as incorporated in the introduction and summary of this report, was not discussed

<u>Simulations Conducted with NPS-TetraTech-2012:</u>

I ran the predictive model with the Scenario 2 MNW package using he authors' own version of MODFLOW. Then I copied and modified the Scenario 2 MNW Package by removing the pumping wells in Tule Desert and ran it again. Each run took 9 hours of computer time on a very fast workstation. I then compared flow rates at the combined Rogers and Blue Point Springs given at the end of each run's listing file

The calculated flow for both Rogers and Blue Point Springs at the start of the predictive simulations was 195,000 ft^3/d. They set the program to collect and save results for both Rogers and Blue Point Springs after 10, 20, 30, 40 50, 100, 200, 500 and 1,000 years. There was no difference between the simulations' calculated flows through 200 years. At 500 years, the flow at Rogers and Blue Point Springs calculated by the unmodified simulation (Tule Desert pumping at 9,340 ac-ft/d) was 1,000 ft^3/d less (approximately 5 gpm less out of the current 1,000 gpm [0.5 %]). At 1,000 years, the flow at Rogers and Blue Point Springs calculated by the unmodified simulation flow was 8,000 ft^3/d less (approximately 40 gpm less out of current 1,000 gpm [4%]).

Thus, this model is calculating an impact due to 9,340 ac-ft/yr pumping in Tule Desert that doesn't change the flows at Rogers and Blue Point Springs until after 200 years. At 500 and 1,000 years, the percentage reductions in the combined calculated spring flows are 0.5% and 4%, respectively. I would point out that 1,000 years of continuous pumping from Tule Desert would amount to 9,340,000 acre feet of water removed from the regional carbonate groundwater system.

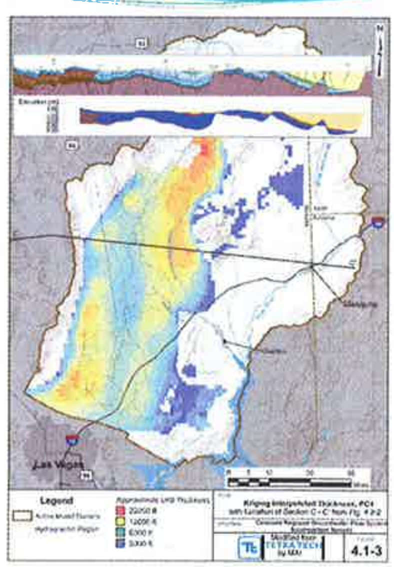
Preliminary review of the Tetra Tech (2012a, b) Groundwater Model

Hydrologic Review Team (HRT) Presentation

Mifflin & Associates, Inc.
November 15, 2012

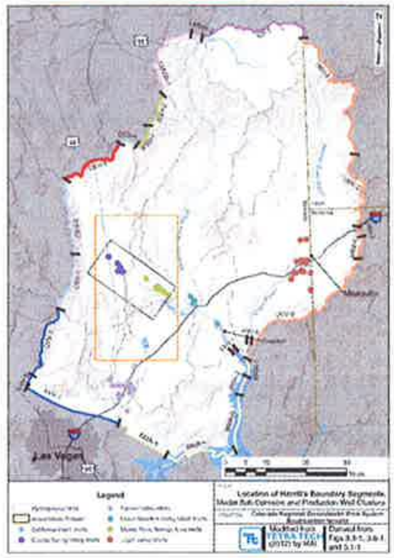
Geologic Model

- In the Tetra Tech model, the PC4 aquifer is thickest west of the Meadow Valley Wash Fault, represented in the Model as a high-angle fault
- Cross-section C-C' crosses the southern Mormon Mountains and northern Coyote Spring Valley
- Low-angle fault surfaces with brittle deformation in the Mormon Mountains have been attributed to gravity slides from high-angle fault blocks (consistent with the Tetra Tech model), or to detachment faulting, perhaps extending beneath the Meadow Valley Mountains (Axen, Wernicke)

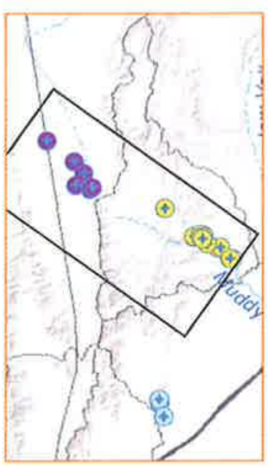


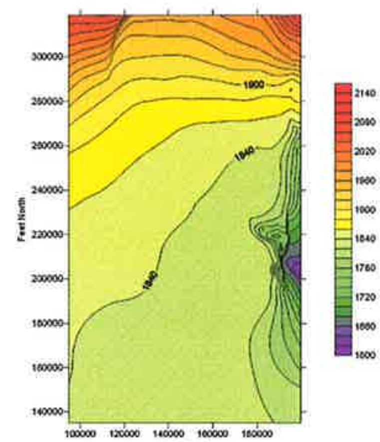
Tetra Tech (2012a,b) Model Domain

- Boundary inflow is greatest along segment CSV-3 as delineated by Harrill (2007)
- Orange inset shows area covered by detailed (250 m x 250 m) grid in the Tetra Tech model
- Black inset shows area covered by Mifflin & Associates' parameter estimation model (2012b); Tetra Tech model required simplification for comparison
- Production well clusters are as shown in the Tetra Tech (2012a) model documentation report
- The figures that follow refer to the area of the detailed Tetra Tech grid, and are accompanied by an enlargement of that area



1987 Heads (feet) from Tetra Tech Model, used as Initial Condition for Order 1169 Simulation

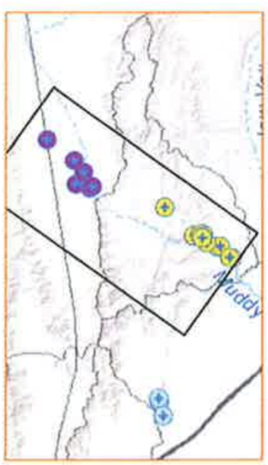


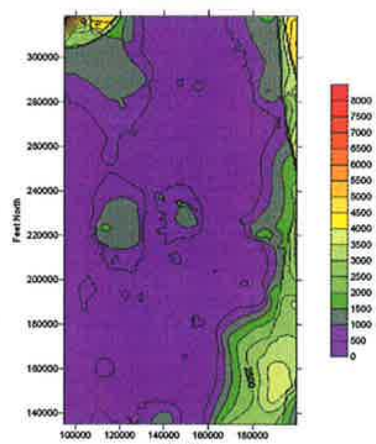


Tetra Tech Grid Design

- The top of the model grid corresponds to the static water-level elevation
- The base of the model grid is uniformly 15,630 feet below the static water-level elevation
- The model grid consists of 18 layers that increase in thickness with depth
- The physical properties of hydrogeologic units (HGUs) were distributed through the 1,181,268 model grid cells according to the top and bottom elevations of the HGUs as described by Anderman and Hill (2000)

Depths (feet) from Land Surface to top of PC4 Aquifer in the Tetra Tech Model

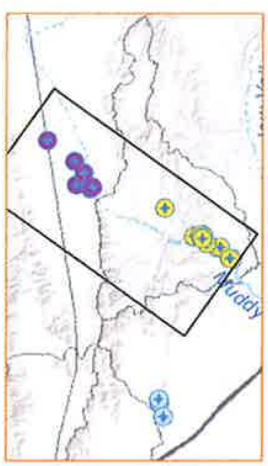


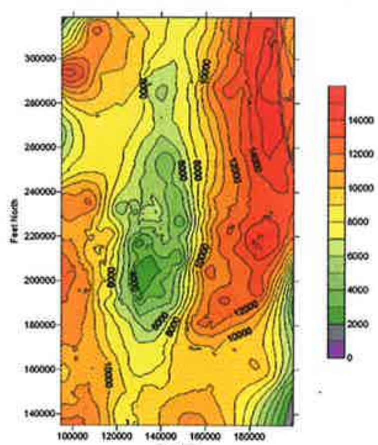


Tetra Tech Hydrogeologic Unit PC4

- Hydrogeologic Unit PC4 is the primary aquifer in the Coyote Spring Valley – Muddy River Springs area, and is the focus of the present evaluation
- The top of PC4 occurs at shallow depths (<500 feet) throughout most of the detailed-grid area
- Multiple-well aquifer tests (which allow storage properties to be estimated) have been conducted at two locations in PC4; wells ECP-1 (on the Moapa Indian Reservation) and MX-5 (in southeastern Coyote Spring Valley) were pumped for these tests

Saturated Thickness of Tetra Tech's PC4 Aquifer (feet)

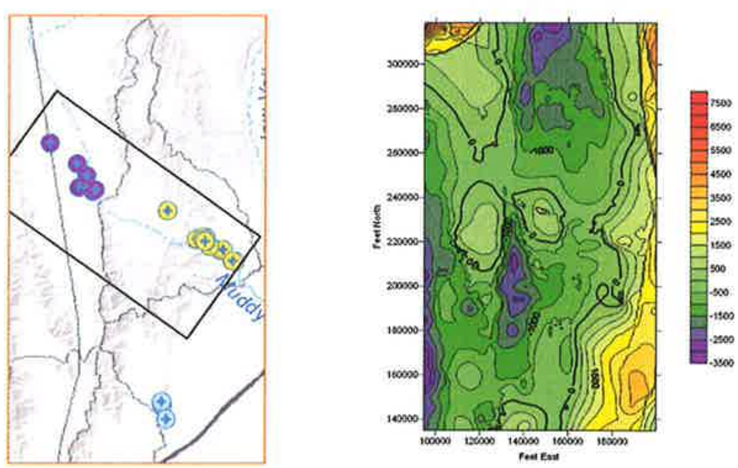




Saturated Thickness of PC4

- The distribution of PC4 varies from zero to the full grid thickness
- Saturated PC4, as represented in the Tetra Tech model, is relatively thin beneath the Arrow Canyon Range and thickest in the vicinity of Meadow Valley Wash

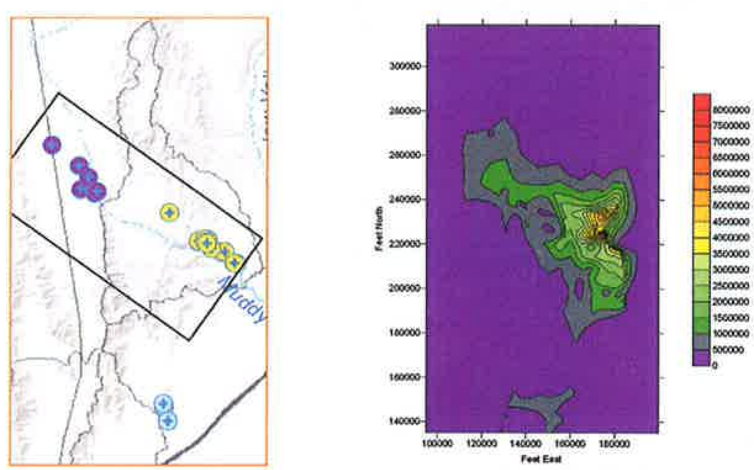
Confined (Positive) and Unconfined (Negative) Regions of Tetra Tech's PC4 Aquifer, Expressed as W.L. Elev. – PC4 Top Elev. (feet)



Storage Properties of Unit PC4

- Carbonate-aquifer Unit PC4 is ***unconfined*** over much of the detailed study area; the two multi-well aquifer tests that have yielded storage estimates were conducted under unconfined conditions
- Tetra Tech used our (MAI's) analysis of aquifer tests on the Moapa Indian Reservation as the basis for estimates of Specific Storage (SS) and Specific Yield (STYP) of PC4
- Tetra Tech assigned storage properties dynamically according to the state of saturation of PC4 in individual grid blocks of layer 1: SS = 1.1E-6 ft^{-1} where saturated, STYP = 0.02 where dewatering
- Johnson and Mifflin (2012b) estimated Specific Yield in the vicinity of MX-5 from responses to the April, 2012 re-start; $STYP_{MAI}$ = 0.003

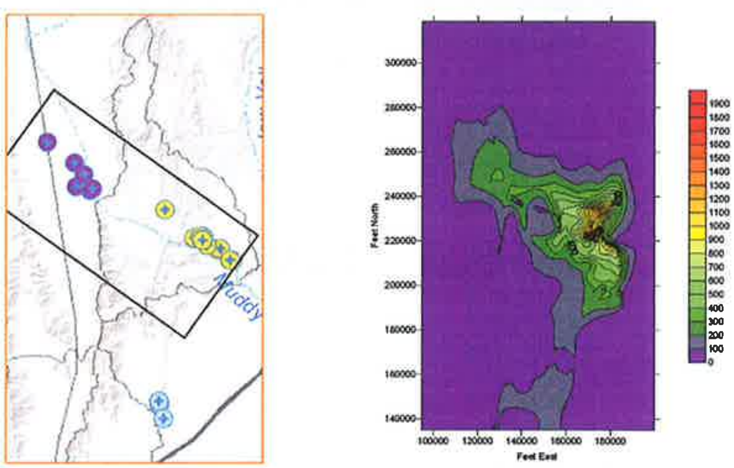
Transmissivity of Tetra Tech's Saturated PC4 Aquifer (ft^2/day)



Transmissivity of Saturated PC4

- Tetra Tech assumed that hydraulic conductivity decreases exponentially with depth from the surface value, due to the weight of the overlying rocks
- MAI derived transmissivity (ft^2/day) of the PC4 carbonate-aquifer unit by summing the (thickness) × (hydraulic conductivity) products of 10 slices across saturated portion the unit to approximate the depth-dependence of hydraulic conductivity, K
- Direct comparison of the Tetra Tech model with MAI's parameter estimation model of 2012 was accomplished by assuming a uniform 4000-foot thickness of an equivalent PC4, consistent with temperature data

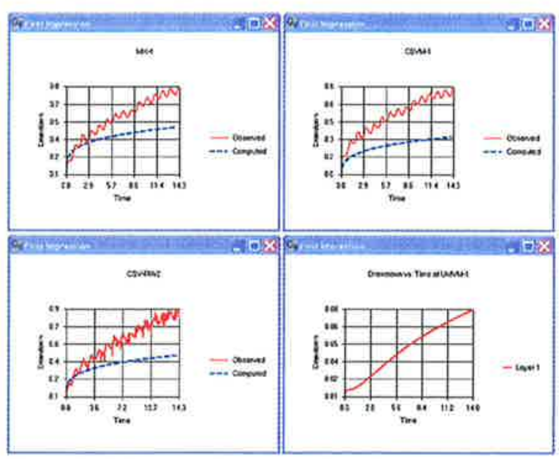
Equivalent Horizontal Hydraulic Conductivity of a 4000-Foot-Thick Representation of Tetra Tech's PC4 Aquifer (ft/day)



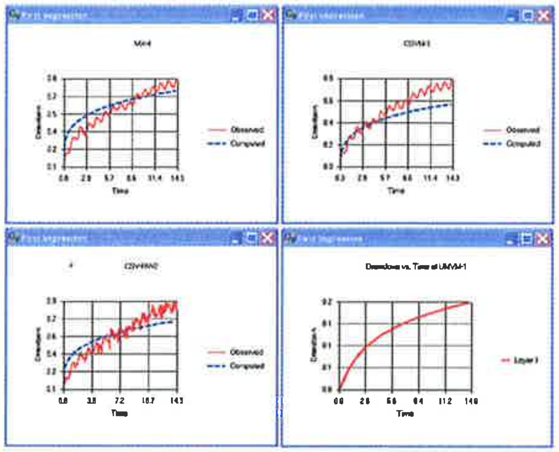
Effective and Equivalent Hydraulic Conductivity

- By calculating the hydraulic conductivities at the mid-point of ten horizontal slices of the PC4 aquifer at each xy grid point, then summing the thickness-weighted hydraulic conductivities of the individual slices, the ***effective*** hydraulic conductivity for the full PC4 was derived by MAI to simplify model evaluation
- Effective K × thickness gives Transmissivity
- Dividing transmissivity by 4000 feet yields ***equivalent*** hydraulic conductivity values for a single layer of uniform 4000-foot thickness

14 Days of Predicted and Observed Drawdowns at Selected Monitoring Wells in Response to April 2012 MX-5 Re-Start, Based on Aquifer Parameters Equivalent to Tetra Tech PC4 Properties



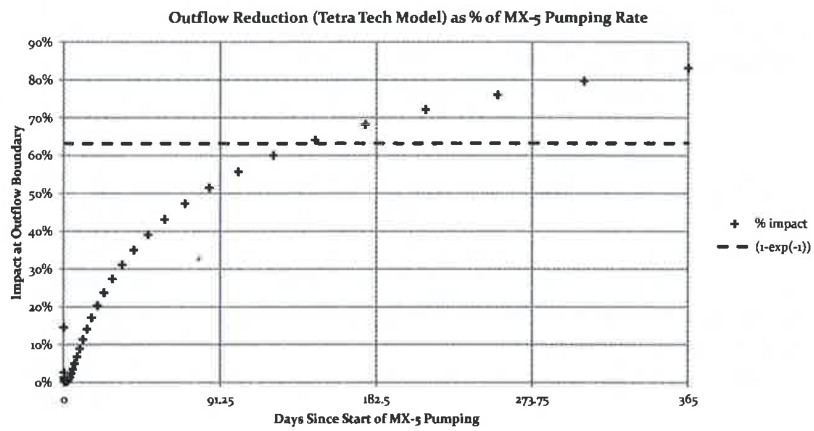
14-Day Results from April-May, 2012 are Improved by Lowering Specific Yield (S_y) in the Equivalent Tetra Tech Model to 0.003



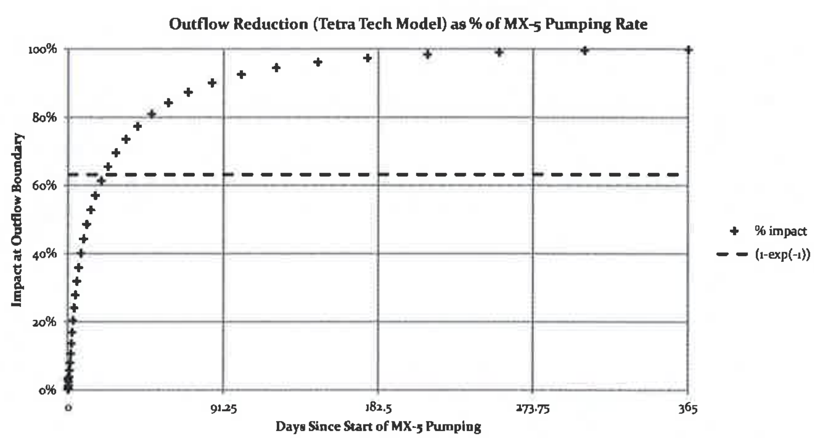
Simulated Pumping Response

- The equivalent Tetra Tech model under-predicts drawdowns at all locations where drawdowns have been resolved (confidently identified) after about one day
- Tetra Tech's specific yield (0.02) is 7x greater than estimated by MAI (2012b)
- The overall match to observations is improved by lowering the specific yield of the PC4 aquifer to 0.003, but...
- Pumping responses suggest that unrecognized horizontal flow barriers (HFBs) are present in the model domain, because at greater times more drawdown is observed than is predicted regardless of choice of specific yield

Impulse Response Function of PC4 Aquifer as Represented by Tetra Tech (2012); Time Constant ≈ 4.5 Months



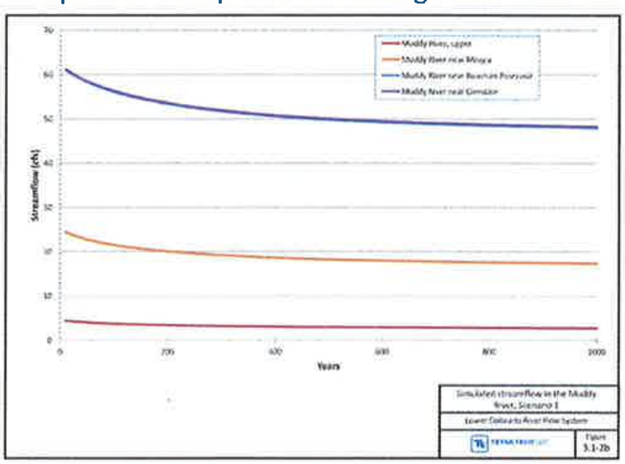
Response Time Decreases to About 21 Days when Specific Yield is Decreased to 0.003



Hydrologic System Inertia

- The Tetra Tech model provides an explanation for the lag of several months between pumping in Coyote Spring Valley and the expression of pumping effects as discharge reductions in the headwaters area
- The time constant of the impulse response function (time to reach 63.2% of the full impact of pumping) is about 4.5 months in the Tetra Tech model
- The longer lag (relative to Johnson and Mifflin, 2012b) is likely due to contributions from storage
- Estimates of ***actual*** timing of impacts on the Muddy River (based on necessary observations supporting reconstituted flows) have not improved in 2012 due to absence of key diversion records

The Tetra Tech model under-predicts Muddy River discharge near Moapa and over-predicts discharge near Glendale



Important Shortcomings of the Tetra Tech Model

- "Note that the simulated flow at the gage near Moapa at the beginning of the predictive simulation (approximately 25 cfs) is approximately two-thirds of the observed flow (37 cfs in early 2010)..." (Tetra Tech, 2012b, p. 14)
- "The average flow measured near Glendale in 2011 was also approximately 37 cfs, but the model simulates additional groundwater and surface water discharge (from Meadow Valley Wash) into the Muddy River upstream of the Glendale gage, producing a simulated flow of approximately 63 cfs at the gage." (Tetra Tech, 2012b, p. 15)

Importance of the Glendale Gage

- "***Below the lowest diversion of the defendants Holmes and Knox, the flow in the stream shall be maintained substantially constant, subject to seasonal variations, only, however, in so far as the defendants can be held to be responsible for the fluctuations of the stream.***" (Muddy River Decree of 1920, p. 21)
- "***No further development of water on the head of the Muddy River stream-system shall be made which in any way diminishes the flow of the waters of the Muddy River or impairs rights defined and referred to in this order.***" State Engineer's Order of Determination published in the Journals of Senate and Assembly of the Thirtieth Session of the Legislature of the State of Nevada, Vol. 2, 1921, p. 4.

Poor Calibration with Respect to Muddy River Streamflow Misses the Objective of Order 1169

- Simulated flows in excess of 60 cfs at the Glendale gage (near historic lowest Knox and Holmes diversion) suggests a source of water that does not exist
- A priority for improving the model should be achieving a better match with Muddy River discharge records at Moapa and Glendale
- Predicted ***changes*** in streamflow over time are the primary objective of Order 1169, and though this problem has not been shown to invalidate Tetra Tech's predictions, a simulated flow excess of 70% at the Holmes and Knox reference point may discredit an otherwise useful model

Recharge Locations?

- "The parameter with the greatest impact on water levels and discharge in the model is the recharge" (Tetra Tech, 2012a, p. 55)
- USGS records indicate that infiltration losses between the SR168 culvert and Moapa Gage are substantial during runoff events
- Routing a portion of recharge to Pahranagat Wash and allowing it to infiltrate there would partially solve the inconsistency between Moapa- and Glendale-gage records and observations, which is a major shortcoming of the Tetra Tech model
- Subsurface diversion of recharge to the west would require revision of the geologic model, perhaps by incorporating a detachment surface beneath the Meadow Valley Mountains

Summary of Observations

- Tetra Tech's approach to model grid design is state-of-the-art
- The Tetra Tech model proved too complex, however, for comprehensive review and and validation; it would not import into the Groundwater Vistas execution environment without simplification
- The model distributes fluxes preferentially to upper portions of the Carbonate Aquifer, in contrast to the Exhibit 54 model, which contained very deep (up to 60,000 ft) active flow zones
- Re-distribution of recharge would potentially solve the most salient shortcoming of the Tetra Tech model

Conclusions

- The Tetra Tech model is an important contribution to ongoing efforts to characterize the regional hydrology of southeastern Nevada
- Aquifer-parameter distributions govern the timing of impacts to the Muddy River system; boundary conditions govern their magnitude
- Capture of Muddy River waters by groundwater pumping in this area has been demonstrated; a developing "perfect storm" with respect to currently-issued groundwater permits and Nevada Water Law should be recognized

References

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ATTACHMENT B

Evaluation of boundary fluxes for the ground-water flow model being prepared as part of the SNPLMA-5 project

by

James R. Harrill

December 31, 2007

This evaluation was made in response to a request by Rick Waddell (Geotrans) that I review the available information and estimate locations and magnitudes of boundary fluxes for the model area. The model area includes all or part of 13 hydrographic areas in southeastern Nevada (figure 1). The model area is tributary to the Colorado drainage and includes the Muddy River drainage, Meadow Valley Wash, the Virgin River downstream from Saint George, and Lake Meade which forms the southern boundary of the area. Hydraulic gradients are toward the Colorado River and consequently the study area can potentially receive subsurface inflow from basins along the west, north, and east boundaries. There is also potential for subsurface outflow to Lake Mead to occur along the southern boundary.

The purpose of this document is to review existing information and develop initial estimates of flows across the model boundary. Information will be organized and discussed by the eight basins that occur along the model boundary.

Las Vegas Valley – The northeastern part of Las Vegas Valley is included in the model area. There is a gradient from parts of the Las Vegas Range towards Hidden Valley, Garnet Valley and Parts of the Black Mountains Area. Consequently recharge from parts of the Las Vegas Range supports ground-water flow into the study area. The western part of the model boundary in Las Vegas Valley is along a ground-water divide and the southern part of the model boundary is roughly parallel to The Las Vegas shear zone. Consequently there is virtually no flow from the main part of Las Vegas Valley into the area of the flow model.

Flow from Las Vegas Valley into Frenchman Mountain and presumably into the Black Mountains Area and Lake Mead was documented by Loletz (1963). A ground-water flow model of Las Vegas Valley (Harrill, 1976) estimated that the total outflow beneath Frenchman Mountain was 1,200 acre-ft/yr. A subsequent model study (Morgan and Dettinger, 1995) estimated subsurface outflow in this area of 2,100 acre-ft/yr. Most of this outflow occurs south of the Las Vegas shear zone so little of this underflow occurs within the model area. This study by Harrill, (1976) indicated the simulated inflow from the area of the Sheep and Las Vegas ranges was less than the amount obtained using the Maxey-Eakin method. Simulated inflow along the north boundary of the Las Vegas model was 1,600 acre-ft/yr down-gradient from the area of the Sheep Range and 680 acre-ft/yr down-gradient from the area of the Las Vegas Range. In addition Corn Creek springs and associated ET area is located near the southwest tip of the study area. The mean spring discharge for water years 1985-1999 is about 200 acre-ft/yr (Jones and others, 1999).There is additional seepage and upward leakage that is consumed by evapotranspiration. Total discharge in the Corn Creek Springs area may be about 500

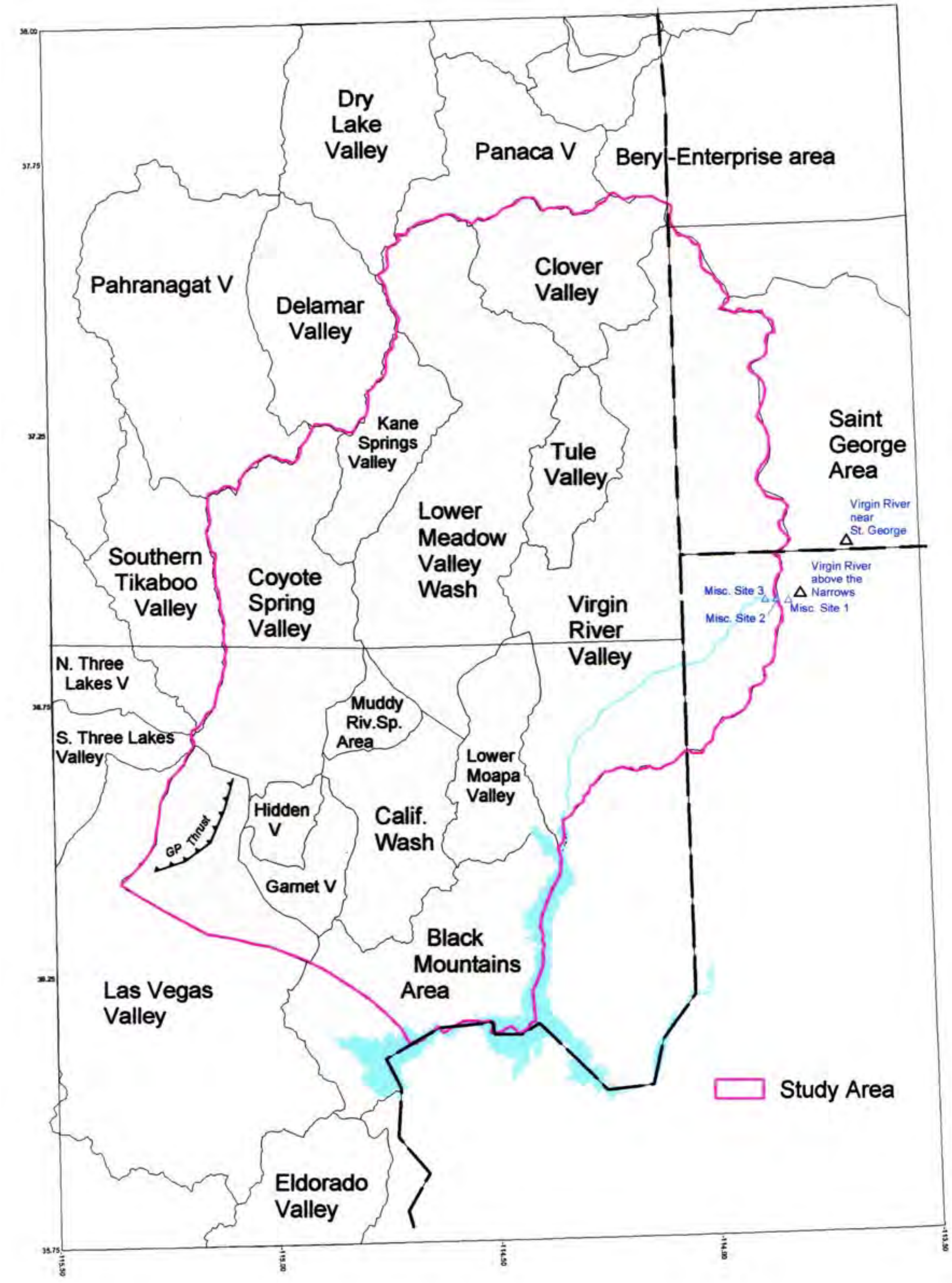

Figure 1. Study area for SNPLMA-5 project

acre-ft/yr. Some or all of this discharge might be supplied by recharge on the east flank of the Sheep range.

The Gass Peak thrust (figure 1) may form an internal barrier in the Las Vegas Valley part of the model that has some control on the flow of ground water. The poorly permeable clastic rocks thrust up be the fault are prominently displayed along Fossil Ridge at the base of the east flank of the Sheep Range. Winograd and Thordarson (1975) used this feature as the effective east boundary of the Ash Meadows ground-water flow system. Adjacent to the southern Sheep Range this feature could be an effective barrier to ground-water flow however as one moves north along the Sheep Range the Keystone Thrust appears to plunge gently to the north and does not form as effective a barrier. Recharge in the Las Vegas Range (east of the Keystone thrust) could readily flow east into the main part of the study area. However, water recharged on the east flank of the southern Sheep Range may not readily flow to the east because of the barrier formed by the Keystone Thrust. Some of the water could back up and then flow around the north end of the effective part of the barrier into Coyote Spring Valley. Part of the water could also flow south to supply discharge at Corn Creek Springs and also support some underflow into the main part of Las Vegas Valley.

Coyote Spring and Kane Springs Valleys – These areas are both adjacent to the Southern part of Pahranagat and Delamar Valleys so they will be discussed together.

A reconnaissance study of Coyote Spring and Kane Springs Valleys and the Muddy River Springs Area (Eakin, 1964, p. 14) recognized that the water supplying the Muddy River Springs is derived largely from ground water that largely moves through Paleozoic carbonate rocks, which in turn are supplied by recharge derived from precipitation in favorable areas generally north and west of the springs. No estimates were made of locations and amounts of subsurface inflow to Coyote Spring Valley.

A reconnaissance study of Pahranagat and Pahroc Valleys (Eakin, 1963b) described the springs in Pahranagat Valley were supplied by flow through carbonate rocks and that the spring discharge was large enough require inflow from upgradient basins to the northwest, north, and northeast. The emphasis of this study was on finding enough water to supply spring discharge in Pahranagat Valley and subsurface outflow was not estimated. However the report states "A minor amount of subsurface outflow may occur through valley fill in the gap at Maynard Lake—the southern end of Pahranagat Valley. A large amount of ground water may discharge through Paleozoic carbonate rocks at the south end of the valley toward areas of lower head, although the proportion derived from the Pahranagat and Pahroc Valley drainage areas cannot be identified at this time" (Eakin, 1963b, p. 19).

Eakin (1966) described a regional interbasin ground-water flow system in the White River Area of southeastern Nevada. In this report 35,000 acre-ft/year of underflow was estimated to occur from Pahranagat Valley to Coyote Spring and Kane Spring Valleys. This water is generally assumed to move directly from Pahranagat Valley to Coyote Spring Valley. However, Delamar, Pahranagat, and Tikaboo Valleys are all upgradient from Coyote Springs Valley. Flow from any of these areas to Coyote Springs Valley is possible if the rocks between the areas are permeable. The Delamar Mountains east and north of Delamar Lake is underlain by a large magnetic source body believed to consist of granitic rocks or crystalline basement (Plume, 1996, plate 5). This same feature is also shown on section A-A' (Page and others, 2006) as a mass of Tertiary intrusive rock. This feature would block interbasin flow into the northern part of Kane Springs Wash. To the west the alluvial deposits of Delamar Valley overlie volcanic rocks which in turn overlie carbonate rocks of Cambrian age. Deposits at the southern end of Delamar Valley are highly faulted (see Page and others 2005) and some water may move south through fractures along the Pahranagat shear zone into the western end of Kane Springs Valley or into Coyote Springs Valley. There is not enough information to make a direct estimate of this interbasin flow however Eakin (1963a) estimated the recharge to all of Delamar Valley to be 1,000 acre-ft/yr. As much as 500 acre-ft/yr might flow south from Delamar Valley with the remaining 500 acre-ft/yr flowing to Pahranagat Valley as originally estimated by Eakin.

Water in Pahranagat Valley may mostly flow directly south into Coyote Springs Valley however there is also a gradient from Pahranagat Valley to Tikaboo Valley. Some of the water from Pahranagat Valley flow southwest along the Pahranagat Shear zone from Pahranagat Valley into Tikaboo Valley.

Very small segments of the boundaries of Three Lakes Valley north and Three Lakes Valley south areas are adjacent to the boundary of Coyote Springs Valley. No significant inflow from this area to Coyote Springs Valley from these two areas occurs.

The southern part of Tikaboo Valley has ground-water levels that are higher than those in adjacent parts of Coyote Springs Valley (elevation of approximately about 3,046 feet at well DDL-1 on the Tikaboo Valley playa compared to about 2,200 feet at the northern end of Coyote Springs Valley), thus ground-water inflow from Tikaboo Valley to Coyote Springs Valley is possible. Also, the depth to water beneath the playa is about 158 feet which precludes discharge by ET and indicates ground-water discharge from Tikapoo Valley is by subsurface flow. Unfortunately there is not enough data to determine the direction of subsurface outflow from water-level gradients. The only other well present is well DDL-2 (water-level elevation about 3076.5 feet) located just south of the playa and completed in carbonate rock. The higher water-level elevation in this well could be due to a different head in the carbonate rock aquifers and not be representative of a gradient between the two wells. At least three wells completed in the playa sediments are needed before the direction of ground-water flow can be determined. Although the exact direction of ground-water flow beneath the Desert Lake playa cannot be determined if a gradient exists between two areas and there is hydraulic continuity between the areas then ground-water flow between the two areas is probable.

Sweetkind and others (2001) developed interpretive cross sections for the Death Valley regional flow system and surrounding areas. Two of their sections cross the northern Sheep Range and show that continuity through carbonate rocks. Cross-sections by Page and others (2006) also show continuity through carbonate rocks across the north end of the Sheep Range. Harrill and Bedinger (2004) used Darcy's law calculations to estimate boundary fluxes for a ground-water flow model of the Death Valley regional ground-water flow system. Their calculations (Harrill and Bedinger, 2004, table A2-4) showed a flux of about 7,300 ac-ft/yr from Tikaboo Valley to Coyote Springs Valley across boundary segments located in the northern Sheep Range. The same table showed that north of the Sheep Range there was both inflow and outflow between the White River flow system and the Death Valley flow system. There was a net flux of about 2,155 acre-ft/yr from Pahranagat, Garden, and Coal Valleys into the Death Valley ground-water flow system. This water then flows down gradient and becomes a source for part of the 7,300 acre-ft/yr estimated to flow from Tikaboo Valley to Coyote Spring Valley. The remainder of the outflow is probably supplied by recharge within Tikaboo Valley. Rush (1971, table 3) estimated recharge to southern Tikaboo Valley to be 3,400 acre-ft/yr. As much as all of this water could contribute to the subsurface inflow to Coyote Spring Valley, depending on the exact location of the hydrologic boundary between the Death Valley flow system and the White River (or Colorado) flow system.

Prudic and others (1995) developed a conceptual ground-water flow model of the carbonate rock province of the Great Basin. In this model Tikaboo Valley is included in the White River subregion and simulated flow is from Tikaboo Valley to Coyote Springs Valley. The amount of flow from Tikaboo Valley is not specifically stated but simulated underflow from Pahranagat Valley and adjacent Tikaboo Valley is about 24,000 acre-ft/yr (Prudic and others, 1995, p.D72). This is about 11,000 acre-ft/yr less than the 35,000 acre-ft/yr estimated by Eakin (1966, p. 265).

Faunt and others (2004) reported results from a transient numerical model of ground-water flow in the Death Valley regional ground-water flow system. Simulated outflow from southern Tikaboo Valley to Coyote Springs Valley was 2,635 acre-ft/yr. (Faunt and others 2004, table 26). This was about half of the 5,570 acre-ft/yr estimated during the initial configuration of the model.

Lower Meadow Valley Wash – Lower Meadow Valley Wash is included in a reconnaissance study of the Meadow Valley area (Rush, 1964). Specific estimates of flow from Panaca Valley to Lower Meadow Valley Wash were not made. The report states that ground-water is transmitted primarily in the alluvium. Volcanic rocks that predominate in Northern Lower Meadow Valley Wash were not considered to transmit large amounts of inter basin flow. In general the ground water movement follows the direction of surface flow from the mountain areas to the centers of the valleys. This pattern is modified, however, by the general flow of ground water from the northern part of the Meadow Valley Area, where most of the recharge occurs, to the southern part of the area where much of the discharge occurs. Nevada State Water Planning Report 3 (Scott and others, 1971) lists ground-water inflow from Panaca Valley as "minor." Surface water inflow from Panaca Valley is listed as "some."

The preceding estimates are for the shallow part of the system. Cross sections prepared by the USGS (Page and others, 2006, section A-A') indicate that the volcanic rocks at the north end of Lower Meadow Valley wash are underlain by Mesozoic and Paleozoic rocks that include sequences of carbonate rocks. These rocks are usually capable of transmitting water, however the degree of subsurface continuity, local composition, and hydraulic gradient at depth are not well understood. Moreover, there no large down-gradient areas of ground water discharge. Consequently, flow in these rocks is probably moderate or small.

Clover Valley – Clover Valley is included in the Meadow Valley area studied at reconnaissance level by Rush (1964). There were no estimates of subsurface inflow to Clover Valley in this report. The area is underlain by volcanic rocks. Alluvial deposits occur along Clover Creek and some of its tributaries. The report states that ground water moves primarily through the alluvium and tends to follow the surface drainage. A small amount of surface and subsurface flow moves into Lower Meadow Valley Wash at Caliente. There is little or no inflow from Panaca Valley in the shallow part of the system. A shallow ground-water divide probably exists between Clover and Panaca Valleys along their common boundary with the possible exception of the first 1 to 2 miles east of Caliente. Here the topographic divide is lower as is precipitation and potential recharge. A shallow ground-water divide may not be present in this area.

The volcanic rocks of Clover Valley are underlain by Mesozoic and Paleozoic rocks. The Paleozoic rocks contain sequences of carbonate rocks that are capable of transmitting ground water. There is a regional gradient from north to south so some deep subsurface inflow from Panaca Valley is possible. The amount depends on the specific location, degree of continuity, and local composition of the carbonate rocks as well as the hydraulic gradient at depth. There are no large down-gradient springs that could only be supplied by subsurface inflow so large amounts of subsurface inflow probably do not occur. In the vicinity of Mesquite, wells drilled into vertical faults in the Muddy Creek formation contain good quality water thought to be derived from deeper carbonate rocks. Upward leakage along vertical faults in the Muddy Creek formation could be the mechanism that would allow for diffuse discharge of water from the carbonate rocks that underlie the area at depth.

Virgin River Valley – A reconnaissance level study of the Lower Virgin River Valley Area was made by Glancy and Van Denburgh (1969). A study of the hydrology and water quality of the Beaver Dam Wash, at the northern end of the Virgin River Valley area, was made by Holmes and others (1997).

The north and northeast borders of the area are underlain primarily by noncarbonate rocks. The ground-water divide in this area conforms to the topographic divide and there is no significant inflow from the north and northeast.

The southeastern boundary of the area is along the crest of the Virgin Mountains and is underlain by noncarbonate rocks. A ground-water divide coincides with the topographic divide so no significant subsurface inflow occurs along this part of the boundary.

A segment of the eastern boundary of the area that is about 20 miles long (from approximately where US route 91 crosses the Beaver Dam Mountains south to about 6 miles south of the Virgin River) that is underlain by carbonate rocks. These rocks are capable of transmitting large amounts of ground water. Also, this area is at the transition between the Great Basin and the Colorado Plateau. There elevation is offset, the valley floor east of the Beaver Dam Mountains is about 430 feet higher than the valley floor west of the Beaver Dam Mountains where the Virgin River exits from a deep canyon that cuts through the Beaver Dam Mountains. These two features could cause a ground-water divide that may have been present along the boundary of the study area to be shifted to the east or not be present. In either case there would be subsurface inflow across the boundary of the study area.

The combination of a topographic gradient and permeable carbonate rocks also impacts the flow of the Virgin River. In theory one would expect flow losses as water flowed into the upper end of the Virgin River Canyon and gains in flow in the lower portion of the canyon. In addition, the Virgin River Canyon has been cut deeply into the Beaver Dam Mountains and at least in the lower part of the canyon the river forms a drain and collects water recharged in the mountains adjacent to the river. Available information supports this conceptual description. Streamflow above the Virgin River Canyon is measured by USGS gage 09413500 (Virgin River near Saint George, Utah). Average annual flow for the eight year period 1999 through 2006 is 188.67 cfs. USGS gage 09413700 (Virgin River above the Narrows near Littlefield) is in the Virgin River Canyon about 11 miles downstream from the gage near St. George. Average annual flow for the 8 year period 1999 through 2006 is 55.6 cfs. This is a loss in flow of about 33 cfs. There do not appear to be significant diversions between the gages so the loss is due almost entirely to infiltration into carbonate rocks. Gains in the lower part of the canyon are not as well documented however Glancy and Van Denburgh (1969, table 4) list miscellaneous Streamflow measurements in the lower Virgin River Valley. Measurement sites 1 and 2 are in the Narrows at the lower end of the Virgin River Canyon and site 3 is in the valley just downstream from the mouth of the canyon. Measurements were made at all 3 sites on 12/13/1951. The flow increased consistently at all sites (#1-143 cfs, #2-158 cfs, and #3-170 cfs). The total gain is about 27 cfs. Also, Holmes and others (1997, p. 29) cite Trudeau and others (1983) when they state “in the Virgin River Gorge springs discharge a total of about 20 cfs from rocks of Paleozoic age”. It is probable that some gain in streamflow occurs between the gage above the Narrows and miscellaneous measurement site 1. This amount is not known but a gain of about 6 cfs would be needed to restore all of the flow lost to infiltration in the upper part of the canyon. This amount is suggested as a working estimate of the gain in this reach although if significant recharge from the adjacent mountains is draining into the river the actual gain may be larger.

The study area boundary crosses the Virgin River between miscellaneous measurement sites 1 and 2. Streamflow across the study area boundary can be estimated as the flow at the gage above the narrows plus the gain between sites 1 and 2 (15 cfs) plus the estimated gain between the gage above the Narrows and site 1 (6 cfs).

The boundary flux that occurs due to the offset of the ground-water divide mentioned previously is not known. The amount of offset may vary with location. Along the Virgin River Canyon and adjacent to the river there may be no divide at all but just a gradient from the western edge of the Saint George area to the mouth of the canyon. It is not known if this condition persists north and south of the river where carbonate rocks are the dominant rock type. The noncarbonate rocks of the Colorado Plateau do not typically transmit large amounts of ground water. Consequently, the offset of the ground-water divide will probably be limited to the east flank of the Beaver Dam Mountains and adjacent hills. The boundary flux can be estimated as a percentage of the potential recharge generated on the east flank of the Beaver Dam Mountains and adjacent hills. The percentage of recharge that becomes a boundary flux is probably between 30 and 100 percent of the estimated potential recharge. Rough estimates of this amount can also be made using information presented by Glancy and Van Denburgh (1969, p.33). They estimated the total spring flow contribution to flow at the Littlefield gage to be about 70 cfs. If one assumes that all of the recharge to the carbonate-rock area of the Beaver Dam Mountains circulates deep and discharges as springflow below the Littlefield gage. Given this assumption the boundary flux can be estimated as:

Boundary flux = 70 cfs - 33 cfs (gain above site 3) – pot. recharge to W flank of Beaver Dam Mountains and adjacent hills

The boundary flux estimated using this procedure can be compared to the potential recharge calculated for the east flank of the Beaver Dam Mountains and adjacent hills. There is no guarantee that these recommended calculations will yield acceptable results. They are suggested simply as means of developing an initial estimate of boundary flux using existing information.

There is subsurface outflow from the Virgin River Valley to Lake Mead. Glancy and Van Denburgh (1969, p. 51, table 16) state "subsurface outflow to Lake Mead beneath the Virgin River Valley occurs through the valley fill and probably through the underlying consolidated rocks. Although no direct estimates have been made the water budget suggests that the subsurface outflow maybe substantial, possibly as much as 40,000 acre-ft/yr." They go on to say that this estimate may seem unreasonably large but given the gains observed upstream from Littlefield outflow on the order of 40,000 acre-ft/yr may be possible. Simple Darcy's law calculations suggest that the subsurface outflow may be more on the order of several thousand acre-ft/yr. Use of the estimate based on Darcy's law is recommended by the author.

Lower Moapa Valley – The lower Moapa Valley area was studied by Rush (1968). The Lower Moapa Valley discharges both surface and ground water into Lake Mead. Surface outflow to Lake Mead was estimated to be about 10,000 acre-ft/yr (Rush, 1968, table 14). Subsurface outflow to Lake Mead was estimated to be about 1,100 acre-ft/yr using Darcy's law calculations (Rush, 1968, table 7).

Black Mountains Area – The Black Mountains area is included in the Lower Moapa-Lake Mead area studied by Rush (1968). Subsurface outflow to Lake Mead was estimated to be about less than 100 acre-ft/yr assuming that all of the estimated recharge was discharged as subsurface outflow (Rush, 1968, table 7). This discharge is distributed along the shore line of the Black Mountains Area. Harrill (1976) estimated that about

1,200 acre-ft/yr of subsurface flow discharged from Las Vegas Valley and flowed into the Black Mountains area to be discharged as underflow to Lake Mead. A subsequent model study by Morgan and Dettinger (1994) estimated underflow in this area is about 2,100 acre-ft/yr. The value of 2,100 acre-ft/yr was used by Dettinger and others (1995, table 8) as an estimate of underflow beneath Frenchman Mountain toward the Colorado River. This underflow would occur in the general vicinity of Gypsum and Government Washes in the western part of the Black Mountains Area and occurs largely south of the model area. On the east side of the area Rogers and Blue Point springs, located at the east end of the Muddy Mountains at elevations several hundred feet above Lake Mead, discharge a combined flow of about 1,160 acre-ft/yr (Dettinger and others, 1995, table 8) from carbonate rocks. Part of this water is consumed by evapotranspiration and the remainder infiltrates into the soil and percolates down gradient to Lake Mead. There are also a number of small springs and seeps down gradient from Rogers and Blue Point Springs which suggests ground water flow to Lake Mead. The total amount of subsurface flow to Lake Mead is not known but may be on the order of 2,000 to 3,000 acre-ft/yr.

Summary of Flux estimates – The external boundaries of each hydrographic area have been divided into segments representative of similar flux conditions. The segments are numbered in a clockwise direction and are shown on figure 2. The flux estimates are summarized in Table 1.

The boundary of the part of Las Vegas Valley included in the study area is divided into three segments. Segment LV-1 includes the southern part of the boundary. This segment parallels the Las Vegas shear zone and the general direction of ground-water flow. This segment could be simulated as a no-flow boundary. Segment LV-2 is a short segment at the southwest end of the Las Vegas part of the study area. Some water from the study area may cross this segment to support discharge in the Corn Creek area. There are not adequate data to determine how much of the discharge is supplied from within the study area and how much is supplied from the west flank of the Sheep Range outside of the study area. The amount is probably between 0 and 500 acre-ft/yr. This segment is remote from the principal areas of interest. If the model is not sensitive to changes in boundary flux across this segment, no flow conditions could be assumed. Segment LV-3 is the west boundary o the Las Vegas part of the study area. This segment can be simulated as a no-flow boundary.

The boundary of Coyote Spring Valley is divided into 4 segments. Segment CSV-1 extends north from the north end of Las Vegas segment 3 to just north of the Lincoln County line. A ground-water generally coincides with the topographic divide along this segment and the segment can be simulated as a no-flow boundary. Segment CSV-2 extends north from the Lincoln County line to the southeast end of Pahranagat Valley. There is a hydraulic gradient from Tikaboo Valley to Coyote Spring Valley and there is continuity through carbonate rocks across the north end of the Sheep Range. Subsurface inflow to Coyote Spring Valley probably occurs. Based on estimates previously discussed the flux could range from 2,600 to 7,300 acre-ft/yr. This includes up to 2,200 acre-ft/yr of water that flows from Pahranagat Valley to Tikaboo Valley and then to

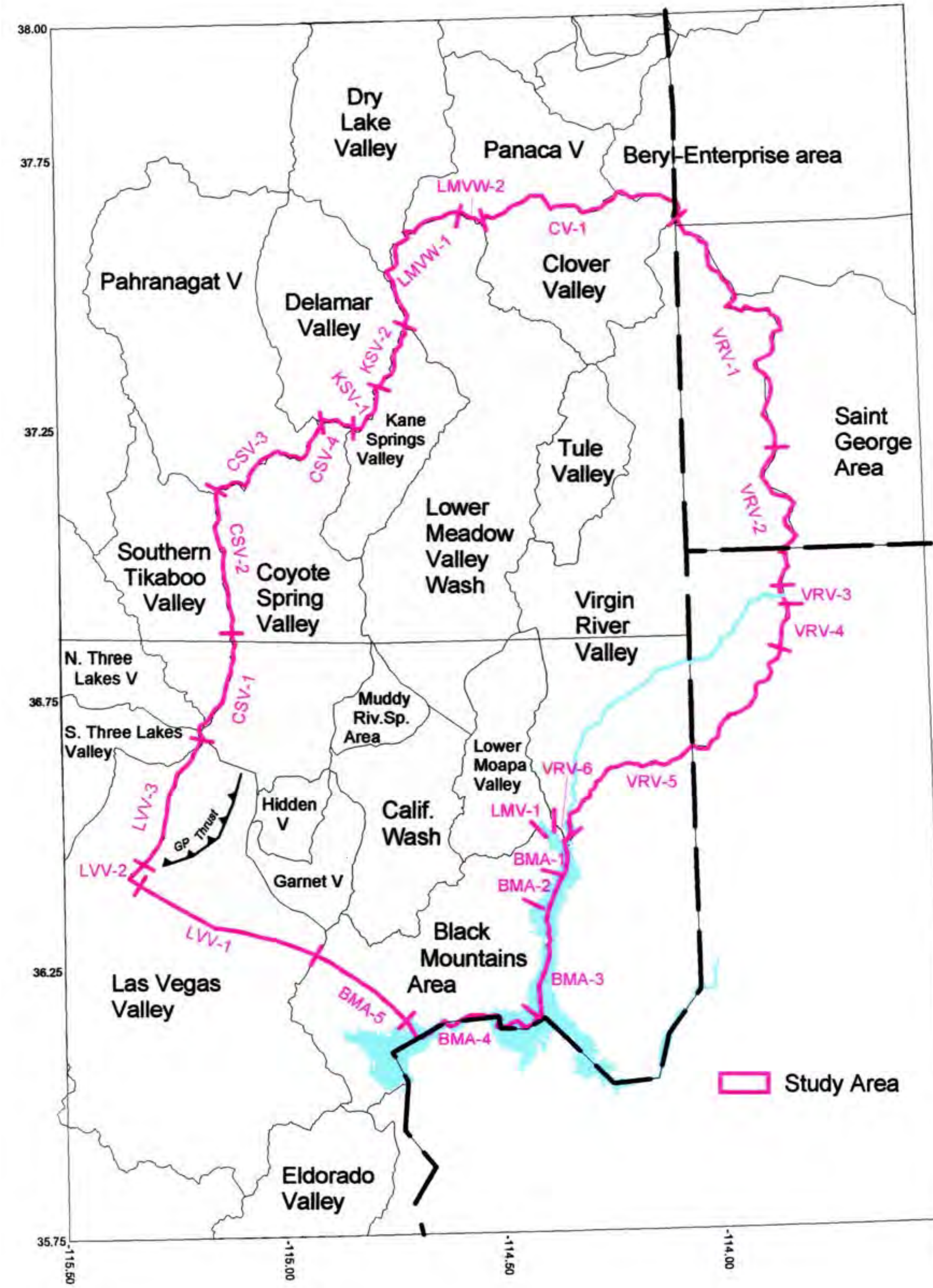

Figure 2. Boundary segments for SNPLMA-5 project

Table 1. Summary of boundary flux estimates
{estimates in acre-ft/yr unless otherwise indicated, Abbreviations: LVV-Las Vegas Valley; CSV-Coyote Spring Valley; KSV-Kane Springs Valley; LMVW-Lower Meadow Valley Wash: CV-Clover Valley: VRV-Virgin River Valley; BDM-Beaver Dam Mountains; BMA-Black Mountains Area}

Boundary Segment	Flux ac-ft/yr	Remarks
LVV-1	0	No flow
LVV-2	0 to -500	Outflow. Water for Corn Creek discharge area, use only if model performance is improved.
LVV-3	0	No flow
CSV-1	0	No flow
CSV-2	2,600 to 7,300	Includes up to 2,200 acre-ft/yr from Pahranagat Valley
CSV-3	32,300	35,000 less 2,200 to CSV and 500 that flow directly from Delamar Valley
CSV-4	250	Flow directly from Delamar Valley
KSV-1	250	
KSV-2	0	No flow
LMVW-1	0	No flow
LMVW-2	Minor	Surface flow, minor
	100 to 300	Shallow flow in alluvium. May be some deep flow in carbonate rocks not estimated here.
CV-1	0	No flow. May be some deep flow in carbonate rocks not estimated here.
VRV-!	0	No flow
VRV-2	From calculation	Calculate as suggested in text
VRV-3	76.6 cfs	Average surface flux
	12cfs +	Subsurface flux, 12 cfs plus recharge E flank of BDM plus drainage from north and south areas.
VRV-4	From calculation	Calculate as suggested in text
VRV-5	0	No flow
VRV-6	-80,000	Surface outflow
	-2,000 to -4,000	Rough estimate by author. Estimate in Reconnaissance Report 51 is probably high.
LMV-1	-10,000	Surface outflow.
	-1,100	Subsurface outflow
BMA-1	Less than -30	From local recharge
BMA-2	-2,000 to -3,000	Primarily discharge from carbonate rocks
BMA-3	Less than -30	From local recharge
BMA-4	Less than -30	From local recharge
BMA-5	Less than -50	From local recharge.

Coyote Spring Valley. Segment CSV-3 extends from the end of segment CSV-2 northeast along the southern boundary of Pahranagat Valley until the boundary of Delamar Valley is encountered. Flux across this segment is about 32,300 acre-ft/yr. This is based on the 35,000 of flux estimated by Eakin (1966) less 2,200 acre-ft/yr that is routed through Tikaboo Valley and 500 acre-ft/yr that flows directly from Delamar Valley to Coyote Springs Valley and Kane Springs Valley. Segment CSV-4 extends from the end of segment CSV-3 to the contact with Kane Springs Valley. There is a gradient from Delamar Valley to Coyote Springs Valley and about 250 acre-ft.yr is estimated to flow into Coyote Springs Valley from Delamar Valley.

The boundary of Kane Springs Valley is divided into two segments. Segment KSV-1 extends east from the boundary of Coyote Spring Valley to about the crest of the Delamar Range. There is a gradient from Delamar Valley to Kane Springs Valley and about 250 acre-ft/yr of subsurface inflow occurs from Delamar Valley to Kane Springs Valley. Segment KSV-2 extends east from the end of segment KSV-1 to the boundary of Lower Meadow Valley Wash. This segment is in the Delamar Mountains south of a large subsurface intrusive mass of poorly permeable rock. No significant inflow is considered to cross this segment.

The boundary of Lower Meadow Valley Wash is divided into two segments. Segment LMVW-1 extends east from the boundary of Kane Springs Valley to a point about 2 miles northeast of Caliente. A regional gradient from north to south exists in this area but the volcanic rocks present at shallow depths probably do not transmit significant water. Carbonate rocks are present at depth but there are no indications that a large amount of subsurface inflow occurs at depth. A no flow condition could be assumed for the initial simulations. Segment LMVW-2 extends from the end of segment LMVW-1 to the boundary with Clover Valley. The channel of Meadow Valley Wash crosses this segment and there is some surface inflow and some ground-water inflow. Surface inflow was given as some and could be considered to be on the order of 100 to 300 acre-ft/yr. Most of the ground-water inflow occurs in the shallow alluvium and was listed as minor. The amount of subsurface inflow could be considered to be between 100 and 300 acre-ft/yr.

The boundary of Clover Valley was not subdivided. Segment CV-1 is underlain mostly be volcanic rocks that probably do not transmit significant subsurface inflow from Panaca Valley. This segment is also underlain by carbonate rocks at depth and there is a regional gradient from north to south. However there are no indications of large down-gradient discharge areas supplied by flow through carbonate rocks. Initial simulations could assume no flow conditions for this segment. Small boundary fluxes at depth could be added during model calibration if required to provide the best fit to observed head.

The boundary of the Virgin River Valley is subdivided into 6 segments. Segment VRV-1 extends east and south from the boundary of Clover Valley to near where US 91 crosses the divide and carbonate rocks become the dominant lithology. This segment is underlain primarily by volcanic rocks and a ground-water divide is thought to be present. This segment can be simulated as a no-flow boundary. Segment VRV-2 extends south from the end of segment 1 to a point about 0.5 miles north of the river. The boundary along this segment is underlain by carbonate rocks and there is thought to be subsurface inflow from recharge generated on the east flank of the Beaver Dam Mountains and adjacent hills. When recharge estimates become available trial values of the boundary flux can be estimated using the calculations suggested previously. Segment VRV-3 extends south from the end of segment VRV-2 to a point about 0.5 miles south of the river. This segment is underlain by carbonate rocks and is centered beneath the channel of the Virgin River. High stream flow losses and gains suggest that the carbonate rocks underlying this segment are very permeable. The permeability may actually have been increased by solution caused by water from the Virgin River. There is both surface and subsurface inflow across this segment. Using an eight year average for flow at the gage above the Narrows and gains discussed previously the surface inflow can be estimated at about 76.6 cfs. Subsurface inflow can be estimated as the water needed to support a spring-flow contribution to the River that occurs just inside of the boundary (estimated at about 12 cfs, the gain between miscellaneous stations 2 and 3) plus recharge from the east flank of the Beaver Dam Mountains and adjacent hills plus possible drainage from areas north and south of this segment (the high transmissivity may cause the rocks underlying this segment to act as a local drain). Segment VRV-4 extends south from the end of segment 3 to a point about 6 miles south of the river where carbonate rocks cease to be the dominant lithology. The boundary along this segment is underlain by carbonate rocks and there is thought to be subsurface inflow from recharge generated on the east flank of the Beaver Dam Mountains and adjacent hills. When recharge estimates become available trial values of the boundary flux can be estimated using the calculations suggested previously. Segment VRV-5 extends south from the end of segment VRV-4 to the edge of the Virgin River floodplain at the south end of the valley. Most of this segment is underlain by a ground water divide. This segment can be simulated as a no-flow boundary. Segment VRV-6 extends across the floodplain of the Virgin River at the south end of the valley. There is surface and subsurface outflow across this boundary. Surface outflow was estimated to be about 80,000 acre-ft/yr by Glancy and Van Denburgh (1969, p. 22). Subsurface outflow is estimated to be on the order of 2,000 to 4,000 acre-ft/yr based on Darcy's Law calculations.

The Lower Moapa Valley boundary has only one segment. Segment LMV-1 extends across the floodplain of the Muddy River just above Lake Mead. Both surface and subsurface outflow cross this segment. Surface outflow has been estimated to be about 10,000 acre-ft/yr and subsurface outflow has been estimated to be about 1,100 acre-ft/yr.

The boundary of the Black Mountains area has been subdivided into 5 segments. Note that the boundary of the study area generally follows the channels of the Virgin and Colorado Rivers which have been submerged by Lake Mead. Outflow to Lake Mead would occur along the shoreline of the Lake adjacent to each segment. Segment BMA-1 begins at the north end of the Overton Arm of Lake Mead where the Lower Moapa Valley segment ends and extends south to a point adjacent to Black Point. Subsurface outflow to Lake Meade is derived from local recharge and is probably less than 30 acre-ft/yr. Segment BMA-2 extends from the end of segment 1 south to the south end of

Rogers Bay. Subsurface outflow along this segment is derived from local recharge (small, <20 acre-ft.yr) and outflow from carbonate rocks that supplies Rogers and Blue Point Springs and a number of smaller springs and seeps. Total discharge to Lake Mead may be on the order of 2,000 to 3,000 acre/ft/yr. Segment BMA-3 extends south from the end of segment BMA-2 to Middle Point. Subsurface outflow along this section is from local recharge is small, probably less than 30 acre-ft/yr. Segment BMA-4 extends west from the end of segment BMA-3 to the west shore of Callville Bay. Subsurface outflow along this segment is from local recharge and is probably less than 30 acre-ft/yr. Segment BMA-5 extends from the end of segment 4 northwest to the boundary of Las Vegas Valley. This segment cuts across the western part of the Black Mountains Area and separates the western Black Mountains area from the study area. Subsurface outflow from Las Vegas Valley to the Black Mountains area and then to Lake Mead estimated to be as much as 2,100 acre-ft/yr occurs in the western part of the Black Mountains area outside of the study area. This segment approximately parallels the regional flow direction and flow across the segment is probably less than 50 acre-ft/yr.

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LINCOLN COUNTY WATER DISTRICT

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ELECTRONIC COPY – HARD COPY TO FOLLOW

March 5, 2014

Mr. Bill Hansen
Chief, Water Rights Branch
National Park Service
1201 Oak Ridge Drive, Suite 250
Ft. Collins, CO 80525

Re: ***Groundwater Flow Model of Part of the Colorado Regional Groundwater Flow System, Southeastern Nevada (Version 1.0) prepared by Tetra Tech, Inc.***

Dear Mr. Hansen,

While Lincoln County Water District and Vidler Water Company (Lincoln/Vidler) appreciate the response that the National Park Service (NPS) provided to our comments on the above referenced Tetra Tech model, we firmly believe that the model as currently constructed cannot be used as a predictive tool in its current form. Lincoln/Vidler provided specific comments to NPS outlining the absence of any site-specific data from Tule Desert in the model and the complete lack of steady-state calibration of the model for Tule Desert and Clover Valley. The NPS response did little to address our comments, and the fact still remains that the Tetra Tech model cannot be used as a predictive tool specific to these areas. Furthermore, in our letter dated March 1, 2013, Lincoln/Vidler clearly stated the reasons the Tetra Tech model could not be used as a tool to assess impacts to NPS resources specifically related to the Stipulation between Lincoln/Vidler and the NPS with regards to Lincoln/Vidler's water rights in the Tule Desert.

Lincoln/Vidler remain firm in our resolve to use the best credible science and data collection that can be applied in our efforts to further understand the hydrogeology of Tule Desert and Clover Valley. Without significant revision, the Tetra Tech model does not further this cause.

Sincerely,

Paul Mathews
Paul Mathews
Chairman
Lincoln County Water District

Sincerely,

Greg L. Bushner
Greg L. Bushner, R.G.
Vice President/Chief Hydrogeologist
Vidler Water Company

LINCOLN COUNTY WATER DISTRICT

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cc: Rick Felling, Nevada Division of Water Resources
John Guillory, Nevada Division of Water Resources
Jeff Johnson, Southern Nevada Water Authority
Andrew Burns, Southern Nevada Water Authority
Carl Savely, Wingfield Nevada Group (General Counsel to Coyote Springs Investment)
Bob Ott, NV Energy
Joe Davis, Moapa Valley Water District
Wade Poulsen, Lincoln County Water District
Aaron Bunker, Virgin Valley Water District
Bill Dickinson, National Park Service
Jennifer Haley, National Park Service
Gary Karst, National Park Service
Bill Van Liew, National Park Service
Peter Fahmy, National Park Service
Mike Senn, U.S. Fish & Wildlife Service
Amy Lavoie, U.S. Fish & Wildlife Service
Tim Mayer, U.S. Fish & Wildlife Service
Sue Braumiller, U.S. Fish & Wildlife Service
Sarah Peterson, Bureau of Land Management
Boris Poff, Bureau of Land Management
Dan Netcher, Bureau of Land Management
Ray Roessel, Bureau of Indian Affairs
Pam Adams, U.S. Bureau of Reclamation
Doug Blatchford, U.S. Bureau of Reclamation
Steve Palmer, DOI Office of the Solicitor
Keith Halford, U.S. Geological Survey
Wayne Belcher, U.S. Geological Survey
Richard Waddell, Tetra Tech, Inc.
Peter Mock, PMGC, Inc.
Zane Marshall, Southern Nevada Water Authority
Martin Mifflin and Cady Johnson, Consulting Hydrogeologists to the Moapa Band of Paiutes

SETTLEMENT AGREEMENT AMONG THE STATE ENGINEER, STATE OF NEVADA, TRACY TAYLOR, P.E., NEVADA STATE ENGINEER, JASON KING, P.E., ACTING NEVADA STATE ENGINEER, LINCOLN COUNTY WATER DISTRICT AND VIDLER WATER COMPANY

Lincoln County Water District (the "District"), Vidler Water Company ("Vidler"), the State Engineer, State of Nevada, Tracy Taylor, P.E., Nevada State Engineer, and Jason King, P.E., Acting Nevada State Engineer, (collectively, the "State Engineer") enter into the following Settlement Agreement and Mutual Release ("Agreement") this 1st of April, 2010. The parties shall be referred to individually as "Party" and collectively as "Parties."

RECITALS

1. On December 11, 1998, the District and Vidler filed Application 64692 to appropriate 7,240 acre feet of groundwater in the Tule Desert Hydrographic Basin.

2. On December 11, 1998, the District and Vidler filed Application 64693 to appropriate 7, 240 acre feet of groundwater in Tule Desert Hydrographic Basin. On November 8, 2000, the District and Vidler filed Change Application 66932 to change the point of diversion and place of use requested under Application 64693.

3. On November 26, 2002, the State Engineer issued Ruling 5181 granting Application 66932 in the amount of 2,100 acre feet per year.

4. Ruling 5181 also allowed the District and Lincoln to perform additional work to determine if additional water was available for appropriation in the Tule Desert Hydrographic Basin under Application 64692.

5. After the District and Vidler performed the work provided for under Ruling 5181, the State Engineer issued Ruling 5986 granting Application 64692 in the amount of 396 acre feet per year.

6. On May 27, 2009, the District and Vidler appealed Ruling 5986 to the Seventh Judicial District Court of the State of Nevada, in and for the County of Lincoln in Case No. CV-0518009 entitled *Lincoln County Water District and Vidler Water Company v. State Engineer, State of Nevada.*

7. On July 21, 2009, the District and Vidler sued State Engineer Tracy Taylor and Acting State Engineer King in the United States District Court for the District of Nevada in Case No. CV00392-LRH-VPC entitled *Lincoln County Water District and Vidler Water Company v. Tracy Taylor, P.E. and Jason King, P.E.*

8. In order to avoid the expense and uncertainty of litigation the Parties desire to settle the two lawsuits on the terms and conditions set forth below.

AGREEMENT

In consideration of the mutual promises, duties, and agreements set forth below, the Parties agree as follows:

I. **Conditional Grant of 7,240 Acre-Feet of Groundwater Per Year to the Lincoln County Water District and Vidler Water Company in the Tule Desert Hydrographic Basin Under N.R.S. § 533.3705 with 2,900 Acre-Feet Per Year Immediately Available for Use and the Remainder Subject to Staged Development.**

A. There are two projects supported by the water rights developed from the Tule Desert that have been identified under Lincoln County's Water Master Plan: the development of 13,000 acres under the Lincoln County Land Act and the development of the Toquop Energy Park. The District and Vidler estimate the total water demand for these projects at build out to range from 15,000 acre feet per year to 16,000 acre feet per year. The State Engineer granted 2,100 acre feet per year to the District and Vidler under Permit 66932. The water rights granted under Permit 66932 have been conveyed to owner-developers for dedication under the Lincoln County Land Act.

B. The State Engineer shall grant Application 64692 in the amount of 7,240 acre feet annually. The total combined duty of Permits 64692 and 66932 shall not exceed 9,340 acre-feet annually. However, the State Engineer finds, in order to gather the necessary information to more accurately determine the additional water available to appropriate under N.R.S. § 533.370, development of water will occur in stages in conjunction with the updated June 2005 Monitoring Plan approved by the State Engineer.

1. The initial use of water under Permit 64692 is limited to 2,900 acre-feet annually (a total of 5,000 acre-feet annually including Permit 66932).
2. The Applicant shall calibrate to actual field conditions the Tule Desert Groundwater Flow Model developed by Peter Mock Groundwater Consulting, Inc., which calibration may be peer reviewed by the third party Reviewing Consultant (as described below) at the cost of the District and Vidler.
3. The District and Vidler shall continue to collect hydrologic data throughout Tule Desert using the existing metering and data collection equipment at the locations they currently maintain and submit such data at least annually to the State Engineer.
4. The State Engineer, the District, and Vidler shall meet annually to review the data submitted by the District and Vidler. The third party Reviewing Consultant (as described below) shall participate in these meetings. The State Engineer shall apply the provisions of Section III of this Settlement Agreement in setting criteria and in determining whether to authorize the use of additional water under Permit 64692 and in identifying necessary studies.

5. The District and Vidler shall implement a staged pumping development program that shall consist of a minimum of eight consecutive years (the "Staged Development Period"). During this Stage Development Period, pumping must average at least 2,500 acre feet annually, and in no year shall pumping be less than 2,000 acre feet annually.

6. Annually after the initial calibration and every year thereafter during the Staged Development Period, the District and Vidler shall submit the updated groundwater flow model with the data obtained during the Staged Development Period and provide predictive results for 10 years, 25 years, 100 years, and 500 years.

7. The District and Vidler may at any time seek the use of additional water up to the full amount under Permit 64692 to the extent that the additional studies and evidence demonstrate to the satisfaction of the State Engineer that additional water is available for appropriation under N.R.S. § 533.370.

8. At any time, the State Engineer may at his discretion authorize the use of all or a portion of the remaining quantity of water permitted under Application 64692 to the extent that the additional studies and evidence demonstrate to the satisfaction of the State Engineer that such additional water is available for appropriation and use pursuant to N.R.S. § 533.370. If, prior to the completion of the Staged Development Period described above, the State Engineer refuses a request from the District and Vidler to pump additional water, such refusal by the State Engineer shall not be considered an appealable order or decision under N.R.S. § 533.370.

9. The District, Vidler, and the State Engineer agree that Daniel B. Stephens and Peter Mock shall serve as the Study Consultants (as described below) for Application 64692.

II. Monitoring and Reporting.

The District and Vidler shall submit a revised Monitoring Plan, updating the June 2005 Monitoring Plan approved by the State Engineer in the matter of Permit 66932, to include pumping under Permit 64692.

III. Studies Under N.R.S. § 533.368 and the Use of Third Party Technical Consultants.

A. Nevada Revised Statute § 533.368 provides that if the State Engineer determines that a hydrological study, an environmental study, or any other study is necessary before he makes a final determination on an application pursuant to N.R.S. § 533.370 and the applicant, a governmental agency or other person has not conducted such a study or the required study is not available, the State Engineer shall advise the applicant of the need for the study and the type of study required. The required study must be conducted by the State Engineer or a person designated by him, the applicant, or a consultant approved by the State Engineer, as determined by the State Engineer. The applicant is to bear the cost of study. The State Engineer is to consult with the applicant and the governing body of the county in which the point of diversion and place of use is located concerning the scope and progress of the study.

B. The following steps will be followed for all current and future applications to appropriate groundwater in hydrographic basins located wholly or partially within the boundaries of Lincoln County, filed by the District and Vidler, either individually or jointly, unless it is necessary for the State Engineer to deny the applications pursuant to N.R.S. § 533.370(1) and (6). This provision shall stay in effect for five (5) years from the date of the settlement, but may be renewed by agreement of the State Engineer, the District, and Vidler.

1. The State Engineer shall require the District and/or Vidler to perform a hydrological study to address the water resources of the particular hydrographic basin unless otherwise agreed to by the State Engineer, the District and Vidler. The District and Vidler may select the consultant ("Study Consultant") to perform the hydrologic study.

2. As set forth in NRS § 533.368(4)(a), the State Engineer shall consult with the District and Vidler concerning the scope and progress of the study and to determine the criteria necessary to adequately evaluate the applications. In addition to those required by Nevada law, the State Engineer shall set forth in writing as part of the criteria, any other procedures, policies, or methodologies that will be used to determine the amount of groundwater that is appropriable in the basins in which the applications are filed. This consultation will include the Reviewing Consultant discussed below. Additional meetings may be held as necessary among the State Engineer, the Reviewing Consultant, the District and Vidler concerning the scope and progress of the study. If during the course of study the State Engineer finds that additional studies, criteria, or scientific information are required to determine the amount of groundwater that is appropriable in the basins in which the applications are filed, the State Engineer shall identify the additional studies, criteria, or scientific information necessary and inform the District and/or Vidler. The District and/or Vidler

shall then develop studies and reports relating to the identified criteria. The State Engineer will agree to a reasonable extension of time to complete approved studies that are in progress. Once all reasonable extensions of time have elapsed, if the District and Vidler have not performed and submitted the required hydrologic study, the State Engineer may move forward under the provisions of N.R.S. § 533.368 with any study the State Engineer considers necessary for consideration of pending applications in the relevant hydrographic basins.

3. The State Engineer shall use an independent third party Reviewing Consultant selected by the State Engineer and paid for by the District and/or Vidler as set forth in N.R.S. § 533.368(3) to review and analyze the study or studies submitted to the State Engineer by the District and/or Vidler. The State Engineer shall advise the applicant of his selection and the applicant may indicate concerns relative to the qualifications and experience of the selected Reviewing Consultant, in writing to the State Engineer. The Reviewing Consultant shall serve as an advisor to the State Engineer on a hydrologic study prior to taking action on any application filed by the District and/or Vidler. The Reviewing Consultant may subcontract with other technical consultants to provide expertise in a given discipline after consulting with and approval by the State Engineer. If the State Engineer determines that an independent third party technical consultant is not needed, this provision to appoint a Reviewing Consultant can be waived by agreement of the Parties.

4. After a hydrologic study is completed and submitted to the State Engineer, the Reviewing Consultant shall evaluate the study and provide a report to the State Engineer regarding the study. The report shall be made part of the public records of the Nevada Division of Water Resources and shall be served by the applicant on any protestant to the particular applications. The District and/or Vidler and any protestant may comment on the Reviewing Consultant's report within 30 days after the date the report is filed in the Nevada Division of Water Resources. Under N.R.S. § 533.365(3), the State Engineer shall determine whether an administrative hearing is required or may require the filing of additional information as necessary for a full understanding of the matter before him. If a hearing is held, the Reviewing Consultant shall attend the hearing. The State Engineer shall consult with the Reviewing Consultant prior to issuing a ruling on the applications.

5. The State Engineer shall make the determination of the amount of water to be appropriated under each application taking into account the criteria established in Section III (B)(2), above, the report of the Reviewing Consultant, the comments filed with the State Engineer, and the criteria established in the Nevada Revised Statutes. The final determination of the water available for appropriation is the sole authority of the State Engineer.

IV. <u>Kane Springs Hydrographic Basin</u>.

Applications 74147 through 74150 for appropriations in the Kane Springs Hydrographic Basin filed by the District and Vidler will be returned to application status in the same priority as the applications had under the original filing in the records of the Nevada Division of Water Resources under a separate settlement agreement that follows the same general format as found in Section III of this Agreement.

V. <u>Ratification by Lincoln County Water District and Authority</u>.

A. The Parties recognize that this Agreement needs ratification by Lincoln County Water District's Board of Trustees.

B. The representatives of the Parties executing this Agreement represent and warrant that they are authorized to enter into this Agreement.

VI. <u>Dismissal of Actions</u>.

Upon full execution of the Agreements containing the terms herein and ratification by the Lincoln County Water District Board of Trustees, the State Engineer, the District, and Vidler shall stipulate to dismiss the state district court appeal of State Engineer's Ruling No. 5986, more specifically identified as *Lincoln County Water District and Vidler Water Company v. State Engineer, State of Nevada*, Case No. CV-0518009, filed in the Seventh Judicial District Court in and for the State of Nevada, and the federal lawsuit, more specifically identified as *Lincoln County Water District and Vidler Water Company v. Tracy Taylor, P.E. and Jason King, P.E.*, Case No. CV00392-LRH-VPC filed in the United States District Court in and for the District of Nevada, with each Party to bear its or his own costs and attorneys fees.

VII. <u>Extensions of Time</u>.

This Agreement shall not affect or limit the State Engineer's discretion in considering any applications for extensions of time for the filing of proof of completion of work, proofs of beneficial use, or to avoid a forfeiture. Any requests for extension of time shall be addressed under controlling provisions of law.

VIII. No Precedential Effect.

The State Engineer enters into this Agreement because of the unique factual circumstances surrounding this case. Aside from the rights and responsibilities established in this Agreement, the Agreement has no precedential effect in any proceeding involving these Parties or any other parties and may not be relied upon as evidence of policy or practices of the State Engineer; provided, however, that the provisions of Section III may be relied upon and control the processing of applications as set forth in the provisions of Section III. This Agreement does not limit the State Engineer's authority or discretion as it relates to consideration of any application to appropriate water, application for extension of time, or any application to change the manner of use, place of use, point of diversion, or means of diversion of any water right.

IX. Mutual Release.

Other than claims arising from rights and obligations set forth in this Agreement, each of the Parties, for and in consideration of the mutual promises, duties, agreements, and consideration set forth in this Agreement, release, acquit, and forever discharge the other Parties, their agents, employees, officers, directors, representatives, affiliate, successors, and assigns, of and from any and all claims, liabilities, demands, and causes of action, known or unknown, asserted or unasserted, which they had or may now have as a result of or arising out of or by reason of the facts and circumstances surrounding the claims and allegations filed in Case No. CV-0518009 entitled *Lincoln County Water District and Vidler Water Company v. State Engineer, State of Nevada* and in Case No. CV00392-LRH-VPC entitled *Lincoln County Water District and Vidler Water Company v. Tracy Taylor, P.E. and Jason King, P.E.*

X. No Admission of Liability.

The Parties agree and acknowledge that this is a compromise of disputed claims and that the agreements shall not be construed as an admission of liability on the part of any Party; the Parties expressly deny any liability relating to the claims asserted.

XI. Entire Agreement.

This Agreement contains the entire agreement among the Parties, and the terms of the Agreement are contracted and not mere recitals. No provision of the Agreement may be modified except in writing signed by all Parties hereto.

XII. Successors and Assigns.

This Agreement, and the rights and obligations contained herein, shall inure to the benefit and burden of and shall be binding on the grantees, successors, and assigns of the Parties to this Agreement.

XIII. Governing Law.

This Agreement will be governed by and in accordance with the laws of the State of Nevada. Any rule requiring construction or interpretation against the drafter of the document is waived and this Agreement has been and is deemed drafted by all Parties in a mutual effort.

XIV. Agreement Freely Entered into by the Parties.

Each Party represents and warrants that each has freely entered into this Agreement without fraud, duress, or any undue influence. Each Party represents and warrants that no promise or inducement has been offered except as set forth herein; that this Agreement is executed without reliance upon any statement or representation except as contained herein; and that the terms and conditions of this Agreement are fair and reasonable. Each Party represents and warrants that it or he was represented by competent counsel and was advised regarding the risks, duties, and obligations set forth in this Agreement.

XV. Facsimile and Photocopies.

Facsimiles and photocopies of this Agreement shall be considered originals for all purposes, including, but in no way limited to, any court proceedings.

XVI. Signed Counterparts.

This Agreement may be executed in any number of counterparts, each of which together shall be deemed to be an original, and all of which together shall be deemed to be one and the same instrument. The signatures required for execution may be transmitted by facsimile or e-mail, and such signatures shall be deemed duplicate originals, shall be effective upon receipt, may be admitted in evidence, and shall fully bind the Parties and persons making such signatures.

THE STATE ENGINEER, STATE OF NEVADA

Jason King P.E.
By: Jason King, P.E.,
Acting State Engineer

Dated: 4/15/10

TRACY TAYLOR, P.E., NEVADA STATE ENGINEER

Tracy Taylor P.E.
By: Tracy Taylor, P.E.,
Nevada State Engineer

Dated: 4/15/10

JASON KING, P.E., ACTING STATE ENGINEER

Jason King P.E.
By: Jason King, P.E.,
Acting State Engineer

Dated: 4/15/10

LINCOLN COUNTY WATER DISTRICT

Wade Poulsen

By: Wade Poulsen, Lincoln
County Water District Manager

Dated: 4/15/2010

VIDLER WATER COMPANY

Dorothy Timian-Palmer

By: Dorothy Timian-Palmer, P.E.,
President and Chief Operating Officer

Dated: 4/16/2010

Approved and Consented to as to form:

RYLEY CARLOCK & APPLEWHITE

By:____________________________
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Jenny J. Winkler, Esq.
Sean T. Hood, Esq.

Dated: ________________

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By: Karen Peterson
Karen A. Peterson, Esq.

Dated: April 16, 2010

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Dylan V. Frehner, Esq.

Dated: ________________

Attorney for Lincoln County Water District

LINCOLN COUNTY WATER DISTRICT

______________________________ Dated: ____________________
By: Wade Poulsen, Lincoln
County Water District Manager

VIDLER WATER COMPANY

______________________________ Dated: ____________________
By: Dorothy Timian-Palmer, P.E.,
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______________________________ Dated: ______________
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County Water District Manager

VIDLER WATER COMPANY

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By:______________________________ Dated: 4/15/10
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NEVADA ATTORNEY GENERAL'S OFFICE

By: Bryan L. Stockton
Bryan L. Stockton, Esq.
Michael L. Wolz, Esq.

Dated: 15 APR 2010

Attorneys for the State Engineer, State of Nevada, Tracy Taylor, P.E., Nevada State Engineer, and Jason King, P.E., Acting State Engineer

INDEX MAP OF NEVADA SHOWING LOCATION OF LINCOLN COUNTY

INDEX MAP OF LINCOLN COUNTY, NEVADA, SHOWING SOURCES OF GEOLOGIC DATA THROUGH 1963
(Numbers correspond to those shown on index map)

1. Westgate and Knopf (1932)
2. Callaghan (1937)
3. Callaghan (1936)
4. Humphrey (1945)
5. Park, Gemmill, and Tschanz (1958)
6. Kellogg (1960, 1963)
7. Tschanz (1960b)
8. C.R. Longwell (unpublished data)
9. D. H. Duley (unpublished data)
10. Wheeler (1948)
    Langenheim (1956b)
11. Reso and Croneis (1959)
    Reso (1963)
12. Webb (1956)
13. Wheeler (1940)
    Wheeler and Lemmon (1939)
14. Webb (1956)
15. Langenheim and Peck (1957)
16. Langenheim (1956a)
17. Merriam (1940)
18. Webb (1956)
19. Hintze (1952)
20. E. F. Cook (unpublished data)

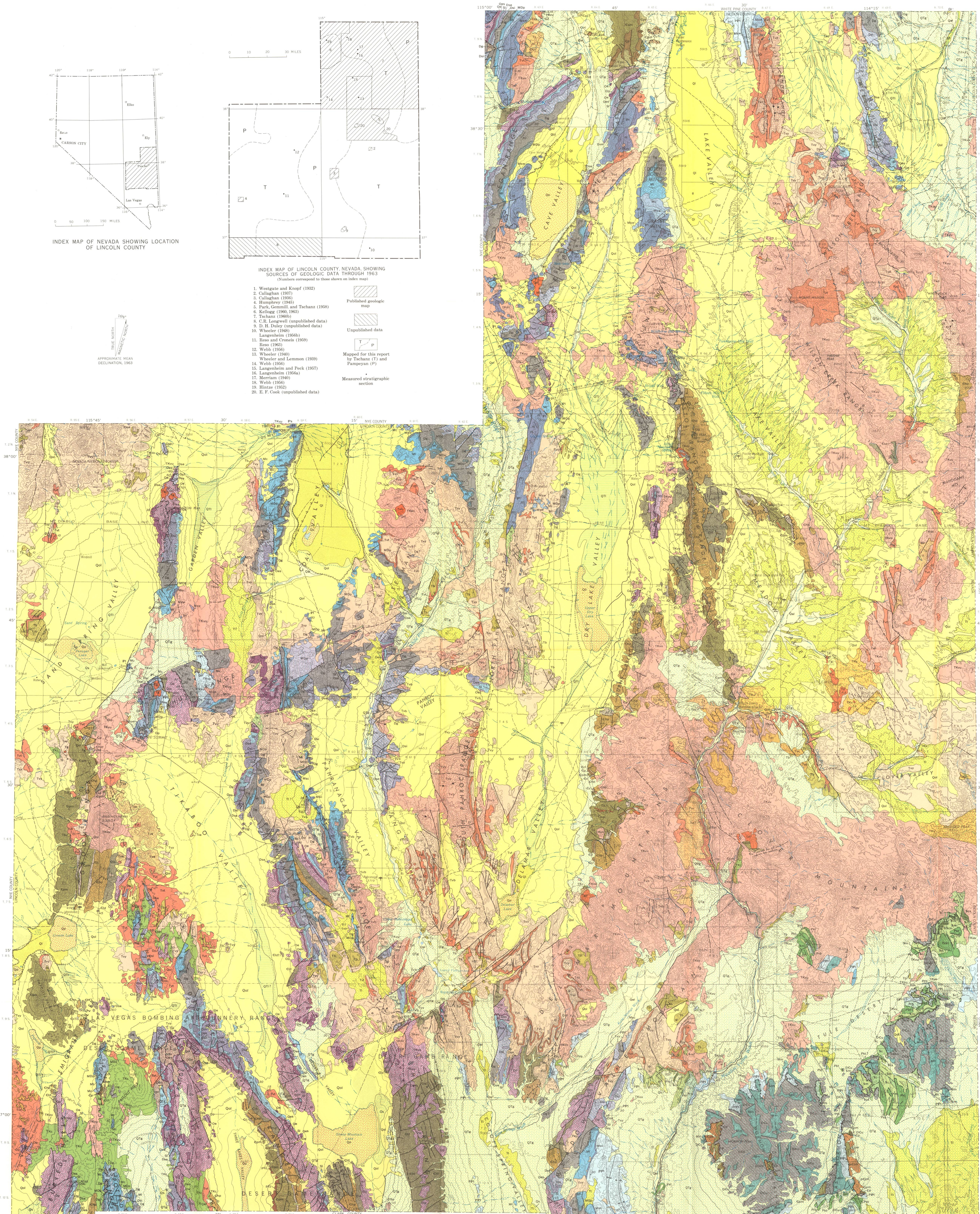
Published geologic map

Unpublished data

Mapped for this report by Tschanz (T) and Pampeyan (P)

Measured stratigraphic section

APPROXIMATE MEAN DECLINATION, 1963



EXPLANATION

Qp — Recent playa deposits
Qs — Dune sand
Qal — Younger alluvium
Ql — Younger lake beds
Qol — Older alluvium
QTl — Intermediate lake beds
QTg — Older gravels

UNCONFORMITY

TERTIARY(?), QUATERNARY AND QUATERNARY(?)

Tl — Older lake beds
Muddy Creek Formation, Panaca Formation, and lake beds in White River Valley

Tb — Basalt
Includes some older basalt flows and basalt dikes of several ages

ANGULAR UNCONFORMITY

Younger volcanic rocks
Tvy, *younger volcanic rocks, undivided, including intravolcanic sedimentary rocks (Ts) and perlite (p)*
Tva, *andesite*
Tvb, *spheroidal-weathering ignimbrite*
Tvc, *rhyolitic unit*
Tvd, *biotite dacite*
Tvr, *rhyolite complex*
Tvt, *tuffs and tuffaceous sediments*

Intrusive rocks
Tg, *granite stocks and dikes*
Tr, *rhyolite and microgranite dikes*
Tgp, *granite porphyry*
Tgd, *granodiorite*
Tqm, *quartz monzonite or quartz diorite*
Td, *diorite*
Tdi, *diabase*
Tvn, *andesitic volcanic neck*

Tt — Lacustrine limestone

Tsp — Sheep Pass Formation

TERTIARY

TKvu — Volcanic rocks, undifferentiated

ANGULAR UNCONFORMITY

TKv — Older volcanic rocks

TKc — Older clastic rocks

CRETACEOUS(?) OR TERTIARY

UNCONFORMITY

Ꞓc, Ꞓcs — Chinle Formation
Ꞓcs, *Shinarump Member*

UNCONFORMITY (?)

Ꞓm — Moenkopi Formation

TRIASSIC

EROSIONAL UNCONFORMITY

Pkt — Kaibab Limestone and Toroweap Formation, undivided

Prb — Red beds

PERMIAN

PIPl, Pl, IPs, IPl — Limestone and sandstone
PIPl, *Permian and Pennsylvanian limestone and sandstone, undivided*
Pl, *Permian limestone; contains some fossiliferous Pennsylvanian beds in western part of county*
IPs, *Upper Pennsylvanian sandstone; contains some Permian beds just east of the Limestone Hills*
IPl, *Pennsylvanian limestone; lower most beds locally contain a very Late Mississippian fauna*

PENNSYLVANIAN

Msc, Msw, Mc — Clastic rocks
Msc, *Upper Mississippian clastic rocks, undivided*
Msw, *Scotty Wash Quartzite*
Mc, *Chainman Shale*

Ml — Limestone
Includes Joana, Mercury, and Bristol Pass Limestones

Mm — Monte Cristo Limestone

MISSISSIPPIAN

CARBONIFEROUS

LOCAL UNCONFORMITY

MDp — Pilot Shale

LOCAL UNCONFORMITY

Dg — Guilmette Formation

Dsi — Simonson Dolomite

Dse — Sevy Dolomite

DEVONIAN

LOCAL UNCONFORMITY

MDu — Mississippian and Devonian rocks, undifferentiated

Du — Devonian rocks, undifferentiated

DSu — Devonian and Silurian dolomite, undifferentiated

SOu — Silurian and Ordovician dolomite, undifferentiated

DꞒu — Devonian to Cambrian limestone and dolomite, undifferentiated

Sl — Laketown Dolomite

SILURIAN

Oes — Ely Springs Dolomite

Oe — Eureka Quartzite

Op — Pogonip Group

ORDOVICIAN

Ꞓld — Limestone and dolomite, and Dunderberg Shale, undifferentiated

Ꞓhp — Highland Peak Formation

Ꞓs — Patterson Pass Shale of Kellogg (1959)

Ꞓpc — Pole Canyon Limestone

Ꞓu — Cambrian limestone and dolomite, undifferentiated

Ꞓc, Ꞓcl, Ꞓp — Chisholm Shale, Lyndon Limestone, and Pioche Shale, undivided
Pioche Shale, where mapped separately, shown as marker bed

Ꞓpm — Prospect Mountain Quartzite
Includes Wood Canyon Formation and Stirling Quartzite in the Desert Range

CAMBRIAN

pꞒj — Johnnie Formation
Mapped only in the Desert Range. Equivalent beds may be included in Prospect Mountain Quartzite in the Groom Range

UNCONFORMITY

pꞒim — Igneous and metamorphic rocks

PRECAMBRIAN

Jasperoid

Highest beach or strand line, or wave-cut terrace

Contact
Dashed where approximately located, dotted where generalized or inferred

Fault, showing dip
Dashed where approximately located, dotted where concealed; query indicates probable or inferred fault. U, upthrown side; D, downthrown side. Arrows show relative horizontal movement

Thrust fault
Dashed where approximately located, dotted where concealed; queried where probable or inferred. Sawteeth on upper plate

Fault breccia

Anticline

Syncline

Overturned syncline
Showing trace of axial plane and direction of plunge of axis. Dashed where approximately located

Strike and dip of beds

Strike and dip of overturned beds

Strike of vertical beds

Horizontal beds

Strike of vertical joints

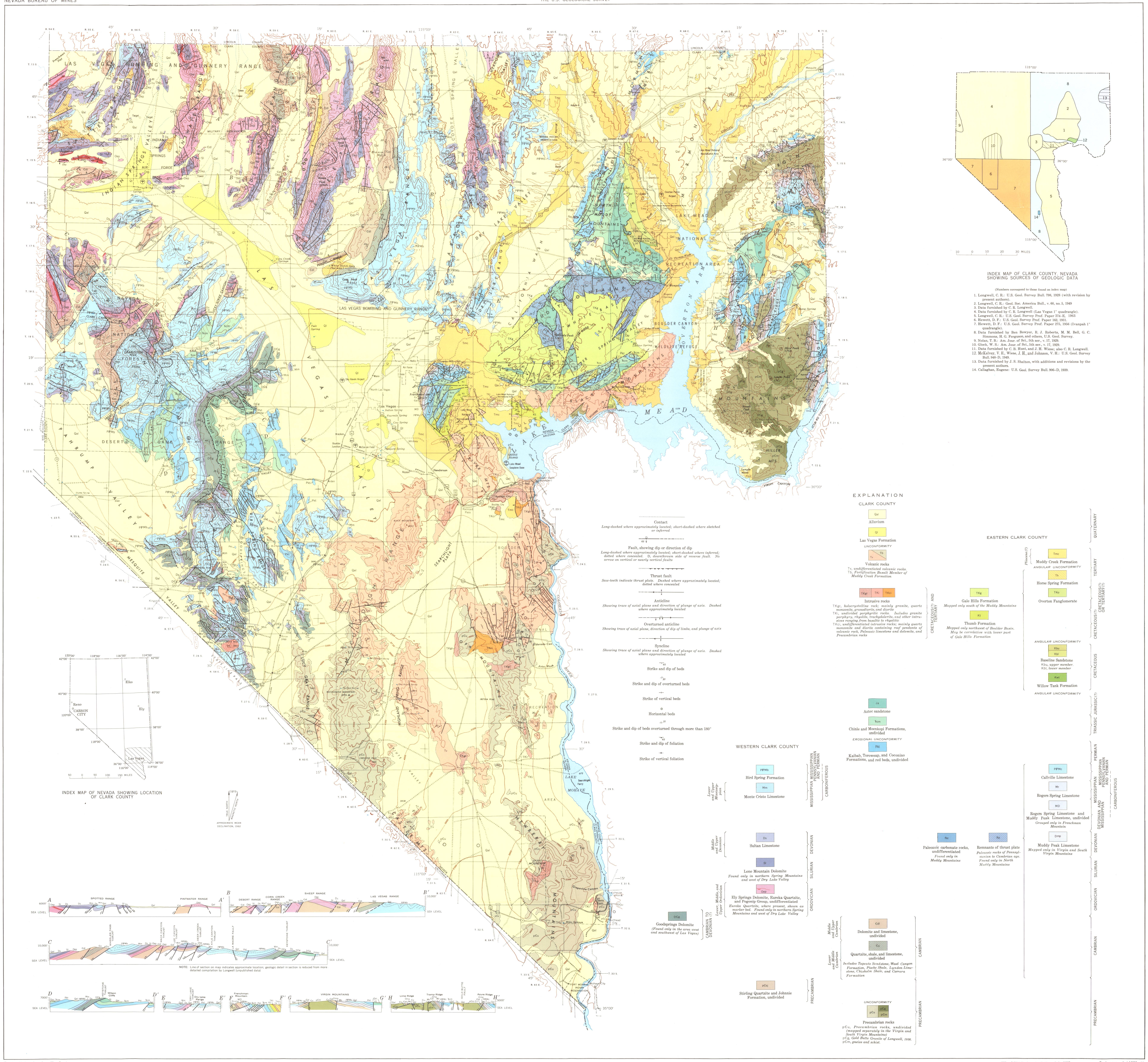
Topographic base from Army Map Service Lund (1960), Caliente (1954), and Las Vegas (1954) two-degree quadrangles

GEOLOGIC MAP OF LINCOLN COUNTY, NEVADA

By
C. M. Tschanz and E. H. Pampeyan

SCALE 1:250,000

Geology, except for Pioche region, by C. M. Tschanz and E. H. Pampeyan, 1956–1958 with revisions and additions through 1963 (see inset for mapping credit)



Topographic base from Army Map Service Kingman (1947) and Las Vegas (1953) two-degree quadrangle
More recent editions were published after geologic compilation and are used on Plate 2

GEOLOGIC MAP OF CLARK COUNTY, NEVADA

By

C. R. Longwell, E. H. Pampeyan, and Ben Bowyer

SCALE 1:250 000

CONTOUR INTERVAL 500 FEET
DATUM IS MEAN SEA LEVEL

Williams & Heintz Map Corporation, Washington, D. C. 20027

Geology compiled 1955 with revisions and additions to 1964 (see inset for mapping credit

MEMORANDUM 022618.0

STETSON ENGINEERS INC.

785 Grand Ave, Suite 202, Carlsbad, California 92008
TEL: (760) 730-0701 FAX: (415) 457-1638 e-mail: stever@stetsonengineers.com

TO:	Coyote Springs Investment, LLC	DATE:	March 5, 2018
FROM:	Stetson Engineers Inc.	JOB NO:	2674

RE: Review of Nevada State Engineer's Ruling #6255 and Order 1169 Pumping Test in the Coyote Spring Valley, Nevada

BACKGROUND

Coyote Springs Investment, LLC (CSI) requested Stetson Engineers to review Nevada State Engineer's (NSE) Ruling #6255 and Order 1169 Pumping Test in Coyote Spring Basin (Basin 210). CSI holds four underground water right permits to pump 4,600 AFY of water from the carbonate aquifer for municipal and domestic beneficial uses (Table 1). The purpose of the review was to determine if NSE Ruling #6255 addressed the availability of water supply used by existing water right holders in Coyote Spring Valley.

TABLE 1 SUMMARY OF UNDERGROUND WATER RIGHT PERMITS HELD BY CSI

Owner	Permit	Annual Duty (AF)	Comment
CSI	70429	1,500	Well CSI #2; Original Duty 2,500 AFY
CSI	74094	1,000	Well CSI #4; Change based on Permit 70429
CSI	70430	1,600	Well CSI #3; Original Duty 2,100 AFY
CSI	74095	500	Well CSI #3; Change based on Permit 70430
	Total	4,600	

Note: 2,000 AFY under Permits 70429 and 74094 were dedicated to Coyote Springs Water Resources General Improvement District in 2006.

The NSE issued Ruling #6255 on January 29, 2014, after reviewing pumping test reports resulting from Order 1169 (March 8, 2002) and Order 1169A (December 21, 2012). NSE Order 1169 placed new application for appropriation of water from Coyote Spring Valley, Black Mountains Area, Garnet Valley, Hidden Valley, Muddy River Springs, and Lower Moapa Valley (collectively termed Order 1169 Basins) in abeyance until the pumping test was completed. NSE Order 1169A stated that the pumping test was completed as of December 31, 2012 and the parties had until June 28, 2013 to file reports based on the pumping test data[1]. Subsequently, pumping test reports were submitted by Southern Nevada Water Agency (SNWA), CSI, U.S. Department of Interior, Moapa Band of Paiute Indians (MBOP), Moapa Valley Water District (MVWD), Great Basin Water Network (GBWN), and the Center for Biological Diversity (CBD).

After reviewing the pumping test reports, Ruling 6255 upheld the protests to applications for new appropriations in Order 1169 Basins, denying new applications based on the grounds that there is no unappropriated water and that they would conflict with existing water rights. Ruling 6255 also addressed perennial yield and found that the scientific literature supported that the Coyote Spring Valley, Muddy River Springs Area, Hidden Valley, Garnet Valley and California Wash should be jointly managed[2]. Ruling 6255 did not determine the perennial yield of Coyote Spring Valley, but instead indicated that the total supply to the Order 1169 Basins is likely less than 50,000 AFY[3].

1.0 April 2006 Memorandum of Agreement

A Memorandum of Agreement (MOA) was reached between SNWA, the United States Fish and Wildlife Service (FWS), CSI, and MBOP on April 20, 2006 to support conservation measures to protect the Moapa dace (*Moapa coriacea*), an endemic fish that inhabits the upper Muddy River area. The MOA outlines a series of conservation measures that includes: 1) Establishment of Recovery Implementation Program; 2) Dedication of Water Rights; 3) Habitat Restoration and Recovery Measures; 4) Protection of Instream Flows; 5) and formation of a Hydrologic Review Team. The MOA identifies the need for operational coordination among FWS, SNWA, CSI, and MWD and directs SNWA and CSI to coordinate in locating and drilling production wells.

CSI dedicated 460 AFY of its water rights to the survival and recovery of the Moapa dace and its habitat. CSI has already relinquished these rights to Permit 70430 under order 70430R01. SNWA and MVWD also worked together to dedicate the one cubic foot per second (cfs) Jones Right to support Apcar Spring. The Jones Right and CSI's dedication of a portion of Permit 70430 will be managed by the FWS to support the Moapa dace.

1 Order 1169A also rescinded provision 8 of Order 1169 that required an update to Exhibit No. 54 from the July 2001 hearing.
2 Ruling 6255, para V, page 26.
3 Ibid.

Specific to maintaining in-stream flows in the Warm Springs area, the parties have agreed to an adaptive management approach based on flows at the Warm Springs West flume. Consistent with other management techniques used throughout the western United States, the parties have determined trigger levels and action items for flow at the flume. Each trigger level has a related action item that ranges from meetings to reduction and cessation of groundwater pumping.

The 2006 MOA specifically identifies the need for the parties to follow adaptive management methods to protect and recover Moapa dace following initiation of the Recovery Implementation Program. Specifically, the parties agree to cooperate in continuing to re-evaluate necessary measures to protect and recover the Moapa dace. These measures include funding studies, establishing a science-based monitoring and management plan, and assessing feasibility of augmenting and/or restoring in-stream flows. The adaptive management techniques would be applied to all aspects of the conservation measures included in the 2006 MOA.

2.0 2013 Pumping Test Reports

Pump test reports were prepared by multiple parties following the completion of the November 2010 to December 2012 pumping test and Order 1169A. Groundwater from the carbonate aquifer was pumped at the MX-5 well in Coyote Spring Valley and piped to Bowman Reservoir in Lower Moapa Valley and ultimately released from Bowman Reservoir to Lake Mead. Other pumping by CSI wells contributed to the total pumping from Coyote Spring Valley during the pumping test, resulting in 11,249 acre-feet pumped over the 25 ½ month period. Other pumping occurring in the other Order 1169 Basins was recorded at 30 production wells. Groundwater level data were collected at 79 monitoring and pumping wells in addition to barometric data collected in Coyote Spring Valley and California Wash.

Three main pumping centers were identified within the Order 1169 Basins, including: Coyote Spring Valley, Muddy River Springs Area, and Garnet Valley Black Mountain Area. During the pumping test in 2011 and 2012, pumping in Coyote Spring Valley was 5,331 AFY and 5,102 AFY[4], respectively. Pumping and diversions in the Muddy Springs River Area[5] during 2011 and 2012 was 8,100 AFY and 6,100 AFY, respectively. Finally, pumping in Garnet Valley Black Mountain Area6 was 2,440 AFY and 2,707 AFY during 2011 and 2012, respectively. Total pumping in the three main pumping areas in 2011 and 2012 was 15,871 AFY and 13,909 AFY, respectively. Generally,

4 Nevada State Engineer Order 1169 and 1169A Study Report, SNWA, June 2013.
5 Ibid, Figure 6.
6 Ibid, Figure 9.

pumping in Coyote Spring Valley accounted for slightly more than 1/3 of the annual pumping and water diversions during the 25½-month test period.

Declines in groundwater levels were measured throughout the Order 1169 Basins during the pumping test. Reductions in spring flow was observed at the Pederson and Pederson East gages. The reduction in flow at the springs did not result in a reduction in flows at the Warm Springs West gage that would have triggered an action under the 2006 MOA[7]. Additionally, The SNWA Study Report found that there is a lack of pumping responses north of the Kane Springs Fault, north of the MX-5 pumping site.

The MBOP Order 1169 Study observed that declines in groundwater levels during the test period were affected by several environmental factors[8]. The report indicates that water level fluctuations occurred due to local and regional climate, atmospheric pressure, tides, and crustal loading phenomena. One of the MBOP Study's conclusions was that the pumping response from groundwater pumped at MX-5 is dominated by boundary conditions, not groundwater storage[9]. The impact of regional and local environmental factors and boundary conditions on observed groundwater levels throughout the Order 1169 Basins complicate the analysis of discerning the difference between impacts caused by pumping in Coyote Spring Valley and pumping in other basins.

The DOI Study[10] also reviewed impacts from the Order 1169 pumping test, finding that water captured during the test was likely from groundwater storage and only a fraction was from natural discharge.[11] The DOI Study draws their conclusion based on assuming an average 1.4-foot drawdown over a 690,000-acre area and an average storage coefficient of 0.01 (dimensionless), a value typical for semi-confined aquifers. The study further suggests that the test did not reach equilibrium and that natural recharge had not yet been captured.

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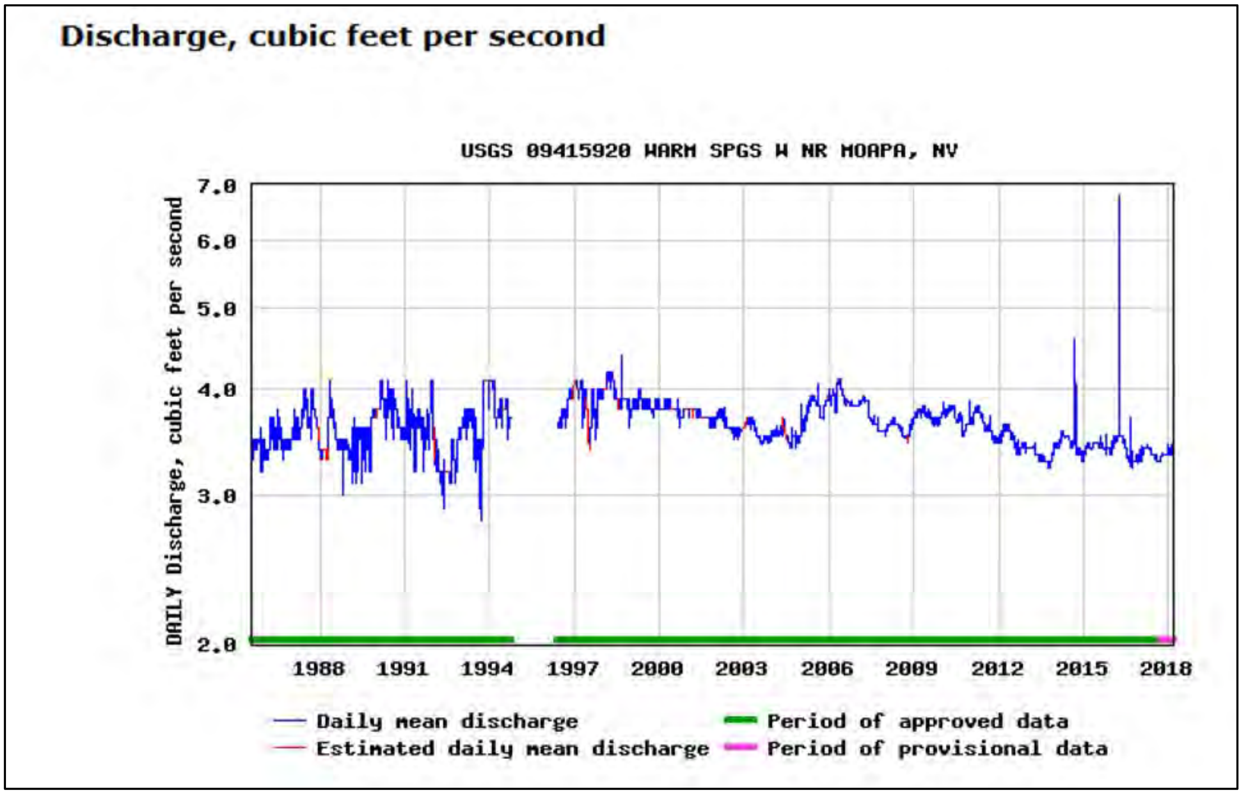
7 Ibid, page 56.
8 MBOP Order 1169 Study, page 31 (Mifflin and Associates, June 28, 2013).
9 MBOP Order 1169 Study, page 32 (Mifflin and Associates, June 28, 2013).
10 Test Impacts and Availability of Water Pursuant to Applications Pending Under Order 1169, U.S. Fish and Wildlife Service, Bureau of Land Management, National Park Service, June 28, 2013.
11 Ibid, page 31.

The GBWN Study[12] found that "*groundwater levels for all wells have been decreasing since the mid 1990 with some recovery due to wet conditions from 2004 to 2005. During the 2010 to 2012 pump test period the rate of decline in carbonate wells increased.*"[13] Data provided in their report indicates that groundwater levels in the carbonate aquifer[14] and spring discharge at Petersen[15] increased following the 2005 wet year event. Review of the USGS data at Warm Springs West near Moapa, Nevada (USGS 09415920) depicts the response to 2005 wet year conditions as shown below. Further investigation of the streamflow at this gage also shows a response to wet climatic conditions that occurred in the late 1990s, followed by a long decrease in streamflow until the



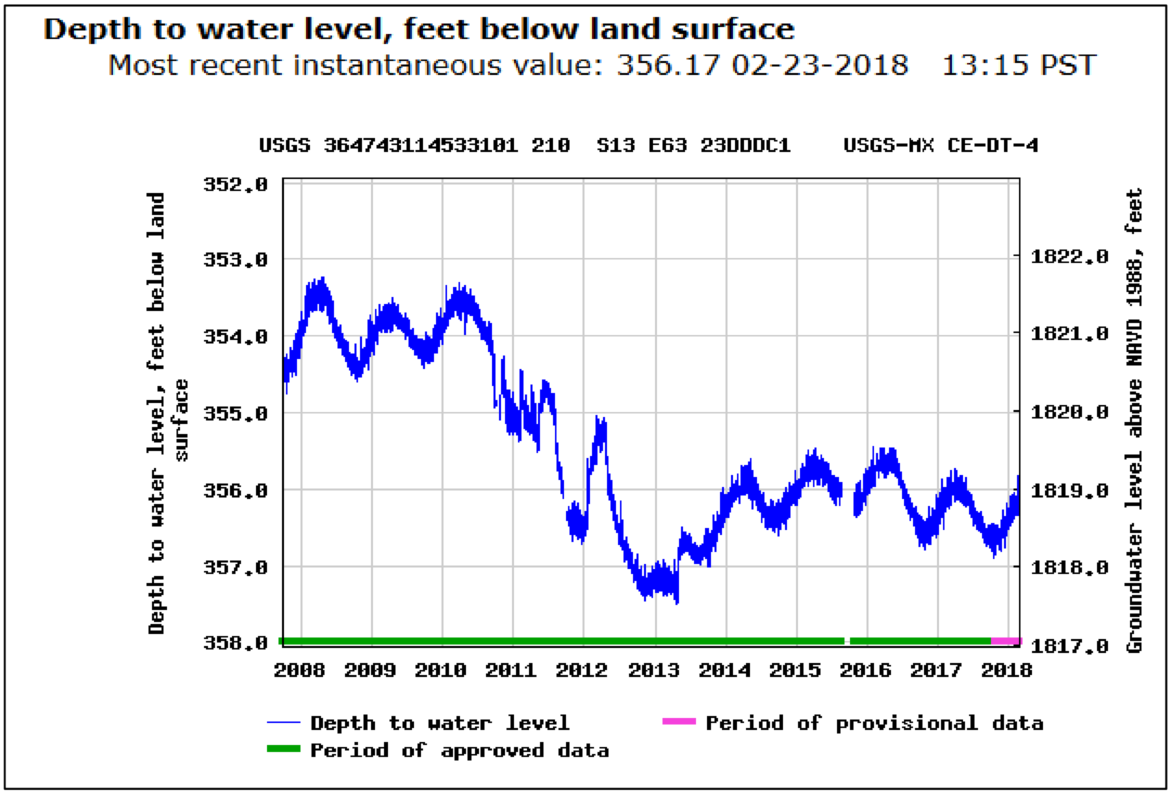
https://nwis.waterdata.usgs.gov/nv/nwis/dv?cb_00060=on&cb_00065=on&format=gif_default&site_no=09415920&referred_module=sw&period=&begin_date=1985-08-22&end_date=2018-03-05

beginning of the 2005 wet period. While the GBWN Study discusses that "*After 2005 the region primarily returned to drought conditions. The late 1990s were among the wettest years since 1980 (Mayer and Congdon 2008)*"[16], it does not differentiate the impacts caused by Order 1169 pumping,

12 Technical Memorandum Comments on Carbonate Order 1169 Pump Test Data and the Groundwater Flow System in Coyote Spring and Muddy River Springs Valley, Nevada. Prepared by Tom Myers, Ph.D., June 12, 2013.
13 Ibid, Section: Muddy River Springs Area
14 Ibid, Figure 13
15 Ibid, Figure 17
16 Ibid, Section: Discussion of Pumpage, Groundwater Levels and Spring Discharges.

other pumping in the five-basin area, and climatic conditions. Additional groundwater, spring, and climatic data would be required to assess how the carbonate aquifer and springs respond to prolonged wet and dry cycles. Based on the USGS streamflow data, it appears that streamflow at Warm Springs West near Moapa is being managed in consideration of both climatic and man-induced pumping responses to support the Moapa dace, as shown by recent streamflow levels slightly below the 2004 levels.

The figure below shows groundwater levels at Coyote Spring Valley monitoring well MX-4 from water year 2008 to the present[17]. The seasonal variation due to environmental factors described in the MBOP Study can be clearly seen in the sinusoidal pattern that appears to vary annually by approximately 1 foot. The impact of the Order 1169 pumping test can also be seen, starting in November 2010 and ending in December 2013. The impact of MX-5 pumping cessation for



https://nwis.waterdata.usgs.gov/nwis/uv?cb_72019=on&format=gif_default&site_no=364743114533101&period=&begin_date=2007-10-01&end_date=2018-02-23

maintenance is reflected in the graph during the summer of 2011 and winter of 2012 where water levels either flatten or recover, respectively. Furthermore, water levels at MX-4 appear to flatten

17 Period of record available from USGS NWIS.

from November 2012 through March 2013 when pumping in Coyote Spring Valley averaged slightly less than 500 AF per month[18], equivalent to a rate of 6,000 AFY.

The relatively flat groundwater levels at MX-4 between 2008 and 2011 suggest that groundwater levels have reached a steady-state, indicating groundwater mining is not occurring. The same general trend in groundwater levels can be seen between 2013 and the present, also suggesting that groundwater mining is not occurring. During steady state conditions when groundwater mining is not occurring, groundwater levels are maintained by natural recharge to the basin.

This simplified explanation of steady-state conditions in Coyote Spring Valley does not account for environmental factors, regional climatic trends, boundary conditions, and pumping by others. Analytical or numerical solutions required to identify and describe boundary conditions within the Coyote Spring Valley would require exact location and specific quantities of pumping that occurred between 2008 and the present. Groundwater level recovery data, following an aquifer test, provides useful information regarding the occurrence and movement of groundwater in an aquifer. Regardless of whether the pumping test reached equilibrium after 25 ½ months, analysis of groundwater level responses throughout the Order 1169 Basins, following the end of the test period, provides valuable and useful information of the aquifer properties and groundwater movement.

3.0 Conclusions and Recommendations

The Order 1169 pumping test began in November 2010 and ended in December 2012 after a total of 5,331 AFY and 5,102 AFY were pumped from Coyote Spring Valley during 2011 and 2012, respectively. Groundwater was extracted from the MX-5 and CSI-1 through CSI-4 wells consistent with the NSE letter[19] of July 1, 2010. Pumping test reports were prepared and submitted to the NSE by multiple parties on or before June 28, 2013, consistent with Order 1169A (December 21, 2012). NSE Ruling #6255 was then issued on January 29, 2014, indicating that there was no available unappropriated water in the Order 1169 Basins.

CSI holds four underground water rights to appropriate 4,600 AFY from the carbonate aquifer in Coyote Spring Valley. A portion of these rights have been dedicated to the Coyote Springs Water Resources General Improvement District (GID) to provide service to CSI development, while other portions of these rights have been relinquished for habitat support.

18 SNWA Order 1169 Study, Figure 4, page 12.
19 July 1, 2010 letter from NSE to Study Participants regarding Applications 54055-54059, 63272-63276, 54076; Order No. 1169.

Currently, CSI and GID exercise their rights to underground carbonate water from wells CSI-1 through CSI-4.

The 2006 MOA between SNWA, FWS, CSI, and MBOP supports adaptive management and conservation measures to protect the Moapa dace in the upper Muddy River area. The conservation measures include: 1) Establishment of Recovery Implementation Program; 2) Dedication of Water Rights; 3) Habitat Restoration and Recovery Measures; 4) Protection of In-stream Flows; 5) and formation of a Hydrologic Review Team. The parties have agreed to follow adaptive management methods to protect and recover Moapa dace following initiation of the Recovery Implementation Program. These methods include funding studies, establishing a science-based monitoring and management plan, and assessing feasibility of augmenting and/or restoring in-stream flows. The 2006 MOA clearly outlines the Muddy Springs West gage as a trigger, flow levels as thresholds, and action items to implement in order to protect the Moapa dace.

Our review of the SNWA, MBOP, DOI, and GBWN Study Reports found that they were all consistent in indicating that there was no available unappropriated groundwater in the Coyote Spring Valley. These reports did raise questions though as to the extent of the impact from the pumping test and the physical parameters that control the occurrence and movement of groundwater in the carbonate aquifer throughout the Order 1169 Basins. Some of the reports were not consistent in assessing the difference between groundwater mining and capture of natural inflow, raising the question as to the source of the water pumped from MX-5 and the CSI wells. Additional monitoring and analysis is required to delineate the source of the groundwater and its impact on other resources in the Order 1169 Basins.

The response in the carbonate aquifer groundwater levels and springs, as well as streamflow at Warm Springs West near Moapa, is related to both pumping and climatic variability. While the GBWN Study indicates that the region returned to drought conditions after 2005, streamflow at the Warm Springs West gage is slightly less than levels observed in 2004. While we can't differentiate the difference between natural and anthropogenic impacts based on our review of available data, streamflow required to protect the Moapa dace at the 2006 MOA gage is being managed.

Total groundwater pumping and diversions in the Order 1169 Basins in 2011 and 2012 was 15,871 AFY and 13,909 AFY, respectively, including up to 8,100 AFY in the Muddy Springs River area. Pumping from Coyote Spring Valley during the pumping test was approximately one-third of the annual pumping and extractions that occurred in 2011 and 2012 throughout the Order 1169 Basins. When environmental factors and changes in regional climate are considered, conclusions regarding the extent of the impact from the pumping test remain in question.

Because the pumping test only occurred for 25 ½ months and the study reports were completed within 180 days, analysis of water level and climatic data following the end of the pumping test was not addressed. The groundwater levels at MX-4 between 2008 and the present suggest that steady-state conditions have existed, indicating the groundwater mining in Coyote Spring Valley was not occurring. Based on the limits of the available data used in the Order 1169 Study Reports, no conclusion can be drawn regarding how existing rights impact resources. Therefore, we conclude that Order 6255 only addressed whether or not unappropriated water was available in the Order 1169 Basins.

RECOMMENDATIONS

The Order 1169 pumping test raises uncertainty regarding the occurrence and movement of groundwater in the Coyote Spring Valley Basin, as well as its impact on down-gradient springs and stream flows. Regional climatic variability and other environmental factors affect the response in historical groundwater levels in the Order 1169 Basins as shown by the water level response in MX-4. CSI should continue to exercise their water rights through adaptive management techniques with other parties in the Order 1169 Basins in order to eliminate uncertainties regarding groundwater occurrence and movement. The existing 2006 MOA, and other supporting agreements, provide the structure for a cooperative long-term process through monitoring and adaptive management to protect public interest. Execution of adaptive management techniques, extensive monitoring, and existing agreements allows current water right holders to exercise their right and collect data over the long-term that better defines the flow system in the Order 1169 Basins.

Evaluation of boundary fluxes for the ground-water flow model being prepared as part of the SNPLMA-5 project

by
James R. Harrill
December 31, 2007

This evaluation was made in response to a request by Rick Waddell (Geotrans) that I review the available information and estimate locations and magnitudes of boundary fluxes for the model area. The model area includes all or part of 13 hydrographic areas in southeastern Nevada (figure 1). The model area is tributary to the Colorado drainage and includes the Muddy River drainage, Meadow Valley Wash, the Virgin River downstream from Saint George, and Lake Meade which forms the southern boundary of the area. Hydraulic gradients are toward the Colorado River and consequently the study area can potentially receive subsurface inflow from basins along the west, north, and east boundaries. There is also potential for subsurface outflow to Lake Mead to occur along the southern boundary.

The purpose of this document is to review existing information and develop initial estimates of flows across the model boundary. Information will be organized and discussed by the eight basins that occur along the model boundary.

Las Vegas Valley – The northeastern part of Las Vegas Valley is included in the model area. There is a gradient from parts of the Las Vegas Range towards Hidden Valley, Garnet Valley and Parts of the Black Mountains Area. Consequently recharge from parts of the Las Vegas Range supports ground-water flow into the study area. The western part of the model boundary in Las Vegas Valley is along a ground-water divide and the southern part of the model boundary is roughly parallel to The Las Vegas shear zone. Consequently there is virtually no flow from the main part of Las Vegas Valley into the area of the flow model.

Flow from Las Vegas Valley into Frenchman Mountain and presumably into the Black Mountains Area and Lake Mead was documented by Loletz (1963). A ground-water flow model of Las Vegas Valley (Harrill, 1976) estimated that the total outflow beneath Frenchman Mountain was 1,200 acre-ft/yr. A subsequent model study (Morgan and Dettinger, 1995) estimated subsurface outflow in this area of 2,100 acre-ft/yr. Most of this outflow occurs south of the Las Vegas shear zone so little of this underflow occurs within the model area. This study by Harrill, (1976) indicated the simulated inflow from the area of the Sheep and Las Vegas ranges was less than the amount obtained using the Maxey-Eakin method. Simulated inflow along the north boundary of the Las Vegas model was 1,600 acre-ft/yr down-gradient from the area of the Sheep Range and 680 acre-ft/yr down-gradient from the area of the Las Vegas Range. In addition Corn Creek springs and associated ET area is located near the southwest tip of the study area. The mean spring discharge for water years 1985-1999 is about 200 acre-ft/yr (Jones and others, 1999).There is additional seepage and upward leakage that is consumed by evapotranspiration. Total discharge in the Corn Creek Springs area may be about 500

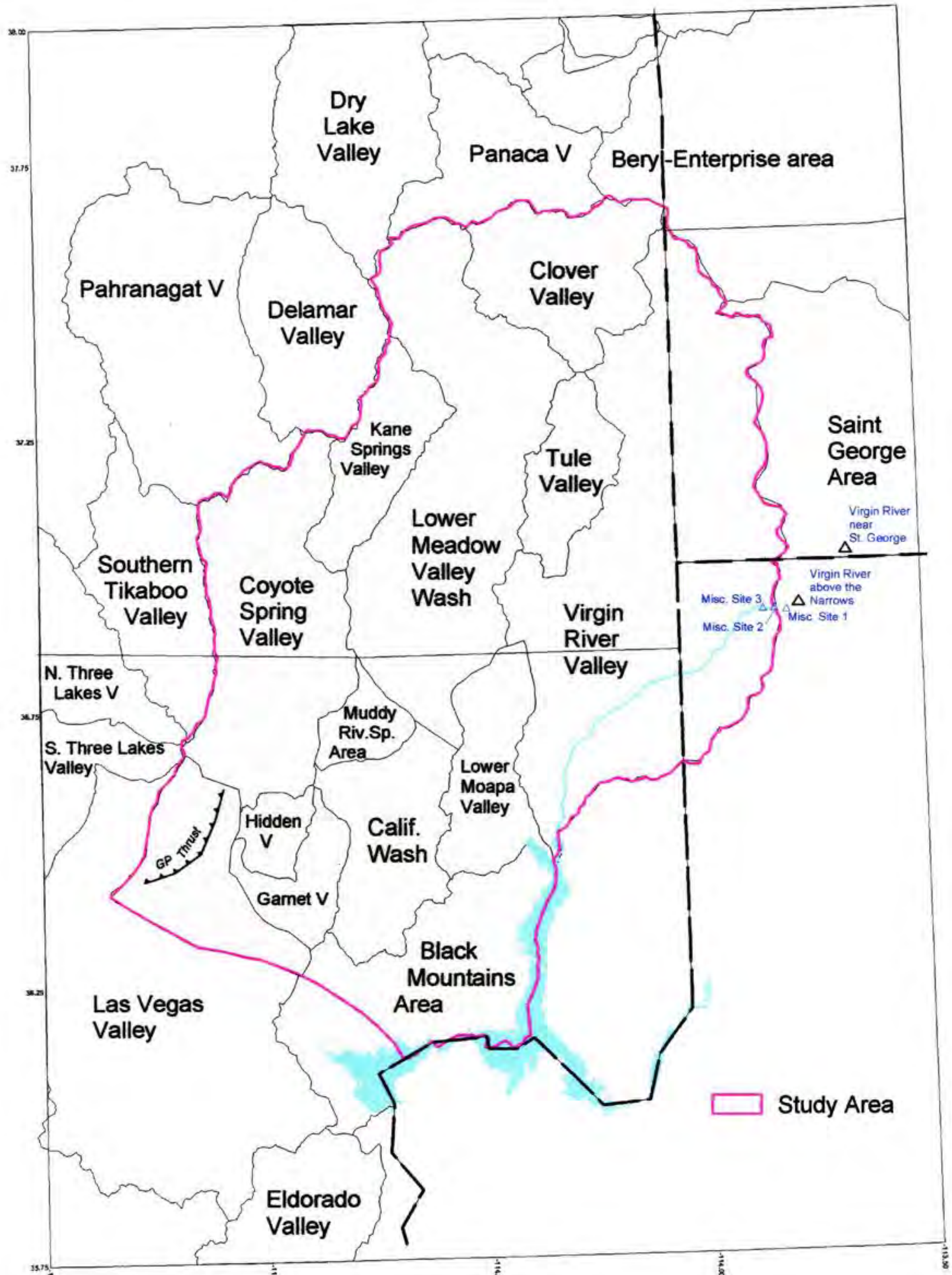


Figure 1. Study area for SNPLMA-5 project

acre-ft/yr. Some or all of this discharge might be supplied by recharge on the east flank of the Sheep range.

The Gass Peak thrust (figure 1) may form an internal barrier in the Las Vegas Valley part of the model that has some control on the flow of ground water. The poorly permeable clastic rocks thrust up be the fault are prominently displayed along Fossil Ridge at the base of the east flank of the Sheep Range. Winograd and Thordarson (1975) used this feature as the effective east boundary of the Ash Meadows ground-water flow system. Adjacent to the southern Sheep Range this feature could be an effective barrier to ground-water flow however as one moves north along the Sheep Range the Keystone Thrust appears to plunge gently to the north and does not form as effective a barrier. Recharge in the Las Vegas Range (east of the Keystone thrust) could readily flow east into the main part of the study area. However, water recharged on the east flank of the southern Sheep Range may not readily flow to the east because of the barrier formed by the Keystone Thrust. Some of the water could back up and then flow around the north end of the effective part of the barrier into Coyote Spring Valley. Part of the water could also flow south to supply discharge at Corn Creek Springs and also support some underflow into the main part of Las Vegas Valley.

Coyote Spring and Kane Springs Valleys – These areas are both adjacent to the Southern part of Pahranagat and Delamar Valleys so they will be discussed together.

A reconnaissance study of Coyote Spring and Kane Springs Valleys and the Muddy River Springs Area (Eakin, 1964, p. 14) recognized that the water supplying the Muddy River Springs is derived largely from ground water that largely moves through Paleozoic carbonate rocks, which in turn are supplied by recharge derived from precipitation in favorable areas generally north and west of the springs. No estimates were made of locations and amounts of subsurface inflow to Coyote Spring Valley.

A reconnaissance study of Pahranagat and Pahroc Valleys (Eakin, 1963b) described the springs in Pahranagat Valley were supplied by flow through carbonate rocks and that the spring discharge was large enough require inflow from upgradient basins to the northwest, north, and northeast. The emphasis of this study was on finding enough water to supply spring discharge in Pahranagat Valley and subsurface outflow was not estimated. However the report states “A minor amount of subsurface outflow may occur through valley fill in the gap at Maynard Lake—the southern end of Pahranagat Valley. A large amount of ground water may discharge through Paleozoic carbonate rocks at the south end of the valley toward areas of lower head, although the proportion derived from the Pahranagat and Pahroc Valley drainage areas cannot be identified at this time” (Eakin, 1963b, p. 19).

Eakin (1966) described a regional interbasin ground-water flow system in the White River Area of southeastern Nevada. In this report 35,000 acre-ft/year of underflow was estimated to occur from Pahranagat Valley to Coyote Spring and Kane Spring Valleys. This water is generally assumed to move directly from Pahranagat Valley to Coyote Spring Valley. However, Delamar, Pahranagat, and Tikaboo Valleys are all upgradient from Coyote Springs Valley. Flow from any of these areas to Coyote Springs Valley is possible if the rocks between the areas are permeable. The Delamar Mountains east and north of Delamar Lake is underlain by a large magnetic source body believed to consist of granitic rocks or crystalline basement (Plume, 1996, plate 5). This same feature is also shown on section A-A' (Page and others, 2006) as a mass of Tertiary intrusive rock. This feature would block interbasin flow into the northern part of Kane Springs Wash. To the west the alluvial deposits of Delamar Valley overlie volcanic rocks which in turn overlie carbonate rocks of Cambrian age. Deposits at the southern end of Delamar Valley are highly faulted (see Page and others 2005) and some water may move south through fractures along the Pahranagat shear zone into the western end of Kane Springs Valley or into Coyote Springs Valley. There is not enough information to make a direct estimate of this interbasin flow however Eakin (1963a) estimated the recharge to all of Delamar Valley to be 1,000 acre-ft/yr. As much as 500 acre-ft/yr might flow south from Delamar Valley with the remaining 500 acre-ft/yr flowing to Pahranagat Valley as originally estimated by Eakin.

Water in Pahranagat Valley may mostly flow directly south into Coyote Springs Valley however there is also a gradient from Pahranagat Valley to Tikaboo Valley. Some of the water from Pahranagat Valley flow southwest along the Pahranagat Shear zone from Pahranagat Valley into Tikaboo Valley.

Very small segments of the boundaries of Three Lakes Valley north and Three Lakes Valley south areas are adjacent to the boundary of Coyote Springs Valley. No significant inflow from this area to Coyote Springs Valley from these two areas occurs.

The southern part of Tikaboo Valley has ground-water levels that are higher than those in adjacent parts of Coyote Springs Valley (elevation of approximately about 3,046 feet at well DDL-1 on the Tikaboo Valley playa compared to about 2,200 feet at the northern end of Coyote Springs Valley), thus ground-water inflow from Tikaboo Valley to Coyote Springs Valley is possible. Also, the depth to water beneath the playa is about 158 feet which precludes discharge by ET and indicates ground-water discharge from Tikapoo Valley is by subsurface flow. Unfortunately there is not enough data to determine the direction of subsurface outflow from water-level gradients. The only other well present is well DDL-2 (water-level elevation about 3076.5 feet) located just south of the playa and completed in carbonate rock. The higher water-level elevation in this well could be due to a different head in the carbonate rock aquifers and not be representative of a gradient between the two wells. At least three wells completed in the playa sediments are needed before the direction of ground-water flow can be determined. Although the exact direction of ground-water flow beneath the Desert Lake playa cannot be determined if a gradient exists between two areas and there is hydraulic continuity between the areas then ground-water flow between the two areas is probable.

Sweetkind and others (2001) developed interpretive cross sections for the Death Valley regional flow system and surrounding areas. Two of their sections cross the northern Sheep Range and show that continuity through carbonate rocks. Cross-sections by Page and others (2006) also show continuity through carbonate rocks across the north end of the Sheep Range. Harrill and Bedinger (2004) used Darcy's law calculations to estimate boundary fluxes for a ground-water flow model of the Death Valley regional ground-water flow system. Their calculations (Harrill and Bedinger, 2004, table A2-4) showed a flux of about 7,300 ac-ft/yr from Tikaboo Valley to Coyote Springs Valley across boundary segments located in the northern Sheep Range. The same table showed that north of the Sheep Range there was both inflow and outflow between the White River flow system and the Death Valley flow system. There was a net flux of about 2,155 acre-ft/yr from Pahranagat, Garden, and Coal Valleys into the Death Valley ground-water flow system. This water then flows down gradient and becomes a source for part of the 7,300 acre-ft/yr estimated to flow from Tikaboo Valley to Coyote Spring Valley. The remainder of the outflow is probably supplied by recharge within Tikaboo Valley. Rush (1971, table 3) estimated recharge to southern Tikaboo Valley to be 3,400 acre-ft/yr. As much as all of this water could contribute to the subsurface inflow to Coyote Spring Valley, depending on the exact location of the hydrologic boundary between the Death Valley flow system and the White River (or Colorado) flow system.

Prudic and others (1995) developed a conceptual ground-water flow model of the carbonate rock province of the Great Basin. In this model Tikaboo Valley is included in the White River subregion and simulated flow is from Tikaboo Valley to Coyote Springs Valley. The amount of flow from Tikaboo Valley is not specifically stated but simulated underflow from Pahranagat Valley and adjacent Tikaboo Valley is about 24,000 acre-ft/yr (Prudic and others, 1995, p.D72). This is about 11,000 acre-ft/yr less than the 35,000 acre-ft/yr estimated by Eakin (1966, p. 265).

Faunt and others (2004) reported results from a transient numerical model of ground-water flow in the Death Valley regional ground-water flow system. Simulated outflow from southern Tikaboo Valley to Coyote Springs Valley was 2,635 acre-ft/yr. (Faunt and others 2004, table 26). This was about half of the 5,570 acre-ft/yr estimated during the initial configuration of the model.

Lower Meadow Valley Wash – Lower Meadow Valley Wash is included in a reconnaissance study of the Meadow Valley area (Rush, 1964). Specific estimates of flow from Panaca Valley to Lower Meadow Valley Wash were not made. The report states that ground-water is transmitted primarily in the alluvium. Volcanic rocks that predominate in Northern Lower Meadow Valley Wash were not considered to transmit large amounts of inter basin flow. In general the ground water movement follows the direction of surface flow from the mountain areas to the centers of the valleys. This pattern is modified, however, by the general flow of ground water from the northern part of the Meadow Valley Area, where most of the recharge occurs, to the southern part of the area where much of the discharge occurs. Nevada State Water Planning Report 3 (Scott and others, 1971) lists ground-water inflow from Panaca Valley as "minor." Surface water inflow from Panaca Valley is listed as "some."

The preceding estimates are for the shallow part of the system. Cross sections prepared by the USGS (Page and others, 2006, section A-A') indicate that the volcanic rocks at the north end of Lower Meadow Valley wash are underlain by Mesozoic and Paleozoic rocks that include sequences of carbonate rocks. These rocks are usually capable of transmitting water, however the degree of subsurface continuity, local composition, and hydraulic gradient at depth are not well understood. Moreover, there no large down-gradient areas of ground water discharge. Consequently, flow in these rocks is probably moderate or small.

Clover Valley – Clover Valley is included in the Meadow Valley area studied at reconnaissance level by Rush (1964). There were no estimates of subsurface inflow to Clover Valley in this report. The area is underlain by volcanic rocks. Alluvial deposits occur along Clover Creek and some of its tributaries. The report states that ground water moves primarily through the alluvium and tends to follow the surface drainage. A small amount of surface and subsurface flow moves into Lower Meadow Valley Wash at Caliente. There is little or no inflow from Panaca Valley in the shallow part of the system. A shallow ground-water divide probably exists between Clover and Panaca Valleys along their common boundary with the possible exception of the first 1 to 2 miles east of Caliente. Here the topographic divide is lower as is precipitation and potential recharge. A shallow ground-water divide may not be present in this area.

The volcanic rocks of Clover Valley are underlain by Mesozoic and Paleozoic rocks. The Paleozoic rocks contain sequences of carbonate rocks that are capable of transmitting ground water. There is a regional gradient from north to south so some deep subsurface inflow from Panaca Valley is possible. The amount depends on the specific location, degree of continuity, and local composition of the carbonate rocks as well as the hydraulic gradient at depth. There are no large down-gradient springs that could only be supplied by subsurface inflow so large amounts of subsurface inflow probably do not occur. In the vicinity of Mesquite, wells drilled into vertical faults in the Muddy Creek formation contain good quality water thought to be derived from deeper carbonate rocks. Upward leakage along vertical faults in the Muddy Creek formation could be the mechanism that would allow for diffuse discharge of water from the carbonate rocks that underlie the area at depth.

Virgin River Valley – A reconnaissance level study of the Lower Virgin River Valley Area was made by Glancy and Van Denburgh (1969). A study of the hydrology and water quality of the Beaver Dam Wash, at the northern end of the Virgin River Valley area, was made by Holmes and others (1997).

The north and northeast borders of the area are underlain primarily by noncarbonate rocks. The ground-water divide in this area conforms to the topographic divide and there is no significant inflow from the north and northeast.

The southeastern boundary of the area is along the crest of the Virgin Mountains and is underlain by noncarbonate rocks. A ground-water divide coincides with the topographic divide so no significant subsurface inflow occurs along this part of the boundary.

A segment of the eastern boundary of the area that is about 20 miles long (from approximately where US route 91 crosses the Beaver Dam Mountains south to about 6 miles south of the Virgin River) that is underlain by carbonate rocks. These rocks are capable of transmitting large amounts of ground water. Also, this area is at the transition between the Great Basin and the Colorado Plateau. There elevation is offset, the valley floor east of the Beaver Dam Mountains is about 430 feet higher than the valley floor west of the Beaver Dam Mountains where the Virgin River exits from a deep canyon that cuts through the Beaver Dam Mountains. These two features could cause a ground-water divide that may have been present along the boundary of the study area to be shifted to the east or not be present. In either case there would be subsurface inflow across the boundary of the study area.

The combination of a topographic gradient and permeable carbonate rocks also impacts the flow of the Virgin River. In theory one would expect flow losses as water flowed into the upper end of the Virgin River Canyon and gains in flow in the lower portion of the canyon. In addition, the Virgin River Canyon has been cut deeply into the Beaver Dam Mountains and at least in the lower part of the canyon the river forms a drain and collects water recharged in the mountains adjacent to the river. Available information supports this conceptual description. Streamflow above the Virgin River Canyon is measured by USGS gage 09413500 (Virgin River near Saint George, Utah). Average annual flow for the eight year period 1999 through 2006 is 188.67 cfs. USGS gage 09413700 (Virgin River above the Narrows near Littlefield) is in the Virgin River Canyon about 11 miles downstream from the gage near St. George. Average annual flow for the 8 year period 1999 through 2006 is 55.6 cfs. This is a loss in flow of about 33 cfs. There do not appear to be significant diversions between the gages so the loss is due almost entirely to infiltration into carbonate rocks. Gains in the lower part of the canyon are not as well documented however Glancy and Van Denburgh (1969, table 4) list miscellaneous Streamflow measurements in the lower Virgin River Valley. Measurement sites 1 and 2 are in the Narrows at the lower end of the Virgin River Canyon and site 3 is in the valley just downstream from the mouth of the canyon. Measurements were made at all 3 sites on 12/13/1951. The flow increased consistently at all sites (#1-143 cfs, #2-158 cfs, and #3-170 cfs). The total gain is about 27 cfs. Also, Holmes and others (1997, p. 29) cite Trudeau and others (1983) when they state “in the Virgin River Gorge springs discharge a total of about 20 cfs from rocks of Paleozoic age”. It is probable that some gain in streamflow occurs between the gage above the Narrows and miscellaneous measurement site 1. This amount is not known but a gain of about 6 cfs would be needed to restore all of the flow lost to infiltration in the upper part of the canyon. This amount is suggested as a working estimate of the gain in this reach although if significant recharge from the adjacent mountains is draining into the river the actual gain may be larger.

The study area boundary crosses the Virgin River between miscellaneous measurement sites 1 and 2. Streamflow across the study area boundary can be estimated as the flow at the gage above the narrows plus the gain between sites 1 and 2 (15 cfs) plus the estimated gain between the gage above the Narrows and site 1 (6 cfs).

The boundary flux that occurs due to the offset of the ground-water divide mentioned previously is not known. The amount of offset may vary with location. Along the Virgin River Canyon and adjacent to the river there may be no divide at all but just a gradient from the western edge of the Saint George area to the mouth of the canyon. It is not known if this condition persists north and south of the river where carbonate rocks are the dominant rock type. The noncarbonate rocks of the Colorado Plateau do not typically transmit large amounts of ground water. Consequently, the offset of the ground-water divide will probably be limited to the east flank of the Beaver Dam Mountains and adjacent hills. The boundary flux can be estimated as a percentage of the potential recharge generated on the east flank of the Beaver Dam Mountains and adjacent hills. The percentage of recharge that becomes a boundary flux is probably between 30 and 100 percent of the estimated potential recharge. Rough estimates of this amount can also be made using information presented by Glancy and Van Denburgh (1969, p.33). They estimated the total spring flow contribution to flow at the Littlefield gage to be about 70 cfs. If one assumes that all of the recharge to the carbonate-rock area of the Beaver Dam Mountains circulates deep and discharges as springflow below the Littlefield gage. Given this assumption the boundary flux can be estimated as:

Boundary flux = 70 cfs - 33 cfs (gain above site 3) – pot. recharge to W flank of Beaver Dam Mountains and adjacent hills

The boundary flux estimated using this procedure can be compared to the potential recharge calculated for the east flank of the Beaver Dam Mountains and adjacent hills. There is no guarantee that these recommended calculations will yield acceptable results. They are suggested simply as means of developing an initial estimate of boundary flux using existing information.

There is subsurface outflow from the Virgin River Valley to Lake Mead. Glancy and Van Denburgh (1969, p. 51, table 16) state "subsurface outflow to Lake Mead beneath the Virgin River Valley occurs through the valley fill and probably through the underlying consolidated rocks. Although no direct estimates have been made the water budget suggests that the subsurface outflow maybe substantial, possibly as much as 40,000 acre-ft/yr." They go on to say that this estimate may seem unreasonably large but given the gains observed upstream from Littlefield outflow on the order of 40,000 acre-ft/yr may be possible. Simple Darcy's law calculations suggest that the subsurface outflow may be more on the order of several thousand acre-ft/yr. Use of the estimate based on Darcy's law is recommended by the author.

Lower Moapa Valley – The lower Moapa Valley area was studied by Rush (1968). The Lower Moapa Valley discharges both surface and ground water into Lake Mead. Surface outflow to Lake Mead was estimated to be about 10,000 acre-ft/yr (Rush, 1968, table 14). Subsurface outflow to Lake Mead was estimated to be about 1,100 acre-ft/yr using Darcy's law calculations (Rush, 1968, table 7).

Black Mountains Area – The Black Mountains area is included in the Lower Moapa-Lake Mead area studied by Rush (1968). Subsurface outflow to Lake Mead was estimated to be about less than 100 acre-ft/yr assuming that all of the estimated recharge was discharged as subsurface outflow (Rush, 1968, table 7). This discharge is distributed along the shore line of the Black Mountains Area. Harrill (1976) estimated that about

1,200 acre-ft/yr of subsurface flow discharged from Las Vegas Valley and flowed into the Black Mountains area to be discharged as underflow to Lake Mead. A subsequent model study by Morgan and Dettinger (1994) estimated underflow in this area is about 2,100 acre-ft/yr. The value of 2,100 acre-ft/yr was used by Dettinger and others (1995, table 8) as an estimate of underflow beneath Frenchman Mountain toward the Colorado River. This underflow would occur in the general vicinity of Gypsum and Government Washes in the western part of the Black Mountains Area and occurs largely south of the model area. On the east side of the area Rogers and Blue Point springs, located at the east end of the Muddy Mountains at elevations several hundred feet above Lake Mead, discharge a combined flow of about 1,160 acre-ft/yr (Dettinger and others, 1995, table 8) from carbonate rocks. Part of this water is consumed by evapotranspiration and the remainder infiltrates into the soil and percolates down gradient to Lake Mead. There are also a number of small springs and seeps down gradient from Rogers and Blue Point Springs which suggests ground water flow to Lake Mead. The total amount of subsurface flow to Lake Mead is not known but may be on the order of 2,000 to 3,000 acre-ft/yr.

Summary of Flux estimates – The external boundaries of each hydrographic area have been divided into segments representative of similar flux conditions. The segments are numbered in a clockwise direction and are shown on figure 2. The flux estimates are summarized in Table 1.

The boundary of the part of Las Vegas Valley included in the study area is divided into three segments. Segment LV-1 includes the southern part of the boundary. This segment parallels the Las Vegas shear zone and the general direction of ground-water flow. This segment could be simulated as a no-flow boundary. Segment LV-2 is a short segment at the southwest end of the Las Vegas part of the study area. Some water from the study area may cross this segment to support discharge in the Corn Creek area. There are not adequate data to determine how much of the discharge is supplied from within the study area and how much is supplied from the west flank of the Sheep Range outside of the study area. The amount is probably between 0 and 500 acre-ft/yr. This segment is remote from the principal areas of interest. If the model is not sensitive to changes in boundary flux across this segment, no flow conditions could be assumed. Segment LV-3 is the west boundary o the Las Vegas part of the study area. This segment can be simulated as a no-flow boundary.

The boundary of Coyote Spring Valley is divided into 4 segments. Segment CSV-1 extends north from the north end of Las Vegas segment 3 to just north of the Lincoln County line. A ground-water generally coincides with the topographic divide along this segment and the segment can be simulated as a no-flow boundary. Segment CSV-2 extends north from the Lincoln County line to the southeast end of Pahranagat Valley. There is a hydraulic gradient from Tikaboo Valley to Coyote Spring Valley and there is continuity through carbonate rocks across the north end of the Sheep Range. Subsurface inflow to Coyote Spring Valley probably occurs. Based on estimates previously discussed the flux could range from 2,600 to 7,300 acre-ft/yr. This includes up to 2,200 acre-ft/yr of water that flows from Pahranagat Valley to Tikaboo Valley and then to

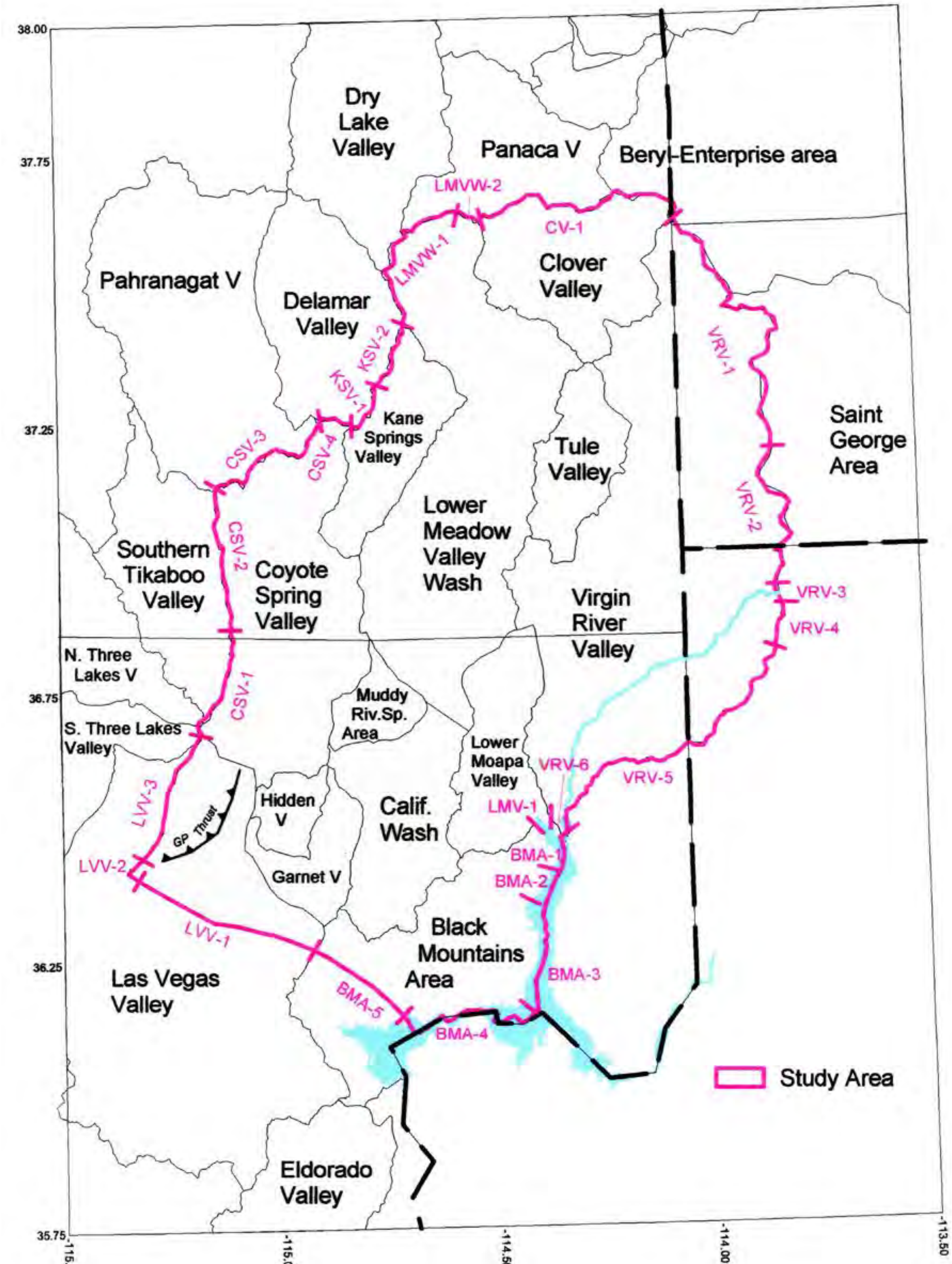


Figure 2. Boundary segments for SNPLMA-5 project

Table 1. Summary of boundary flux estimates
{estimates in acre-ft/yr unless otherwise indicated, Abbreviations: LVV-Las Vegas Valley; CSV-Coyote Spring Valley; KSV-Kane Springs Valley; LMVW-Lower Meadow Valley Wash: CV-Clover Valley: VRV-Virgin River Valley; BDM-Beaver Dam Mountains; BMA-Black Mountains Area}

Boundary Segment	**Flux ac-ft/yr**	**Remarks**
LVV-1	**0**	**No flow**
LVV-2	**0 to -500**	**Outflow. Water for Corn Creek discharge area, use only if model performance is improved.**
LVV-3	**0**	**No flow**
CSV-1	**0**	**No flow**
CSV-2	**2,600 to 7,300**	**Includes up to 2,200 acre-ft/yr from Pahranagat Valley**
CSV-3	**32,300**	**35,000 less 2,200 to CSV and 500 that flow directly from Delamar Valley**
CSV-4	**250**	**Flow directly from Delamar Valley**
KSV-1	**250**	
KSV-2	**0**	**No flow**
LMVW-1	**0**	**No flow**
LMVW-2	**Minor**	**Surface flow, minor**
	100 to 300	**Shallow flow in alluvium. May be some deep flow in carbonate rocks not estimated here.**
CV-1	**0**	**No flow. May be some deep flow in carbonate rocks not estimated here.**
VRV-!	**0**	**No flow**
VRV-2	**From calculation**	**Calculate as suggested in text**
VRV-3	**76.6 cfs**	**Average surface flux**
	12cfs +	**Subsurface flux, 12 cfs plus recharge E flank of BDM plus drainage from north and south areas.**
VRV-4	**From calculation**	**Calculate as suggested in text**
VRV-5	**0**	**No flow**
VRV-6	**-80,000**	**Surface outflow**
	-2,000 to -4,000	**Rough estimate by author. Estimate in Reconnaissance Report 51 is probably high.**
LMV-1	**-10,000**	**Surface outflow.**
	-1,100	**Subsurface outflow**
BMA-1	**Less than -30**	**From local recharge**
BMA-2	**-2,000 to -3,000**	**Primarily discharge from carbonate rocks**
BMA-3	**Less than -30**	**From local recharge**
BMA-4	**Less than -30**	**From local recharge**

BMA-5	**Less than -50**	**From local recharge.**

Coyote Spring Valley. Segment CSV-3 extends from the end of segment CSV-2 northeast along the southern boundary of Pahranagat Valley until the boundary of Delamar Valley is encountered. Flux across this segment is about 32,300 acre-ft/yr. This is based on the 35,000 of flux estimated by Eakin (1966) less 2,200 acre-ft/yr that is routed through Tikaboo Valley and 500 acre-ft/yr that flows directly from Delamar Valley to Coyote Springs Valley and Kane Springs Valley. Segment CSV-4 extends from the end of segment CSV-3 to the contact with Kane Springs Valley. There is a gradient from Delamar Valley to Coyote Springs Valley and about 250 acre-ft.yr is estimated to flow into Coyote Springs Valley from Delamar Valley.

The boundary of Kane Springs Valley is divided into two segments. Segment KSV-1 extends east from the boundary of Coyote Spring Valley to about the crest of the Delamar Range. There is a gradient from Delamar Valley to Kane Springs Valley and about 250 acre-ft/yr of subsurface inflow occurs from Delamar Valley to Kane Springs Valley. Segment KSV-2 extends east from the end of segment KSV-1 to the boundary of Lower Meadow Valley Wash. This segment is in the Delamar Mountains south of a large subsurface intrusive mass of poorly permeable rock. No significant inflow is considered to cross this segment.

The boundary of Lower Meadow Valley Wash is divided into two segments. Segment LMVW-1 extends east from the boundary of Kane Springs Valley to a point about 2 miles northeast of Caliente. A regional gradient from north to south exists in this area but the volcanic rocks present at shallow depths probably do not transmit significant water. Carbonate rocks are present at depth but there are no indications that a large amount of subsurface inflow occurs at depth. A no flow condition could be assumed for the initial simulations. Segment LMVW-2 extends from the end of segment LMVW-1 to the boundary with Clover Valley. The channel of Meadow Valley Wash crosses this segment and there is some surface inflow and some ground-water inflow. Surface inflow was given as some and could be considered to be on the order of 100 to 300 acre-ft/yr. Most of the ground-water inflow occurs in the shallow alluvium and was listed as minor. The amount of subsurface inflow could be considered to be between 100 and 300 acre-ft/yr.

The boundary of Clover Valley was not subdivided. Segment CV-1 is underlain mostly be volcanic rocks that probably do not transmit significant subsurface inflow from Panaca Valley. This segment is also underlain by carbonate rocks at depth and there is a regional gradient from north to south. However there are no indications of large down-gradient discharge areas supplied by flow through carbonate rocks. Initial simulations could assume no flow conditions for this segment. Small boundary fluxes at depth could be added during model calibration if required to provide the best fit to observed head.

The boundary of the Virgin River Valley is subdivided into 6 segments. Segment VRV-1 extends east and south from the boundary of Clover Valley to near where US 91 crosses the divide and carbonate rocks become the dominant lithology. This segment is underlain primarily by volcanic rocks and a ground-water divide is thought to be present. This segment can be simulated as a no-flow boundary. Segment VRV-2 extends south from the end of segment 1 to a point about 0.5 miles north of the river. The boundary along this segment is underlain by carbonate rocks and there is thought to be subsurface inflow from recharge generated on the east flank of the Beaver Dam Mountains and adjacent hills. When recharge estimates become available trial values of the boundary flux can be estimated using the calculations suggested previously. Segment VRV-3 extends south from the end of segment VRV-2 to a point about 0.5 miles south of the river. This segment is underlain by carbonate rocks and is centered beneath the channel of the Virgin River. High stream flow losses and gains suggest that the carbonate rocks underlying this segment are very permeable. The permeability may actually have been increased by solution caused by water from the Virgin River. There is both surface and subsurface inflow across this segment. Using an eight year average for flow at the gage above the Narrows and gains discussed previously the surface inflow can be estimated at about 76.6 cfs. Subsurface inflow can be estimated as the water needed to support a spring-flow contribution to the River that occurs just inside of the boundary (estimated at about 12 cfs, the gain between miscellaneous stations 2 and 3) plus recharge from the east flank of the Beaver Dam Mountains and adjacent hills plus possible drainage from areas north and south of this segment (the high transmissivity may cause the rocks underlying this segment to act as a local drain). Segment VRV-4 extends south from the end of segment 3 to a point about 6 miles south of the river where carbonate rocks cease to be the dominant lithology. The boundary along this segment is underlain by carbonate rocks and there is thought to be subsurface inflow from recharge generated on the east flank of the Beaver Dam Mountains and adjacent hills. When recharge estimates become available trial values of the boundary flux can be estimated using the calculations suggested previously. Segment VRV-5 extends south from the end of segment VRV-4 to the edge of the Virgin River floodplain at the south end of the valley. Most of this segment is underlain by a ground water divide. This segment can be simulated as a no-flow boundary. Segment VRV-6 extends across the floodplain of the Virgin River at the south end of the valley. There is surface and subsurface outflow across this boundary. Surface outflow was estimated to be about 80,000 acre-ft/yr by Glancy and Van Denburgh (1969, p. 22). Subsurface outflow is estimated to be on the order of 2,000 to 4,000 acre-ft/yr based on Darcy’s Law calculations.

The Lower Moapa Valley boundary has only one segment. Segment LMV-1 extends across the floodplain of the Muddy River just above Lake Mead. Both surface and subsurface outflow cross this segment. Surface outflow has been estimated to be about 10,000 acre-ft/yr and subsurface outflow has been estimated to be about 1,100 acre-ft/yr.

The boundary of the Black Mountains area has been subdivided into 5 segments. Note that the boundary of the study area generally follows the channels of the Virgin and Colorado Rivers which have been submerged by Lake Mead. Outflow to Lake Mead would occur along the shoreline of the Lake adjacent to each segment. Segment BMA-1 begins at the north end of the Overton Arm of Lake Mead where the Lower Moapa Valley segment ends and extends south to a point adjacent to Black Point. Subsurface outflow to Lake Meade is derived from local recharge and is probably less than 30 acre-ft/yr. Segment BMA-2 extends from the end of segment 1 south to the south end of Rogers Bay. Subsurface outflow along this segment is derived from local recharge (small, <20 acre-ft.yr) and outflow from carbonate rocks that supplies Rogers and Blue Point Springs and a number of smaller springs and seeps. Total discharge to Lake Mead may be on the order of 2,000 to 3,000 acre/ft/yr. Segment BMA-3 extends south from the end of segment BMA-2 to Middle Point. Subsurface outflow along this section is from local recharge is small, probably less than 30 acre-ft/yr. Segment BMA-4 extends west from the end of segment BMA-3 to the west shore of Callville Bay. Subsurface outflow along this segment is from local recharge and is probably less than 30 acre-ft/yr. Segment BMA-5 extends from the end of segment 4 northwest to the boundary of Las Vegas Valley. This segment cuts across the western part of the Black Mountains Area and separates the western Black Mountains area from the study area. Subsurface outflow from Las Vegas Valley to the Black Mountains area and then to Lake Mead estimated to be as much as 2,100 acre-ft/yr occurs in the western part of the Black Mountains area outside of the study area. This segment approximately parallels the regional flow direction and flow across the segment is probably less than 50 acre-ft/yr.

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HS-14

NEVADA

EXHIBIT NO.__________

IDEN.__________ ADM.__________

COPY OF DECREE

"In the Matter of the Determination of the Relative Rights in and to the Waters of the Muddy River and Its Tributaries in Clark County, State of Nevada

IN THE TENTH JUDICIAL DISTRICT COURT OF THE STATE OF NEVADA,

IN AND FOR THE COUNTY OF CLARK.

MUDDY VALLEY IRRIGATION COMPANY, a corporation, NEVADA LAND & LIVESTOCK COMPANY, a corporation, SAMUEL H. WELLS, JOHN F. PERKINS and ELLEN C. PERKINS, his wife,

Plaintiffs

Vs.

MOAPA & SALT LAKE PRODUCE COMPANY, a corporation, GEORGE BALDWIN and ALETHA L. BALDWIN, his wife, ISAIAH COX and ANNA M. COX, his wife, JOSEPH PERKINS and KATHRYN PERKINS, his wife, D. H. LIVINGSTON and RICHARD SMITH, G. S. HOLMES and JULIA MAY KNOX, W. J. POWERS and MARY A. POWERS, his wife, SADIE GEORGE, LOS ANGELES & SALT LAKE RAILROAD COMPANY, a corporation, and WALKER D. HINES, as Director General of Railroads, and JACOB BLOEDEL.

Defendants.

AND

IN THE MATTER OF THE DETERMINATION OF THE RELATIVE RIGHTS IN AND TO THE WATERS OF THE MUDDY RIVER AND ITS TRIBUTARIES IN CLARK COUNTY, STATE OF NEVADA

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JUDGMENT AND DECREE.

The above entitled action and the above entitled matter having come on for hearing before the Court on the 10th day of March, 1920, all of the parties to said action, appearing and being represented in court by their respective attorneys, and J. G. Scrugham, the State Engineer of the State of Nevada, appearing in person, and after hearing and the taking of testimony and evidence, and the making of an order for a further determination by the State Engineer, as hereinafter set forth in the said action and matter having been continued for further hearing and determination and have now come on for hearing this 12 th day of March, 1920, all of the parties to the above entitled action appearing and being represented in open court by their respective attorneys;

And it appearing that on the 23rd day of April, 1919, a stipulation was made and filed herein by and on behalf of all of the parties who had then appeared in said action, signed by their respective attorneys, which said stipulation, after the title of the court and cause was in words and figures following to-wit:

STIPULATION

The parties to the above entitled action, by their respective attorneys, for the purpose of settling and determining as between themselves the issues in said action, do hereby stipulate and agree as follows:

1. That the defendants in this paragraph named, their grantors and predecessors in interest, have diverted and appropriated from the Muddy River, its head waters, sources of supply and tributaries, for use upon the lands herein described or referred to, and that said defendants are respectively entitled to divert to their said lands for use thereon, the respective amounts of water herein speciified.

The defendants, George Baldwin, and Aletha L. Baldwin, his wife, for use on the lands described in their Amended and Supplemental Answer, other than those described in their original answer, 16/70 of one cubic foot of water per second.

The defendant, Moapa and Salt Lake Produce Company, for use on the lands described in its separate Answer, 2 and 15/70 cubic feet of water per second.

The defendants, D. H. Livingston and Richard Smith, for use upon the said lands described in their separate Answer, 2 and 20/70 cubic feet of water per second.

The defendants, Joseph Perkins and Kathryn Perkins, his wife, for use upon the lands described in their separate Answer, 30/70 of a cubic foot of water per second.

The defendants, G. S. Holmes and Julia May Knox, for use upon the lands described in their separate Answer, 1 and 25/70 of a cubic foot of water per second.

The defendants, Isaiah Cox and Annie Cox, his wife, for use on ten acres of land described in their separate Answer, 10/70 of a cubic foot of water per second. Provided, that if the State Engineer in his adjudication shall find that because of the situation of said land, and the small stream or small head of water diverted, or other causes, said defendants need more than said amount to properly irrigate said land, the said defendants shall be entitled to divert such amount of water as the State Engineer may find necessary for said purpose.

The defendants, W. J. Powers and Mary Powers, his wife, for use on the land described in their separate Answer, and for 2 and 8/10 acres situate in the NW 1/4 of the SE 1/4 and the N. E. 1/4 of the S. W. 1/4, of Section 27, Township 14 South, Range 65 East, 29/70 of a cubic foot of water per second. Provided, however, that if the State Engineer in his adjudication shall find that because of the situation and character of said lands, the length of the ditch, or other causes, said defendants need more than said amount to properly irrigate, twenty-nine acres of said lands, being the lands heretofore irrigated, said defendants shall be entitled to divert such amount of water as the State Engineer may find necessary for said purposes.

The defendant, Sadie George, for use on 2.1 acres of land situate in the West side of the S. E. 1/4 of the N. E. 1/4, of Section 1, Township 15, South, Range 65 East, 21/700 of a cubic foot of water per second.

The defendants, Los Angeles and Salt Lake Railway and Walker D. Hines, as Director General of Railroads, are entitled to take from the Muddy River, by the pumping plant of said Railroad at Moapa, such amount of water as the State Engineer may find has by said Railroad been lawfully appropriated for any beneficial use at Moapa. Subject, however, to contest by any party hereto and to an appeal from such finding and review thereof by the Court.

The above volumes or amounts of water to which it is agreed the respective parties are entitled shall be understood to include and define the amount of all the waters now or heretobefore rightfully used on said lands, whether diverted directly from said Muddy River, or from its tributaries, springs, head waters or other sources of supply, including the waters claimed to have been developed heretofore by any of the said parties. All measurements of amounts diverted are to be made at the places of diversion, or as near thereto as practicable or convenient, as the State Engineer or Water Commissioner may select or approve.

2. That the waters now and heretofore used by defendants, George Baldwin and Aletha L. Baldwin, his wife, upon the lands described in their original separate Answer, are waters which have been developed and appropriated by said defendants in the manner and by the means alleged in their said Answer, and that such development and use has not and does not diminish the flow or volume of the Muddy River, or interfere with the rights of any of the other parties to this action.

The said defendants Baldwin shall during the present 1919 irrigating season permit the plaintiffs, or any agent or agents of plaintiffs, to enter upon the said lands of said defendants and make measurements of the cultivated areas and of the waters now developed or used thereon. The said defendants Baldwin shall not make any attempt to develop any additional water upon said land before October 1, 1919, and thereafter no further development of water, or additional use of water, shall be made on or for said lands which in any way diminishes the flow of the waters of the Muddy River, or impairs the rights therein or thereto of the other parties to this action.

3. The Indian Reservation, situated above Moapa, and the inhabitants thereof, are entitled to divert from the waters of said Muddy River, and to use upon lands on said reservation, 1.25 of a cubic foot of water per second, and no more, measured at place of diversion or such place as the State Engineer or Water Commissioner may select.

4. That the Plaintiff, Muddy Valley Irrigation Company, and the Plaintiffs John F. Perkins, and Ellen C. Perkins, his wife and their grantors and predecessors in interest, have diverted and appropriated from the Muddy River, its head waters, sources of supply and tributaries, for use on the lands hereinafter described or referred to, all of the waters flowing therein or therefrom, save and except the several amounts specified in paragraph 1 and 3 hereof. The said plaintiffs Perkins are entitled to water for the irrigation of two acres of ground at or near St. Thomas, in the N. E 1/4 of the S. E. 1/4, of Section 10, Township 17 South, Range 68 East, which water is diverted from the River and conveyed to their land by said Muddy Valley Irrigation Company.

The said Muddy Valley Irrigation Company is and at the time of the commencement of this action was the legal owner of the rights to divert, convey and use all of said waters of said River, its head waters, sources of supply and tributaries, save and except the rights hereinbefore specified and described, and to divert said waters, convey and distribute the same to its present stockholders, and future stockholders, and other persons who may have acquired or who may acquire temporary or permanent rights through said Company, for the various purposes described in the Complaint, and upon the land situated as stated in the Complaint; and that its stockholders are the equitable owners of rights to use said waters in accordance with its articles and amended Articles of Incorporation, and its By Laws, and the accepted uses and practices of said corporation.

5. That the parties named in paragraphs 1 and 3 of this Stipulation shall not be required to take or use the waters of said River in continuous flow, but may cumulate the same or any part thereof in rotation and in turn periods, with the approval of the Water Commissioner, and subject to his control and direction, and under such rules and regulations as may be prescribed by the State Engineer and the statutes of the State of Nevada. The whole amount of water diverted from the River at any one time by all of the parties named in paragraph 1 shall not exceed in the aggregate the total of the amounts of water awarded to the several parties named in said paragraph 1. Below the lowest diversion of the defendants Holmes and Knox the flow in the stream shall be maintained substantially constant, subject to seasonal variations, but only in so far as the parties named in paragraph 1 can be held to be responsible for the fluctuations of said stream. The whole of said River system shall be under the supervision, rules and regulations of the State Engineer, and the direction and control of the Water Commissioner, to be appointed as hereafter provided or as provided by law, as a fully adjudicated stream; but it is the intention hereof that so far as practicable the stream shall be treated as divided into two parts, that above and that below the lowest diversion of the ranch now belonging to the defendants Holmes and Knox; and the Muddy Valley Irrigation Company, although under the supervision and control of the State Engineer and Water Commissioner, will, subject to said supervision and general control, distribute and control the distribution of the waters diverted and conveyed by its works to its stockholders and other persons obtaining water by means thereof. Such head gates, measuring devices, etc., as the State Engineer or Water Commissioner may order shall be installed by all who divert or use the waters of said stream system.

6. The owners of land on the upper part of said River, as in the last paragraph defined, shall keep the channels through their respective lands clear of all ordinary obstructions, but

in case of ~~of~~ extraordinary obstruction, such as the formation of lime beds or deposits, in the channel of the stream, the same shall be removed under the direction of the Water Commissioner, and the expense thereof paid as he or the State Engineer may assess the same.

7. All the water rights hereinbefore specified shall be deemed and held to be vested rights, acquired by valid appropriation and beneficial use prior to March 1, 1905, and by continued, uninterrupted use since said date, and shall be considered as equal in rank, without one having any priority over any other. This stipulation shall apply to and include whatever rights are held or possessed by the Muddy Valley Irrigation Company under the certificates of appropriation issued to the plaintiff, Nevada Land and Live Stock Company, as set forth in paragraph twelve of the Complaint herein.

8. All abnormal losses from the flow of said stream shall be pro rated and shared among the parties hereto. Abnormal losses shall include such as any substantial loss from the permanent flow of the stream, caused by some cataclysm of nature, as a cloudburst, destroying or obstructing the channel thereof, or as the opening up of a fissure in the bed of the stream, or in one of the courses of supply, and the disappearance therein of a substantial amount of the waters, thereby causing a substantial diminution in the flow available for appropriation by any of the parties. Any diversion of water by the Indian Reservation, or the inhabitants thereof, in excess of the 1.25 cubic foot per second, specified in paragraph 3, or any award by the State Engineer to or for the lands of the Indian Reservation in excess of said 1.25 cubic foot per second, and any water in excess of such amount, which in any suit or action may be awarded or decreed to or for the lands on said Indian Reservation, or any water which in the final adjudication of this action or any other may be awarded or decreed to any party not a party to this action, shall also be deemed an abnormal loss from the stream.

If any such abnormal loss occur at any time the pro-rata share of such loss to be borne by each party shall be as follows:

The defendants Baldwin and wife shall bear 16/3169 of such loss.

The defendant, Moapa and Salt Lake Produce Company, 155/3169 thereof.

The defendants, Livingston and Smith, 160/3169 thereof.

The defendants, Perkins and wife, 30/3169 thereof.

The defendants Holmes and Knox 95/3169 thereof.

The defendants, Cox and wife, 10/3169 thereof.

The defendants, Powers and wife, 29/3169 thereof.

The defendant, Sadie George, 2/3169 thereof.

And the Plaintiff, Muddy Valley Irrigation Company 2672/3169 of such loss.

9. An order may be entered by the Court referring this suit to the State Engineer for an adjudication of the water rights on the Muddy River, in accordance with the provision of Chapter 140 of the Statutes of Nevada, of 1913, approved March 22, 1913, and all acts amendatory thereof. The order shall direct that said State Engineer in making such adjudication shall as between the parties to this Stipulation, and in determining their relative rights as between themselves, be bound by and give effect to the terms and conditions of this Stipulation, and the division of the waters which said parties have made between themselves.

And the parties further stipulate and agree that any final Decree entered herein shall, in determining the relative rights of the parties hereto, follow and give effect to the terms and conditions of this Stipulation.

10. Pending the final adjudication of said River, and final Decree in this action, and the legal organization of a Water District embracing the Muddy River Valley, and the legal appointment of a Water Commissioner, therefor, the parties themselves shall select and employ a Water Commissioner to act under the terms of this

Stipulation, subject to the supervision of the State Engineer, and such rules and regulations as he may prescribe not inconsistent with this Stipulation. Said Water Commissioner shall be selected by a representative of the Muddy Valley Irrigation Company and a representative chosen by a majority in interest of the defendants, and if such representatives cannot agree then the State Engineer shall have the selection and appointment of the Water Commissioner. The salary and expenses of such Water Commissioner shall be borne by the parties hereto in the same proportion as fixed in paragraph eight hereof for the sharing of losses. The representatives of the respective parties who are to select the Water Commissioner shall agree on the time and manner and person through whom each party shall pay his share of such salary and expenses, and such agreement shall be binding on each party and become a legal obligation.

11. An Order shall also be entered, binding on all of the parties hereto, modifying the terms of the temporary injunction heretofore made and granted, in accordance with the terms of this Stipulation, so that during the pendency of this action and until the final adjudication and final Decree each party shall be injoined from interfering with or impairing any right given by this Stipulation to any other party and from violating any of the terms and conditions and agreements of this Stipulation, or any part thereof.

12. Each party shall pay its or his own costs in this action, but the costs and expenses of the adjudication of the State Engineer, including any surveys or maps made by him, shall be borne by the respective parties, in accordance with the Statutes of this State. But in determining the Water Right and acreage against which such expense shall be assessed the numerators in the fractions in paragraph eight shall as between these parties be deemed to be the number of acres to be irrigated by the respective parties.

Dated this 23rd day of April, A. D., 1919.

A. S. Henderson,
Brown & Belford
Attorneys for Plaintiffs.

F. R. McNamee and
Leo A. McNamee
Attorneys for all defendants, except W. J. Powers and Mary Powers.

C. D. Breeze
Attorney for Defendants, W. J. Powers and Mary Powers.

That on the said 23rd day of April, 1919, an order was made and entered by the Court in the above entitled action referring to the State Engineer of the State of Nevada the said action for an adjudication of the water rights of the Muddy River, its head waters and tributaries and providing that the said State Engineer in making such adjudication should, as between the parties to said Stipulation, in determining their relative rights, as between themselves, be bound by, and give affect to, the terms and conditions of said stipulation and the division of the waters which said parties have made between themselves. That a copy of said Order of reference, duly certified, was delivered to said State Engineer and thereupon the said State Engineer proceeded in accordance with said order and with the provisions of the Statutes of the State of Nevada to make an adjudication of said Muddy River; that the various notices as required by Statute were given by said State Engineer and that claims were filed by various claimants for the use of water on said river and proofs taken and used by said State Engineer in accordance with the provisions of said Statute. That thereafter and on the 21st day of January 1920, said State Engineer made his order of determination entitled "In the matter of the determination of the relative rights in and to the waters of the Muddy River and its tributaries in Clark County, State of Nevada."

That on the 26th day of January, 1920, a copy of the said Order of Determination, duly certified by the State Engineer was filed with the Clerk of the above entitled court and an order made and entered by the Judge of said Court appointing the 10th day of March, 1920, 10 o'clock A.M. of said day, as the time for hearing the matter of said determination and that a certified copy of such order and a notice of such hearing was duly published and served as required by law and that thereafter, and within the time provided by law, various parties to the above entitled action, claimants of water rights in said Muddy River, duly filed with the clerk of said court and served upon the State Engineer their exceptions to the said order of determination.

That on the 10th day of March, 1920, the defendant Jacob Bloedel, a claimant of a water right on said river who had not theretobefore been a party to said action, was by stipulation made a party defendant thereto and duly appeared by his attorneys and it was stipulated that he should be deemed to have made a claim for water right in said Muddy River without further pleading; and also on said date it was stipulated that the defendants Isaiah Cox and Anna Cox his wife, who appeared to the satisfaction of the court to have become the owners of and entitled to land and water rights of J. H. Mitchell, should be deemed to have made a claim in said action for the water rights for said land so acquired by them without further pleading. That on the said 10th day of March, 1920 there was made and filed in said action a stipulation supplemental to said stipulation of April 23rd, 1919 which said stipulation after the entitlement of the court and cause is in words and figures following, to-wit:

STIPULATION SUPPLEMENTAL TO STIPULATION OF APRIL 23, 1919.

WHEREAS, since the making and filing of a stipulation by all of the parties to the above entitled action, who has then appeared therein under date of April 23rd, 1919, Jacob Bloedel has been made a party defendant to said action and has duly appeared therein by F. R. McNamee and Leo A. McNamee, his attorneys;

AND, WHEREAS, since the making of said stipulation the rights of J. H. Mitchell, and the lands belonging to him have been sold and conveyed to Isaiah Cox and Annie M. Cox, his wife, two of said defendants, and whereas a stipulation has been filed herein providing and allowing water rights in behalf of the land so sold by Mitchell to Cox and wife, and providing that the same may be considered as having been made in this action without further pleading,

AND WHEREAS, in view of the foregoing premises it is deemed desirable to supplement and amend the said stipulation of April 23rd, 1919.

The parties to the above entitled action by their respective attorneys do hereby agree and stipulate as follows:

1. The said defendant, Jacob Bloedel, and the said defendants, Isaiah Cox and Anna M. Cox, his wife, in behalf of the land and water rights so acquired from Mitchell, do hereby assent to and make themselves parties in all respects to the said stipulation of April 23rd, 1919, except as the same is changed and amended hereinafter.

2. The said defendant, Jacob Bloedel, his grantors and predecessors in interest have diverted and appropriated from the Muddy River, its headwaters, sources of supply and tributaries, and the said defendant, Bloedel, is entitled to divert from said river 2/70 of one cubic foot of water per second, for use upon the NE 1/4 of the NE 1/4 of Sec. 21, T. 14 S. R. 65 E. M. D. B. & M.

The defendants, Isaiah Cox and Anna M. Cox, his wife, their grantors and predecessors in interest have diverted and appropriated from the said Muddy River, its headwaters, tributaries and sources of supply and are entitled to divert, in addition to the quantity of water described in the said original stipulation of April 23rd, 1919, 3/70 of one cubic foot of water per second for use upon said land in the N.W1/4 of the NE 1/4 of the N. E. 1/4 of Section 16 T. 14 S. R. 65 E. M. D. B. & M., the same being the land acquired by said defendants Cox and wife from J. H. Mitchell.

3. Paragraph 3 of said stipulation of April 23rd, 1919, is amended to read as follows:

""the Indian Reservation, situate above Moapa, and the inhabitants thereof, are entitled to divert from the waters of said Muddy River, and to use upon said land on said Reservation 1.242 of a cubic foot of water per second, and no more, measured at the place of diversion, or such place as the State Engineer or Water Commissioner, may select."

4. That portion of Paragraph 8 of said stipulation of April 23rd, 1919, fixing the pro rata share of any abnormal loss to be borne by each party, is amended to read as follows:

"If any such abnormal loss occurs at any time the pro-rata share of such loss to be borne by each party shall be as follows:

The defendants, Baldwin and Wife, shall bear 16/3169 of such loss;

The defendant Moapa and Salt Lake Produce Company 155/3169 thereof;

The defendants Livingston & Smith 160/3169 thereof;

The defendants Perkins and wife 30/3169 thereof;

The defendants Knox and Holmes 95/3169 thereof;

The defendants Cox and wife 13/3169 thereof;

The defendants Powers and wife 29/3169 thereof;

The defendant Sadie George 2/3169 thereof;

The defendant Jacob Bloedel 2/3169 thereof; and

The Plaintiff Muddy Valley Irrigation Company 2667/3169 thereof."

5. In Paragraph 8 of said stipulation of April 23rd, 1919, is amended, so that the definition of abnormal losses from the flow of said stream wherever the figures 1.25 occur, the same shall be struck out and the figures 1.242 substituted therefor. The parties hereto do not admit or recognize any rights to the use of the

Muddy River by or for the Indian Reservation and the inhabitants thereof, except the amount awarded and found to belong to such reservation by the State Engineer. The parties have included in their definition of abnormal losses a possible diversion of a greater amount by said reservation or possible acquisition of an increase right, only as a measure of security against a possible contingency which might arise through the uncertainty of litigation.

6. Paragraph 7 of said stipulation of April 23rd, 1919, is amended to read as follows:

"All of the water rights hereinbefore specified shall be deemed and held to be vested rights acquired by valid appropriation and beneficial use prior to March 1, 1905, and by continued and uninterrupted use since said date, and shall be considered as equal in right, without one having any priority over any other. This stipulation shall apply to and include whatever rights are held or possessed by the Muddy Valley Irrigation Company under the certificates of appropriation issued to the plaintiff Nevada Land & Live Stock Company as set forth in paragraph twelve of the amended complaint herein and under any certificate of appropriation which may be issued to the Muddy Valley Irrigation Company under its application to the State Engineer numbered 1611.

7. The amount of water awarded in the said stipulation of April 23rd, 1919, and in this stipulation to the respective parties shall be deemed a continuous right during the entire year, it being understood that the minimum duty of water during the summer season shall be one cubic foot per second for 70 acres of land; during the winter season, one cubic foot per second for 100 acres of land, and that by the summer season is meant the period between and including the first day of May of each year up to and including the 30th day of September of each year, and by the winter season is meant the period from and including the 1st day of October to and including the following 30th day of April.

8. It is understood and agreed that the amounts of water awarded by this stipulation to the respective parties and to the Indian Reservation absorbs and exhausts all of the flow of the said stream, its sources of supply, headwaters and tributaries during the entire year.

9. The order of determination of the State Engineer and any further or supplemental order of determination made by him under order of the court shall give effect to the terms and conditions of said stipulation of April 23rd, 1919 and of this supplemental stipulation as said order of determination may define or effect the rights of the parties to the above entitled action and any final decree entered herein shall, in determining the relative rights of the parties hereto follow and give effect to the terms of the said new stipulation.

DATED this 10th day of March, 1920.

A. S. Henderson
Brown & Belford
Attorneys for Plaintiff

F. R. McNamee &
Leo A. McNamee
Attorneys for Defendants other than W. J. and Mary Powers.

C. D. Breeze
Attorney for W. J. and Mary Powers.

That the said exceptions of the respective parties to the order of determination came regularly on for hearing on said 10th day of March, 1920 and witnesses were sworn and testified for and on behalf of the said excepting parties and documentary and other evidence was introduced in support of said exceptions and thereupon the court made and entered an order requiring the State Engineer to make a further determination of the waters of the said Muddy River and its tributaries, subject to instructions of the court which were embodied in such order; and thereafter, to-wit, on the 11th day of March, 1920 said State Engineer did make and file in his office a further and supplemental order of determination and has filed a duly certified copy thereof with the Clerk of this Court.

And the above entitled action and the above entitled matter and the said original and said further and supplemental order of determination of the State Engineer in said matter having now come on for hearing and the Court having considered the pleadings of the parties, the oral and documentay evidence heretofore taken herein, and the stipulations of the parties filed herein, and written findings having been waived by attorneys for the respective parties, thereupon, upon motion of the attorneys for plaintiffs and defendants,

It is by the Court ORDERED, ADJUDGED AND DECREED as follows:

First: That the said order of determination of the State Engineer in the matter of the determination of the relative rights in and to the waters of the Muddy River and tributaries in Clark County, State of Nevada, as amended and modified by the said further and supplemental order of determination, and the said further and supplemental order of determination be and the same hereby are affirmed and confirmed. Wherever the said further and supplemental order of determination differs from, changes, modifies, or is in conflict with the original order of determination, the said original order of determination is and shall be deemed to be modified by the said further and supplemental order of determination and by the order and decree of this court and the same as so modified is hereby affirmed. A copy of said original order of determination marked "Exhibit "A" and a copy of said further and supplemental order of determination marked "Exhibit 'B" are annexed to this decree and are made parts hereof as if set forth at length herein. Hereinafter in this decree whenever the order of determination is referred to it shall, unless otherwise specified, be understood to include both the original order of determination and the further and supplemental order of determination and the former as amended, changed and modified by the latter. Said order of determination shall and does define the rights of the parties named therein except as hereinafter in this decree provided.

Second: That the parties to the above entitled action, their grantors and predecessors in interest have diverted and appropriated from the Muddy River, its headwaters, sources of supply and tributaries for use upon the lands described in their several answers and specifically described in the order of determination and the said parties are respectively entitled to divert to said lands for use in the irrigation thereof, the respective amounts of water herein setforth:

The defendants George Baldwin and Aletha Baldwin his wife, .2286 of one cubic foot of water per second.

The defendant Moapa and Salt Lake Produce Company 2.215 cubic feet per second.

The defendants D. H. Livingston and Richard Smith, 2.286 cubic feet per second.

The defendants Joseph Perkins and Kathyrn Perkins, his wife, .428 cubic feet per second.

The defendants G. S. Holmes and Julia May Knox, 1.357 cubic feet per second.

The defendants Isaiah Cox and Anna Cox his wife for use on 10 acres of land described in their separate answer .143 of a cubic foot per second.

The defendants Isaiah Cox and Anna Cox his wife for use upon the lands formerly belonging to J. H. Mitchell, described in the order of determination .043 of a cubic foot per second.

The defendants, W. J. Powers and Mary Powers his wife, .4143 of a cubic foot per second.

The defendant, Sadie George for use on the land described in the order of determination, .03 of a cubic foot per second.

The defendant, Los Angeles & Salt Lake Railroad Company for the use specified in the order of determination, .04646 of a cubic foot per second.

The defendant, Jacob Bloedel for use upon the land described in the order of determination, .0286 of a cubic foot per second.

The plaintiff, John F. Perkins, .0286 of a cubic foot per second.

The plaintiff, Muddy Valley Irrigation Company, for use during the summer season, as hereinafter defined and as defined in said order of determination, upon the lands described in said order of determination, 36.2588 cubic feet per second, which said amount includes the amount of water for summer use allowed by State Engineer's certificate No. 59. Said company is also the owner of the right to and entitled to divert during the winter season for use upon the lands described in said order of determination and in State Engineer's Certificate Nos. 58, 59 and 60, and also upon the lands described in any certificate or permit granted or issued by said State Engineer upon said Company's application No. 1611 - the several amounts of water allowed by said certificate or permits for winter use.

Third: That the Moapa Indian Reservation has diverted and appropriated from the said Muddy River for use upon the lands of said reservation and is entitled to divert upon said lands for use thereon 1.242 cubic feet per second during the summer season and .87 of a cubic foot per second during the winter season.

Fourth: That all of the defendants to the above entitled action and the plaintiff John F. Perkins are and shall be entitled to use the several amounts of water which they have appropriated as aforesaid during both the summer and winter seasons.

Fifth: That the duty of water allowed for all land in the Muddy Valley except on the Moapa Indian Reservation shall be one cubic foot per second of flow to 70 acres for the summer irrigation season which is defined as extending from May 1st to October 1st, and one cubic foot per second flow to 100 acres for the winter irrigation season which is defined as extending from October 1st to May 1st. On said Indian Reservation the duty of water allowed is 1 cubic foot per second flow to 70 acres for the summer irrigation season which is defined as from April 1st to October 1st, and one cubic foot per second flow to 100 acres for the winter irrigation season which is defined as from October 1st to April 1st.

The volumes or amounts of water awarded and allotted by this decree to the parties hereinbefore named and to which they are entitled shall be understood to include and define the amount of all the waters now or heretofore rightfully used on the lands given in the tabulation in the original order of determination whether diverted directly from said Muddy River or from its tributaries, springs, head waters or other sources of supply, including waters claimed to have been developed heretofore by any of the said parties. All measurements of amounts to which the said several parties are entitled except that awarded to the Moapa Indian Reservation shall be made at the places of diversion or as near thereto as practicable or convenient, as the State Engineer or Water Commissinner may select or approve. On said Indian Reservation all measurements of amounts diverted are to be made at the point where the main ditch enters or becomes adjacent to the land irrigated or as near thereto as practicable as the State Engineer or Water Commissioner may select or approve.

Sixth: That the waters now and heretofore used by the defendants George Baldwin and Aletha Baldwin his wife, upon the lands described in their original separate answer, and which are the waters of what is known as the George Baldwin Spring, the maximum flow of which is found to be .8298 of a cubic foot per second of water are waters which have been developed and appropriated by said defendants in the manner and by the means alleged in their said answer; and that such development and use has not and does not diminish the flow or volume of the Muddy River or interfere with the rights of any of the other parties to the above entitled action or the Moapa Indian Reservation.

Seventh: That, as between the parties to the above entitled action, the Muddy Valley Irrigation Company is declared and decreed to have acquired by valid appropriations and beneficial use and to be entitled to divert and use upon the lands described in the amended complaint and more particularly described in the order of determination, all the waters of said Muddy River, its head waters, sources of supply and tributaries, save and except the several amounts and rights hereinbefore specified and described as awarded and decreed to the other parties to this action and to the Moapa Indian Reservation, and said Company is to divert said waters, convey and distribute the same to its present stockholders and to its future stockholders and to other persons who have acquired or who may hereafter acquire temporary or permanent rights from said Company, for the various purposes described in the complaint and upon the lands situated as stated in the complaint and specifically designated in the order of determination and that the stock holders of said Company are the equitable owners of rights to use said waters in this decree and by the order of determination allotted and decreed to said Company, in accordance with its articles and amended articles of incorporation, or its by-laws or the accepted uses and practices of said corporation.

Eighth: As between the parties to this action and except against the rights awarded the Indian Reservation and the Inhabitants thereof, all of the water rights enumerated as belonging to the parties to the action shall be deemed and held to be and are hereby decreed to be vested rights acquired by valid appropriation and beneficial use prior to March 1st, 1905, and by continued uninterrupted use since said date and shall be considered as equal in rank without anyone having any priority over another and that this shall apply to and include the rights held by the Muddy Valley Irrigation Company as grantee or assignee of Nevada Land & Live Stock Company under the State Engineer's certificates, 58, 59 and 60, and under such permit or certificate as may hereafter be granted by the State Engineer to the Muddy Valley Irrigation Company under its application No. 1611. That, as against the water right granted and allotted to the said Indian Reservation, the water rights held by the Muddy Valley Irrigation Company under said certificates or permits shall be deemed to be subsequent to the water rights allotted and decreed the said Indian Reservation. The water right allotted and decreed the Indian Reservation shall be deemed and held to be vested rights acquired by valid appropriation prior to March 1st, 1905 and by uninterrupted use thereafter and shall, to the extent decreed and allotted, rank, as equal in priority with all the other rights, allotted, awarded and decreed to the said several parties, except those granted by the said certificates or permits.

Ninth: That the defendants in said action shall not be required to take or use the waters in said river in continuous flow, but may cumulate the same or any part thereof in rotation and turn periods, with the approval of the Water Commissioner, and subject to his control and direction and under such rules and regulations as may be prescribed by the State Engineer and the statutes of the State of Nevada. That the whole amount of water diverted from said river at any one time by all of the defendants shall not exceed in the aggregate the total of the amounts of water awarded to the said defendants. Below the lowest diversion of the defendants Holmes and Knox, the flow in the stream shall be maintained substantially constant, subject to seasonal variations, only, however, in so far as the defendants can be held to be responsible for the fluctuations of the stream. The whole of said river system shall be under the supervision, rules and regulations of the State Engineer, and the direction and control of the water commissioner to be appointed as provided by law, as a fully adjudicated stream; but it is the intention hereof, and it is hereby decreed that, so far as practicable, the stream shall be treated as divided into two parts, that above and that below the lowest diversion on the ranch now belonging to Knox and Holmes. The Muddy Valley Irrigation Company, although under the supervision and control of the state engineer and water commissioner, shall, subject to said supervision and general control, distribute and control the distribution of the waters diverted and conveyed by its works to its stockholders and other persons obtaining water by means thereof. Substantial headgates, weirs or other measuring devices and sand boxes, as the State Engineer, through the water commissioner may direct or require, shall be installed and maintained in good order by all who divert or use the waters of said stream system.

Tenth: That the owners of land on the upper part of said river as in the last paragraph defined, and defined in the said order of determination, as that part of said river above the "narrows", shall keep the channel through their respective lands cleared, of all ordinary obstructions, but in case of extraordinary obstructions, such as the formation of lime beds or deposits in the channel of the stream, the same shall be removed under the direction of the water commissioner and the expenses thereof paid pro rata by all parties to the determination in proportion to the acreage owned or controlled by them as defined in said order of determination.

Eleventh: That all abnormal losses from the flow of the stream shall be pro rated and shared among the parties holding water rights on the stream, but as between the parties to the above entitled action, abnormal losses shall be defined as in paragraph 8 of said stipulation of April 23rd, 1919, as amended by paragraph 5 of the stipulation supplemental thereto, and, as between the parties to said action, such abnormal losses shall be borne by the parties to said action, pro rata in the proportions named and set forth in paragraph 4 of said supplemental stipulation.

Twelfth: That the aggregate volume of the several amounts and quantities of water awarded and allotted to the parties named in said order of determination, which include all of the parties to said action and the said Moapa Indian Reservation, is the total available flow of the said Muddy River and consumes and exhausts all of the available flow of the said Muddy River, its head waters, sources of supply and tributaries.

Thirteenth: That the salary and the expenses of any water commissioner, who may be appointed to supervise, control and regulate the distribution of the waters of said Muddy River in accordance with the provisions of said order of determination and this decree, shall be paid pro-rata by the parties to the said stipulation supplemental to the stipulation of April 23rd, 1919, in the same proportion as for the sharing of abnormal losses set forth in paragraph 4 of said supplemental stipulation. If in the opinion of the State Engineer a suitable and competent water commissioner cannot be employed at the salary fixed by statute, the State Engineer is authorized to fix the salary of the Water Commissioner in such amount as he may determine to be reasonable, subject, in case of objection by any of the water users, to the approval of the Judge of the above entitled Court. The State Engineer may also allow such expenses of such water commissioner as he may deem necessary or proper to be incurred in the performance of the duties of such water commissioner, subject, also, in case of objection, to the approval of the Judge of said Court.

That any money due or which may hereafter become due from any party for his, her or its pro rata share of such salary or such expenses of the water commissioner shall be paid by the party at the times and in the manner provided by law for the payment of the salary of the water commissioner, and any neglect or failure of any party to make any such payment shall be deemed a violation of this decree and a contempt of Court, and shall be punished accordingly, or the same may be deemed a debt and collected by civil process.

Fourteenth: That each of the parties to this action his, her or its grantees and successors in interest and every person acting under his, her or its direction or control be and hereby is perpetually restrained and enjoined from in any way interfering with or in any way impairing any right given or awarded or decreed by this decree to any other party and from violating any of the provisions of this decree, and is also perpetually restrained and enjoined from opening, closing, changing or interfering with any headgate or water box established by or under the order of the State Engineer or Water Commissioner without the authority of said State Engineer or Water Commissioner, and also from using water or conducting water into or through his, her or its ditch which has not been awarded to such party by this decree.

Fifteenth: Each party shall pay his or its own costs in this action, but the costs and expenses of the adjudication by the State Engineer, including any surveys or maps made by him, shall be borne by the respective parties in accordance with the Statutes of this State. But in determining the water right and acreage, against which said expense shall be assessed the numerators in the fractions in said paragraph 4 of said supplemental stipulation, shall, as between said parties, be deemed to be the number of acres to be irrigated by the said respective parties.

Done in open Court this 12th day of March, A. D. 1920.

/s/ Wm. E. Orr
District Judge.

EXHIBIT "A"

STATE OF NEVADA

ORDER OF DETERMINATION OF RELATIVE RIGHTS

TO THE

Waters of the Muddy River and Its Tributaries

J. G. SCRUGHAM, State Engineer

CARSON CITY, NEVADA
STATE PRINTING OFFICE : : : JOE FARNSWORTH, SUPERINTENDENT
1920

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ORDER OF DETERMINATION

In the Matter of the Determination of the Relative Rights in and to the Waters of the Muddy River and its Tributaries in Clark County, State of Nevada.

In accordance with stipulated agreement entered into by the Muddy Valley Irrigation Company, et al., v. Moapa and Salt Lake Produce Company, et al., on the 23d day of April, 1919, an order was entered in the Tenth Judicial District Court of the State of Nevada referring the above-entitled action to the State Engineer for an adjudication of the water rights on the Muddy River stream-system as provided for in Chapter 140, Statutes of 1913, and all Acts amendatory thereof.

The tabulation of the allotments of the waters of the Muddy River stream-system, as attached hereto, covers all claims filed in the office of the State Engineer as provided for by law, and also an allotment to the Moapa Indian Reservation. Although duly notified of the pending adjudication proceedings in the statutory manner, the United States Indian Service authorities did not file a claim and state that they refuse to recognize the authority of the State of Nevada to determine the water rights of the Moapa Indian Reservation. In the absence of any showing on part of the United States Indian Service, the State Engineer has based the Moapa Indian Reservation allotment on the official investigations and reports made in the year 1906 by Henry Thurtell, at that time State Engineer of Nevada. These reports gave the Moapa Indian Reservation an allotment of water sufficient to properly irrigate an area of 87 acres, which was found to be the full area on the Reservation entitled to a vested water right under the law of the State.

(a) *Duty and point of diversion defined.*

The duty of water allowed for all land in the Muddy River Valley shall be 1 c.f.s. flow to 70 acres for the summer irrigation season from April 1 to October 1 and 1 c.f.s. flow to 100 acres for the winter irrigation season from October 1 to April 1.

The volumes or amounts of water allotted and to which it is agreed the respective parties are entitled shall be understood to include and define the amount of all the waters now or heretofore rightfully used on the lands given in the tabulation whether diverted directly from said Muddy River or from its tributaries, springs, headwaters or other sources of supply, including water claimed to have been developed heretofore by any of the said parties. All measurements of amounts diverted are to be made at the point where the main ditch enters or becomes adjacent to the land to be irrigated or as near thereto as practicable, as the State Engineer or water commissioner may select or approve.

(b) *Baldwin Spring flow defined.*

The maximum flow of .8298 c.f.s. of water of the George Baldwin Spring now and heretofore used by George Baldwin and Aletha L. Baldwin, his wife, is water which has been developed by said parties.

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c.f.s. signifies cubic foot per second.

Such development and use of this amount of water has not and does not diminish the flow or volume of the Muddy River, or interfere with the rights of any other water users on the stream-system. No further development of water on the head of the Muddy River stream-system shall be made which in any way diminishes the flow of the waters of the Muddy River or impairs rights defined and referred to in this order.

(c) *Method of use.*

The parties named in this order shall not be required to take or use the water of said river in continuous flow, but may cumulate same or any part thereof in rotation and in periodic turn, with the approval of the water commissioner, subject to his control and direction and under such rules and regulations as are prescribed by the State Engineer and the statutes of the State of Nevada.

The whole amount of water diverted from the river at any one time by all the parties allotted water for use above the "narrows" is not to exceed in the aggregate the total amount of water allotted to the several parties resident in the Upper Muddy Valley. Below the lowest diversion of Knox and Holmes the flow in the stream shall be maintained substantially constant subject to seasonal variation. The whole of said river system shall be under supervision of the rules and regulations of the State Engineer and the direction and control of the water commissioner, to be appointed as provided by law. Substantial headgates, weirs, and sand-boxes, as the State Engineer through the water commissioner may order, shall be installed and maintained in good order by all who divert or use the waters of said stream-system.

(d) *Channel upkeep, responsibility for.*

The owners of land on that part of said river above the "narrows" shall keep the channel through their respective lands cleared of all ordinary obstructions, but in case of extraordinary obstruction, such as the formation of lime deposits in the channel of the stream, the same shall be removed under the direction of the water commissioner and the expenses thereof paid pro rata by all parties to this determination in proportion to the acreage owned or controlled by them as defined in this order.

(e) *Priority—Vested and granted rights.*

All the water rights enumerated in this order of determination, except those held under permit from the State Engineer's office, shall be deemed and held to be vested rights acquired by valid appropriation and beneficial use prior to March 1, 1905, and by continued uninterrupted use since said date and shall be considered as equal in rank without having any priority over one another.

Permits Nos. 31 and 1372, which are the basis for certificates Nos. 58, 59, and 60, granted by the State Engineer, cover certain water rights which are enumerated in the appended tabulation of allotments. These granted rights are next in priority to the vested rights on the Muddy River stream-system.

(f) *Losses, apportionment of.*

All abnormal losses from the flow of said stream shall be pro-rated and shared among the parties holding water rights on the stream. Abnormal losses shall include any substantial loss from the permanent flow of the stream, such as a cloudburst destroying or obstructing the channel thereof or an opening up of a fissure in the bed of the stream or in one of the sources of supply and the disappearance therein of a substantial amount of the waters, thereby causing a diminution in the available flow.

If any such abnormal loss occurs at any time, the pro-rata share of such loss to be borne by each party to this order shall be as follows:

George Baldwin and Aletha Baldwin, his wife	16/2839
Moapa & Salt Lake Produce Co	155/2839
Livingston & Smith	160/2839
Joseph Perkins and wife	30/2839
Knox and Holmes	95/2839
Isaiah Cox and wife	10/2839
W. J. Powers and wife	29/2839
Sadie George	2.1/2839
Jacob Bloedel	2/2839
J. H. Mitchell	3/2839
U. S. Indian Service, Moapa Reservation	87/2839
John F. Perkins	2/2839
Muddy Valley Irrigation Co	2244.80/2839

(g) *Expense of commissioner.*

The salary and expenses of the water commissioner shall be paid pro rata by all parties to this adjudication in the proportion of acreage owned and controlled by them as defined in this order.

SUMMARY OF ALLOTMENTS AND CERTIFICATES

Claimant	*Acreage*	*C.F.S. flow* *Summer*	*Winter*
Jacob Bloedel	2	.0286	.02
Moapa & Salt Lake Produce Co	155	2.215	0
Isaiah Cox and wife	10	.143	0
J. H. Mitchell	3	.043	0
George Baldwin	16	.2286	0
Sadie George	2.1	.0300	0
John F. Perkins	2	.0286	.02
Los Angeles & Salt Lake Ry		.04646	.04646
Livingston and Smith	160	2.286	0
Knox and Holmes	95	1.357	0
W. J. Powers	29	.4143	.29
Muddy Valley Irr. Co	2244.80	32.0068	22.448
Muddy Valley Irr. Co. (Cert. 58)	398.11	....	3.98
Muddy Valley Irr. Co. (Cert. 59)	425.2	4.252	....
	846.6	....	8.466
Muddy Valley Irr. Co. (Cert. 60)	80	....	.8
Joseph Perkins	30	.428	0
Moapa Indian Reservation	87	1.242	.87

01625

Appropriator—Jacob Bloedel.

Source—Muddy River Tributary (Bloedel Spring).

Ditch Title	*Date when construction commenced*	*Date when land first irrigated*	*Number of acres irrigated*	*Sec.*	*Subdivision*	*Tp.S.*	*R.E.*
Morris & Jones Ditches	1896		2.00	21	NE¼NE¼	14	65

Domestic use allowed.
2/70 c.f.s. allowed for irrigation.

Appropriator—Moapa and Salt Lake Produce Co.

Source—Muddy River and Tributaries.

Big Spring, Jones Spring, High Springs, and Rock Cabin Spring Ditches.				14	W½SW¼	14	65
				15	S½	14	65
				15	S½N½NW¼	14	65
				15	S½N½	14	65
				16	NE¼	14	65
				16	E½SE¼	14	65
Excepting and excluding from the above description the				16	NE¼ NW¼NE¼	14	65
				16	NW¼ NE¼NE¼	14	65

Domestic use allowed.
Total acreage allotted water, 155 acres.
2 and 15/70 c.f.s. allowed for irrigation.

Appropriator—Isaiah Cox and Anna Cox, His Wife.

Source—Muddy River and Tributaries.

Cox Ditch and Cox Spring Ditch			10.00	16	NE¼ NW¼NE¼	14	65

Domestic use allowed.
10/70 c.f.s. allowed for irrigation.

Appropriator—J. H. Mitchell.

Source—Muddy River.

Mowry & Mitchell or Cox Ditch			3.00	16	NW¼ NE¼NE¼	14	65

Domestic use allowed.
3/70 c.f.s. allowed for irrigation.

Appropriator—U. S. Indian Service (Moapa Indian Reservation).

Source—Muddy River.

Indian Ditches			87.00	36		14	65
				35		14	65
				31		14	66
				1		15	66
				6		15	66
Total			87.00				

This allotment is based on the Thurtell findings as covered in Certificate No. 479, issued by Henry Thurtell on March 30, 1907.

Domestic use allowed.
87/70 c.f.s. allowed for irrigation.

Appropriator—**George Baldwin.**

Source—**Muddy River and Tributaries.**

Ditch Title	*Date when construction commenced*	*Date when land first irrigated*	*Number of acres irrigated*	*Sec.*	*Subdivision*	*Tp.S.*	*R.E.*
George A. Davis and Dry Ditch....			16.00	25	SE¼SW¼	14	65
				25	SW¼SE¼	14	65
				36	Lots 2 and 3 NE¼	14	65

Domestic use allowed.
16/70 c.f.s. allowed for irrigation.

Appropriator—**Sadie George.**

Source—**Muddy River and Tributaries.**

Ditch Title	*Date when construction commenced*	*Date when land first irrigated*	*Number of acres irrigated*	*Sec.*	*Subdivision*	*Tp.S.*	*R.E.*
Indian Ditch....................................			2.10	1	SE¼NE¼	15	65

Domestic use allowed.
21/700 c.f.s. allowed fpr irrigation.

Appropriator—**Joseph Perkins.**

Source—**Muddy River and Tributaries.**

Ditch Title	*Date when construction commenced*	*Date when land first irrigated*	*Number of acres irrigated*	*Sec.*	*Subdivision*	*Tp.S.*	*R.E.*
Barnes & Harris Ditch and Bradfute Ditch.			30.00	6	Lots 4 and 5 NW¼	15	66
				6	Lot 6 SW¼	15	66
				6	SE¼NE¼	15	66
				6	SW¼NE¼	15	66
				6	Lots 2 and 3	15	66

Domestic use allowed.
30/70 c.f.s. allowed for irrigation.

Appropriator—**Los Angeles and Salt Lake Ry. Co.**

Source—**Muddy River.**

Ditch Title	*Date when construction commenced*	*Date when land first irrigated*	*Number of acres irrigated*	*Sec.*	*Subdivision*	*Tp.S.*	*R.E.*
Pipe Line..			equiv. to .0322	32	NE¼	14	66

NOTE—Water used for locomotives, cars, depot, stock yards, and town supply.
.04646 c.f.s. allowed.

Appropriator—**D. H. Livingston and Richard Smith.**

Source—**Muddy River and Tributaries.**

Ditch Title	*Date when construction commenced*	*Date when land first irrigated*	*Number of acres irrigated*	*Sec.*	*Subdivision*	*Tp.S.*	*R.E.*
White, Livingston, and Crosby Ditches.				5	S½SE¼	15	66
				8	N½NE¼	15	66
				9	N½NW¼	15	66
				9	NW¼NE¼	15	66
				4	SW¼SE¼	15	66
				4	SE¼SW¼	15	66
			20.00	4	N½SE¼	15	66
				9	NE¼NE¼	15	66
				4	SE¼SE¼	15	66
				3	W½SW¼	15	66
				8	N½NW¼	15	66
				5	S½SW¼	15	66
All that portion of..				6	S½SE¼ situated east of the R. R. track		
Total..			160.00				

Domestic use allowed.
2 and 20/70 c.f.s. allowed for irrigation.

Appropriator—G. S. Holmes and Julia May Knox.
Source—Muddy River and Tributaries.

Ditch Title	*Date when construction commenced*	*Date when land first irrigated*	*Number of acres irrigated*	*Sec.*	*Subdivision*	*Tp.S.*	*R.E.*
Weiser Ditch			95.00	1	S½NW¼SW¼	15	66
				1	S½SW¼	15	66
				1	S½SE¼	15	66
				12	NE¼	15	66
				12	NE¼SE¼	15	66
				7	SW¼NW¼	15	67
				7	NE¼SW¼	15	67
				7	Frac. ½SW¼	15	67

Domestic use allowed.
1 and 25/70 c.f.s. allowed for irrigation.

Appropriator—W. J. Powers.
Source—Muddy River.

Cook Ditch			29.00	4	NW¼SE¼	15	66
				4	NE¼SE¼	15	66
				4	NW¼SE¼& NE¼SW¼	15	66
				4	NE¼SE¼	15	66
				4	SE¼NE¼	15	66
				8	NW¼SW¼	15	66

Domestic use allowed.
29/70 c.f.s. allowed for irrigation.

Appropriator—Muddy Valley Irrigation Co.
Source—Muddy River.

St. Joe Ditch			20.00	15	SE¼SW¼		
			14.00	15	SW¼SW¼		
			34.00	15		15	67
			20.00	21	SE¼NE¼		
			7.25	21	NE¼NE¼		
			27.25	21		15	67
			20.00	22	NE¼NW¼		
			24.00	22	SE¼NW¼		
			14.00	22	NW¼NW¼		
			14.00	22	SW¼NW¼		
			14.00	22	NW¼SW¼		
			14.00	22	NE¼SW¼		
			15.00	22	SW¼SW¼		
			20.00	22	NW¼NE¼		
			20.00	22	SW¼NE¼		
			15.00	22	NW¼SE¼		
			14.00	22	SE¼SW¼		
			184.00	22		15	67
			14.00	27	NE¼NW¼		
			14.00	27	NW¼NE¼		
			16.50	27	SW¼NE¼		
			30.00	27	SE¼NE¼		
			26.00	27	NE¼SE¼		
			10.00	27	SE¼SE¼		
			110.50	27		15	67
			2.60	26	SW¼NW¼		
			24.40	26	NW¼SW¼		
			3.00	26	SW¼SW¼		
			30.00	26		15	67
			17.50	35	SE¼NW¼		
			40.00	35	NW¼NW¼		
			20.00	35	NE¼NW¼		
			77.50	35		15	67
Total			463.25				

46325/7000 c.f.s. allowed for irrigation.

Appropriator—**Muddy Valley Irrigation Co.**

Source—**Muddy River.**

Ditch Title	*Date when construction commenced*	*Date when land first irrigated*	*Number of acres irrigated*	*Sec.*	*Subdivision*	*Tp.S.*	*R.E.*
Sprole-Averitt			22.25	27	NW¼NW¼		
			25.00	27	SW¼NW¼		
			10.00	27	SE¼NW¼		
			35.50	27	NE¼SW¼		
			22.50	27	SE¼SW¼		
			28.00	27	SW¼SE¼		
			143.25	27		15	67
			6.00	34	NE¼NW¼		
			15.00	34	SE¼NW¼		
			17.75	34	NE¼NE¼		
			40.00	34	NE¼NE¼		
			13.75	34	SW¼NE¼		
			6.50	34	SE¼SE¼		
			99.00	34		15	67
Total			242.25				

24225/7000 c.f.s. allowed for irrigation.

Appropriator—**Muddy Valley Irrigation Co.**

Source—**Muddy River.**

Kapalapa Ditch	10.00	2	NW¼NW¼		
	20.00	2	NE¼NW¼		
	20.00	2	SE¼NW¼		
	20.00	2	NW¼NE¼		
	7.50	2	NE¼NE¼		
	20.00	2	SE¼NE¼		
	20.00	2	SW¼NE¼		
	20.00	2	NW¼SE¼		
	20.00	2	NE¼SW¼		
Total	157.50	2		16	67

15750/7000 c.f.s. allowed for irrigation.

Appropriator—**Muddy Valley Irrigation Co.**

Source—**Muddy River.**

Stringtown Ditch	17.80	12	NE¼NW¼		
	12.50	12	SW¼NW¼		
	12.50	12	SE¼NW¼		
	7.50	12	SW¼NE¼		
	12.00	12	NE¼SE¼		
	30.00	12	NW¼SE¼		
	36.20	12	SW¼SE¼		
	24.10	12	SE¼SE¼		
	7.00	12	NE¼SW¼		
	15.00	12	SE¼SW¼		
	8.00	12	SW¼SW¼		
	182.60	12		16	67
	21.40	13	NW¼NE¼		
	25.80	13	NE¼NE¼		
	47.20	13		16	67
	5.00	18	SW¼NW¼		
	5.00	18	NW¼NW¼		
	10.00	18		16	68
Total	239.80				

23980/7000 c.f.s. allowed for irrigation.

Appropriator—Muddy Valley Irrigation Co.

Source—Muddy River.

Ditch Title	Date when construction commenced	Date when land first irrigated	Number of acres irrigated	Sec.	Subdivision	Tp.S.	R.E.
Sparks Canal			13.00	1	SE¼SW¼	16	67
			21.80	7	SW¼SW¼		
			1.20	7	NW¼SW¼		
			23.00	7		16	68
			1.80	12	NE¼SE¼		
			8.20	12	SE¼SE¼		
			10.00	12		16	67
Total			46.00				

46/70 c.f.s. allowed for irrigation.

Appropriator—Muddy Valley Irrigation Co.

Source—Muddy River.

Ditch Title	Number of acres irrigated	Sec.	Subdivision	Tp.S.	R.E.
Overton Canal	18.00	2	SW¼SE¼		
	20.00	2	SE¼SW¼		
	12.00	2	SW¼SW¼		
	50.00	2		16	67
	7.00	3	SE¼SE¼	16	67
	5.00	10	NE¼NE¼	16	67
	10.00	11	NW¼NW¼		
	20.00	11	NE¼NW¼		
	20.00	11	NW¼NE¼		
	13.475	11	NE¼NE¼		
	7.50	11	SE¼NE¼		
	7.50	11	SW¼NE¼		
	10.00	11	NE¼SE¼		
	10.00	11	NW¼SE¼		
	27.525	11	SE¼SE¼		
	126.00	11		16	67
	13.00	13	NW¼NW¼		
	5.00	13	NE¼NW¼		
	20.00	13	SW¼NW¼		
	15.00	13	SE¼NW¼		
	4.50	13	SW¼NE¼		
	7.50	13	SE¼NE¼		
	24.50	13	NW¼SE¼		
	32.75	13	NE¼SE¼		
	26.40	13	SE¼SE¼		
	31.35	13	SW¼SE¼		
	24.50	13	NE¼SW¼		
	12.00	13	SE¼SW¼		
	216.50	13		16	67
	7.50	14	NE¼NE¼	16	67
	5.00	18	SW¼SW¼	16	68
	3.00	19	SW¼SE¼		
	6.00	19	NE¼SW¼		
	5.00	19	SE¼SW¼		
	14.00	19		16	68
	3.00	24	NW¼NE¼		
	20.00	24	NE¼NE¼		
	5.00	24	SW¼NE¼		
	4.00	24	SE¼NE¼		
	32.00	24		16	67
	3.00	30	NW¼NE¼	1[illegible]	68
Total	466.00				

466/70 c.f.s. allowed for irrigation.

Appropriator—**Muddy Valley Irrigation Co.**

Source—**Muddy River.**

Ditch Title	*Date when construction commenced*	*Date when land first irrigated*	*Number of acres irrigated*	*Sec.*	*Subdivision*	*Tp.S*	*R.E.*
Kaolin Ditch			28.00	19	SE¼SE¼	16	[illegible]
			20.00	30	SW¼NE¼		
			20.00	30	NW¼SE¼		
			7.00	30	NE¼NE¼		
			47.00	30		16	68
			20.00	32	NE¼SE¼		
			20.00	32	NW¼SE¼		
			40.00	32		16	68
			4.00	29	NE¼NW¼	16	68
Total			119.00				

119/70 c.f.s. allowed for irrigation.

Appropriator—**Muddy Valley Irrigation Co.**

Source—**Muddy River.**

St. Thomas Ditch	15.00	10	SE¼NW¼		
	20.05	10	NW¼NE¼		
	19.00	10	NE¼NE¼		
	23.00	10	SW¼NE¼		
	13.50	10	SE¼NE¼		
	17.25	10	NE¼SE¼		
	2.50	10	SE¼SE¼		
	110.30	10		17	68
	5.00	11	NW¼NW¼		
	28.00	11	SW¼NW¼		
	30.25	11	NW¼SW¼		
	20.25	11	NE¼SW¼		
	34.00	11	SW¼SW¼		
	37.75	11	SE¼SW¼		
	20.80	11	SW¼SE¼		
	176.05	11		17	68
	17.80	14	NW¼NW¼		
	37.00	14	NE¼NW¼		
	25.20	14	NW¼NE¼		
	24.20	14	NE¼NE¼		
	10.50	14	SW¼NE¼		
	19.40	14	SE¼NE¼		
	134.10	14		17	68
Total	420.45				

42045/7000 c.f.s. allowed for irrigation.

Appropriator—**Muddy Valley Irrigation Co.**

Source—**Muddy River.**

East St. Thomas Ditch	4.00	2	SW¼SW¼	17	68
	17.00	3	SE¼SE¼		
	7.00	3	NE¼SE¼		
	24.00	3		17	68
	15.85	11	NW¼NW¼		
	16.10	11	NE¼NW¼		
	8.00	11	SW¼NW¼		
	12.00	11	SE¼NW¼		
	10.60	11	NW¼SE¼		
	62.55	11		17	68
Total	90.55				

Domestic use allowed from all Muddy Valley Irrigation Company Ditches.

9055/7000 c.f s. allowed for irrigation.

Appropriator—John F. Perkins.

Source—Muddy River.

Ditch Title	*Date when construction commenced*	*Date when land first irrigated*	*Number of acres irrigated*	*Sec.*	*Subdivision*	*Tp.S.*	*R.E.*
St. Thomas Ditch			2.00	10	E part of NE¼SE¼		
				11	W part of NW¼SW¼	17	68

Domestic use allowed.

2/70 c.f.s. allowed for irrigation.

Appropriator—Muddy Valley Irrigation Co., Assignee of Nevada Land and Livestock Co., Under Certificate No. 58.

Source—Muddy River.

Overton Canal			20.00	2	W½ NW¼NW¼		
			5.00	2	SW¼SE¼ and SE¼SE¼		
			115.00	11	NE¼NE¼ and SE¼		
			40.00	12	W½SW¼		
			25.00	12	E½SW¼		
			40.00	13	NW¼NW¼		
			6.50	13	NW¼SW¼		
			25.36	13	NW¼		
			7.09	13	NW¼SE¼		
			16.00	14	NE¼NE¼	16	67
			27.36	19	SW¼		
			34.00	30	SW¼NE¼		
			20.00	30	N½SE¼		
			16.80	30	SE¼SE¼	16	68
Total			398.11				

2.98 c.f.s. allowed for irrigation.

The use of this water is determined as a winter use; diversion to commence October 1 of each year and to extend to April 1 of the year following. The use is limited to irrigation, stockwatering, and domestic purposes.

Appropriator—Muddy Valley Irrigation Co., Assignee of Nevada Land and Livestock Co., Under Certificate No. 59.

Source—Muddy River.

	WINTER USE						
Kaolin Ditch			40.00	20	SW¼SW¼	16	68
			150.00	29	SW¼	16	68
			310.00	32	N½	16	68
			35.20	32	N½SW¼	16	68
			111.61	32	SE¼	16	68
			70.00	33	S½SW¼	16	68
			36.36	33	NW¼SW¼	16	68
			24.43	31	E½NE¼	16	68
			62.70	3	W½SW¼&	17	68
				4	SE¼	17	68
			16.35	4	NE¼NW¼	17	68
	SUMMER USE						
			140.00	29	SW¼	16	68
			250.00	32	N½	16	68
			35.20	32	N½SW¼	16	68
Total summer use			425.20				
Total winter use			846.65				

Summer use—4.252 c.f.s.

Winter use—8.466 c.f.s.

The use is limited to irrigation, stockwatering, and domestic purposes.

Appropriator—**Muddy Valley Irrigation Co., Assignee of Nevada Land and Livestock Co., Under Certificate No. 60.**

Source—**Muddy River.**

Ditch Title	*Date when construction commenced*	*Date when land first irrigated*	*Number of acres irrigated*	*Sec.*	*Subdivision*	*Tp.S.*	*R.E.*
St. Joe or Logan Ditch			20.00	26	SE¼SW¼		
			20.00	35	E½NE¼		
			40.00	35	SE¼NW¼	15	67
Total			80.00				

The use of this water is determined as a winter use; diversion to commence October 1 of each year, and to extend to April 1 of the year following. Use limited to irrigation, stock-watering and domestic purposes.

0.8 c.f.s. allowed for irrigation.

STATE OF NEVADA
STATE ENGINEER'S OFFICE

I, J. G. Scrugham, State Engineer of the State of Nevada, duly appointed and qualified, having charge of the records and files of the office of the State Engineer, do hereby certify that the foregoing is a full, complete and true copy of the Order of Determination of the Relative Rights in and to the Waters of Muddy River and its Tributaries in Clark County, Nevada, prepared and filed in said office on the 21st day of January, 1920, as appears by the records and files of the office of the State Engineer of Nevada, and nothing more or less.

In Witness Whereof, I have hereunto set my hand and affixed my seal of office at the City of Carson, State of Nevada, this 21st day of January, A. D. 1920.

J. G. SCRUGHAM,
State Engineer.

[SEAL]

EXHIBIT "B"

IN THE MATTER OF THE DETERMINATION OF THE RELATIVE RIGHTS IN AND TO THE WATERS OF THE MUDDY RIVER AND ITS TRIBUTARIES IN CLARK COUNTY, STATE OF NEVADA.

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FURTHER AND SUPPLEMENTAL ORDER OF DETERMINATION.

In accordance with a stipulated agreement entered into by the parties in the suit of Muddy Valley Irrigation Company, et al, Vs. Moapa and Salt Lake Produce Company, et al, on the 23rd day of April, 1919, an order was entered in the Tenth Judicial District Court of the State of Nevada, in and for the County of Clark referring the above entitled action to the State Engineer for an adjudication of the water rights on the Muddy River stream system as provided for in Chapter 140, Statutes of 1913, and all Acts amendatory thereof.

On the 10th day of March, 1920, the matter having come on for hearing before the Court upon exceptions duly filed with the Clerk of the Court and served as required by law on the State Engineer, said exceptions having been filed by various parties to the said suit of Muddy Valley Irrigation Company et al. Vs. Moapa and Salt Lake Produce Company, et al., and the Court having heard said exceptions and proofs adduced by and on behalf of the excepting parties, the Court made and entered an order requiring the State Engineer to make a further determination of the waters of the said Muddy River and its tributaries subject to the Court's instructions which were set forth in said order, the said order being made by said District Court and entered in said suit.

In accordance with the said order of said Court and the said instructions the State Engineer makes the following:

FURTHER AND SUPPLEMENTAL ORDER OF DETERMINATION.

The tabulation of the allotments of the waters of the Muddy River stream system as set forth in the original order of determination with the changes herein made in this order, cover all claims filed in the office of the State Engineer as provided by law, and also an allotment to the Moapa Indian Reservation. Although duly notified of the pending adjudication proceedings in the statutory manner, the United States Indian Service authorities, did not file a claim and state that they refuse to recognize the authority of the State of Nevada to determine the water rights of the Moapa Indian Reservation. In the absence of any showing on the part of the United States Indian Service, the State Engineer has based the Moapa Indian Reservation allotment on the official investigations and reports made in the year 1906 by Henry Thurtell, at that time State Engineer of Nevada. These reports gave the Moapa Indian Reservation an allotment of water sufficient to properly irrigate an area of 87 acres, which was found to be the full area on the Reservation entitled to a vested water right under the law of this State.

(a) DUTY AND POINT OF DIVERSION DEFINED.

The duty of water allowed for all lands in the Muddy Valley, except on the Indian Reservation, shall be 1 c.f.s. flow to 70 acres for the summer irrigation season from May 1st to October 1st, and 1 c.f.s. flow to 100 acres for the winter irrigation season from October 1st to May 1st. On the Reservation, the duty of water allowed shall be 1 c.f.s. flow to 70 acres for the summer irrigation season from April 1st to October 1st, and 1 c.f.s. flow to 100 acres for the winter irrigation season from October 1st to April 1st.

The volumes or amounts of water alloted and to which it is agreed the respective parties are entitled shall be understood to include and define the amount of all the waters now or heretofore rightfully used on the lands given in the tabulation in the original order of determination whether diverted directly from said Muddy River or from its tributaries, springs, head-waters or other sources of supply, including waters claimed to have been developed heretofore by any of the said parties. All measurements of amounts except that awarded to the Indian Reservation shall be made at the places of diversion or as near thereto as practicable or convenient as the State Engineer or Water Commissioner may select or approve. On the Indian Reservation, all measurements of amounts diverted are to be made at the point where the main ditch enters or becomes adjacent to the land irrigated or as near thereto as practicable, as the State Engineer or Water Commissioner may select or approve.

(b) BALDWIN SPRING FLOW DEFINED.

The maximum flow of .8298 c. f. s. of water of the George Baldwin Spring now and heretofore used by George Baldwin and Aletha L. Baldwin, his wife, is water which has been developed by said parties. Such development and use of this amount of water has not and does not diminish the flow or volume of the Muddy River, or interfere with the rights of any other water users on the stream system. No further development of water on the head of the Muddy River stream system shall be made which in any way diminishes the flow of waters of the Muddy River or impairs rights defined and referred to in this order.

(c) METHOD OF USE.

The Muddy Valley Irrigation Company, subject to the supervision and general control of the State Engineer or Water Commissioner, shall distribute and control the distribution of the water alloted to it, and diverted and conveyed by its work to its stockholders and other persons obtaining water by means thereof.

All other parties named in this order shall not be required to take or use the water of said River in continuous flow but may cumulate the same or any part thereof in rotation and in periodic turn, with the approval of the water commissioner, subject to his control and direction and under such rules and regulations as are prescribed by the State Engineer and the statutes of the State of Nevada.

The whole amount of water diverted from the river at any one time by all the parties alloted water for use above the "narrows" is not to exceed in the aggregate the total amount of water alloted to the several parties resident in the Upper Muddy Valley. Below the lowest diversion of Knox and Holmes the flow in the stream shall be maintained substantially constant subject to seasonal variation. The whole of said river system shall be under the supervision and the rules and regulations of the State Engineer and the direction and control of the Water Commissioner, to be appointed as provided by law, except as hereinbefore specified as to the Muddy Valley Irrigation Company. Substantial headgates, weirs and sand-boxes, as the State Engineer through the Water Commissioner may order, shall be installed and maintained in good order by all who divert or use the waters of said stream system.

(d) Channel upkeep, responsibility for.

The owners of land on that part of said river above the "narrows" shall keep the channel through their respective lands cleared of all ordinary obstructions, but in case of extraordinary obstruction, such as the formation of lime deposits in the channel of the stream, the same shall be removed under the direction of the water commissioner and the expenses thereof paid pro rata by all parties to this determination in proportion to the acreage owned or controlled by them as defined in this order.

(e) Priority, vested and granted rights.

As between the parties to the above entitled suit and except against the rights awarded the Indian Reservation and the inhabitants thereof, all of the water rights enumerated as belonging to the parties to the suit shall be deemed and held to be vested rights acquired by valid appropriation and beneficial use prior to March 1, 1905, and by continued uninterrupted use since said date and shall be considered as equal in rank without anyone having any priority over another; this shall apply to and include the rights held by the Muddy Valley Irrigation Company as grantee or assignee of Nevada Land & Live Stock Company under certificates Nos. 58, 59 and 60 and to such permit or certificate as may be granted by the State Engineer to the Muddy Valley Irrigation Company under its application No. 1611. Against the right granted and alloted to the Indian Reservation, the rights held by the Muddy Valley Irrigation Company, under said certificates or permits, shall be deemed to be subsequent to the right by this order alloted to said Indian Reservation. The right allowed the Indian Reservation shall be deemed and held to be a vested right acquired by valid appropriation prior to March 1st, 1905, and uninterrupted use thereafter and shall to the extent allowed rank as of equal priority with all the other rights alloted and awarded to the various parties except those granted by the said certificates or permits.

(f) Losses, apportionments of.

All abnormal losses from the flow of said stream shall be pro-rated and shared among the parties holding water rights on the stream. Abnormal losses shall include any substantial loss from the permanent flow of the stream, such as a cloudburst destroying or obstructing the channel thereof or an opening up of a fissure in the bed of the stream or in one of the sources of supply and the disappearance therein of a substantial amount of the waters, thereby causing a diminution in the available flow.

If and such abnormal loss occurs at any time, the pro-rata share of such loss to be borne by each party to this order shall be as follows:

George Baldwin and Aletha L. Baldwin, his wife	16/2839
Moapa & Salt Lake Produce Co.	155/2839
Livingston and Smith	160/2839
Joseph Perkins and wife	30/2839
Knox and Holmes	95/2839
Issiah Cox and wife	10/2839
W. J. Powers and wife	29/2839
Sadie George	2.1/2839
Jacob Bloedel	2/2839

J. H. Mitchell	3/2839
U. S. Indian Service, Moapa Reservation	87/2839
John F. Perkins	2/2839
Muddy Valley Irrigation Company	2244.80/2839

As between the parties to the said suit the definition of abnormal losses shall be as contained in paragraph 8 of a stipulation filed in said court and suit on April 23rd, 1919, and the stipulation supplemental thereto filed in said court and suit and dated March 10th, 1920; and as between the parties to said suit the pro rata share of such abnormal losses shall be as set forth in paragraph 4 of the said stipulation supplemental to the stipulation of April 23rd, 1919.

(g) Expense of Commissioner.

The salary and expenses of the Water Commissioner shall be paid pro rata by the parties to the stipulation supplemented to the stipulation of April 23rd, 1919, made and filed in said suit March 10th, 1920, in the same proportion as for the sharing of abnormal losses set forth in paragraph 4 of said supplemental stipulation.

(h) All the waters of the stream system appropriated and alloted.

The aggregate volume of the several amounts and quantities of water awarded and alloted to the parties named in this order of determination which includes all the parties to said suit and the Indian Reservation is the total available flow of the said Muddy River and consumes and exhausts all of the available flow of the said Muddy River, its headwaters, sources of supply and tributaries.

(i) Water alloted to Muddy Valley Irrigation Company.

In accordance with the said stipulation and supplemental stipulation filed in said suit and the instructions of the Court requiring a further order of determination, as between the parties of the suit, the Muddy Valley Irrigation Company is hereby declared to be entitled to divert and use upon its lands all the waters of the said stream except the amounts specifically awarded and alloted to the other parties to said suit and to the Indian Reservation. In addition to the certificate rights belonging to the Muddy Valley Irrigation Company set forth in the original order of determination the Muddy Valley Irrigation Company is entitled to such rights as have accrued to it under its water application No. 1611 and which will be specifically defined in the certificate or permit to be issued by the State Engineer upon said application No. 1611, which said permit will be for approximately 10 C. F. S. of water (more or less) for use upon approximately 1000 acres of land (more or less) during the winter season.

The summary of allotments and certificates, contained in the original order of determination is amended so as to allow winter use of water to the parties hereinafter named and for the amounts hereinafter specified:

To	c.f.s. flow.
Moapa & Salt Lake Produce Company	2.215
Isaiah Cox and wife	.143
Isaiah Cox and wife (as grantees of J. H. Mitchell)	.043
George Baldwin	.2286
Sadie George	.03
John F. Perkins	.0286
Livingston and Smith	2.286
Knox and Holmes	1.357
Joseph Perkins	.428
W. J. Powers and wife	.4143

The amount allowed for winter use is allowed under a duty of water of 1 c. f. s. for 100 acres.

There is also the additional allotment to the Muddy Valley Irrigation Company for winter use under its application No. 1611. Except as hereinbefore changed the summary of allotments and certificates shall be as stated in the original order of determination.

The names of the respective appropriators, the sources of their appropriation, the titles of the ditches, the number of acres irrigated and the description of the land to which the water is appurtenant, the uses allowed and the amounts of water allowed for irrigation shall be as set forth in the original order of determination, except that it is understood that the rights of J. H. Mitchell have been acquired by and conveyed to Isaiah Cox and Anna M. Cox, his wife, and except that the periods of winter and summer use, as between the parties to said suit, shall be as hereinbefore defined in this further and supplemental order of determination.

/s/ J. G. Scrugham
State Engineer.

STATE OF NEVADA

STATE ENGINEER'S OFFICE.

I, J. G. SCRUGHAM, State Engineer of the State of Nevada, duly appointed and qualified, having charge of the records and files of the office of the State Engineer, do hereby certify that the foregoing is a full, complete and true copy of the further and supplemental order of determination of the relative rights in and to the waters of Muddy River and its tributaries in Clark County, Nevada, made under order of the Tenth Judicial District Court of the State of Nevada in and for the County of Clark, and in accordance with the instructions of said Court and filed in said office on the 11th day of March, 1920, as appears by the records and files of the office of the State Engineer of Nevada, and nothing more or less.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal of office this 11th day of March, A. D. 1920.

/s/ J. G. Scrugham
State Engineer.

SEAL

CERTIFICATION OF COPY

STATE OF NEVADA,)
) SS.
COUNTY OF CLARK,)

I, HARLEY A. HARMON, the duly elected, qualified and acting Clerk of Clark County, in the State of Nevada, and Ex-Officio Clerk of the District Court, do hereby certify that the foregoing is a true, full and correct copy of the original

JUDGMENT AND DECREE IN THE CASE ENTITLED

MUDDY VALLEY IRRIGATION COMPANY ET AL.,

Plaintiffs

VS.

MOAPA & SALT LAKE PRODUCE COMPANY, ET AL.

Defendants.

and

IN THE MATTER OF THE DETERMINATION OF THE RELATIVE RIGHTS IN AND TO THE WATERS OF THE MUDDY RIVER AND ITS TRIBUTARIES IN CLARK COUNTY, STATE OF NEVADA.

now on file and of record in this office.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the Seal of the Court at my office, Las Vegas, Nevada, the 12th day of March, , A. D. 19 20.

(SEAL)

/s/ Harley A. Harmon
CLERK.

/s/ Margaret Ireland
DEPUTY CLERK.

STATE OF NEVADA)
) ss.
COUNTY OF CLARK)

I, Helen Scott Reed, the duly elected, qualified and acting County Clerk of the County of Clark, State of Nevada, and ex-officio Clerk of the District Court of the Eighth Judicial District of the State of Nevada, in and for the County of Clark, do hereby certify and attest the foregoing to be a full, true and correct copy of the original: "JUDGMENT AND DECREE" in the action entitled;
MUDDY VALLEY IRRIGATION COMPANY, a corporation, NEVADA LAND & LIVESTOCK COMPANY, a corporation, SAMUEL H. WELLS, JOHN F. PERKINS and ELLEN C. PERKINS, his wife, Plaintiffs Vs.

MOAPA & SALT LAKE PRODUCE COMPANY, a corporation, GEORGE BALDWIN and ALETHA L. BALDWIN, his wife, ISAIAH COX and ANNA M. COX, his wife, JOSEPH PERKINS and KATHRYN PERKINS, his wife, D.H. LIVINGSTON and RICHARD SMITH, G. S. HOLMES and JULIA MAY KNOX, W. J. POWERS and MARY A. POWERS, his wife, SADIE GEORGE, LOS ANGELES & SALT LAKE RAILROAD COMPANY, a corporation, and WALKER D. HINES, as Director General of Railroads, and JACOB BLOEDEL, Defendants. and IN THE MATTER OF THE DETERMINATION OF THE RELATIVE RIGHTS IN AND TO THE WATERS OF THE MUDDY RIVER AND ITS TRIBUTARIES IN CLARK COUNTY, STATE OF NEVADA

Case No. 377

together with the endorsements thereon, now on file in my office, and that I have carefully compared the same with the original.

IN WITNESS WHEREOF, I have hereunto set my hand and annexed the Seal of the District Court of the Eighth Judicial District of the State of Nevada, in and for the County of Clark, this 16th day of May, 19 56

Helen Scott Reed

COUNTY CLERK OF THE COUNTY OF CLARK, STATE OF NEVADA, AND EX-OFFICIO CLERK OF THE DISTRICT COURT OF THE EIGHTH JUDICIAL DISTRICT OF THE STATE OF NEVADA, IN AND FOR THE COUNTY OF CLARK.

STATE OF NEVADA)
) ss.
COUNTY OF CLARK)

I, Frank McNamee, Judge of the District Court of the Eighth Judicial District of the State of Nevada, in and for the County of Clark, do hereby certify that Helen Scott Reed is County Clerk of the County of Clark, State of Nevada, and ex-officio Clerk of the District Court of the Eighth Judicial District of the State of Nevada, in and for the County of Clark (which Court is a Court of Record having a seal); that the signature to the foregoing certificate and attestation is the genuine signature of the said Helen Scott Reed, as such officer; that the seal annexed thereto is the seal of said District Court; that said Helen Scott Reed, as such clerk, is the proper officer to execute the said certificate of attestation, and that such attestation is in due form according to the laws of the State of Nevada.

IN WITNESS WHEREOF, I have hereunto set my hand in my official character as such Judge, at the City of Las Vegas, County and State aforesaid, this 16th day of May, A. D. 19 56

Frank McNamee

JUDGE OF THE DISTRICT COURT OF THE EIGHTH JUDICIAL DISTRICT OF THE STATE OF NEVADA, IN AND FOR THE COUNTY OF CLARK.

STATE OF NEVADA)
) ss.
COUNTY OF CLARK)

I, Helen Scott Reed, County Clerk of the County of Clark, State of Nevada, and ex-officio Clerk of the District Court of the Eighth Judicial District of the State of Nevada, in and for the County of Clark (which Court is a Court of Record, having a seal, which is annexed hereto) do hereby certify that Frank McNamee, whose name is subscribed to the foregoing certificate of due attestation was, at the time of signing the same, Judge of the District Court aforesaid, and was duly commissioned, qualified and authorized by law to execute said certificate. And I do further certify that the signature of the Judge above named to the said certificate of due attestation is genuine.

IN WITNESS WHEREOF, I have hereunto set my hand and annexed the Seal of the District Court of the Eighth Judicial District of the State of Nevada, in and for the County of Clark, this 16th day of May, 19 56

Helen Scott Reed

COUNTY CLERK OF THE COUNTY OF CLARK, STATE OF NEVADA, AND EX-OFFICIO CLERK OF THE DISTRICT COURT OF THE EIGHTH JUDICIAL DISTRICT OF THE STATE OF NEVADA, IN AND FOR THE COUNTY OF CLARK.

CC-51

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 23, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
1	John & Jane Water (EXAMPLE)	123 Water Ln. Waterville, NV 88888	Self	johnjanewater@yahoo.com	PC
2	ANDREW BURNS	1001 S. Valley View Blvd LV, NV 89153	SNWA	ANDREW.BURNS@SNWA.COM	
3	ZANE MARSHALL	"	"		
4	LISA LUPTOWITZ	"	"		
5	STEVEN ANDERSON	"	"		
6	CASEY COLLINS	"	"		
7	DENISE RODRIGUEZ	"	"		
8	JORDAN BUNKER	"	"		
9	COLBY PELLEGRINO	"	"		
10	Luke Miller	2800 Cottage Way E1712 Sacramento, CA 95825	DOI/FWS	luke.miller@sol.doi.gov	

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 23, 2019

Lower White River Flow System (LWRFS) Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
11	Glen Knowles	4701 Torrey Pines Dr. LV NV 89130	FWS	glen_knowles@fws.gov	
12	Kent Robison	71 Washington Reno	CSI	Krobison@rbsllaw.com ??	E
13	Brad Herrema	100 City Center Pkwy Las Vegas	CSI		E
14	Emilia Cargill	3100 SR 168 PO Box 37010 Coyote Sp 89037	CSI	emilia.cargill@coyotesprings.com	E
15	JEAN MORAN	785 GRAND AVE #202 CARLSBAD CA	CSI	JEANM@STETSONENGINEERS.COM	E
16	STEVE REICH	" "	CSI	STEVER@ "	E
17	ANNE EASTERBROOK	" "	CSI	ANNEE@ "	E
18	MOLLY PALMER	" "	CSI	MOLLYP@ "	E
19	Greg Morrison	50 W. Liberty Ste 750 Reno NV 89501	MVWD	gmorrison@parsonsbehle.com	E
20	Dwight Smith	P.O. Box 1482 Truckee CA 96160	CNLV	dwight.smith@interflowhydro.com	E

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 23, 2019

Lower White River Flow System (LWRFS)
Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
21	Carl Savely	6600 N. Wingfield Pkwy Sparks NV 89436	CSI	csavely@resortatredhawk.com	
22	Jay Lazarus	PO Box 5727 Santa Fe, NM 87502	MVWD	lazarus@glorietageo.com	E
23	Joseph Davis	P.O. 257 Logandale NV 89021	MVWD	[illegible]@moapawater.com	E
24	Laura Schroeder	10615 Double R Blvd, Ste 100 Reno NV 89521	CNLV/Bedroc	counsel@water-law.com	
25	CADY JOHNSON	2113 W ROSE GARDEN LN PHOENIX AZ 85027	MBOP	ircady@yahoo.com	E
26	Patrick Donnelly	7345 S. Durango B-107, Box 217 Las Vegas, NV 89113	Center for Biological Diversity	pdonnelly@biologicaldiversity.org	
27	Justina Caviglia	6100 Neil Rd Reno NV 89509	NV Energy	Jcaviglia@nvenergy.com	E
28	Debbie Leonard	955 S. Virginia St. Ste 220 Reno, NV 89502	Moapa Band of Paiutes	debbie@leonardlawpc.com	
29	Tom Myers	PO Box 177, Laporte PA 18626	Center for Bio Diversity	tommyers1872@gmail.com	E
30	Peter Fahmy	1201 Oakridge Drive, Suite 250 Ft Collins CO 80525	National Park Service	peter_a_fahmy@nps.gov	E

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 23, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
31	GARY KARST	601 Nevada Way Boulder City, NV 89005	NPS	gary-karst@nps.gov	N.
32	STEVE KING	227 RIVER RD DAYTON NV 89403	MVIC	KINGMONT@CHARTER.NET	
33	David Stone	PO Box 510 Alamo, NV 89001	USFWS	david_stone@fws.gov	N
34	Sylvia Harrison	100 W Liberty Reno NV 89501	Republic Georgia Pacific	sharrison@mcdonaldcarano.com	
35	Paulina Williams	98 San Jacinto Blvd 1500 Austin, TX 78701 (Baker Botts)	Georgia Pacific	paulina.williams@bakerbotts.com	
36	Rick Felling		NV Energy		
37	KAREN GLASGOW	333 BUSH ST # 775 SF CA 94104	DOI-NPS	KAREN.GLASGOW@SOL.DOI.GOV	
38	Rick Waddell		DOI - NPS	rick.waddell@tetratech.com	E
39	SUE BRAUMILLER	1530 [illegible] BLVD Reno NV	USFWS	sue_braumiller@gmail.com	
40	ROUTSON, Sam		W.F.I.	greatsam@usfds.com	

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STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 23, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
41	Wade Poulsen	wpoulsen@lincolnnv.com	LCWD		
42	Lisa Tanner	Lisa@Tannerlaw.com	Moapa		
43	Sarah Peterson	sarahpeterson@blm.gov	BLM		
44	Ryan Hoerth	rhoerth@vidlerwater.com	VWC		
45	Greg Bushner	3480 GS Richards Blvd Ste 101 Carson City	Vidler	gbushner@vidlerwater.com	
46	Greg Walch	1001 S Valley View LV, NV 89153	SNWA		
47	Jim Watrus	"	"		
48	Molly Palmer	2171 E. Francisco Blvd Ste K San Rafael CA 94901	CSI (Stetson Engineers)	mollyp@stetsonengineers.com	
49	Beth Baldwin	Ziontz Chestnut 2101 4th Ave Ste 1230 Seattle	Moapa Band of Paiutes	bbaldwin@ziontzchestnut.com	
50	Karen Peterson	402 N. Division St Carson City NV	LCWD/Vidler	kpeterson@allisonmackenzie.com	

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 23, 2019

Lower White River Flow System (LWRFS)
Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 24, 2019

Lower White River Flow System (LWRFS) Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
1	John & Jane Water (EXAMPLE)	123 Water Ln. Waterville, NV 88888	Self	johnjanewater@yahoo.com	PC
2	Luke Miller	2800 Cottage Way Sacramento, CA 95825	DOI/FWS	luke.miller@sol.doi.gov	
3	Carl Savely	6600 N. Wingfield Pkwy Sparks, NV 89436	CSI	csavely@rescitatredhawk.com	
4	Colby Pellegrino	1001 S Valley View Blvd	SNWA	colby.pellegrino@snwa.com	
5	Lisa Luptowitz				
6	Zane Marshall				
7	Jim Watrus				
8	Bob Williams				
9	Greg Walch				
10	Paul Taggart				

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 24, 2019

Lower White River Flow System (LWRFS) Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
11	Tim Mayer	911 NE 11th Ave Portland OR 97232	USFWS	tim-mayer@fws.gov	E
12	Ryan Hoerth		VWC	rhoerth@vidlerwater.com	
13	Brad Herrema		CSI	bherrema@bhfs.com	
14	Sue Braumiller	Financial Blvd Reno, NV	USFWS	sue_braumiller@fws.gov	E
15	STEVE KING		MVIC	KINGMVIC@CHARTER.NET	
16	Debbie Leonard		Moapa Band of Paiutes	debbie@leonardlawpc.com	
17	Denise Rodriguez Stidd		SNWA		
18	EMILIA CARGILL		CSI		E
19	Michael Schwemm		USFWS	michael_schwemm@fws.gov	E
20	Joseph Davis		MVWD	[illegible]@moapawater.com	

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 24, 2019

Lower White River Flow System (LWRFS)
Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
21	Justina Caviglia	6100 Neil Rd Reno NV 89509	NV Energy	jcaviglia@nvenergy.com	E
22	JEAN MORANI	785 GRAND #202 CARLSBAD CA 92008	CSI	JEANM@STETSONENGINEERS.com	PC
23	[illegible]	402 N. Division St. [illegible] NV 89703	LCWD + [illegible]	[illegible]	Yes
24	Patrick Donnelly	7345 S. Durango B-107, Box 217 Las Vegas, NV 89113	Center for Biological Diversity	pdonnelly@biologicaldiversity.org	
25	Doug Chen	4061 Port Chicago Hwy #H Concord CA 94520	CSI	dchen@discoverybuilders.com	N
26	Sylvia Harrison	100 W Liberty Reno NV 89501	Republic Georgia Pacific	sharrison@mcdonaldcarano.com	
27	Richard Waddell		US NPS	rick.waddell@tetratech.com	Y
28	GARY KARST	601 Nevada Way Boulder City NV 89005	NPS	gary_karst@nps.gov	N
29	Beth Baldwin		Moapa Band of Paiutes	bbaldwin@ziontzchestnut.com	
30	Laura Schroeder	10615 Double R Blvd. Ste.100 Reno NV 89521	CNLV	counsel@water-law.com	

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 24, 2019

Lower White River Flow System (LWRFS) Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
31	Glen Knowles	4701 Torrey Pines Dr LV NV 89130	FWS	Glen_Knowles_fws.gov	
32	Paulina Williams	Baker Botts, 98 San Jacinto Blvd STE 1500 AUSTIN, TX 78701	Georgia Pacific	paulina.williams@bakerbotts.com	
33	Sarah Peterson	1340 Financial Blvd Reno NV 89509	BLM	sarahpeterson@blm.gov	
34	Rick Felling		NV Energy		
35	KAREN GLASGOW	333 BUSH ST 775 SF CA 94104	NPS	KAREN.GLASGOW@SOL.DOI.GOV	
36	CADY JOHNSON	2113 W ROSE GARDEN LN PHOENIX, AZ 85027	MBOP	ircady@yahoo.com	E
37	Dylan Frehner	P.O. Box 60 Pioche NV 89043	LCWD	dfrehner@lincolncountynv.gov	
38	WADE POULSEN	Box 936 Panaca, NV 89042	LCWD		
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 24, 2019

Lower White River Flow System (LWRFS)
Hearing

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STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 24, 2019

Lower White River Flow System (LWRFS)
Hearing

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STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 25, 2019

Lower White River Flow System (LWRFS)
Hearing

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2	Laura Schroeder	10615 Double R Blvd, #100 Reno NV 89521	CNLV	counsel@water-law.com	
3	Justina Caviglia	6100 Neil Rd Reno NV 89521	NV Energy	jcaviglia@nvenergy.com	E
4	Luke Miller	2800 Cottage Way, E-1712 Sacramento, CA 95825	DOI/FWS	luke.miller@sol.doi.gov	
5	STEVE KING	227 RIVER RD DAYTON, NV 89403	MVIC	KINGMONT@CHARTER.NET	
6	Joseph Davis		MVWD	[illegible]@mvwater.com	
7	Carl Savely	6600 N. Wingfield Pkwy Sparks 89436	CSI	csavely@prescotttrailhawk.com	
8	Tim Mayer	911 NE 11th Ave Portland, OR 97232	USFWS	tim.mayer@fws.gov	
9	Sarah Ferguson	100 W. Liberty Reno NV 89503	Georgia Pac	sferguson@mcdonaldcarano.com	
10	Colby Pellegrino		SNWA		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 25, 2019

Lower White River Flow System (LWRFS)
Hearing

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11	Glen Knowles	4701 Torrey Pines Dr. LV NV 89130	FWS	glen_knowles@fws.gov	
12	Patrick Donnelly	7345 S. Durango B-107 Box 217 LV NV 89113	Center for Biological Diversity	pdonnelly@biologicaldiversity.org	
13	Lina Tanner	216 E. Liberty St. Reno 89501	Moapa Band	LINA@TANNERLAW.COM	
14	Beth Baldwin		Moapa Band of Paiutes		
15	Sue Braumiller	Financial Blvd Reno NV	USFWS	sue_braumiller@fws.gov	—
16	Sarah Peterson	1340 Financial Blvd Reno NV 89502	BLM	sarahpeterson@blm.gov	
17	Peter Fahmy		NPS	peter_a_fahmy@nps.gov	
18	Richard Waddell		NPS	rick.waddell@tetratech.com	E
19	KAREN GLASGOW	333 BUSH ST 775 SF CA 94104	NPS	KAREN.GLASGOW@SOL.DOI.GOV	
20	CADY JOHNSON	2113 W ROSEGARDEN LN PHOENIX, AZ 85027	MBOP	ircady@yahoo.com	E

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 25, 2019

Lower White River Flow System (LWRFS) Hearing

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21	Greg Walsh		SNWA		
22	Steven Anderson		SNWA	sc.anderson@snwa.com	
23	Denise Rodriguez		SNWA		
24	Paul Taggart		SNWA		
25	GARY KARST	601 Nevada Way Boulder City, NV 89005	NPS	gary-karst@nps.gov	
26	EMILIA Cargill		CSI		
27	Brad Herrema		CSI		
28	Steve Reich		CSI		
29	Ryan Hoerth		VWC		
30	Greg Bushner		VWC		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 25, 2019

Lower White River Flow System (LWRFS)
Hearing

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31	Steve Hartman		VVWC		
32	Windo Paulson		LLWD		
33	Dylan Frehner		LCWD		
34	Peter Mock		PMC		
35	Michael Schwemm		USFWS		
36	Karen Peterson		Allison MacKenzie		
37	Dwight Smith		CNLV		
38	Dylan Frehner		LCWD		
39	Brad Herrema		CSI		
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 25, 2019

Lower White River Flow System (LWRFS)
Hearing

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STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 25, 2019

Lower White River Flow System (LWRFS)
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 26, 2019

Lower White River Flow System (LWRFS)
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3	Carl Savely	6600 N. Wingfield Pkwy Sparks, NV 89436	CSI	csavely@resortatredhawk.com	
4	Emilia Cargill		CSI		
5	Steve Reich		CSI		
6	Brad Herrema		CSI		
7	Luke Miller	2800 Cottage Way, E-1712 Sacramento, CA 95825	FWS/DOI	luke.miller@sol.doi.gov	
8	Ryan Hoerth		VWC		
9	Peter Mock		PMC		
10	Karan Petersen		A+M		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 26, 2019

Lower White River Flow System (LWRFS)
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11	Dylan Frehner		LCWD		
12	Wade Poulsen		LCWD		
13	Greg Bushner		VWC		
14	Beth Baldwin		MBOP		
15	STEVE KING		MVIC		
16	Joseph Davis		MVWD	joe@mvpwater.com	
17	Dennis Rodriguez Steidl		SNWA		
18	Colby Pellegrino		SNWA		
19	Paul Taggart		SNWA		
20	Steven Anderson		SNWA		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 26, 2019

Lower White River Flow System (LWRFS) Hearing

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21	Darlene Leonard		Moapa Band of Paiutes		
22	Patrick Donnelly	7345 S. Durango B-107, Box 217 LV, NV 89113	Center for Biological Diversity	pdonnelly@biologicaldiversity.org	
23	Richard Waddell		NPS	rick.waddell@tetratech.com	
24	GARY KARST	601 Nevada Way Boulder City, NV 89005	NPS	gary_karst@nps.gov	
25	Peter Mock	4130 N. Camelback Manor Dr. Paradise Valley AZ 85253	Vidler/Lucid	pmock@pmgc.net	
26	Therese Ure Lisa Mae Gage	Schroeder Law Office	City of N. Las Vegas	t.ure@water-law.com	
27	Martina Mifflin	HC 38 Box 126 L.V., NV 89166	Moapa Band of Paiutes	martinamifflin@yahoo.com	
28	Emilia Cargill		CSI		
29	Brad Herrema		CSI		
30	Steve Reich		CSI		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 26, 2019

Lower White River Flow System (LWRFS)
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31	Justina Caviglia	6100 Neil Rd Reno NV 89509	NV Energy	jcaviglia@nvenergy.com	E
32	Tim Mayer		USFWS		
33	Glen Knowles		US FWS		
34	Michael Schwemm		USFWS		
35	Sue Braumiller	1530 Financial Blvd Reno NV	USFWS	sue_braumiller@fws.gov	—
36	Sylvia Harrison	4995 S Jumbo Way Washoe Valley	Republic Georgia Pacific	sharrison@mcdonaldcarano.com	—
37	Jay Lazarus		MVWD	lazarus@glorietageo.com	
38	Tom Myers		CBD		
39	Rick Felling		NV Energy		
40	Sarah Peterson	1340 Financial Blvd Reno NV 89502	BLM	sarahpeterson@blm.gov	

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 26, 2019

Lower White River Flow System (LWRFS)
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 26, 2019

Lower White River Flow System (LWRFS)
Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 27, 2019

Lower White River Flow System (LWRFS)
Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
1	John & Jane Water (EXAMPLE)	123 Water Ln. Waterville, NV 88888	Self	johnjanewater@yahoo.com	PC
2	Carl Savely	6600 N. Wingfield Pkwy Sparks, NV 89436	CSI	csavely@sbcglobal.net	
3	STEVE KING		MVIC	KINGMONT@CHARTER.NET	
4	Ryan Hoerth		VWC		
5	Greg Bushner		VWC		
6	Dylan Frehner		LCWD		
7	Peter Mock		PMC		
8	Karen Patterson		A+McK		
9	Luke Miller	2800 Cottage Way, E1712 Sacramento, CA 95825	DOI/FWS		
10	Denise Rodriguez Steidel		SNWA		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 27, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
11	Warda Drici		SNWA		E
12	Andrew Burns		SNWA		E
13	Paul Taggart		SNWA		E
14	Tim OConnor		SNWA		E
15	Colby Pellegrino		SNWA		
16	Jordan Bunker		SNWA		
17	Jim Watrus		SNWA		
18	Casey Collins		SNWA		
19	Greg Walch		SNWA		
20	Michael Schwemm		USFWS		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 27, 2019

Lower White River Flow System (LWRFS)
Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
21	Justina Caviglia	NV Energy			E
22	Patrick Donnelly	7345 S. Durango 5107 Box 217 LV NV 89113	Center for Biological Diversity	pdonnelly@biologicaldiversity.org	
23	Tom Myers	PO B177, Laporte PA 18626	"	Tommyers1872@gmail.com	
24	Joseph Davis	NA	MVWD	@mvwd.com	
25	Emilea Cayll		CSI		
26	Brad Herrema		CSI		
27	Steve Reich		CSI		
28	Scott Millington		MVIC	muddyvalley@mvdsl.com	
29	ZADY Johnson	2113 W ROSE GARDEN LN PHOENIX, AZ 85027	MBOP	ivcady@yahoo.com	E
30	Therese Ure Lisa Mae Gage		Bedroc City N. Vegas		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 27, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
31	Therese Ure Stix	71 Washington St. Reno NV 89503	CSI	tshanks@rssblaw.com	
32	Richard Waddell		NPS	rick.waddell@tetratech.com	
33	GARY KARST	601 Nevada Way Boulder City, NV 89005	NPS	gary_karst@nps.gov	N
34	NORMAN CARLSON	3322 E Fort Lowell Tucson AZ	ZONGE	NORMAN.CARLSON@ZONGE.COM	
35	Dwight Smith		CNLV		E
36	Sylvia Harrison	100 W Liberty Reno NV 89501	Republic Georgia Pacific	sharrison@mcdonaldcarano.com	N
37	SUE BRAUMILLER	Financial Blvd Reno NV	USFWS	sue_braumiller@fws.gov	
38	SEV CARLSON	50 W. Liberty St Ste 700 Reno NV 89501	LDS Church	scarlson@kcnvlaw.com	N
39	Jay Dixon	10299 Culiacan Pass Trl Reno, NV 89521	NCA; Bedroc	dixonjm@gmail.com	
40	ALEX FLANGAS	50 W. Liberty St. Ste 700 Reno NV 89501	NCA	aflangas@kcnvlaw.com	

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 27, 2019

Lower White River Flow System (LWRFS)
Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
41	Beth Baldwin		MBOP		
42	GALEN GLASGOW		NPS		
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 27, 2019

Lower White River Flow System (LWRFS)
Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 30, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
1	John & Jane Water (EXAMPLE)	123 Water Ln. Waterville, NV 88888	Self	johnjanewater@yahoo.com	PC
2	CADY JOHNSON	2113 W ROSE GARDEN LN PHOENIX, AZ 85027	MBOP	ircady@yahoo.com	E
3	Carl Savely	6600 N. Wingfield Pkwy Sparks, NV 89436	CSI	csavely@resortatredhawk.com	
4	WADE POULSEN		LCWD		
5	SNWA/LVVWD STAFF		SNWA	JASON.BAILEY@LVVWD.COM	
6	Brad Herrema		CSI		
7	Steve Reich		CSI		
8	Emilia Cargill		CSI		
9	SEV CARLSON		LDS Church	scarlson@kcnvlaw.com	
10	Ryan Hoertl				

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 30, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
11	Dylan Frahner				
12	Todd Umstead				
13	Peter Mock				
14	Karen Petersen				
15	Greg Bushner				
16	Norm Carlson				
17	Steve King		MVIC	KINGMONT@CHARTER.NET	
18	Scott Millington		MVIC	muddyvalley@mvdsl.com	
19	Greg Morrison		MVWD	gmorrison@parsonsbehle.com	
20	Joseph Davis		MVWD	[illegible]@mvwdwater.com	

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 30, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
21	Therese Ure		Bedroc City of N. Las Vegas		
22	Tom Butler		Vidler		
23	Sarah Peterson		BLM		
24	Justina Caviglia		SNWC		
25	Rick Felling		NVEnergy		
26	Richard Waddell		NPS	rick.waddell@tetratech.com	
27	GARY KARST		NPS	gary_karst@nps.gov	
28	Denise Rodriguez Steidel		SNWA		
29	Patrick Donnelly	7345 S. Durango D-107, Box 217 LV, NV 89113	Center for Biological Diversity	pdonnelly@biologicaldiversity.org	
30	Sue Braumiller	Financial Blvd Reno, NV	USFWS	sue_braumiller@fws.gov	

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 30, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
31	Michael Schwemm		USFWS		
32	Andy Moore		City of North Las Vegas		
33	Karen Glasgow		NPS		
34	Jim Watrus		SNWA		
35	Lisa Luptowitz		SNWA		
36	Colby Pellegrino		SNWA		
37	Zane Marshall		SNWA		
38	Robert Williams		SNWA		
39	Paul Taggart		SNWA		
40	Jason Bailey		SNWA		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 30, 2019

Lower White River Flow System (LWRFS)
Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
41	Jay Lazarus		MVWD		
42	Tom Duensing		SNWA		
43	Sylvia Harrison		Republic, LP		
44	Richard Berley		Moapa Band of Paiutes		
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
September 30, 2019

Lower White River Flow System (LWRFS) Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 1, 2019

Lower White River Flow System (LWRFS)
Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
1	John & Jane Water (EXAMPLE)	123 Water Ln. Waterville, NV 88888	Self	johnjanewater@yahoo.com	PC
2	Carl Savely	6600 N. Wingfield Pkwy Sparks, NV 89436	CSI	csavely@resortatredhawk.com	
3	Joseph Davis		MVWD	joe@moapawater.com	
4	Brad Herrema		CSI		
5	Alex Flangas		NCA	aflangas@kcnvlaw.com	
6	Emilia Cargill		CSI		
7	Steve Reich		CSI		
8	Kent Robison		CSI		
9	Cady Johnson	2113 W Rose Garden Ln Phoenix, AZ 85027	MBOP	ivcady@yahoo.com	E
10	Justina Caviglia		NV Energy		E

STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 1, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
11	STEVE KING		MVIC	KINGMONT@CHARTER.NET	
12	Therese Ure Lisa Mae Gage		City N. Las Vegas Bedroc		
13	Ryan Hoerth				
14	Greg Bushner				
15	Steve Hartman				
16	Wade Poulsen				
17	Dylan Frehner				
18	Tom Butler				
19	Peter Mock				
20	Norm Carlson				

STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 1, 2019

*Lower White River Flow System (LWRFS)
Hearing*

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
21	Karen Peterson				
22	Todd Umstot				
23	Andy Moore		City of North Las Vegas		
24	Sarah Peterson		BLM		
25	Patrick Donnelly	7345 S. Durango B-107, Box 217 LV NV 89113	Center for Biological Diversity	pdonnelly@biologicaldiversity.org	
26	Dwight Smith		CNLV		E
27	Kayleen Glasgow		NPS		
28	Greg Morrison	50 W. Liberty	MVWD		
29	Rick Felling		NV Energy		
30	Sue Braumiller	Financial Blvd Reno, NV	USFWS	sue_braumiller@fws.gov	

STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 1, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
31	Denise Rodriguez Steidel		SNWA		
32	Colby Pellegrino		SNWA		
33	Steven Anderson		SNWA		
34	Paul Taggart		SNWA		
35	Tim OConnor		SNWA		
36	Sev Carlson		LDS Church		
37	Dylan Frehner		LCWD		
38	GARY KARST		NPS		
39	Richard Waddell		NPS		
40	Paulina Williams		Georgia Pacific		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 1, 2019

Lower White River Flow System (LWRFS)
Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
41	Sylvia Harrison		CP Republic		
42	Jonathan Bell		Broadbent & Assoc. LLC		
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 1, 2019

Lower White River Flow System (LWRFS)
Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 2, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
1	John & Jane Water (EXAMPLE)	123 Water Ln. Waterville, NV 88888	Self	johnjanewater@yahoo.com	PC
2	Carl Savely		CSI	csavely@resortatredhawk.com	
3	Joseph Davis		MVWD	[illegible]power[illegible].com	
4	Therese Ure		Bedroc City N. Las Vegas		
5	Steve Reich		CSI		
6	Tom Myers	PO B177, Laporte PA 18626	CBD	tommyers1872@gmail.com	yes
7	STEVE KING		MVIC	KINGHART@[illegible].NET	
8	CADY JOHNSON	2113 W ROSE GARDEN LN PHOENIX, AZ 85027	MBOP	iready@yahoo.com	E
9	EMILIA Cargill		CSI		
10	Brad Herrema		CSI		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 2, 2019

Lower White River Flow System (LWRFS)
Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
11	Steve Reich		CSI		
12	Kent Robison		CSI		
13	Justina Caviglia		NV Energy		
14	Ryan Hoerth				
15	Greg Bushner				
16	Karen Peterson				
17	Wade Poulsen		LCWD		
18	Dylan Frehner		LCWD		
19	Peter Mock				
20	GARY KARST		NPS		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 2, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
21	Paulina Williams	98 San Jacinto Blvd 1500, Austin, TX 78701	Georgia Pacific	pauline.williams@bakerbotts.com	
22	Sarah Peterson	"	BLM		
23	Paul Taggart	1001 S Valley View Blvd Las Vegas NV 89107	SNWA/LVVWD	colby.pellegrino@snwa.com	
24	Colby Pellegrino				
25	Denise Rodriguez-Stidd				
26	Steven Anderson				
27	Sylvia Harrison		Republic GP		
28	RICHARD BERLEY	2101 4th Av, Ste 1230 Seattle WA 98121	Moapa Band of Paiutes	rberley@ziontzchestnut.com	
29	Rick Felling		NV Energy		
30	SUE BRAUMILLER	Financial Blvd Reno, NV	USFWS	sue_braumiller@fws.gov	

STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 2, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
31	Jared Glasgow		WPS		
32	Patrick Donnelly	7345 S. Durango B-107, Box 217 LVNV 89113	Center for Biological Diversity	pdonnelly@biologicaldiversity	
33	Luke Stewart	8000 E. Lake Mead Blvd. N. Las Vegas, NV 89030	PABCO	luke.stewart@pabcogypsum.com	N
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 2, 2019

Lower White River Flow System (LWRFS) Hearing

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STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 2, 2019

Lower White River Flow System (LWRFS)
Hearing

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STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 3, 2019

Lower White River Flow System (LWRFS)
Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

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1	John & Jane Water (EXAMPLE)	123 Water Ln. Waterville, NV 88888	Self	johnjanewater@yahoo.com	PC
2	Carl Savely		CSI	csavely@resolutetiredhawk.com	
3	Justina Caviglia		SNWA		
4	Ryan Hoerth				
5	Greg Buehner				
6	Dylan Frahner				
7	Wade Poulsen				
8	Karen Peterson				
9	Brad Herrema		CSI		
10	Emilia Cargill		CSI		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 3, 2019

Lower White River Flow System (LWRFS)
Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
11	Steve Reich		CSI		
12	Rick Felling		NV Energy		
13	Kent Robison		CSI		
14	Luke Stewart		TABCO		
15	Karen Glasgow		NPS		
16	STEVE KING		MVIC		
17	Therese Ure		Bedroc North Las Vegas		
18	Joseph Davis		MVWD		
19	Patrick Donnelly	8345 S. Durango ~~B~~107 Box 217 LV NV 89113	Center for Biological Diversity	pdonnelly@biologicaldiversity.org	
20	Sue Braumiller	Fernanda Blvd Reno, NV	USFWS	sue_braumiller@fws.gov	

STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 3, 2019

Lower White River Flow System (LWRFS)
Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
21	CADY JOHNSON	2113 W ROSE GARDEN LN PHOENIX, AZ 85027	MBOP	ircady@yahoo.com	E
22	RICHARD BERLEY	2101 4th AVE, Ste 1230 Seattle WA 98121	Moapa Band of Paiutes	rberley@ziontzchestnut.com	
23	Scott Millington	P.O. BOX 665 Overton, NV	MVIC	muddyvalley@mvdsl.com	✓
24	Todd Robison	P.O. BOX 665 Overton, NV	MVIC	trobison@mvdsl.com	yes
25	GARY KARST		NPS	gary-karst@nps.gov	N
26	Greg Morrison		MVIC	gmorrison@parsonsbehle.com	
27	Denise Rodriguez		SNWA		
28	Colby Pellegrino		SNWA		
29	Paul Taggart		SNWA		
30	Tim O'Connor		SNWA		

THE GREAT SEAL OF THE STATE OF NEVADA
ALL FOR OUR COUNTRY

STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 3, 2019

Lower White River Flow System (LWRFS) Hearing

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STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 3, 2019

Lower White River Flow System (LWRFS)
Hearing

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STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 3, 2019

Lower White River Flow System (LWRFS)
Hearing

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STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 4, 2019

Lower White River Flow System (LWRFS)
Hearing

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1	John & Jane Water (EXAMPLE)	123 Water Ln. Waterville, NV 88888	Self	johnjanewater@yahoo.com	PC
2	Carl Savely		CSI		
3	Therese Ure Lisa Mae Gage		Bedroc City N. Las Vegas		
4	Dylan Frehner				
5	Wade Poulsen				
6	Joseph Davis		MVWD		
7	Ryan Hardt				
8	Karen Peterson				
9	Greg Bushner				
10	Steve King		MVIC		

STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 4, 2019

Lower White River Flow System (LWRFS)
Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
11	Kent Robison		CSI		
12	Emilia Cargill		CSI		
13	Justina Caviglia		NV Eng.		
14	GARY KARST		NPS		
15	Scott Millington		MVIC		
16	ROBERT COACHE		NCA		
17	Jay Dixon		Bedroc		
18	Colby Pellegrino		SNWA/LVVWD		
19	Steven Anderson				
20	Paul Taggart				

STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 4, 2019

Lower White River Flow System (LWRFS)
Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
21	Rick Felling		NV Energy		
22	RICHARD BERLEY		MBOP		
23	SUE BRAUMILLER	Tinaxion Blvd Reno, NV	USFWS	sue_braumiller@fws.gov	
24	CADY JOHNSON	2113 W ROSE GARDEN LN PHOENIX AZ 85027	MBOP	icady@yahoo.com	E
25	Sylvia Harrison		Republic, LP		
26	Greg Morrison		MVWD	gmorrison@parsonsbehle.com	
27	Patrick Donnelly	7341 S. Durango Bldg, Box 212 LV, NV 89117	Center for Biological Diversity	pdonnelly@biologicaldiversity.org	
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 4, 2019

Lower White River Flow System (LWRFS) Hearing

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STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 4, 2019

Lower White River Flow System (LWRFS) Hearing

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	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
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STATE OF NEVADA
DIVISION OF WATER RESOURCES
October 4, 2019

Lower White River Flow System (LWRFS) Hearing

SIGN IN SHEET - PLEASE PRINT CLEARLY

	NAME	MAILING ADDRESS	REPRESENTING OR ORGANIZATION	E-MAIL ADDRESS	PRESENTING EVIDENCE (E) OR PUBLIC COMMENT (PC)
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Therese A. Ure, NSB 10255
Laura A. Schroeder, NSB 3595
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Reno, NV 89521
PHONE (775) 786-8800; FAX (877) 600-4971
counsel@water-law.com
Attorneys for Bedroc

Affirmation: This document does not contain the social security number of any person.

IN THE OFFICE OF THE STATE ENGINEER

OF THE STATE OF NEVADA

IN THE MATTER OF THE ADMINISTRATION AND MANAGEMENT OF THE LOWER WHITE RIVER FLOW SYSTEM WITHIN THE COYOTE SPRING VALLEY HYDROGRAPHIC BASIN (210), A PORTION OF BLACK MOUNTAINS AREA HYDROGRAPHIC BASIN (215), GARNET VALLEY HYDROGRAPHIC BASIN (216), HIDDEN VALLEY HYDROGRAPHIC BASIN (217), CALIFORNIA WASH HYDROGRAPHIC BASIN (218), AND MUDDY RIVER SPRINGS AREA (AKA UPPER MOAPA VALLEY) HYDROGRAPHIC BASIN (219), LINCOLN AND CLARK COUNTIES, NEVADA	**WESTERN ELITE ENVIRONMENTAL, INC. AND BEDROC LIMITED, LLC'S WITNESS LIST, SUMMARY OF TESTIMONY, AND EXHIBIT LIST**

Western Elite Environmental, Inc., and Bedroc Limited, LLC (collectively "Bedroc"), by and through its counsel, Therese A. Ure and Laura A. Schroeder of Schroeder Law Offices, P.C., pursuant to the State Engineer's August 23, 2019 Notice of Hearing, submit: 1) the following list of potential witnesses with a brief summary of their testimony; 2) exhibit list; and 3) copies of documentary evidence attached hereto.

This submission does not waive any objections to exhibits submitted by any other party in this proceeding.

Witness List and Summary:

Bedroc may call any or all of the following witnesses and utilize any or all of the following exhibits in this proceeding:

1) Jay Dixon
Dixon Hydrologic, PLLC
10299 Culiacan Pass Trail
Reno, NV 89521

Jay Dixon has previously been qualified before the State Engineer as an expert in the area of hydrology and water rights. Mr. Dixon will testify as to items related to the Interim Order 1303 – Rebuttal Report[1] submitted on behalf of Bedroc Limited and its operating entity Western Elite Environmental Inc. Mr. Dixon will testify as to items contained in the report including 1) Nevada Water Rights, particularly Chapters 533 and 534 and their impacts with regards to the administration and management of the Lower White River Flow System ("LWRFS"), 2) Order 1169 pump test and results of said pump test, 3) Ground water hydrology of the LWRFS, particularly in Coyote Spring Valley, and 4) the interaction of ground water and surface water within the LWRFS.

Exhibit List and Copies: (Exhibit Numbers BEDROC Ex. No. 1 – BEDROC Ex. No. 24)

Bedroc Exhibits are listed in Attachment A hereto. Two original sets as well as a copy on a USB drive of all exhibits listed in Attachment A are being provided to the State Engineer in conjunction with this filing. The exhibit list is also provided to the State Engineer in Excel format on the attached USB drive.

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[1] The Report was signed and submitted by Derek Muaina, general counsel for Western Elite Environmental, Inc. and Bedroc Limited, LLC, however its contents were developed by Jay Dixon. Mr. Dixon will testify to the report.

Bedroc reserves the right to introduce records from the State Engineer's files and records. Bedroc reserves the right to introduce additional exhibits that may be identified as a result of the testimony or exhibits disclosed by other parties to the proceeding. Bedroc further reserves the right to introduce exhibits as may be necessary for rebuttal or impeachment purposes.

DATED this 6th day of September, 2019.

SCHROEDER LAW OFFICES, P.C.

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Attorneys for Bedroc

ATTACHMENT A

Western Elite Environmental, Inc. and
Bedroc Limited, LLC's
Exhibit List
(BEDROC Ex. No. 1- BEDROC Ex. No. 24)

Exhibit Number	Description
BEDROC Ex. No. 1	Jay Dixon – Curriculum Vitae
BEDROC Ex. No. 2	Interim Order 1303 – Rebuttal Report – Prepared by Bedroc and Dixon Hydrologic, PLLC – August 2019
BEDROC Ex. No. 3	NDWR Vested Proof V04545
BEDROC Ex. No. 4	NDWR Application 71031
BEDROC Ex. No. 5	NDWR Permit 83044
BEDROC Ex. No. 6	NDWR Permit 85249
BECROC Ex. No. 7	NDWR Permit 85250
BEDROC Ex. No. 8	NDWR Application 85251
BEDROC Ex. No. 9	NDWR Application 85252
BEDROC Ex. No. 10	NDWR Application 85253
BEDROC Ex. No. 11	NDWR Application 85254
BEDROC Ex. No. 12	NDWR Application 87496
BEDROC Ex. No. 13	NDWR Application 87497
BEDROC Ex. No. 14	NDWR Application 87498
BEDROC Ex. No. 15	NDWR Application 87499
BEDROC Ex. No. 16	NDWR Application 87500
BEDROC Ex. No. 17	Select pages from NDWR water right files for V04545, Permit 71031 and Permit 83044
BEDROC Ex. No. 18	Bedroc Shallow Groundwater Contour and Monitoring Well Location Map
BEDROC Ex. No. 19	Bedroc Borehole Lithologic and Well Log Summaries
BEDROC Ex. No. 20	Bedroc Historical Site Aerial Photos
BEDROC Ex. No. 21	Wilson, J.W., 2019, Drilling, construction, water chemistry, water levels, and regional potentiometric surface of the upper carbonate-rock aquifer in Clark County, Nevada, 2009-2015: U.S. Geological Survey Scientific Investigations Map 3434, scale 1:500,000, https://doi.org/10.3133/sim3434

SCHROEDER
LAW OFFICES, P C
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Exhibit Number	Description
BEDROC Ex. No. 22	Rowley, P.D., G.L. Dixon, E.A. ManKinen, K.T. Pari, D.K. McPhee, E. H. KcKee, A. G. Burns, J.M. Watrus, E.B. Ekren, W.G. Patrick, and J.M. Band, 2017. Geology and geophysics of White Pine and Lincoln counties, Nevada, and adjacent parts of Nevada and Utah – the geologic framework of regional groundwater flow systems. Nevada Bureau of Mines and Geology Report 56. Scale 1:250,000, 4 plates.
BEDROC Ex. No. 23	Assessment of Lower White River Flow System Water Resource Conditions and Aquifer Response. SNWA, June 2019.
BEDROC Ex. No. 24	Center for Biological Diversity. Groundwater Management and the Muddy River Springs, Report in Response to Nevada State Engineer Order 1303. Tom Myers, June 1, 2019.

CERTIFICATE OF SERVICE

I hereby certify that on September 6, 2019, I caused a copy of the foregoing ***WESTERN ELITE ENVIRONMENTAL, INC. AND BEDROC LIMITED, LLC'S WITNESS LIST, SUMMARY OF TESTIMONY, AND EXHIBIT LIST*** to be served on the following parties as outlined below:

VIA HAND DELIVERY:

Nevada State Engineer
Nevada Division of Water Resources
901 South Stewart Street, Suite 2002
Carson City, NV 89701

VIA ELECTRONIC DELIVERY:

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Dated this 6th day of September, 2019.

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Acting State Engineer
Nevada Division of Water Resources
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Carson City, NV 89701

INTERIM ORDER 1303 - REBUTTAL REPORT

On behalf of Bedroc Limited and its operating entity Western Elite Environmental, Inc., this Rebuttal Report is submitted in response to the Nevada Division of Water Resources ("NDWR") request for comments to Interim Order 1303.

Background on Bedroc Limited

Bedroc Limited is the land holding and water-right holding entity for Western Elite Environmental, Inc., part of the Western Elite family of companies that is a leading provider of construction and recyclable waste collection and disposal in Southern Nevada (hereinafter collectively "Bedroc").

Summary of Positions Being Rebutted

For the majority of NDWR's evaluation process for the LWRFS, Bedroc, as the most senior water right holder in the LWRFS, has been content to observe and monitor the proceedings. However, because of the wide variety of opinions being expressed by the various stakeholders, and Bedroc's concern for both protecting its existing rights and securing its future industrial operations, Bedroc would like to express the following opinions in rebuttal to various opinions offered in initial Interim Order 1303 reports:

1) The entire White River Flow System should not be included in the LWRFS designation;
2) Areas with sustainable local recharge, such as alluvial wells in northern Coyote Spring Valley, where pumping is occurring in the absence of a hydraulic connection to the regional carbonate aquifer, should be managed separately within the LWRFS;
3) Alluvial well pumpage within the Muddy River Springs Area (MRSA) and carbonate well pumpage are independent of basin fill alluvium pumpage in some areas within the proposed LWRFS boundaries;
4) Alluvial well pumpage within the Muddy River Springs Area (MRSA) and carbonate well pumping appears to have no effect on alluvial wells in the northern Coyote Spring Valley (CSV);
5) Movement of water rights between alluvial and carbonate wells within the LWRFS may have a negative impact on other senior users.

1) The entire White River Flow System should not be included in the LWRFS designation

The Great Basin Water Network, participating in the Order 1303 process as an NGO, appears to have proposed that the State Engineer consider the entire White River Flow System when administering water resources within the Lower White River Flow System as currently proposed. This recommendation was made with no scientific basis. The LWRFS includes the Muddy River Springs, which are the regional terminus of the White River Flow System. Hydrologic data submitted by the overwhelming majority of stakeholders with valid water rights and vested interests in the LWRFS clearly suggests that if groundwater development is managed at sustainable levels within the LWRFS, Moapa Dace habitat will be protected as will spring flows that support decreed rights on the Muddy River. If these obligations are met within Muddy River Springs area there is little to no risk of impacts propagating north of and beyond the LWRFS boundary as currently proposed by the State Engineer.

2) Areas with sustainable local recharge such as basin alluvial fill should be managed separately within the LWRFS

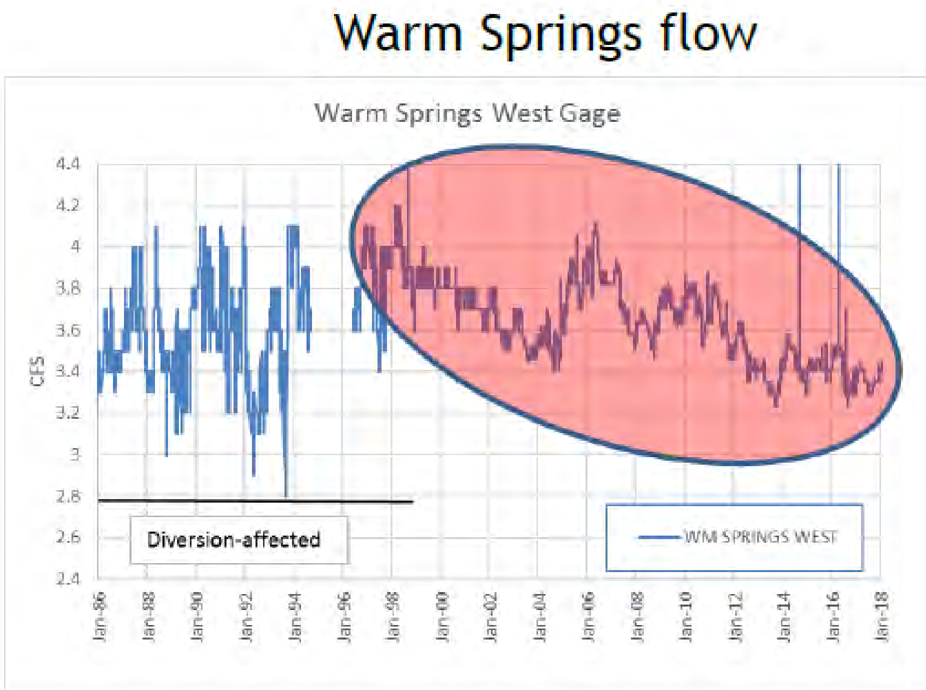
Multiple stakeholders have submitted reports that support the opinion that all groundwater located within the basins included in the LWRFS should be managed conjunctively. However, this opinion arbitrarily impacts existing users whose water neither comes from the regional carbonate system nor impacts the springs of concern downstream. Bedroc's own water use is a perfect example of this hydrologic disconnect between the basin fill alluvial well pumpage within MRSA and carbonate well pumping.

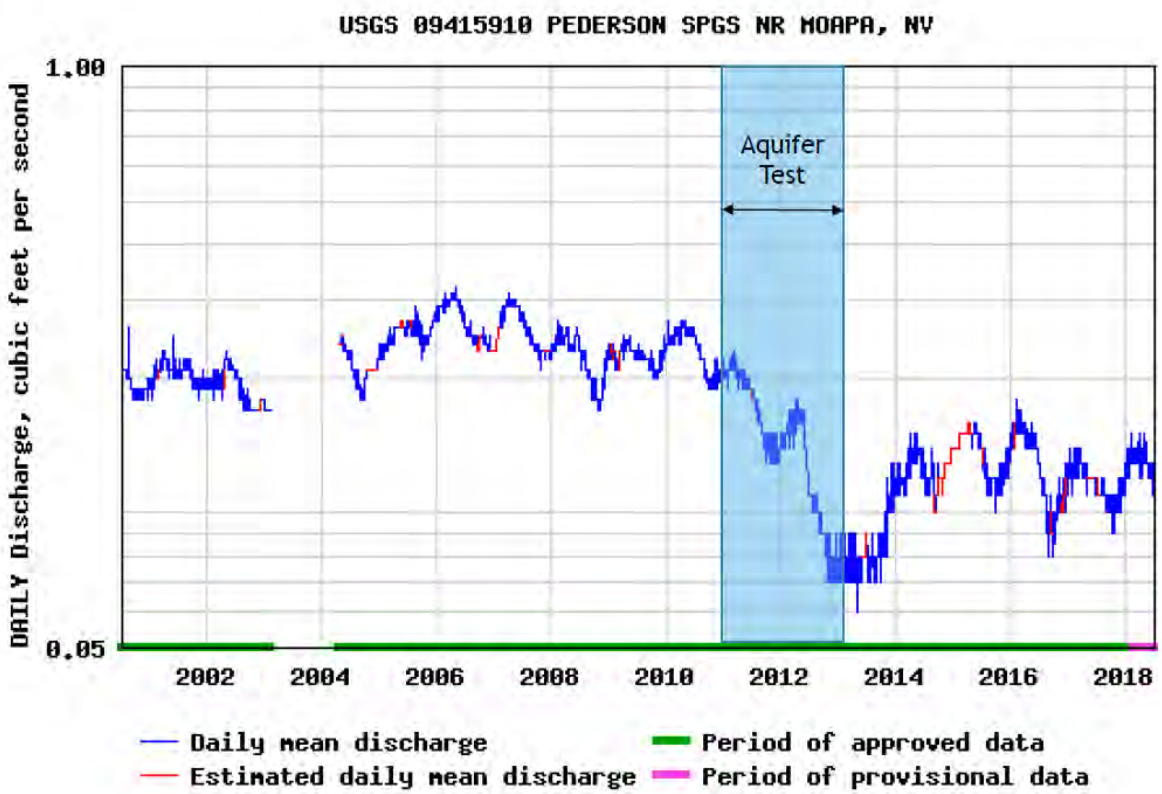
For example, Bedroc has both production and monitoring wells for use on its industrial operations. The groundwater elevations of these wells are all over 2,400 feet above mean sea level (amsl), more than 200 feet higher than the next closest well in the entire CSV and 400 feet higher than the wells directly across US Hwy 93 (CSV3009M and CSV3011M). This is also reflected in the physical characteristics of the water, which is pumped from the ground at an average temperature of 69 degrees Fahrenheit which is significantly different than water in the MRSA. As a result, it needs to be recognized that not all water being used in the CSV is a derivative of the LWRFS and Bedroc simply urges continued caution by NDWR in evaluating all users under one broad stroke. It should be clear from Bedroc's data that not all sites behave or should be evaluated under the same management system.

The Bedroc site is situated within a unique geologic setting in northern CSV that allows the capture of recharge from the Sheep Range. Not allowing a user within the CSV to utilize the local recharge that enters the CSV because it may also eventually make its way to a deeper carbonate system is a slippery slope because of the similar argument that can be made for each and every system that may eventually make its way to the LWRFS, including the upper White River and other local systems that as of yet have not been managed in conjunction with the LWRFS. Again, Bedroc simply urges continued caution by NDWR in accepting as factual the idea that all users in the region should be managed under the same system.

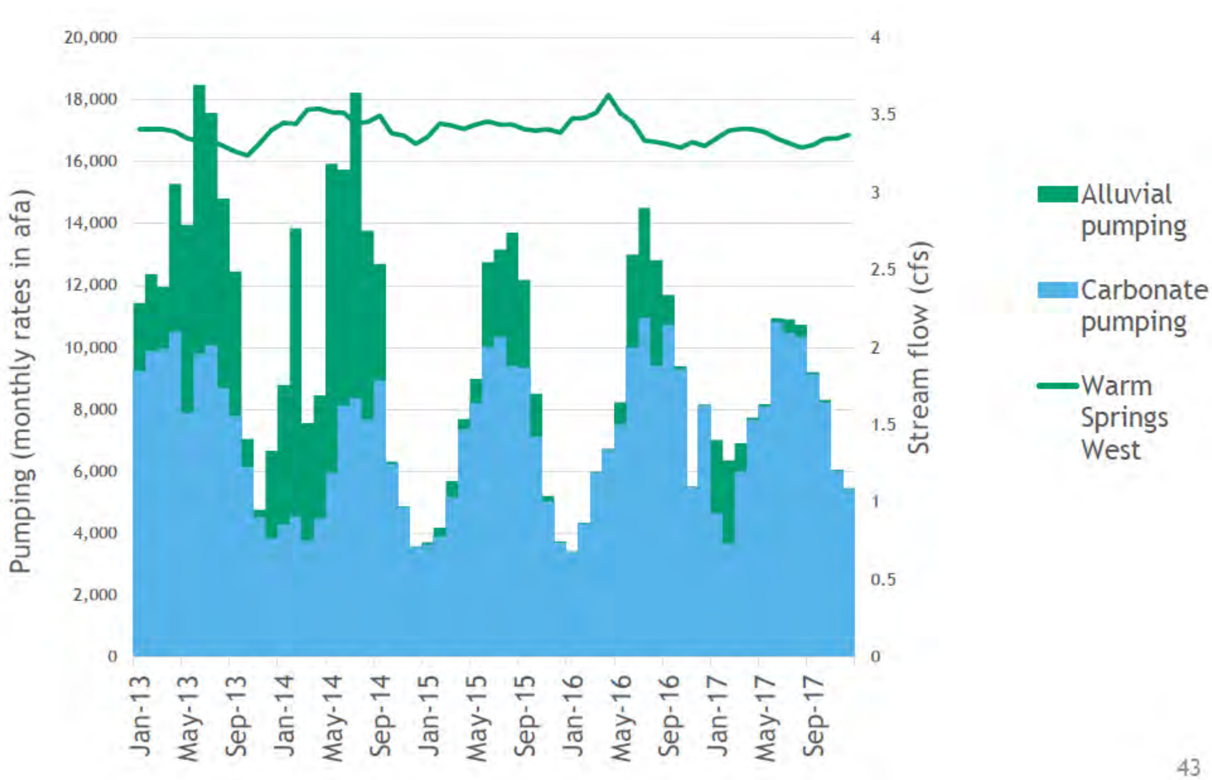
3) Alluvium well pumpage within the MRSA and carbonate well pumpage are independent of basin fill alluvium pumpage

Part of the data that was gathered during the Order 1169 aquifer test and published by NDWR, has been subsequently relied upon by several parties that submitted initial reports, included figures showing the impact of pumping on several springs of concern within the MRSA. Two of these figures are shown below:





These figures are indicative of impacts from carbonate pumping on the MRSA, and not a reflection of pumping from the basin fill as is the case with Bedroc. Bedroc believes that this information does not support extrapolating predicted impacts on alluvial aquifer users throughout the proposed LWRFS, particularly within the northern part of the CSV. Due to this discrepancy, alluvial aquifer users could be disproportionally impacted by the impairment of existing rights; impacts for which they may have not been responsible.



4) Alluvium well pumpage within the MRSA and carbonate well pumping has not impacted basin fill alluvium wells

Observed groundwater levels in the vicinity of Bedroc's alluvial well pumping is an example of the disconnect that exists between the basin fill alluvium and both the carbonate and alluvial aquifer within the MRSA. During the Order 1169 pump test and since that time, the data produced by NDWR and other stakeholders who submitted reports indicates that wells within the LWRFS showed an immediate and fairly significant decrease in elevation. This data has been produced to show the interconnectivity of the carbonate system and as evidence that pumping in MRSA alluvium or carbonate wells would impact the downstream springs of concern. However, there is no indication that this pumping has affected shallow alluvial water levels in certain areas such as northern CSV.

Bedroc maintains a series of monitoring wells as part of its landfill groundwater management plan compliance network. With some data going back as far as 2003, reviewing the historical data reproduced below shows none of the impacts presented by other stakeholders within the LWRFS. In fact, water levels at the conclusion of the pump test were higher than when the wells were originally installed.

	Original Installation(11/2003)	After 1169(11/2012)	Today (8/2019)
OW-1	2406.76	2407.28	2404.34
OW-2	2403.36	2410.58	2404.50
OW-3	2406.34	2410.85	2404.70
OW-4	2416.44	2420.55	2414.37
OW-5	2418.44	2418.36	2412.46
OW-6	2420.67	2423.22	2417.65

Groundwater Elevation of Bedroc Monitoring Wells (amsl)

A second set of compliance network wells that were installed upstream of Bedroc's production wells following the conclusion of Order 1169 testing reflect a stable groundwater elevation that is slowly increasing over time.

	Original Installation (8/2013)	Interim Measurement (9/2017)	Today (8/2019)
OW-8	2423.51	2423.56	2423.79
OW-13	2447.18	2449.22	2449.81
OW-14	2481.72	2482.06	2482.42

Groundwater Elevations of Bedroc Upstream Monitoring Wells (amsl)

The Center for Biological diversity (CBD) technical memorandum (Meyers, 2019)[1] suggests that some water can be pumped if sourced from the basin fill aquifer with the exception of the far southeast portion of MRSA as basin fill groundwater levels did not decline due to carbonate pumping. While the CBD improperly reports that there is no basin fill pumping in CSV, it still states that it is possible that some basin fill pumping there could be sustainable. The evidence for this is that basin fill water is likely disconnected from the carbonate and not responsible for substantial recharge. That basin fill water levels increased during the aquifer test exemplifies that.

The data indicates that Bedroc's basin fill alluvial wells are not connected to carbonate or the MRSA in any appreciable manner. There doesn't appear to have been the instantaneous impacts as a result of the Order 1169 pump test as appeared in the much of the LWRFS and other than direct impacts of Bedroc's own pumpage and storage, the groundwater elevations seem remarkably stable. As a result, there is no indication that pumping from Bedroc's basin fill alluvial wells contributes to potential impacts in the MRSA.

This is but one example using Bedroc's own data and Bedroc simply proffers this evidence to once again urge caution by NDWR in assuming that all alluvial wells within the entire LWRFS would impact the springs in the same way that the carbonate wells would, just because the pumping of certain carbonate wells impacted the springs during a pump test. It would be improper to apply this rule by extension to all

[1] Groundwater Management and the Muddy River Springs, Report in Response to Nevada State Engineer Order 1303

alluvial water users in the system without a comprehensive test on the independent impact of alluvial well pumping.

5) **Movement of water rights between alluvial and carbonate wells may have a negative impact on other senior users**

Several stakeholders have expressed support for the ability to move water between alluvial and carbonate wells. NDWR appears to be mostly concerned with the impact that these transfers may have on senior decreed rights on the Muddy River. However, Bedroc has a concern that this may also impact other senior users like itself. While the physical data does not appear to demonstrate any strong hydrologic connection between Bedroc's alluvial pumping and the LWRFS, if NDWR decides in favor of the parties supporting inclusion of all water located in the basins making up the LWRFS while providing for the ability to transfer points-of-diversion within the LWRFS, the possibly exists for impacts to senior users like Bedroc.

There are thousands of acres of undeveloped private land directly across from Bedroc, which in theory, if NDWR supports the position, could be developed with water transferred from further south in the LWRFS. Any wells that are drilled in the alluvium could then have a tremendous impact on the productivity of Bedroc's wells and significantly impact the future of its industrial operations. In times past individually managed basins could avoid this reaction by appropriately identifying a manageable (basin) yield and appropriating accordingly. This basic tenet of water management in Nevada would no longer apply to basins included within the LWRFS boundary if NDWR allows unfettered transfer of alluvial and carbonate wells across the LWRFS.

For these reasons, Bedroc again urges caution by NDWR in supporting these stakeholders' opinions that there would be no impact or a negligible impact on senior decreed rights, or other senior users within the currently constructed LWRFS. If transfers are allowed, there must be a scientific means for analyzing the impact on senior users that are using local recharge that may not sustain additional users.

Conclusion

In summary, Bedroc has some concerns about some of the opinions that have been offered in the initial Interim Order 1303 reports. The above material is submitted in response to those opinions, based on Bedroc's own data and experience and is submitted in an effort to encourage NDWR to be cautious in their determination of how to handle the all water users within the currently constructed LWRFS.

Bedroc Limited, LLC/
Western Elite Environmental, Inc.

Derek Muaina
General Counsel

Application No. 71031

THE STATE OF NEVADA

APPLICATION TO APPROPRIATE WATER

Name of Applicant:	**BEDROC LIMITED, A NEVADA LLC**
Source:	**UNDERGROUND (PERCOLATING WATER)**
Basin:	**COYOTE SPRING VALLEY**
Manner of Use:	**COMMERCIAL**
Period of Use:	**JANUARY 1ST THROUGH DECEMBER 31ST**
Priority Date:	**04/13/2004**

****

<u>DENIAL</u> OF STATE ENGINEER

The protests to this application are hereby upheld in part and the application is hereby denied on the grounds that there is no unappropriated groundwater at the source of the supply, the proposed use would conflict with existing rights in the Order 1169 basins and the proposed use of the water would threaten to prove detrimental to the public interest in that it would threaten the water resources upon which the endangered Moapa dace are dependent. No ruling is made on the merits of the remaining protest grounds.

IN TESTIMONY WHEREOF, I, JASON KING, P.E.,

State Engineer of Nevada, have hereunto set my hand and the seal of my office, this 29th day of January, 2014.

P.E.

State Engineer

No. 71031

APPLICATION FOR PERMIT TO APPROPRIATE THE PUBLIC WATERS OF THE STATE OF NEVADA

Date of filing in State Engineer's Office APR 13 2004

Returned to applicant for correction

Corrected application filed

Map filed APR 13 2004 under 70859

****

The applicant **Bedroc Limited, a Nevada limited liability corporation** hereby makes application for permission to appropriate the public waters of the State of Nevada, as hereinafter stated. (If applicant is a corporation, give date and place of incorporation; if a copartnership or association give names of members.) **June 20, 1994 in State of Nevada**

****

1. The source of the proposed appropriation is **Underground percolating water – Sheep Range Mtn.**

2. The amount of water applied for is **0.35 c.f.s. – 200 ac.ft./an.** second-feet

   (a) If stored in reservoir give number of acre-feet

3. The water to be used for **Commercial and Domestic Purposes**

4. If use is for:
   (a) Irrigation, state number of acres to be irrigated -
   (b) Stockwater, state number and kinds of animals to be watered -
   (c) Other use (describe fully under No. 12. "Remarks")
   (d) Power:
      (1) Horsepower developed -
      (2) Point of return of water to stream

5. The water is to be diverted from its source at the following point **within NW¼ SE¼ Section 24 T11S, R62E, MDM or at a point from which the W¼ corner of said Section 24 bears N 81 degrees 33 minutes 06 seconds W, a distance of 2,893.29 feet.**

6. Place of Use **SE¼, S½ NE¼, E½ SW¼ and SE¼ NW¼ Section 24 T11S, R62E, MDM.**

7. Use will begin about **January 1** and end about **December 31** of each year.

8. Description of proposed works **water is collected by ditching and is directed to a sump pump. Water is pumped to the place of use.**

9. Estimated cost of works **Existing**

10. Estimated time required to construct works **Existing**

11. Estimated time required to complete the application of water to beneficial use **5 years**

12. Remarks: **Continued mining and milling has caused the water to flow into the mining area. Ditches have been constructed to direct the water to a sump pump and pipeline to the place of use.**

By s/Michael D. Buschelman
Michael D. Buschelman
Post Office Box 51371
Sparks, Nevada 89435

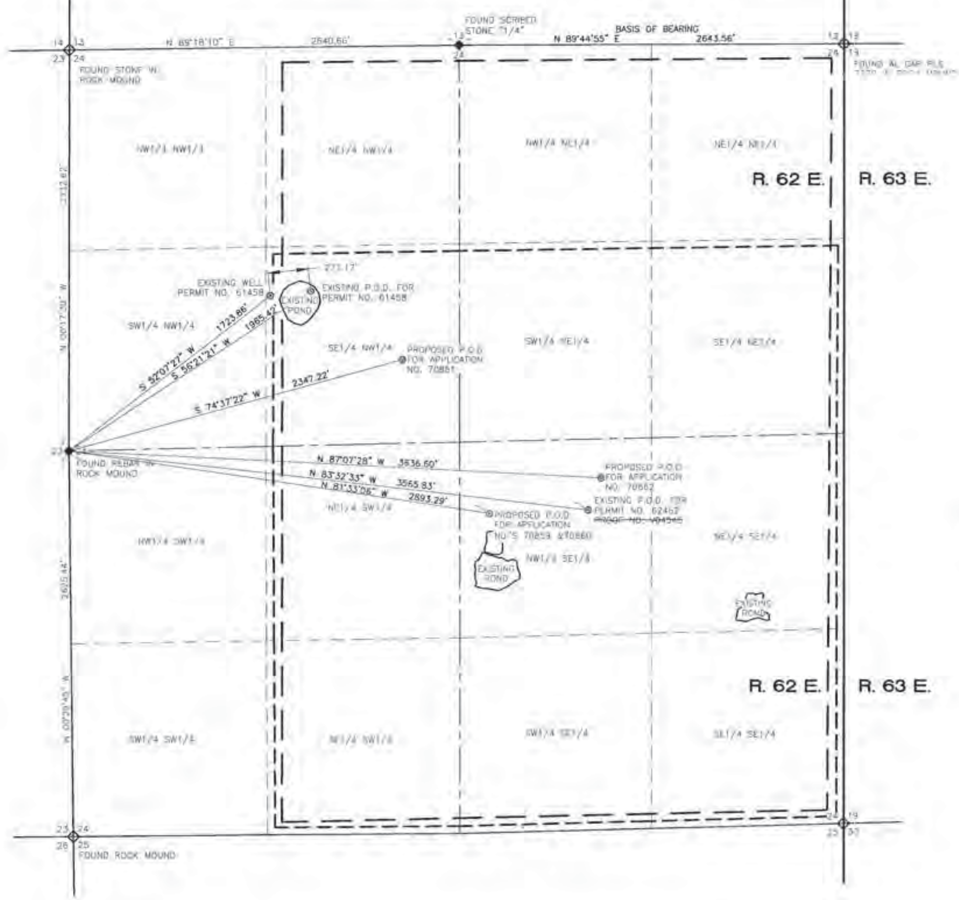
Compared gkl/ sc

Protested

71031

****

SITUATED WITHIN SECTION 24, T. 11 S., R. 62 E., M.D.M., LINCOLN COUNTY, NEVADA



STATE OF NEVADA
SS
COUNTY OF WASHOE

I, MICHAEL D. BUSCHELMAN, BEING FIRST DULY SWORN, DEPOSE AND SAY THAT THIS MAP, CONSISTING OF 1 SHEET, INCLUSIVE, HAS BEEN CORRECTLY DRAWN TO THE DESIGNATED SCALE FROM FIELD NOTES OF A SURVEY MADE BY ME, OR UNDER MY SUPERVISION AND DIRECTION, BETWEEN THE 10TH OF DECEMBER, 2003, AND THE 26TH OF JANUARY, 2004, THAT IT TRULY AND CORRECTLY REPRESENTS THE PROPOSED POINTS OF DIVERSION AND PLACES OF USE FROM UNDERGROUND AND SPRING SOURCES, IN LINCOLN COUNTY, NEVADA, BY BEDROC LIMITED, A NEVADA LIMITED LIABILITY CORPORATION, FOR MINING, MILLING AND DOMESTIC PURPOSES.

Michael D. Buschelman

MICHAEL D. BUSCHELMAN
STATE WATER RIGHT SURVEYOR NO. 792
PROFESSIONAL LAND SURVEYOR
NEVADA CERTIFICATE NO. 7463
EXPIRATION DATE: 12/31/2004

PROFESSIONAL LAND SURVEYOR, STATE OF NEVADA, MICHAEL D. BUSCHELMAN, No. 7463

SUBSCRIBED AND SWORN TO BEFORE ME THIS 12th DAY OF April, 2004

Rae Ann Loving

NOTARY PUBLIC IN AND FOR WASHOE COUNTY, STATE OF NEVADA

MY COMMISSION EXPIRES ON THE 21st DAY OF April, 2005

RAE ANN LOVING
Notary Public - State of Nevada
Appointment Recorded in Washoe County

BASIS OF BEARING

THE BASIS OF BEARING IS A LINE BETWEEN THE N1/4 COR. OF SEC. 24 AND THE NE COR. OF SEC. 24, T. 11 S., R. 62 E., M.D.M., LINCOLN COUNTY NEVADA, AS SHOWN ON RECORD OF SURVEY BOOK PLAT 8, PAGE 19A, OF THE OFFICIAL RECORDS OF THE LINCOLN COUNTY RECORDER, WHICH BEARS N. 89°44'55" E.

LEGEND

- FOUND SEC. COR. AS NOTED
- FOUND 1/4 SEC. COR. AS NOTED
- (R) RECORD DATA
- (M) MEASURED DATA
- PROPOSED AND EXISTING POINTS OF DIVERSION
- PROPOSED PLACE OF USE
- PROPOSED PLACE OF USE

MICHAEL D. BUSCHELMAN CONSULTING, INC.
POST OFFICE BOX 51371
SPARKS, NEVADA 89435
PHONE NO. 775-355-9628

STATE ENGINEER'S USE

71031

Strike of text "Proof No. V04545" authorized by M.D. Buschelman

FILED
APR 1 1 2004
STATE ENGINEER'S OFFICE

MAP TO ACCOMPANY APPLICATION TO CHANGE THE POINT OF DIVERSION AND PLACE OF USE OF PROOF NO. V04545, 62462 AND PORTION OF PERMIT NO. 61458

FOR : MINING, MILLING, IRRIGATION, STOCKWATER, COMMERCIAL AND DOMESTIC
BY : BEDROC LIMITED, A NEVADA LIMITED LIABILITY CORP.
FROM : UNDERGROUND AND SPRING SOURCES
IN : LINCOLN COUNTY, NEVADA

85254 85253 85252 85251 83590 72841 72840 72839 72838 71031 70862 70861 70860 70859

Permit No. 83044

THE STATE OF NEVADA

PERMIT TO CHANGE THE PUBLIC WATERS OF THE STATE OF NEVADA HERETOFORE APPROPRIATED

Name of Permittee:	**BEDROC LLC**
Source:	**UNDERGROUND**
Basin:	**COYOTE SPRING VALLEY**
Manner of Use:	**IRRIGATION AND DOMESTIC**
Period of Use:	**JANUARY 1ST THROUGH DECEMBER 31ST**
Priority Date:	**10/22/1919**

****

APPROVAL OF STATE ENGINEER

This is to certify that I have examined the foregoing application, and do hereby grant the same, subject to the following limitations and conditions:

This permit, to change point of diversion and place of use of a portion of the waters of underground percolating water heretofore appropriated under Amended Claim of Vested Right V04545, is issued with the understanding that no other rights on the source will be affected by the change proposed herein. A totalizing meter must be installed at or near the point of diversion to facilitate the measurement of water used. The State reserves the right to regulate the use of the water under this permit at any and all times. This permit is issued subject to any determination of underground percolating water that may be made under adjudication proceedings under NRS 533.090 through 533.320.

Monthly records shall be kept of the amount of water pumped from this well and the records submitted to the State Engineer on a quarterly basis within 15 days after the end of each calendar quarter.

This permit does not extend the permittee the right of ingress and egress on public, private or corporate lands.

The issuance of this permit does not waive the requirements that the permit holder obtain other permits from State, Federal and local agencies.

Any application to change the manner of use granted under this permit will be subject to additional determination and evaluation with respect to the permanent effects on existing rights and the resource within the Coyote Spring Valley.

The issuance of Permit 83044 expires Permit 70859.

This permit is issued subject to the Settlement Agreement between Bedroc Limited and the State Engineer, dated August, 2014.

The point of diversion and place of use are as described on the submitted application to support this permit.

(Continued on Page 2)

The amount of water to be appropriated shall be limited to the amount which can be applied to beneficial use, **and not to exceed 0.5 cubic feet per second or 343.0 acre-feet annually, but not to exceed 5.0 acre-feet per acre from all sources.**

Work must be prosecuted with reasonable diligence and proof of completion of work shall be filed on or before:	**December** 22 **2015**
Water must be placed to beneficial use and proof of the application of water to beneficial use shall be filed on or before:	**December** 22 **2017**
Map in support of proof of beneficial use shall be filed on or before:	**December** 22 **2017**

IN TESTIMONY WHEREOF, I, JASON KING, P.E.,

State Engineer of Nevada, have hereunto set my hand and the seal of my office, this 22nd day of **December, 2014**

P.E.

State Engineer

Application No. 83044

APPLICATION FOR PERMISSION TO CHANGE POINT OF DIVERSION, MANNER OF USE AND PLACE OF USE OF THE PUBLIC WATERS OF THE STATE OF NEVADA HERETOFORE APPROPRIATED

THIS SPACE FOR OFFICE USE ONLY

Date of filing in State Engineer's Office AUG 26 2013

Returned to applicant for correction AUG 29 2013

Corrected application filed OCT 17 2013 Map filed SEP 26 2013

The applicant Bedroc Limited LLC, a Nevada limited liability company

2745 N. Nellis Blvd. of Las Vegas

Street Address or PO Box — City or Town

Nevada 89115 hereby make(s) application for permission to change the

State and ZIP Code

☑ Point of diversion ☑ Place of use ☐ Manner of use ☑ of a portion

of water heretofore appropriated under (Identify existing rights by Permit, Certificate, Proof or Claim Nos. If Decreed, give title of Decree and identify right in Decree.)

Amended Proof No. V04545

RECEIVED
2013 OCT 17 AM 11:47
STATE ENGINEERS OFFICE

1. The source of water is underground percolating water appropriated under No. V04545

Name of stream, lake, underground, spring or other sources.

2. The amount of water to be changed .5 c.f.s.

Second feet, acre-feet. One second foot equals 448.83 gallons per minute.

3. The water to be used for irrigation and domestic

Irrigation, power, mining, commercial, etc. If for stock, state number and kind of animals. Must limit to one major use

4. The water heretofore used for Same

If for stock, state number and kind of animals.

5. The water is to be diverted at the following point (Describe as being within a 40-acre subdivision of public survey and by course and distance to a found section corner. If on unsurveyed land, it should be stated.)

underground percolating water located under Proof No. V04545 within the NW 1/4 of the SE 1/4 of Section 24, T11S, R62E, MDM, or at a point from which the W 1/4 corner of said Section 24 bears N81°33'06"W, a distance of 2893.29 feet.

6. The existing point of diversion is located within (If point of diversion is not changed, do not answer.)

E 1/2 of W 1/2 of Section 24 T11S, R62E.

7. Proposed place of use (Describe by legal subdivisions. If for irrigation, state number of acres to be irrigated.) 52 acres within the NE 1/4 and the N1/2 of the SE 1/4 and the NE 1/4 of the NW 1/4 of Section 24; and within the NE 1/4 of the NE 1/4 of Section 25, T11S, R62E, MDM, as more particularly shown on the map submitted herewith.

8. Existing place of use (Describe by legal subdivisions. If changing place of use and/or manner of use of irrigation permit, describe acreage to be removed from irrigation.)
E 1/2 and the E 1/2 of the W 1/2 of Section 24, T11S, R62S, MDM.

9. Proposed use will be from January 1 (Month and Day) to December 31 (Month and Day) of each year.

10. Existing use permitted from January 1 (Month and Day) to December 31 (Month and Day) of each year.

11. Description of proposed works. (Under the provision of NRS 535.010 you may be required to submit plans and specifications of your diversion or storage works.) (State manner in which water is to be diverted, i.e., diversion structure, ditches, pipes and flumes or drilled well, pump and motor, etc.)

12. Estimated cost of works Existing

13. Estimated time required to construct works Existing
If well completed, describe well.

14. Estimated time required to complete the application of water to beneficial use 5 years

15. Provide a detailed description of the proposed project and its water usage (use attachments if necessary): (Failure to provide a detailed description may cause a delay in processing.)
After the original tunnel dug by Mr. Butler in the late 1930's from which percolating water flowed, collapsed, water is collected from natural seeps and shallow wells (30-50 feet deep) and conveyed to a pond where it is pumped to a higher pond for gravity flow for irrigation and commercial purposes.

16. Miscellaneous remarks:
Water is used for commercial purposes when irrigation is not utilizing the water.

Robert W. Marshall, Agent
Type or print name clearly

Robert W. Marshall
Signature, applicant or agent

E-mail Address

(775) 323-1601
Phone No. Ext.

Parsons Behle & Latimer
Company Name

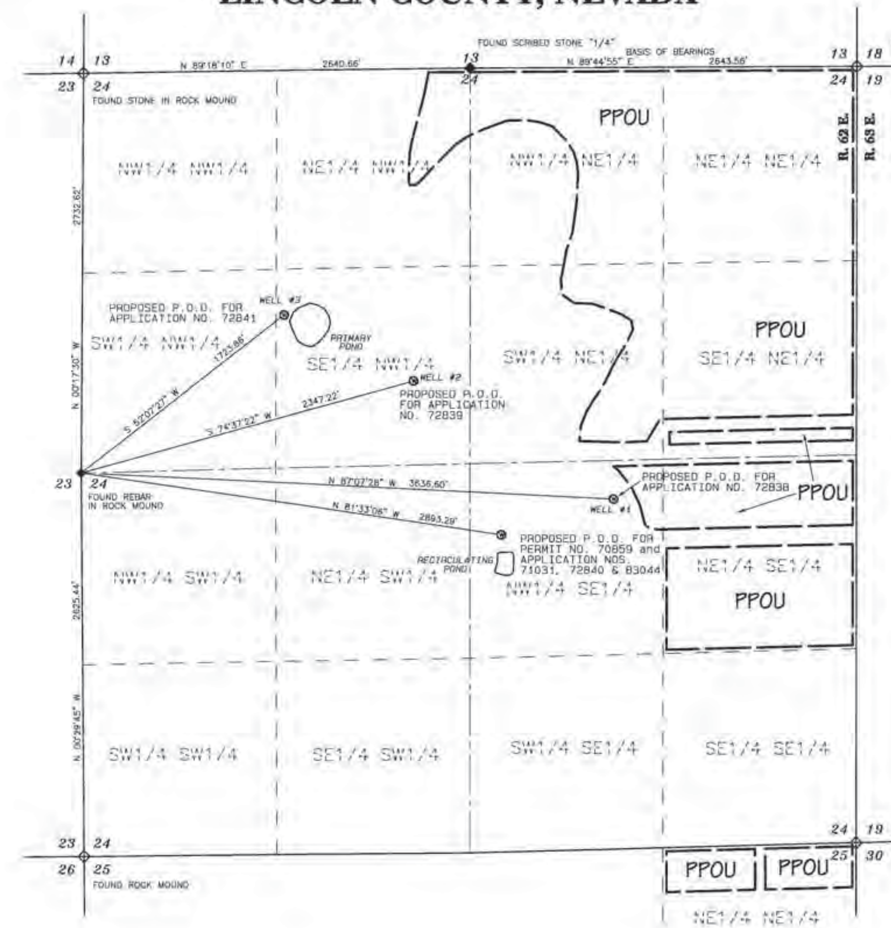
50 W. Liberty Street, Suite 750
Street Address or PO Box

Reno, NV 89501
City, State, ZIP Code

APPLICATION MUST BE SIGNED BY THE APPLICANT OR AGENT

Revised 07/13 $240 FILING FEE AND SUPPORTING MAP MUST ACCOMPANY APPLICATION

SECTIONS 24 & 25, T. 11 S., R. 62 E., M.D.M.
LINCOLN COUNTY, NEVADA



LEGEND

- SECTION LINE
- QUARTER SECTION LINE
- 16TH SECTION LINE
- WELL TIE
- PPOU — PROPOSED PLACE OF USE
- ◇ FOUND SECTION CORNER (AS DESCRIBED)
- ◆ FOUND QUARTER SECTION CORNER (AS DESCRIBED)
- ⊚ WELL/POINT OF DIVERSION (AS NOTED)
- POND

STATE OF NEVADA
COUNTY OF WASHOE } SS

I, Michael D. Buschelman, being first duly sworn, depose and say that this map, consisting of one sheet, has been correctly drawn to the designated scale from field notes of a survey made by me or under my supervision and direction, between the 10th of December, 2003, and the 26th of January, 2004; that it truly and correctly represents the proposed place of use and proposed point of diversion used to divert water from underground percolating water sources in Lincoln County, Nevada, by BEDROC LIMITED, LLC, a Nevada limited liability company, for irrigation and domestic purposes.

Michael D. Buschelman
Michael D. Buschelman, P.L.S.
State Water-Right Surveyor No. 792
Exp 12-31-14

9-26-13

Subscribed and sworn to before me on this 25th day of September, 2013.

Ruth L. Smith
Notary Public

REFERENCES

1. Permits, applications and supporting map(s) as referenced at existing points of diversion, on file in the office of the Nevada State Engineer, Division of Water Resources, Carson City, Nevada.
2. Record of Survey Map, Book B, Page 114A, on file in the Office of the Lincoln County Recorder, Lincoln County, Nevada.

N
W E
S

GRAPHIC SCALE 1"=400'
0 400 800 1200

BASIS OF BEARINGS

The northerly line of the NE 1/4 of Section 24, T. 11 S., R. 62 E., M.D.M., being N 84°44'55" E, as shown on the Record of Survey Map recorded as Book B, Page 114A, in the Official Records of the Lincoln County Recorder.

Michael D. Buschelman Consulting, Inc.
Post Office Box 51371
Sparks, Nevada 89435
(775) 355-9628 Office 355-9629 FAX

STATE ENGINEER'S USE

FILED
SEP 26 2013
STATE ENGINEER'S OFFICE

MAP TO ACCOMPANY APPLICATION NO. 83044 TO CHANGE THE POINT OF DIVERSION, PLACE AND MANNER OF USE OF AMENDED PROOF NO. V04545 FOR IRRIGATION AND DOMESTIC PURPOSES BY

BEDROC LIMITED, LLC
a Nevada Limited Liability Company

FROM UNDERGROUND PERCOLATING WATER SOURCES IN LINCOLN COUNTY, NEVADA

85250 85249 83044

Permit No. 85249

THE STATE OF NEVADA

PERMIT TO CHANGE THE PUBLIC WATERS OF THE STATE OF NEVADA HERETOFORE APPROPRIATED

Name of Permittee:	**BEDROC LIMITED LLC**
Source:	**UNDERGROUND (BEDROC WELL 1)**
Basin:	**COYOTE SPRING VALLEY**
Manner of Use:	**COMMERCIAL AND DOMESTIC**
Period of Use:	**JANUARY 1ST THROUGH DECEMBER 31ST**
Priority Date:	**10/22/1919**

****

APPROVAL OF STATE ENGINEER

This is to certify that I have examined the foregoing application, and do hereby grant the same, subject to the following limitations and conditions:

This permit, to change the point of diversion, place and manner of use of a portion of the waters of an underground source as heretofore granted under Permit 83044, is issued subject to the terms and conditions imposed in said Permit 83044 and with the understanding that no other rights on the source will be affected by the change proposed herein. This well shall be equipped with a two (2) inch opening for measuring depth to water. A totalizing meter must be installed and maintained in the discharge pipeline near the point of diversion and accurate measurements must be kept of water placed to beneficial use. The totalizing meter must be installed before any use of the water begins or before the proof of completion of work is filed. If the well is flowing, a valve must be installed and maintained to prevent waste. This source is located within an area designated by the State Engineer pursuant to NRS 534.030. The State retains the right to regulate the use of the water herein granted at any and all times.

Monthly records shall be kept of the amount of water pumped from this well and the records submitted to the State Engineer on a quarterly basis within 15 days after the end of each calendar quarter.

The total combined duty of water under Permits 85249 and 85250 shall not exceed 315.56 acre-feet annually.

Any application to change the manner of use granted under this permit will be subject to additional determination and evaluation with respect to the permanent effects on existing rights and the resource within the Coyote Spring Valley.

This permit is approved for the entire 109.80 acre-feet annually as requested. However, pursuant to NRS 533.3703, initially only the net consumptive use amount of the base right, 101.02 acre-feet, can be diverted annually. Additional diversion up to the total 109.80 acre-feet may be granted if it can be shown that the additional diversion will not cause the consumptive use of 101.02 acre-feet to be exceeded.

This permit is issued subject to any determination of underground percolating water that may be made under adjudication proceedings under NRS 533.090 through 533.320 and 534.100.

This permit is issued subject to the Settlement Agreement between Bedroc Limited and the State Engineer, dated August 2014.

(Continued on Page 2)

This permit does not extend the permittee the right of ingress and egress on public, private or corporate lands.

The issuance of this permit does not waive the requirements that the permit holder obtain other permits from State, Federal and local agencies.

The point of diversion and place of use are as described on the submitted application to support this permit.

The amount of water to be appropriated shall be limited to the amount which can be applied to beneficial use, **and not to exceed 0.16 cubic feet per second or 101.02 acre-feet annually.**

Work must be prosecuted with reasonable diligence and proof of completion of work shall be filed on or before:	**October** 4 **2017**
Water must be placed to beneficial use and proof of the application of water to beneficial use shall be filed on or before:	**October** 4 **2019**
Map in support of proof of beneficial use shall be filed on or before:	**N/A**

IN TESTIMONY WHEREOF, I, JASON KING, P.E.,

State Engineer of Nevada, have hereunto set my hand and the seal of my office, this 4th day of **October, 2016**

P.E.

State Engineer

Application No. 85249

APPLICATION FOR PERMISSION TO CHANGE POINT OF DIVERSION, MANNER OF USE AND PLACE OF USE OF THE PUBLIC WATERS OF THE STATE OF NEVADA HERETOFORE APPROPRIATED

THIS SPACE FOR OFFICE USE ONLY

Date of filing in State Engineer's Office JUN 23 2015

Returned to applicant for correction

Corrected application filed   Map filed JUN 23 2015

The applicant Bedroc Limited LLC, a Nevada Limited Liability Company

2745 N. Nellis Boulevard of Las Vegas
Street Address or PO Box   City or Town

Nevada 89115 hereby make(s) application for permission to change the
State and ZIP Code

[✓] Point of diversion   [✓] Place of use   [✓] Manner of use   [✓] of a portion

of water heretofore appropriated under (Identify existing rights by Permit, Certificate, Proof or Claim Nos. If Decreed, give title of Decree and identify right in Decree.)

Permit 83044

RECEIVED
2015 JUN 23 AM 8: 44
STATE ENGINEERS OFFICE

1. The source of water is underground - Bedroc Well No. 1
Name of stream, lake, underground, spring or other sources.

2. The amount of water to be changed 0.16 c.f.s., 109.8 acre-feet
Second feet, acre-feet. One second foot equals 448.83 gallons per minute.

3. The water to be used for Commercial and Domestic
Irrigation, power, mining, commercial, etc. If for stock, state number and kind of animals. Must limit to one major use

4. The water heretofore used for Irrigation and Domestic
If for stock, state number and kind of animals.

5. The water is to be diverted at the following point (Describe as being within a 40-acre subdivision of public survey and by course and distance to a found section corner. If on unsurveyed land, it should be stated.)
within the NW 1/4 SE 1/4 of Section 24, Township 11 South, Range 62 East, M.D.M., at a point from which the Northeast corner of said Section 24 bears North 29° 12'40" East, a distance of 3,399.1 feet.

6. The existing point of diversion is located within (If point of diversion is not changed, do not answer.)
the NW 1/4 SE 1/4 of Section 24, Township 11 South, Range 62 East, M.D.M., at a point from which the West 1/4 corner of said Section 24 bears North 81° 33'06" West a distance of 2893.29 feet.

Coyote Spring Valley
13 - 210
L1

7. Proposed place of use (Describe by legal subdivisions. If for irrigation, state number of acres to be irrigated.)
560 acres within the E1/2 W1/2 and the E1/2 of Section 24 and the E1/2 NE1/4 of Section 25 all within Township 11 South, Range 62 East, M.D.M., further described as APN's 008-201-11, 008-201-12, 008-201-13, located within Lincoln County, Nevada.

8. Existing place of use (Describe by legal subdivisions. If changing place of use and/or manner of use of irrigation permit, describe acreage to be removed from irrigation.)
within the NE 1/4, N 1/2 SE 1/4, NE 1/4 NW 1/4 of Section 24 and the NE 1/4 NE 1/4 of Section 25 all located within Township 11 South, Range 62 East M.D.M.

Please refer to map filed under permit No. 83044 for existing place of use.

9. Proposed use will be from January 1st (Month and Day) to December 31st (Month and Day) of each year.

10. Existing use permitted from January 1st (Month and Day) to December 31st (Month and Day) of each year.

11. Description of proposed works. (Under the provision of NRS 535.010 you may be required to submit plans and specifications of your diversion or storage works.) (State manner in which water is to be diverted, i.e., diversion structure, ditches, pipes and flumes or drilled well, pump and motor, etc.)
Existing well equipped with submersible pump, flow meters interconnecting the distribution system with ponds for fire protection, storage and gravity feeding the distribution system.

12. Estimated cost of works existing - Bedroc Well No. 1

13. Estimated time required to construct works existing well, submersible pump and distribution system
If well completed, describe well.

14. Estimated time required to complete the application of water to beneficial use 5 years

15. Provide a detailed description of the proposed project and its water usage (use attachments if necessary): (Failure to provide a detailed description may cause a delay in processing.)
Groundwater is pumped from a shallow well and conveyed via existing distribution system to a pond, then pumped to higher ponds for commercial operations of an approved landfill which includes fire protection, dust control, aggregate crushing operations, irrigation or ornamental landscaping and alfalfa for soil stabilization within the designated place of use.

16. Miscellaneous remarks:
The combined duty under this application and under the other change application filed with respect to Permit 83044 shall not exceed 343 acre feet annually, the permitted duty under Permit 83044.

Robert W. Marshall
Type or print name clearly

Robert W. Marshall
Signature, applicant or agent

E-mail Address

Company Name

(775) 323-1601
Phone No. Ext.

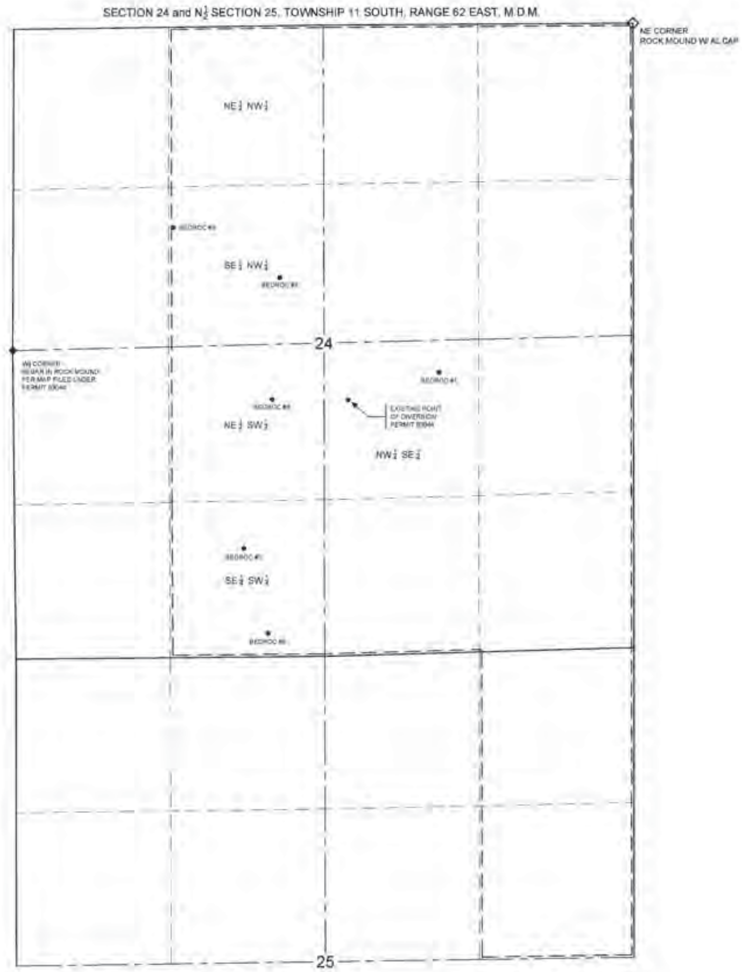
50 W. Liberty St., Suite 750
Street Address or PO Box

Reno, NV 89501
City, State, ZIP Code

APPLICATION MUST BE SIGNED BY THE APPLICANT OR AGENT

RECEIVED 2015 JUN 23 AM 8:44 STATE ENGINEERS OFFICE

Revised 07/13 $240 FILING FEE AND SUPPORTING MAP MUST ACCOMPANY APPLICATION



STATE OF NEVADA)
) S.S.
COUNTY OF CLARK)

I, ROBERT COACHE, P.E., BEING FIRST DULY SWORN, DEPOSE AND SAY THAT THIS MAP CONSISTING OF ONE SHEET, HAS BEEN CORRECTLY DRAWN TO THE DESIGNATED SCALE FROM INFORMATION OBTAINED FROM THE NEVADA DIVISION OF WATER RESOURCES, LINCOLN COUNTY RECORDER AND FIELD NOTES OF A SURVEY MADE BY ME, OR UNDER MY SUPERVISION AND DIRECTION ON OR BEFORE THE 2ND DAY OF FEBRUARY 2015. THAT IT TRULY AND CORRECTLY REPRESENTS THE PROPOSED LOCATIONS AND EXTENT OF THE WORKS USED TO DIVERT WATER FROM AN UNDERGROUND SOURCE IN LINCOLN COUNTY, NEVADA BY BEDROC LIMITED, LLC FOR COMMERCIAL PURPOSES. THAT THE EXISITNG AND PROPOSED POINTS OF DIVERSION AND PROPOSED PLACE OF USE ARE FULLY AND CORRECTLY DESIGNATED HEREON.

, P.E.
ROBERT COACHE, P.E.
STATE WATER RIGHT SURVEYOR
CERTIFICATE No. 1005

ROBERT A. COACHE
EXP. 12-31-16
CIVIL
No. 11505
PROFESSIONAL ENGINEER - STATE OF NEVADA
6-18-15

SUBSCRIBED AND SWORN TO BEFORE ME THIS 18th DAY OF JUNE 2015

Puite Williams
FOR SAID COUNTY AND STATE
MY APPOINTMENT EXPIRES 11-12-2017

PUIKTE WILLIAMS
NOTARY PUBLIC
STATE OF NEVADA

Existing Well Tie to West Quarter Corner
Section 24, T. 11 S., R.62E., M.D.M.

Permit No.	Sub 1/4	Sub 1/4	Bearing	Distance
83044	NW	SE	N 81° 33' 08" W	2,893.29'

Proposed Well Ties to Northeast Corner
Section 24, T. 11 S., R.62E., M.D.M.

Well Name	Sub 1/4	Sub 1/4	Bearing	Distance
Bedroc #1	NW	SE	N 29° 12' 40" E	3,399.1'
Bedroc #2	SE	NW	N 54° 25' 04" E	3,710.8'
Bedroc #3	SE	NW	N 66° 11' 51" E	4,291.6'
Bedroc #4	NE	SW	N 43° 59' 02" E	4,442.5'
Bedroc #5	SE	SW	N 36° 43' 43" E	5,567.7'
Bedroc #6	SE	SW	N 31° 04' 57" E	6,053.4'

LEGEND

1/4 CORNER (OR 1/16 CORNER) FOUND AS SHOWN
SECTION CORNER FOUND AS SHOWN
PROPOSED PLACE OF USE
SECTION LINE
1/4 SECTION LINE
1/16 SECTION LINE

BASIS OF BEARING - GPS

THE NORTH EAST CORNER OF SECTION 24, TOWNSHIP 11 SOUTH, RANGE 62 EAST, M.D.M. WAS ESTABLISHED USING A ASHTECH MOBIL MAPPER 10 GPS DIFFERENTIALLY CORRECTED TO AN ACCURACY OF ONE (1) METER AND A NAD 83 DATUM

PROPOSED PLACE OF USE:

560 acres within the E½ W½ and the E½ of Section 24 and the E½ NE¼ of Section 25 all within Township 11 South, Range 62 East, M.D.M., further described as APN's 008-201-11, 008-201-12, 008-201-13, located within Lincoln County, Nevada

STATE ENGINEER'S USE 85249-85254

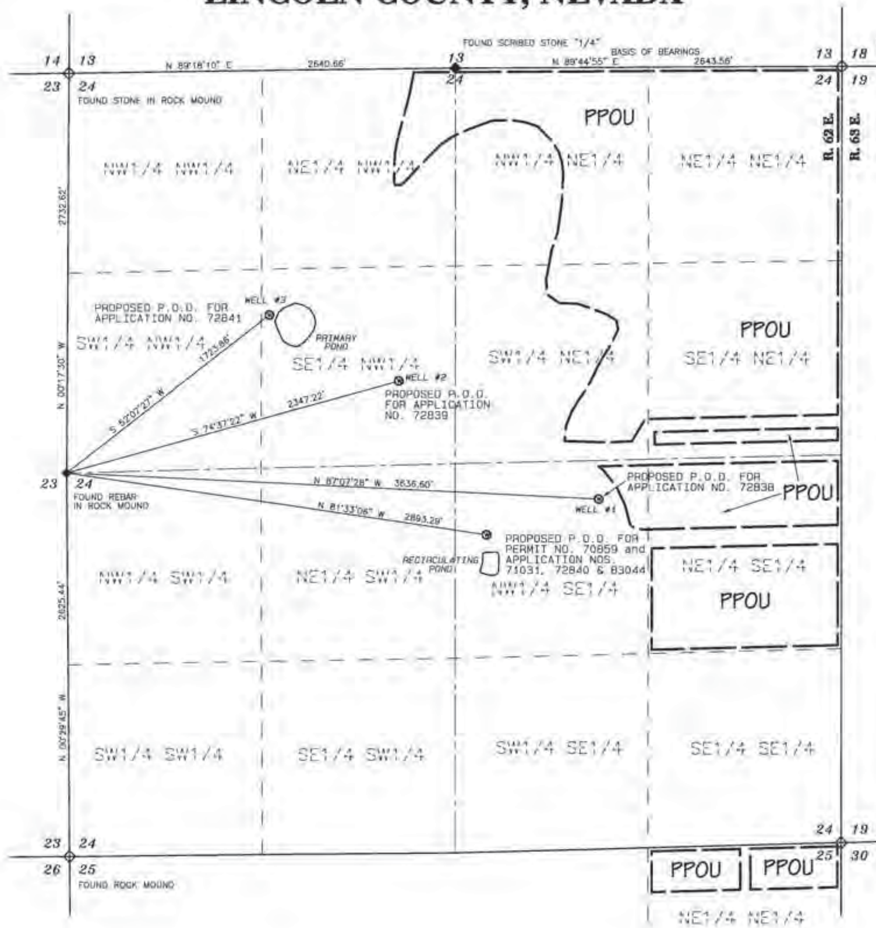
FILED
JUN 23 2015
STATE ENGINEER'S OFFICE

MAP

TO ACCOMPANY APPLICATIONS TO CHANGE THE POINT OF DIVERSION, PLACE OF USE AND MANNER OF USE OF A PORTION UNDER PERMIT 83044 AND TO ACCOMPANY APPLICATIONS TO APPROPRIATE (DIVERSION RATE ONLY) FOR COMMERCIAL AND DOMESTIC PURPOSES FROM AN UNDERGROUND SOURCE IN CLARK COUNTY, NEVADA BY BEDROC LIMITED, LLC

85254 8 53 5252 251 250 85249

SECTIONS 24 & 25, T. 11 S., R. 62 E., M.D.M.
LINCOLN COUNTY, NEVADA



LEGEND

SECTION LINE		◇	FOUND SECTION CORNER (AS DESCRIBED)
QUARTER SECTION LINE		◆	FOUND QUARTER SECTION CORNER (AS DESCRIBED)
16TH SECTION LINE		◎	WELL/POINT OF DIVERSION (AS NOTED)
WELL TIE		⬯	POND
PROPOSED PLACE OF USE	PPOU		

STATE OF NEVADA }
COUNTY OF WASHOE } *SS*

I, Michael D. Buschelman, being first duly sworn, depose and say that this map, consisting of one sheet, has been correctly drawn to the designated scale from field notes of a survey made by me or under my supervision and direction, between the 10th of December, 2003, and the 26th of January, 2004; that it truly and correctly represents the proposed place of use and proposed point of diversion used to divert water from underground percolating water sources in Lincoln County, Nevada, by BEDROC LIMITED, LLC, a Nevada limited liability company, for irrigation and domestic purposes.

Michael D. Buschelman
Michael D. Buschelman, P.L.S.
State Water-Right Surveyor No. 792
Exp 12-31-14

9-26-13
Subscribed and sworn to before me on this 25th day of September, 2013.

Ruth L. Smith
Notary Public

RUTH L. SMITH Notary Public State of Nevada Appt. No. 13-[illegible] My Appt. Expires [illegible]

REFERENCES

1. Permits, applications and supporting map(s) as referenced at existing points of diversion, on file in the office of the Nevada State Engineer, Division of Water Resources, Carson City, Nevada.
2. Record of Survey Map, Book B, Page 141A, on file in the Office of the Lincoln County Recorder, Lincoln County, Nevada.

GRAPHIC SCALE 1"=400'
0 400 800 1200

BASIS OF BEARINGS

The northerly line of the NE 1/4 of Section 24, T. 11 S., R. 62 E., M.D.M., being N 89°44'55" E, as shown on the Record of Survey Map recorded as Book B, Page 141A, in the Official Records of the Lincoln County Recorder.

Michael D. Buschelman Consulting, Inc.
Post Office Box 51371
Sparks, Nevada 89435
(775) 355-9628 Office 355-9629 FAX

STATE ENGINEER'S USE

FILED
SEP 26 2013
STATE ENGINEER'S OFFICE

MAP TO ACCOMPANY APPLICATION NO. 83044 TO CHANGE THE POINT OF DIVERSION, PLACE AND MANNER OF USE OF AMENDED PROOF NO. V04545 FOR IRRIGATION AND DOMESTIC PURPOSES BY

BEDROC LIMITED, LLC
a Nevada Limited Liability Company

FROM UNDERGROUND PERCOLATING WATER SOURCES IN LINCOLN COUNTY, NEVADA

85250 85249 83044

Permit No. 85250

THE STATE OF NEVADA

PERMIT TO CHANGE THE PUBLIC WATERS OF THE STATE OF NEVADA HERETOFORE APPROPRIATED

Name of Permittee:	**BEDROC LIMITED LLC**
Source:	**UNDERGROUND (BEDROC WELL 2)**
Basin:	**COYOTE SPRING VALLEY**
Manner of Use:	**COMMERCIAL AND DOMESTIC**
Period of Use:	**JANUARY 1ST THROUGH DECEMBER 31ST**
Priority Date:	**10/22/1919**

****

APPROVAL OF STATE ENGINEER

This is to certify that I have examined the foregoing application, and do hereby grant the same, subject to the following limitations and conditions:

This permit, to change the point of diversion, place and manner of use of a portion of the waters of an underground source as heretofore granted under Permit 83044, is issued subject to the terms and conditions imposed in said Permit 83044 and with the understanding that no other rights on the source will be affected by the change proposed herein. This well shall be equipped with a two (2) inch opening for measuring depth to water. A totalizing meter must be installed and maintained in the discharge pipeline near the point of diversion and accurate measurements must be kept of water placed to beneficial use. The totalizing meter must be installed before any use of the water begins or before the proof of completion of work is filed. If the well is flowing, a valve must be installed and maintained to prevent waste. This source is located within an area designated by the State Engineer pursuant to NRS 534.030. The State retains the right to regulate the use of the water herein granted at any and all times.

Monthly records shall be kept of the amount of water pumped from this well and the records submitted to the State Engineer on a quarterly basis within 15 days after the end of each calendar quarter.

The total combined duty of water under Permits 85249 and 85250 shall not exceed 315.56 acre-feet annually.

Any application to change the manner of use granted under this permit will be subject to additional determination and evaluation with respect to the permanent effects on existing rights and the resource within the Coyote Spring Valley.

This permit is approved for the entire 233.20 acre-feet annually as requested. However, pursuant to NRS 533.3703, initially only the net consumptive use amount of the base right, 214.54 acre-feet, can be diverted annually. Additional diversion up to the total 233.20 acre-feet may be granted if it can be shown that the additional diversion will not cause the consumptive use of 214.54 acre-feet to be exceeded.

This permit is issued subject to any determination of underground percolating water that may be made under adjudication proceedings under NRS 533.090 through 533.320 and 534.100.

This permit is issued subject to the Settlement Agreement between Bedroc Limited and the State Engineer, dated August 2014.

(Continued on Page 2)

This permit does not extend the permittee the right of ingress and egress on public, private or corporate lands.

The issuance of this permit does not waive the requirements that the permit holder obtain other permits from State, Federal and local agencies.

The point of diversion and place of use are as described on the submitted application to support this permit.

The amount of water to be appropriated shall be limited to the amount which can be applied to beneficial use, **and not to exceed 0.34 cubic feet per second or 214.54 acre-feet annually.**

Work must be prosecuted with reasonable diligence and proof of completion of work shall be filed on or before:	**October** 4 **2017**
Water must be placed to beneficial use and proof of the application of water to beneficial use shall be filed on or before:	**October** 4 **2019**
Map in support of proof of beneficial use shall be filed on or before:	**N/A**

IN TESTIMONY WHEREOF, I, JASON KING, P.E.,

State Engineer of Nevada, have hereunto set my hand and the seal of my office, this 4th day of **October, 2016**

JK P.E.

State Engineer

Application No. 85250

APPLICATION FOR PERMISSION TO CHANGE POINT OF DIVERSION, MANNER OF USE AND PLACE OF USE OF THE PUBLIC WATERS OF THE STATE OF NEVADA HERETOFORE APPROPRIATED

THIS SPACE FOR OFFICE USE ONLY

Date of filing in State Engineer's Office JUN 23 2015

Returned to applicant for correction ______

Corrected application filed ______ Map filed JUN 23 2015 under 85249

The applicant Bedroc Limited LLC, a Nevada Limited Liability Company
2745 N. Nellis Boulevard (Street Address or PO Box) of Las Vegas (City or Town)
Nevada 89115 (State and ZIP Code) hereby make(s) application for permission to change the

☑ Point of diversion ☑ Place of use ☑ Manner of use ☑ of a portion

of water heretofore appropriated under (Identify existing rights by Permit, Certificate, Proof or Claim Nos. If Decreed, give title of Decree and identify right in Decree.)
Permit 83044

RECEIVED
2015 JUN 23 AM 8:45
STATE ENGINEERS OFFICE

1. The source of water is underground - Bedroc Well No. 2
Name of stream, lake, underground, spring or other sources.

2. The amount of water to be changed 0.34 c.f.s., 233.2 acre-feet
Second feet, acre-feet. One second foot equals 448.83 gallons per minute.

3. The water to be used for Commercial and Domestic
Irrigation, power, mining, commercial, etc. If for stock, state number and kind of animals. Must limit to one major use

4. The water heretofore used for Irrigation and Domestic
If for stock, state number and kind of animals.

5. The water is to be diverted at the following point (Describe as being within a 40-acre subdivision of public survey and by course and distance to a found section corner. If on unsurveyed land, it should be stated.)
within the SE 1/4 NW 1/4 of Section 24, township 11 South, Range 62 East, M.D.M., at a point from which the Northeast corner of said Section 24 bears North 54° 25'04" East, a distance of 3,710.8 feet.

6. The existing point of diversion is located within (If point of diversion is not changed, do not answer.)
the NW 1/4 SE 1/4 of Section 24, Township 11 South, Range 62 East, M.D.M., at a point from which the West 1/4 corner of said Section 24 bears North 81° 33'06" West a distance of 2893.29 feet.

13-210
L1

85250

7. Proposed place of use (Describe by legal subdivisions. If for irrigation, state number of acres to be irrigated.)

560 acres within the E1/2 W1/2 and the E1/2 of Section 24 and the E1/2 NE1/4 of Section 25 all within Township 11 South, Range 62 East, M.D.M., further described as APN's 008-201-11, 008-201-12, 008-201-13, located within Lincoln County, Nevada.

8. Existing place of use (Describe by legal subdivisions. If changing place of use and/or manner of use of irrigation permit, describe acreage to be removed from irrigation.)

within the NE 1/4, N 1/2 SE 1/4, NE 1/4 NW 1/4 of Section 24 and the NE 1/4 NE 1/4 of Section 25 all located within Township 11 South, Range 62 East M.D.M.

Please refer to map filed under permit No. 83044 for existing place of use.

9. Proposed use will be from January 1st (Month and Day) to December 31st (Month and Day) of each year.

10. Existing use permitted from January 1st (Month and Day) to December 31st (Month and Day) of each year.

11. Description of proposed works. (Under the provision of NRS 535.010 you may be required to submit plans and specifications of your diversion or storage works.) (State manner in which water is to be diverted, i.e., diversion structure, ditches, pipes and flumes or drilled well, pump and motor, etc.)

Existing well equipped with submersible pump, flow meters interconnecting the distribution system with ponds for fire protection storage and gravity feeding the distribution system.

12. Estimated cost of works existing - Bedroc Well No. 2

13. Estimated time required to construct works existing well, submersible pump and distribution system

If well completed, describe well.

14. Estimated time required to complete the application of water to beneficial use 5 years

15. Provide a detailed description of the proposed project and its water usage (use attachments if necessary): (Failure to provide a detailed description may cause a delay in processing.)

Groundwater is pumped from a shallow well and conveyed via existing distribution system to a pond, then pumped to higher ponds for commercial operations of an approved landfill which includes fire protection, dust control, aggregate crushing operations, irrigation or ornamental landscaping and alfalfa for soil stabilization within the designated place of use.

16. Miscellaneous remarks:

The combined duty under this application and under the other change application filed with respect to Permit 83044 shall not exceed 343 acre feet annually, the permitted duty under Permit 83044.

Robert W. Marshall

Type or print name clearly

Robert W. Marshall

Signature, applicant or agent

E-mail Address

(775) 323-1601

Phone No. Ext.

Company Name

50 W. Liberty St., Suite 750

Street Address or PO Box

Reno, NV 89501

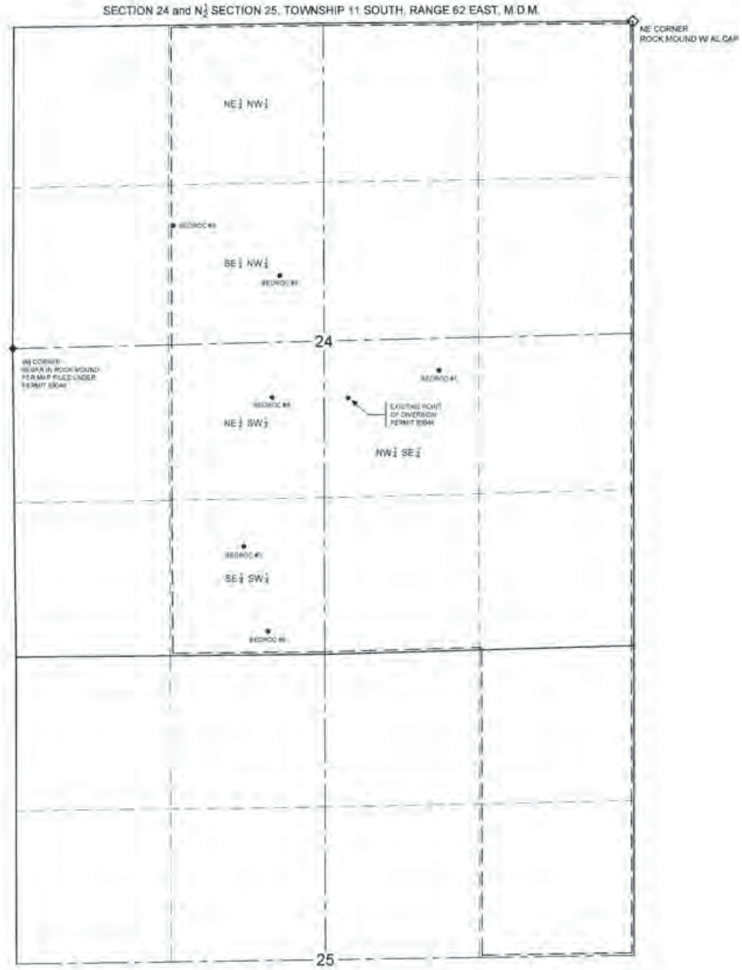
City, State, ZIP Code

APPLICATION MUST BE SIGNED
BY THE APPLICANT OR AGENT

RECEIVED 2015 JUN 23 AM 8:43 STATE ENGINEERS OFFICE

Revised 07/13 $240 FILING FEE AND SUPPORTING MAP MUST ACCOMPANY APPLICATION

SECTION 24 and N½ SECTION 25, TOWNSHIP 11 SOUTH, RANGE 62 EAST, M.D.M.



STATE OF NEVADA }
} S.S.
COUNTY OF CLARK }

I, ROBERT COACHE, P.E., BEING FIRST DULY SWORN, DEPOSE AND SAY THAT THIS MAP CONSISTING OF ONE SHEET, HAS BEEN CORRECTLY DRAWN TO THE DESIGNATED SCALE FROM INFORMATION OBTAINED FROM THE NEVADA DIVISION OF WATER RESOURCES, LINCOLN COUNTY RECORDER AND FIELD NOTES OF A SURVEY MADE BY ME, OR UNDER MY SUPERVISION AND DIRECTION ON OR BEFORE THE 2ND DAY OF FEBRUARY 2015. THAT IT TRULY AND CORRECTLY REPRESENTS THE PROPOSED LOCATIONS AND EXTENT OF THE WORKS USED TO DIVERT WATER FROM AN UNDERGROUND SOURCE IN LINCOLN COUNTY, NEVADA BY BEDROC LIMITED, LLC FOR COMMERCIAL PURPOSES. THAT THE EXISITNG AND PROPOSED POINTS OF DIVERSION AND PROPOSED PLACE OF USE ARE FULLY AND CORRECTLY DESIGNATED HEREON.

ROBERT COACHE, P.E.
STATE WATER RIGHT SURVEYOR
CERTIFICATE No. 1005

PROFESSIONAL ENGINEER - STATE OF NEVADA
ROBERT A. COACHE
EXP. 12-31-16
CIVIL
No. 11505
6-18-15

SUBSCRIBED AND SWORN TO BEFORE ME THIS 18th DAY OF JUNE 2015

FOR SAID COUNTY AND STATE
MY APPOINTMENT EXPIRES 11-12-2017

Existing Well Tie to West Quarter Corner Section 24, T. 11 S., R.62E., M.D.M.				
Permit No.	Sub 1/4	Sub 1/4	Bearing	Distance
83044	NW	SE	N 81° 33' 08" W	2,893.29'

Proposed Well Ties to Northeast Corner Section 24, T. 11 S., R.62E., M.D.M.				
Well Name	Sub 1/4	Sub 1/4	Bearing	Distance
Bedroc #1	NW	SE	N 29° 12' 40" E	3,399.1'
Bedroc #2	SE	NW	N 54° 25' 04" E	3,710.8'
Bedroc #3	SE	NW	N 66° 11' 51" E	4,291.6'
Bedroc #4	NE	SW	N 43° 59' 02" E	4,442.5'
Bedroc #5	SE	SW	N 36° 43' 43" E	5,567.7'
Bedroc #6	SE	SW	N 31° 04' 57" E	6,053.4'

NORTH

GRAPHIC SCALE

(IN FEET)
1 inch = 500 ft.

LEGEND

- 1/4 CORNER (OR 1/16 CORNER) FOUND AS SHOWN
- SECTION CORNER FOUND AS SHOWN
- PROPOSED PLACE OF USE
- SECTION LINE
- 1/4 SECTION LINE
- 1/16 SECTION LINE

BASIS OF BEARING - GPS

THE NORTH EAST CORNER OF SECTION 24, TOWNSHIP 11 SOUTH, RANGE 62 EAST, M.D.M. WAS ESTABLISHED USING A ASHTECH MOBIL MAPPER 10 GPS DIFFERENTIALLY CORRECTED TO AN ACCURACY OF ONE (1) METER AND A NAD 83 DATUM

PROPOSED PLACE OF USE:

560 acres within the E½ W½ and the E½ of Section 24 and the E½ NE¼ of Section 25 all within Township 11 South, Range 62 East, M.D.M., further described as APN's 008-201-11, 008-201-12, 008-201-13, located within Lincoln County, Nevada

STATE ENGINEER'S USE 85249-85254

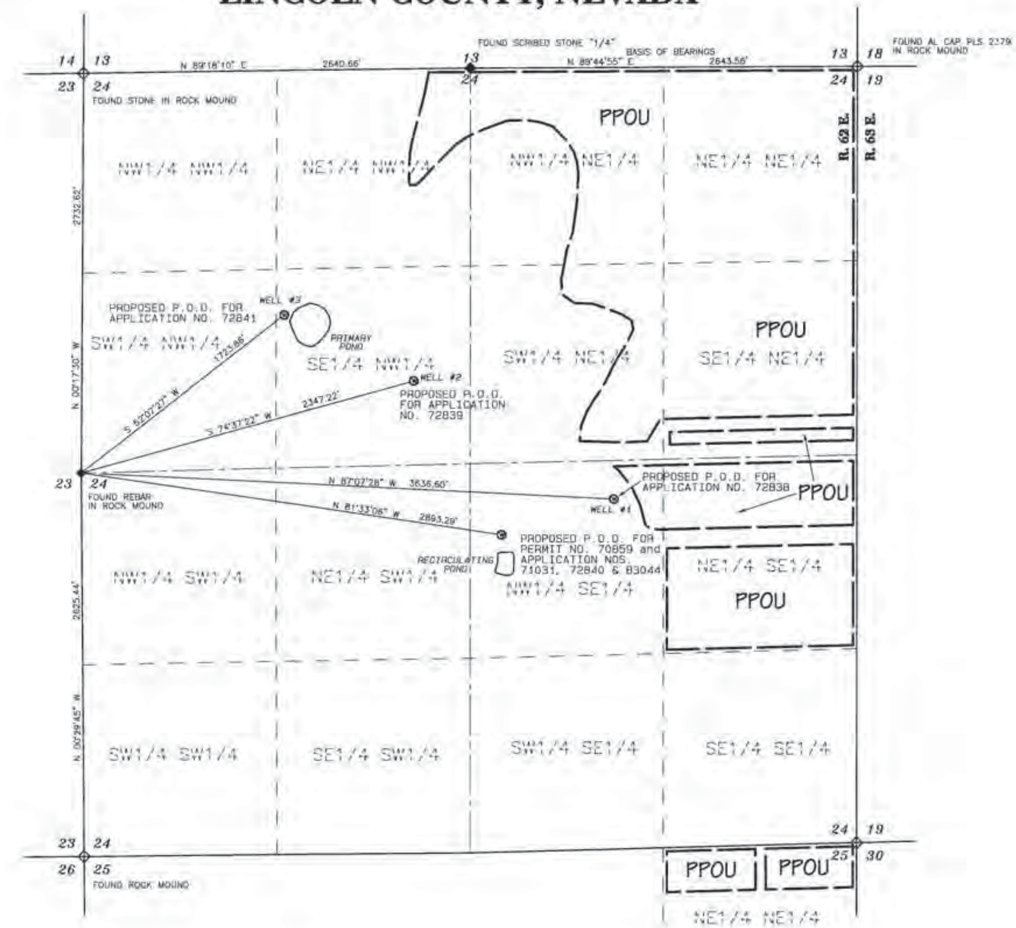
FILED
JUN 23 2015
STATE ENGINEER'S OFFICE

MAP

TO ACCOMPANY APPLICATIONS TO CHANGE THE POINT OF DIVERSION, PLACE OF USE AND MANNER OF USE OF A PORTION UNDER PERMIT 83044 AND TO ACCOMPANY APPLICATIONS TO APPROPRIATE (DIVERSION RATE ONLY) FOR COMMERCIAL AND DOMESTIC PURPOSES FROM AN UNDERGROUND SOURCE IN CLARK COUNTY, NEVADA BY BEDROC LIMITED, LLC

85254 85252 85249

SECTIONS 24 & 25, T. 11 S., R. 62 E., M.D.M.
LINCOLN COUNTY, NEVADA



LEGEND

SECTION LINE	FOUND SECTION CORNER (AS DESCRIBED)
QUARTER SECTION LINE	FOUND QUARTER SECTION CORNER (AS DESCRIBED)
16TH SECTION LINE	WELL/POINT OF DIVERSION (AS NOTED)
WELL TIE	POND
PPOU PROPOSED PLACE OF USE	

STATE OF NEVADA }
COUNTY OF WASHOE } SS

I, Michael D. Buschelman, being first duly sworn, depose and say that this map, consisting of one sheet, has been correctly drawn to the designated scale from field notes of a survey made by me or under my supervision and direction, between the 10th of December, 2003, and the 26th of January, 2004; that it truly and correctly represents the proposed place of use and proposed point of diversion used to divert water from underground percolating water sources in Lincoln County, Nevada, by BEDROC LIMITED, LLC, a Nevada limited liability company, for irrigation and domestic purposes.

Michael D. Buschelman
Michael D. Buschelman, P.L.S.
State Water-Right Surveyor No. 792
Exp 12-31-14

9-26-13
Subscribed and sworn to before me on this 25th day of September, 2013.

Ruth L. Smith
Notary Public

REFERENCES

1. Permits, applications and supporting map(s) as referenced at existing points of diversion, on file in the office of the Nevada State Engineer, Division of Water Resources, Carson City, Nevada.
2. Record of Survey Map, Book B, Page 19A, on file in the Office of the Lincoln County Recorder, Lincoln County, Nevada.

N S W E

GRAPHIC SCALE 1"=400'
0 400 800 1200

BASIS OF BEARINGS

The northerly line of the NE 1/4 of Section 24, T. 11 S., R. 62 E., M.D.M., being N 89°44'55" E, as shown on the Record of Survey Map recorded as Book B, Page 19A, in the Official Records of the Lincoln County Recorder.

Michael D. Buschelman Consulting, Inc.
Post Office Box 51371
Sparks, Nevada 89435
(775) 355-9628 Office 355-9629 FAX

STATE ENGINEER'S USE

FILED
SEP 26 2013
STATE ENGINEER'S OFFICE

MAP TO ACCOMPANY APPLICATION NO. 83044 TO CHANGE THE POINT OF DIVERSION, PLACE AND MANNER OF USE OF AMENDED PROOF NO. V04545 FOR IRRIGATION AND DOMESTIC PURPOSES BY

BEDROC LIMITED, LLC
a Nevada Limited Liability Company

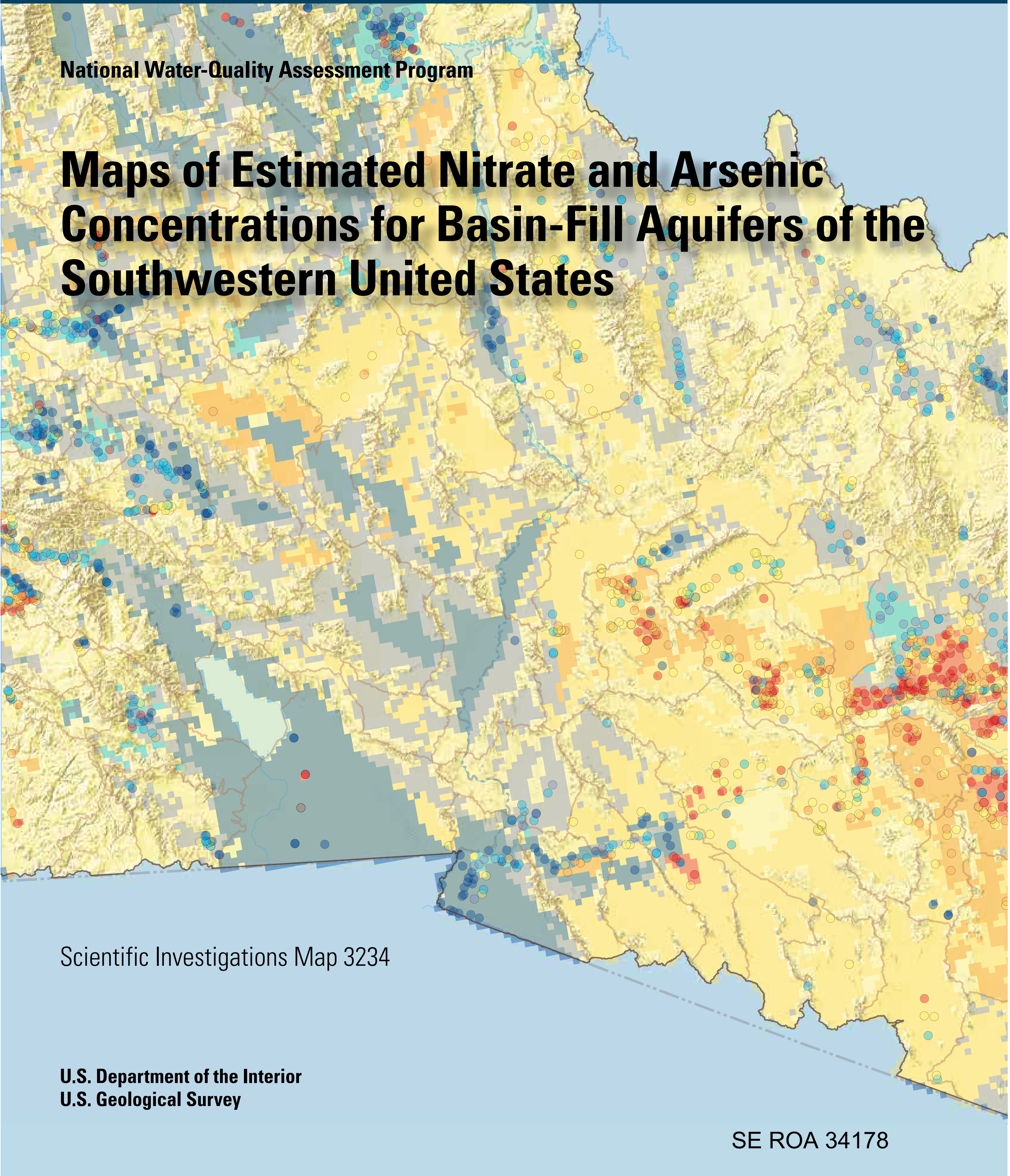
FROM UNDERGROUND PERCOLATING WATER SOURCES IN LINCOLN COUNTY, NEVADA

85250 85249 83044

USGS
science for a changing world

National Water-Quality Assessment Program

Maps of Estimated Nitrate and Arsenic Concentrations for Basin-Fill Aquifers of the Southwestern United States



Scientific Investigations Map 3234

U.S. Department of the Interior
U.S. Geological Survey

SE ROA 34178

JA_6776

Cover art: Observed and predicted nitrate concentrations in basin-fill aquifers of the Southwest Principal Aquifers study area.

SE ROA 34179

Maps of Estimated Nitrate and Arsenic Concentrations for Basin-Fill Aquifers of the Southwestern United States

By Kimberly R. Beisner, David W. Anning, Angela P. Paul, Tim S. McKinney, Jena M. Huntington, Laura M. Bexfield, and Susan A. Thiros

National Water-Quality Assessment Program

Scientific Investigations Map 3234

U.S. Department of the Interior
U.S. Geological Survey

SE ROA 34180

U.S. Department of the Interior
KEN SALAZAR, Secretary

U.S. Geological Survey
Marcia K. McNutt, Director

U.S. Geological Survey, Reston, Virginia: 2012

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Suggested citation:
Beisner, K.R., Anning, D.W., Paul, A.P., McKinney, T.S., Huntington, J.M., Bexfield, L.M., and Thiros, S.A., 2012, Maps of estimated nitrate and arsenic concentrations in basin-fill aquifers of the southwestern United States: U.S. Geological Survey Scientific Investigations Map 3234, pamphlet 8 p., 2 sheets.

Contents

Figures

Plates

Tables

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Maps of Estimated Nitrate and Arsenic Concentrations for Basin-Fill Aquifers of the Southwestern United States

By Kimberly R. Beisner, David W. Anning, Angela P. Paul, Tim S. McKinney, Jena M. Huntington, Laura M. Bexfield, and Susan A. Thiros

Abstract

Human-health concerns and economic considerations associated with meeting drinking-water standards motivated a study of the vulnerability of basin-fill aquifers to nitrate contamination and arsenic enrichment in the southwestern United States. Statistical models were developed by using the random forest classifier algorithm to predict concentrations of nitrate and arsenic across a model grid representing about 190,600 square miles of basin-fill aquifers in parts of Arizona, California, Colorado, Nevada, New Mexico, and Utah. The statistical models, referred to as classifiers, reflect natural and human-related factors that affect aquifer vulnerability to contamination and relate nitrate and arsenic concentrations to explanatory variables representing local- and basin-scale measures of source and aquifer susceptibility conditions. Geochemical variables were not used in concentration predictions because they were not available for the entire study area. The models were calibrated to assess model accuracy on the basis of measured values.

Only 2 percent of the area underlain by basin-fill aquifers in the study area was predicted to equal or exceed the U.S. Environmental Protection Agency drinking-water standard for nitrate as N (10 milligrams per liter), whereas 43 percent of the area was predicted to equal or exceed the standard for arsenic (10 micrograms per liter). Areas predicted to equal or exceed the drinking-water standard for nitrate include basins in central Arizona near Phoenix; the San Joaquin Valley, the Santa Ana Inland, and San Jacinto Basins of California; and the San Luis Valley of Colorado. Much of the area predicted to equal or exceed the drinking-water standard for arsenic is within a belt of basins along the western portion of the Basin and Range Physiographic Province that includes almost all of Nevada and parts of California and Arizona. Predicted nitrate and arsenic concentrations are substantially lower than the drinking-water standards in much of the study area—about 93 percent of the area underlain by basin-fill aquifers was less than one-half the standard for nitrate as N (5.0 milligrams per liter), and 50 percent was less than one-half the standard for arsenic (5.0 micrograms per liter). The predicted concentrations and the improved understanding of the susceptibility and vulnerability of southwestern basin-fill aquifers to nitrate contamination and arsenic enrichment can be used by water managers as a qualitative tool to assess and protect the quality of groundwater resources in the Southwest.

Introduction

The National Water-Quality Assessment (NAWQA) Program of the U.S. Geological Survey (USGS) is performing a regional analysis of water quality in the principal aquifer systems across the United States (Lapham and others, 2005). The Southwest Principal Aquifers (SWPA) study is developing a better understanding of the susceptibility and vulnerability of basin-fill aquifers in the Southwest to groundwater contamination by synthesizing baseline knowledge of groundwater-quality conditions in 16 basins previously studied by the NAWQA Program (fig. 1).

About 46.6 million people live in the SWPA study area (Oak Ridge National Laboratory, 2005), mostly in urban areas, but also in rural agricultural communities that cultivate about 14.4 million acres of cropland (U.S. Geological Survey, 2003). Other rural areas contain small communities with mining, retirement, or tourism/recreational-based economies. Because of the generally limited availability of surface-water supplies in the arid to semiarid climate, cultural and economic activities in the region are dependent on high-quality groundwater supplies. In the year 2000, about 33.7 million acre-feet (acre-ft) of surface water was diverted from streams, and about 23.0 million acre-ft of groundwater was withdrawn from basin-fill aquifers in the SWPA study area (U.S. Geological Survey, 2004). Irrigation and public-supply groundwater withdrawals from basin-fill aquifers in the study area were about 18.0 million acre-ft and 4.1 million acre-ft, respectively, and together account for about one quarter of the total withdrawals from all aquifers in the United States (Maupin and Barber, 2005).

Basin-fill aquifers underlie about half (190,600 square miles (mi^2)) of the 409,000 mi^2 SWPA study area (fig. 1) and are the primary groundwater supply for most cities and agricultural communities. In several areas, these aquifers provide base flow to streams that support important aquatic and riparian habitats. Basin-fill aquifers primarily consist of sand and gravel deposits that partly fill faulted basins and are bounded by consolidated rock mountains.

SE ROA 34184

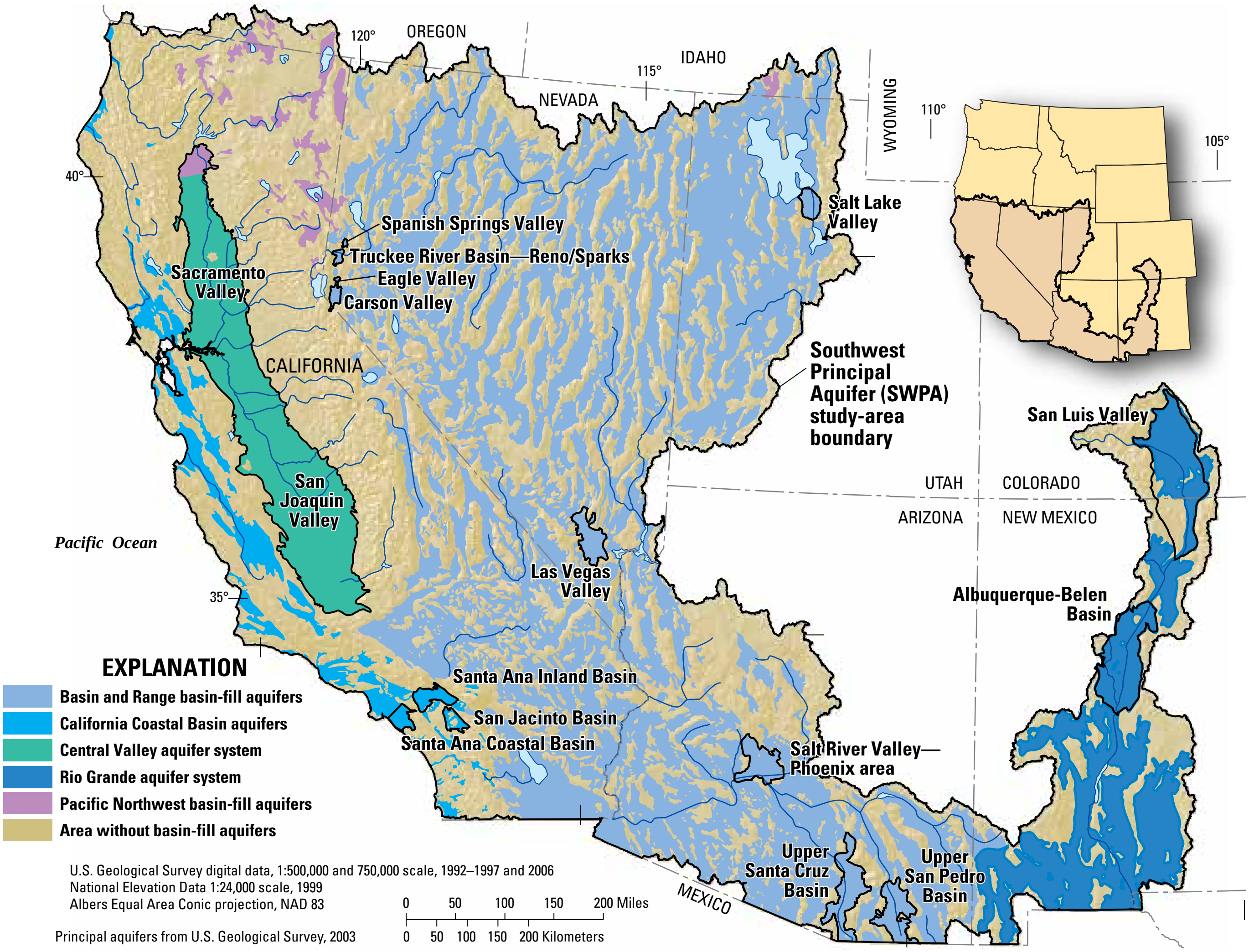

Figure 1. The principal aquifers and locations of basins previously studied by the National Water-Quality Assessment Program in the Southwest Principal Aquifers study area.

Similarities in the hydrogeology, land- and water-use practices, and water-quality issues allow for regional analysis of the vulnerability of basin-fill aquifers to contamination in the SWPA study area. Published studies have summarized current knowledge about the water quality of groundwater systems of basin-fill aquifers in the 16 basins previously studied by NAWQA (Thiros and others, 2010) and developed conceptual models of the primary natural and human-related factors commonly affecting groundwater quality in basin-fill aquifers on a regional scale (Bexfield and others, 2011).

Nitrate and arsenic concentrations are known to be elevated in many areas of the west; however, the contributing factors are distinct for each constituent. The motivation for study of nitrate and arsenic concentrations in basin-fill aquifers in the SWPA study area arose from concerns about human-health issues and economic costs associated with the protection and treatment of drinking water with respect to these constituents, as well as the potential for contaminant concentrations to increase over time and degrade the quality of groundwater in the aquifers as development progresses.

The U.S. Environmental Protection Agency (USEPA) regulates nitrate in drinking water because of the potential for elevated nitrate to restrict oxygen transport in the blood of infants in a condition known as acquired methemoglobinemia or blue-baby syndrome (U.S. Environmental Protection Agency, 2012). Recent concern also has arisen over transformation of nitrate within the human body into *N*-nitroso compounds, which are known carcinogens (Ward and others, 2005). The current nitrate as N standard of 10 milligrams per liter (mg/L) is the maximum allowable concentration of nitrate in drinking water delivered to the consumer by a public-supply system.

Arsenic has been recognized as a toxic element for centuries and is a human-health concern because elevated concentrations can contribute to a wide variety of adverse health effects, including skin damage and circulatory problems. In addition, arsenic in drinking water can lead to several types of cancers, including bladder, lung, skin, and possibly kidney and liver (National Research Council, 2001). On the basis of a review of available scientific research on health effects of arsenic, long-term consumption of drinking water in excess of 5 micrograms per liter (µg/L) has been linked with an increased human-health risk (National Research Council, 2001). In light of the risk level, the USEPA lowered the drinking-water standard for arsenic from 50 µg/L to 10 µg/L, effective in 2006, as a compromise between the risk to individuals and the expense to water suppliers (U.S. Environmental Protection Agency, 2012).

This report summarizes statistical models developed by Anning and others (2012) that relate concentrations of nitrate and arsenic in basin-fill aquifers of the SWPA study area to selected natural and human-related factors representing contaminant sources and aquifer susceptibility conditions. Statistical models allow the understanding of nitrate and arsenic concentrations to be expanded from discrete observations to broader spatial predictions. Specifically, this report presents the spatial and statistical distribution of nitrate (plate 1) and arsenic (plate 2) concentrations in basin-fill aquifers across the SWPA study area as determined by using predictions from statistical models.

Approach and Methods

Statistical models used in this investigation were constructed by using the random forest classifier algorithm (Breiman, 2001) and are hereafter called 'classifiers.' In short, the classifiers "learn" the relations between known nitrate and arsenic concentrations and known environmental conditions associated with the aquifer. These relations take the form of complex decision trees and are used with known spatially-distributed environmental-condition data to predict concentrations in areas where observed concentration data are unavailable.

The concentration data used for training the classifiers were from 6,234 well samples stored in the USGS National Water Information System (NWIS; U.S. Geological Survey, 2010). These data were partitioned into six concentration groups for nitrate and seven concentration groups for arsenic. The break points between concentration classes were 0.50, 1.0, 2.0, 5.0, and 10 mg/L for nitrate and 1.0, 2.0, 3.0, 5.0, 10, and 25 µg/L for arsenic. The environmental conditions represented in the classifiers were from several existing geospatial datasets and included factors such as nitrogen loading rates, geologic characteristics, soil conditions, land use, water use, and other hydrologic conditions. Anning and others (2012) developed exploratory models with geochemical conditions that were found not to greatly improve the accuracy of the predictions. The environmental factors considered in the statistical model are related to geochemical conditions and likely account for much of the variability without the need for direct use of geochemical data. Additionally, geochemical data were not available for the entire study area.

Classifier and Predicted Concentration Results

The random forest classifiers provided a context to evaluate the spatial distribution of nitrate and arsenic within the upper 200 ft of basin-fill aquifers in the study area and to assess the vulnerability of aquifers throughout the SWPA study area to nitrate contamination and arsenic enrichment. Predicted nitrate and arsenic concentrations are discussed in this report for the upper 200 ft of the aquifer primarily because regression analysis on observed data showed that, at the regional scale, systematic concentration variations with depth were not found in the aquifers.

The classifiers were successfully trained to relations between observed nitrate and arsenic concentrations and important factors affecting them. This enabled the extrapolation of predicted nitrate and arsenic concentrations from areas where concentrations were measured into areas where data were unavailable. The nitrate and arsenic classifiers were found to be generally consistent with, and provided additional information and detail for, the conceptual models for natural and human-related factors affecting these constituents as described in Bexfield and others (2011).

Classifier Goodness-of-Fit and Prediction Uncertainty

The classifiers for nitrate and for arsenic performed well for assessing the vulnerability of basin-fill aquifers in the SWPA study area to contamination by these constituents. The classifiers generally produced unbiased predictions, and misclassification errors for each classifier were generally low, given the spatial variability within individual model grid cells. For each explanatory variable, the range of values in the study area was well represented by nitrate and arsenic observations, and there were no environmental conditions poorly represented by the dataset used to train the classifiers. In addition, analysis of the misclassification errors indicated that there were no environmental conditions where the classifier tended to overpredict or underpredict concentrations. Analysis of the misclassifications indicated that the models were unbiased spatially and unbiased across the distribution of values for the explanatory variables.

The ability of the model to predict concentrations across the study area within plus or minus one concentration class was 72 percent for nitrate and 70 percent for arsenic. Misclassification errors were generally symmetric about the correct (true) class; 29 percent of nitrate and 34 percent of arsenic observations were misclassified into lower concentration classes than the true class, and 29 percent of nitrate and 31 percent of arsenic observations were misclassified into higher concentration classes (fig. 2).

Nitrate

While the training observations indicate nitrate concentrations were equal to or exceeded 10 mg/L in 11 percent of the groundwater samples, use of the prediction classifier to extrapolate concentrations across the SWPA study area (plate 1) revealed that only about 2 percent of the study area underlain by basin-fill aquifers is likely to exceed this concentration, and 93 percent of the area could have groundwater with less than 5.0 mg/L of nitrate as N (fig. 3). These differences in the distribution of observed and predicted nitrate concentrations are expected and result from the fact that the prediction dataset represents the full extent of basin-fill aquifers in the SWPA study area, whereas the training dataset represents a subset of those aquifers where observations were available. Generally, samples of groundwater were collected from areas where groundwater resources have been developed. The measured and predicted concentration datasets have somewhat different but overlapping distributions of source and aquifer-susceptibility variables that affect nitrate in groundwater.

Relative background concentrations of nitrate in groundwater in undeveloped land-use settings were determined to be less than 2.0 mg/L for most biotic communities overlaying basin-fill aquifers, except for the Semidesert Grassland, Mojave Desertscrub, Sonoran Desertscrub-Arizona Uplands,

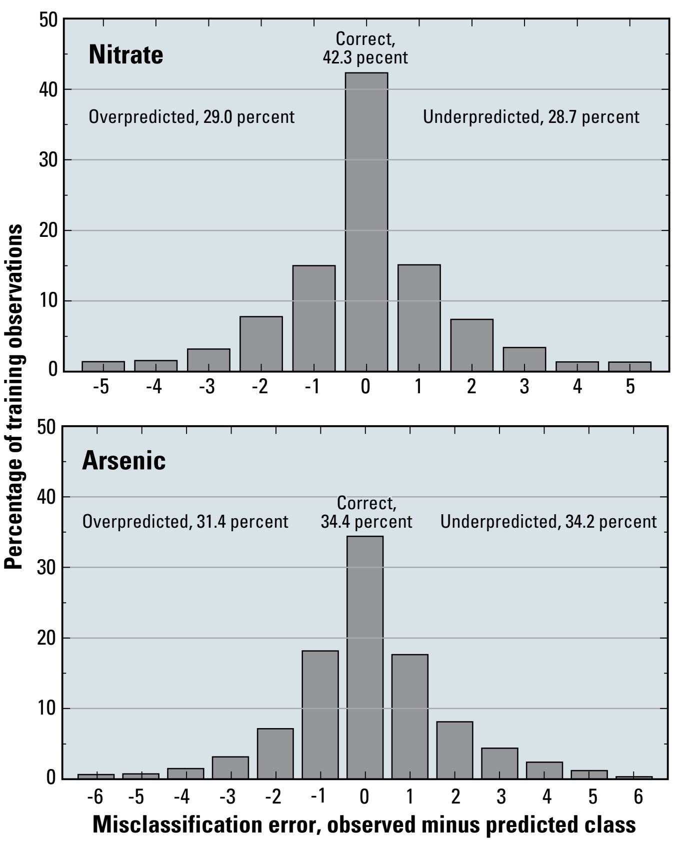

Figure 2. Statistical distribution of misclassification errors for the random forest prediction classifiers of basin-fill aquifers of the Southwest Principal Aquifers study area for nitrate and arsenic concentrations.

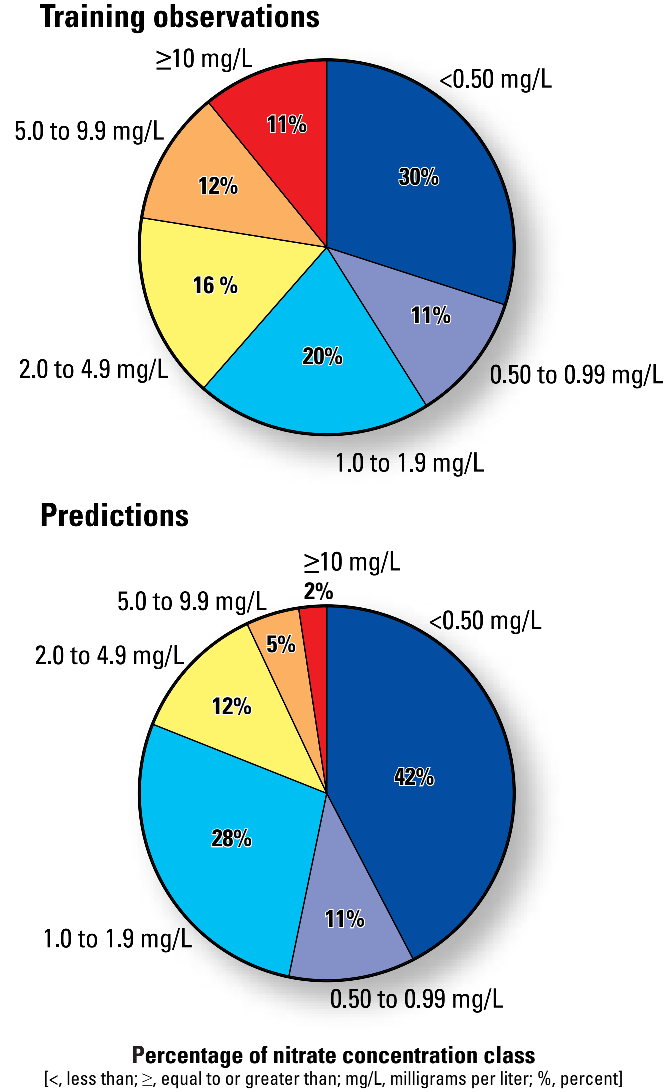

Figure 3. Percentage of nitrate concentration class for training observations and predictions.

and Sonoran Desertscrub-Lower Colorado River Valley communities generally located in southern Arizona. In these four biotic communities, concentrations were estimated to be less than 5.0 mg/L but greater than 2.0 mg/L. Nitrate concentrations greater than these relative background concentrations are largely found in areas with agricultural or urban land development.

Concentrations of nitrate in the basin-fill aquifers were predicted to exceed relative background concentrations in about 34 percent of areas having more than 5-percent agricultural or urban land. Exceedance of relative background concentrations increased with the amount of agricultural or urban development. Nitrate concentrations in basin-fill aquifers underlying land where greater than half the area has been developed for agricultural or urban uses are predicted to equal or exceed 10 mg/L in 15 percent of that area, which increases to 48 percent for areas entirely used for agricultural or urban related activities. Predicted concentrations generally decreased along groundwater-flow paths from the basin margin to the basin lowlands. Nearly all wetland areas in the basin lowlands have concentrations less than 0.50 mg/L, regardless of the amount of land development. These low concentrations could result from denitrification, a microbially facilitated process where nitrate is converted to nitrogen gas, although other explanations are possible (Anning and others, 2012).

A further understanding of conditions that render the basin-fill aquifers in the SWPA study area vulnerable to nitrate contamination was gained from an analysis of the correlations between the predicted concentrations and the explanatory variables (table 1), as well as correlations between observed nitrate and other constituent concentrations in the training dataset, which are described in detail in Anning and others (2012). These univariate correlations indicated that areas are more likely to have higher concentrations and, therefore, are generally more vulnerable to nitrate contamination, where one or more of the following conditions is found:

- Land is used for agricultural or urban purposes, especially where fertilizers are used or where there are livestock.

Table 1. Relation between predicted nitrate and arsenic concentrations and explanatory variables representing conditions for basin-fill aquifers in the Southwest Principal Aquifers study area.

[Positive values of Kendall’s tau indicate that higher concentrations are associated with greater values of the explanatory variable and lower concentrations are associated with lesser values of the explanatory variable. Negative values of Kendall’s tau indicate that the opposite relation exists between concentration and the explanatory variable. Small p-values (<0.001) indicate the Kendall’s tau correlation between the nitrate or arsenic concentration and a given explanatory variable is statistically significant. **Abbreviations:** —, constituent not tested in classifier; <, less than]

Variable group	Explanatory variable	Represented area	Kendall’s tau test on predicted nitrate concentration		Kendall’s tau test on predicted arsenic concentration	
			tau	p-value	tau	p-value
Source variables						
Nitrogen loading	Atmospheric deposition	Grid cell	–0.06	<0.001	—	—
	Farm fertilizer	Grid cell	0.06	<0.001	—	—
	Non-farm fertilizer	Grid cell	0.05	<0.001	—	—
	Confined manure	Grid cell	0.06	<0.001	—	—
	Unconfined manure	Grid cell	0.03	<0.001	—	—
	Total nitrogen	Grid cell	0.01	<0.001	—	—
Land use	Septic/sewer ratio	Grid cell	–0.02	<0.001	–0.07	<0.001
	Local population	Grid cell	0.09	<0.001	–0.16	<0.001
	Local population density	Grid cell	0.09	<0.001	–0.16	<0.001
	Basin population	Basin average	0.08	<0.001	–0.18	<0.001
	Basin population density	Basin average	0.10	<0.001	–0.20	<0.001
	Local urban land	Grid cell	0.08	<0.001	–0.15	<0.001
	Local agricultural land	Grid cell	0.04	<0.001	–0.11	<0.001
	Basin urban land	Basin average	0.08	<0.001	–0.21	<0.001
	Basin agricultural land	Basin average	0.02	<0.001	–0.20	<0.001
	Basin rangeland	Basin average	0.00	0.551	0.29	<0.001
	Basin other land cover	Basin average	–0.11	<0.001	–0.26	<0.001
Geologic sources	Carbonate rocks	Contributing area	-0.15	<0.001	–0.07	<0.001
	Crystalline rocks	Contributing area	0.18	<0.001	0.04	<0.001
	Clastic sedimentary rocks	Contributing area	–0.10	<0.001	–0.16	<0.001
	Mafic volcanic rocks	Contributing area	0.08	<0.001	0.16	<0.001
	Felsic and silicic volcanic rocks	Contributing area	–0.11	<0.001	0.04	<0.001
	Intermediate composition volcanic rocks	Contributing area	0.05	<0.001	0.11	<0.001
	Undifferentiated volcanic rocks	Contributing area	0.00	0.855	–0.07	<0.001
	Distance to carbonate rocks	Grid cell	0.11	<0.001	0.07	<0.001
	Distance to crystalline rocks	Grid cell	–0.11	<0.001	–0.02	<0.001
	Distantce to clastic sedimentary rocks	Grid cell	0.03	<0.001	0.14	<0.001
	Distance to mafic volcanic rocks	Grid cell	–0.10	<0.001	–0.19	<0.001
	Distance to felsic and silicic volcanic rocks	Grid cell	0.07	<0.001	–0.06	<0.001
	Distance to intermediate composition volcanic rocks	Grid cell	–0.02	<0.001	–0.12	<0.001
	Distance to undifferentiated volcanic rocks	Grid cell	0.01	0.006	0.03	<0.001
	Soil and rock equivalent uranium-238	Grid cell	—	—	0.14	<0.001

Table 1. Relation between predicted nitrate and arsenic concentrations and explanatory variables representing conditions for basin-fill aquifers in the Southwest Principal Aquifers study area.—Continued

[Positive values of Kendall's tau indicate that higher concentrations are associated with greater values of the explanatory variable and lower concentrations are associated with lesser values of the explanatory variable. Negative values of Kendall's tau indicate that the opposite relation exists between concentration and the explanatory variable. Small p-values (<0.001) indicate the Kendall's tau correlation between the nitrate or arsenic concentration and a given explanatory variable is statistically significant. **Abbreviations:** —, constituent not tested in classifier; <, less than]

Variable group	Explanatory variable	Represented area	Kendall's tau test on predicted nitrate concentration		Kendall's tau test on predicted arsenic concentration	
			tau	p-value	tau	p-value
Aquifer susceptibility variables						
Flow path	Land-surface slope	Grid cell	0.05	<0.001	–0.12	<0.001
Flow path	Land-surface elevation	Grid cell	–0.17	<0.001	–0.10	<0.001
Flow path	Land-surface elevation percentile	Grid cell	0.15	<0.001	–0.16	<0.001
Flow path	Basin elevation	Basin average	–0.20	<0.001	–0.07	<0.001
Flow path	Distance to basin margin	Grid cell	–0.02	<0.001	0.08	<0.001
Soil properties	Seasonally high water depth	Grid cell	0.25	<0.001	–0.03	<0.001
Soil properties	Hydric	Grid cell	–0.22	<0.001	0.04	<0.001
Soil properties	Hydrologic group A[1]	Grid cell	–0.13	<0.001	0.14	<0.001
Soil properties	Hydrologic group B[2]	Grid cell	0.20	<0.001	–0.04	<0.001
Soil properties	Hydrologic group C[3]	Grid cell	–0.01	<0.001	–0.11	<0.001
Soil properties	Hydrologic group D[4]	Grid cell	–0.20	<0.001	0.00	0.806
Soil properties	Permeability	Grid cell	–0.07	<0.001	0.16	<0.001
Soil properties	Organic material	Grid cell	0.00	0.695	–0.15	<0.001
Soil properties	Clay	Grid cell	–0.02	<0.001	–0.07	<0.001
Soil properties	Silt	Grid cell	–0.13	<0.001	–0.09	<0.001
Soil properties	Sand	Grid cell	0.12	<0.001	0.09	<0.001
Water use and hydroclimatic	Water-resources development index	Basin average	0.04	<0.001	–0.20	<0.001
Water use and hydroclimatic	Groundwater use, irrigated agriculture	Grid cell	0.05	<0.001	–0.11	<0.001
Water use and hydroclimatic	Surface-water use, irrigated agriculture	Grid cell	0.04	<0.001	–0.11	<0.001
Water use and hydroclimatic	Groundwater use, public water supply	Grid cell	0.03	<0.001	–0.06	<0.001
Water use and hydroclimatic	Surface-water use, public water supply	Grid cell	0.03	<0.001	–0.05	<0.001
Water use and hydroclimatic	Recharge, contributing area	Contributing area	0.00	0.938	–0.37	<0.001
Water use and hydroclimatic	Recharge, basin	Basin average	0.02	<0.001	–0.37	<0.001
Water use and hydroclimatic	Potential evapotranspiration	Grid cell	0.23	<0.001	0.13	<0.001
Water use and hydroclimatic	Mean air temperature	Grid cell	0.23	<0.001	0.13	<0.001

[1] Hydrologic Group A—Sand, loamy sand, or sandy loam types of soils. Low runoff potential and high infiltration rates even when thoroughly wetted. Consists chiefly of deep, well to excessively drained sands or gravels and has a high rate of water transmission.

[2] Hydrologic Group B—Silt loam or loam types of soils. Moderate infiltration rate when thoroughly wetted and consists chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.

[3] Hydrologic Group C—Sandy clay loam type of soil. Low infiltration rates when thoroughly wetted and consists chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.

[4] Hydrologic Group D—Clay loam, silty clay loam, sandy clay, silty clay, or clay types of soils. Highest runoff potential and very low infiltration rates when thoroughly wetted. Consists chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material.

- Nitrogen is fixed by natural vegetation, such as legumes in the Sonoran Desert.
- Soils are present that have textures favorable to water infiltration, lack hydric conditions, or lack organic material.
- High water-use from groundwater or surface-water supplies for agricultural purposes or public-water supply.
- Natural recharge is low in the drainage area contributing flow to the groundwater basin.
- Mean air temperatures and potential evapotranspiration are high.
- Bedrock surrounding the basin-fill aquifer has an abundance of crystalline, mafic volcanic, and intermediate composition volcanic rock, which likely produces geochemical conditions favorable to nitrate persistence.

SE ROA 34189

Arsenic

While the training observations indicated arsenic concentrations equal or exceed 10 µg/L in 25 percent of the groundwater samples, use of the prediction classifier to extrapolate concentrations across the SWPA study area (plate 2) revealed 43 percent of the area underlain by basin-fill aquifers is likely to exceed this concentration, whereas 50 percent of the area could have concentrations less than 5.0 µg/L (fig. 4). Such differences in the distributions of observed and predicted arsenic concentrations are expected and result from the fact that the prediction dataset represents the full extent of basin-fill aquifers in the SWPA study area, whereas the training dataset represents a subset of those aquifers where observations were available, and each dataset has somewhat different but overlapping distributions of source and aquifer-susceptibility variables that affect arsenic in groundwater.

The largest area where arsenic concentrations in groundwater were predicted to be equal to or greater than the drinking-water standard of 10 µg/L was in the Basin and Range basin-fill aquifers (fig. 1, plate 2). Spatially, the Basin and Range basin-fill aquifers compose about 73 percent of the regional study area, and much of the area is undeveloped or used as open rangeland. Distribution patterns with depth obtained from the random forest classifiers support the conceptual-model findings indicating that arsenic concentrations can exceed 10 µg/L at various depths within aquifers throughout the SWPA study area (Bexfield and others, 2011).

Within a given basin, predicted concentrations generally increased along groundwater-flow paths from the upper basin margins to the basin lowlands, with greater concentrations associated with basin-fill sediments derived from surrounding mountains predominately composed of volcanic or crystalline bedrock. Basins surrounded by carbonate rocks generally contained groundwater with lower predicted concentrations of arsenic. Although areas developed for agricultural or urban use had lower observed and predicted arsenic concentrations compared to minimally developed areas, this is thought to be largely an artifact of the hydrogeologic nature of the developed areas. Generally, the more developed areas have higher rates of natural recharge because of the availability of water resources and possibly greater flushing rates of solutes out of the basin either to rivers or the ocean. In contrast, basins with lower rates of natural recharge, and likely correspondingly lower flushing rates of solutes, tend to be less developed and generally located in areas with relatively high potential evapotranspiration rates.

A further understanding of conditions that render the basin-fill aquifers in the SWPA study area vulnerable to arsenic enrichment was gained from an analysis of the correlations between the predicted concentrations and the explanatory variables (table 1), as well as correlations between observed arsenic and other constituent concentrations in the training dataset, which are described in detail in Anning and others (2012). These univariate correlations indicated that higher arsenic concentrations are more likely to be found in areas where the following conditions exist:

- Basins are surrounded by mafic volcanic bedrock, felsic/silicic volcanic bedrock, or crystalline bedrock.
- Long groundwater-flow paths.
- There is a general lack of groundwater flushing as indicated by low rates of natural recharge, high potential evapotranspiration rates, and minimal or altogether absent groundwater flow out of the basin.
- Geochemical conditions favor the release of arsenic from aquifer substrates to surrounding groundwater.

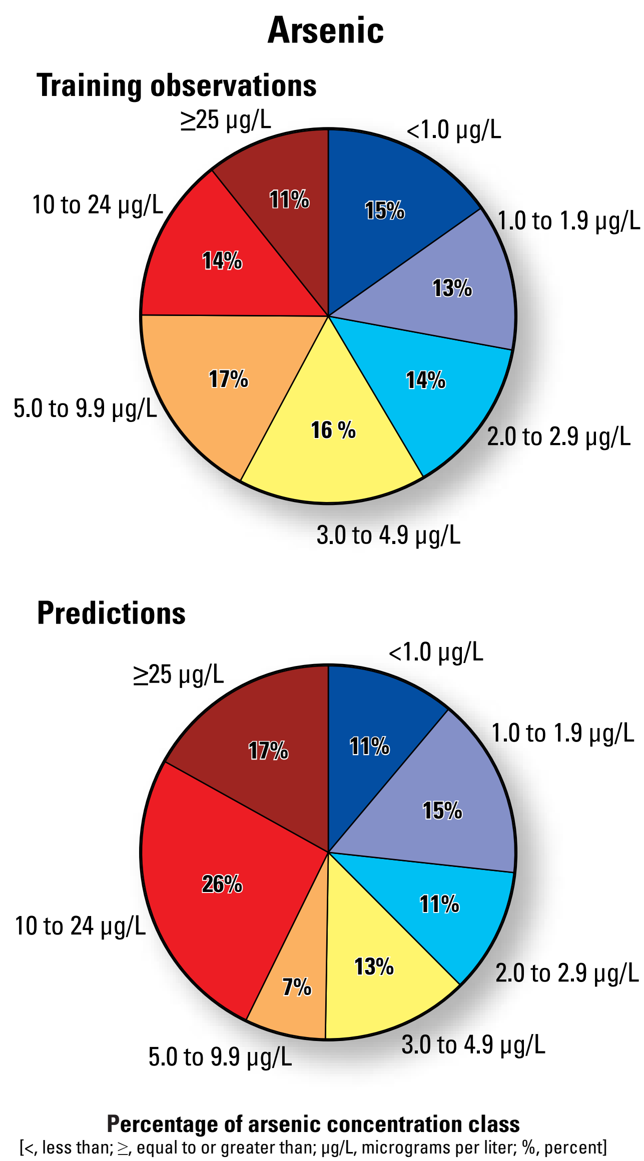

Figure 4. Percentage of arsenic concentration class for training observations and predictions.

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Relevance and Implications

Areas predicted to exceed the nitrate drinking-water standard are generally developed, especially for irrigated agriculture, but are also located in more urbanized locations such as Phoenix, Arizona, and Modesto and suburbs east of Los Angeles, California. While population densities are generally much lower in agricultural areas than in urban areas, high nitrate concentrations underlying agricultural landscapes could be problematic with respect to public supply for large populations if those lands are eventually converted to urban uses. For the areas affected by high nitrate concentrations in agricultural land-use settings, fertilizer and livestock manure are significant sources and are typically mitigated with best management practices. Large tracks of land in the Sonoran Desert with nitrate concentrations between 2.0 and 5.0 mg/L, however, appear to be affected by natural nitrogen fixation by legumes and present a more challenging condition for nitrogen management.

Arsenic in groundwater is derived primarily from natural sources, namely the basin-fill sediments and the parent bedrock from which the sediments were derived. Whereas most of the area predicted to have arsenic concentrations equal to or greater than the current drinking-water standard of 10 µg/L is sparsely populated, major population centers are not necessarily unaffected. Areas within or adjacent to the metropolitan areas of Albuquerque, Bakersfield, Phoenix, Reno, Sacramento, Salt Lake City, and Stockton have measured and predicted arsenic concentrations above the drinking-water standard, which could affect future groundwater development as these cities grow.

As population centers in the west continue to grow, areas that are currently undeveloped are sought for alternative public-water supplies. Currently available groundwater data are generally focused on areas where wells already exist for groundwater development. The statistical model and associated reconnaissance scale maps of predictions (plates 1 and 2) for nitrate and arsenic concentrations are representative of the entire basin-fill groundwater resource available in the Southwest. The maps are based on statistical models that do not include geochemical data, and can help inform future management strategies as well as identify the need for additional locally relevant information in areas of interest.

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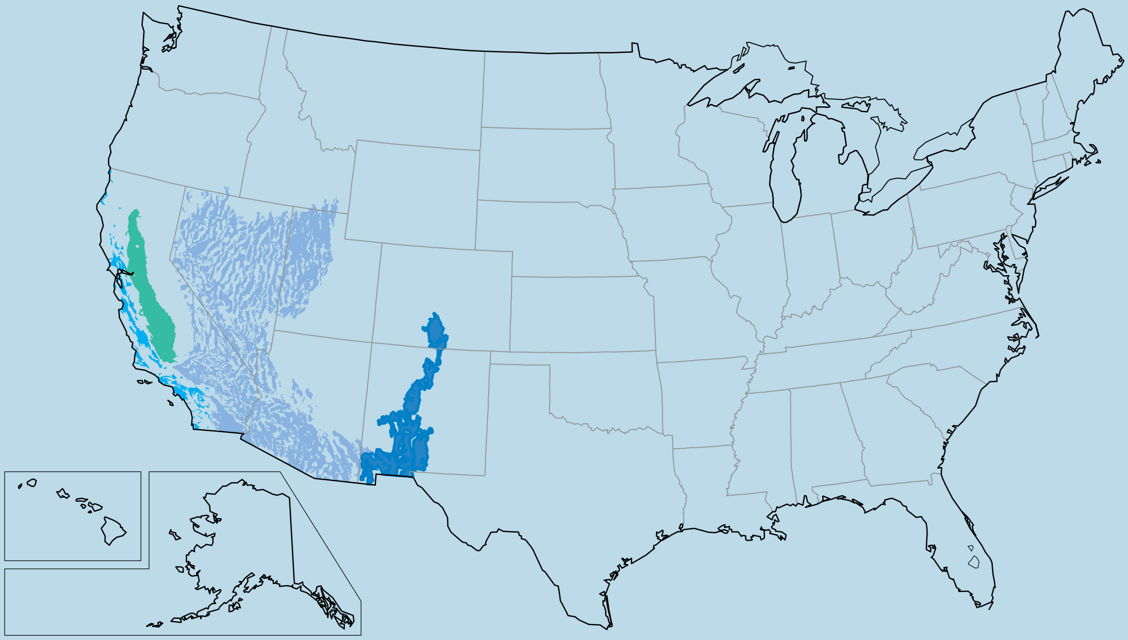
SE ROA 34192

USGS



Southwest Principal Aquifers—Includes (from left to right) California Coastal Basin aquifers, Central Valley aquifer system, Basin and Range basin-fill aquifers, and Rio Grande aquifer system

Beisner and others—**Maps of Estimated Nitrate and Arsenic Concentrations for Basin-Fill Aquifers of the Southwestern United States**—Scientific Investigations Map 3234

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U.S. Geological Survey

Prepared in cooperation with the
Bureau of Land Management

Scientific Investigations Map 3434

Introduction

The U.S. Geological Survey (USGS) and the Bureau of Land Management (BLM) initiated a cooperative study through the Southern Nevada Public Land Management Act (Bureau of Land Management, 1998) to install six wells in the carbonate-rock and basin-fill aquifers of Clark County, Nevada, in areas of sparse groundwater data. This map uses water levels from these new wells, water levels from existing wells, and altitudes of spring discharge points to update a regional potentiometric map of the carbonate-rock aquifer and provide evidence to interpret the direction of regional groundwater flow. This potentiometric surface map is accompanied by drilling and borehole geophysical logs, well-construction information, lithology, water chemistry, and water levels from the newly drilled wells.

Carbonate-Rock Aquifer and Regional Groundwater Flow

The carbonate-rock aquifer in Clark County consists of thick sequences of Paleozoic-age limestone and dolomite with thinner beds of shale, sandstone, and quartzite that are deformed and extended. Mountain blocks of carbonate rock, separated by intermountain basins, thicken westward from the Muddy Mountains toward the Las Vegas and Sheep Ranges (Dettinger and others, 1995; Prudic and others, 1995; Harrill and Prudic, 1998; Heilweil and Brooks, 2011). Groundwater in the aquifer flows through fractures and faults associated with regional deformation and through small-scale brittle fractures.

The aquifer is primarily recharged through fractures in high-precipitation areas that are in high-altitude mountain ranges near groundwater divides. Regional discharge is from springs and riparian areas at low altitudes in major drainage basins. Discharge from springs at the regional scale is generally constant and less transient than from springs discharging from more localized flow systems (Toth, 1963). Active groundwater withdrawals (or pumping) can affect local spring discharge, producing fluctuations not characteristic of discharge from natural regional springs.

Parts of three groundwater flow systems compose the carbonate-rock aquifer in Clark County: (1) the Colorado System, (2) Death Valley System, and (3) Mesquite Valley System (Harrill and others, 1988). In Clark County, groundwater flow in the Colorado System is principally to the southeast, discharging at the headwaters to the Muddy River. Flow in the Death Valley System is principally to the west, discharging to springs in Amargosa Valley and Death Valley (Faunt and others, 2010). Localized flow in the Mesquite Valley System discharges by evapotranspiration from phreatophytes and evaporation on the valley playa (Glancy, 1968).

Groundwater flow directions and gradients are presented on potentiometric maps by Bedinger and Harrill (2010) and Brooks and others (2014). Both studies used available groundwater levels, spring altitudes, and discharge data to classify groundwater and springs as regional or local. Bedinger and Harrill (2010) generalized hydrogeologic and geologic characteristics as proxy data to define regional hydraulic heads, which are described as water levels that are (1) lower than the water table in areas of recharge, (2) above the altitude of intermediate and regional discharge areas, and (3) below the altitude of non-discharging dry playas.

Brooks and others (2014) developed a regional-scale numerical groundwater flow model to evaluate groundwater availability in the Great Basin. The published potentiometric contours, representative of the carbonate-rock aquifer, were based on water-level observations from wells completed in basin fill and carbonate rock. These studies were conducted at a regional scale and included relatively few direct observations from wells in Clark County, which are completed in carbonate rock.

Selected Existing Hydrogeologic Data

Water levels, water chemistry, lithology, and construction data from monitoring wells were compiled from the USGS National Water Information System (NWIS) database (U.S. Geological Survey, 2016) and from Thomas and others (1996), and compared to information obtained from the six new wells. Sites near production wells were excluded from this selection because of the potential for pumping related drawdown to affect water levels, and monitoring wells were excluded if screened across multiple intervals. Wells were selected if they were screened in the carbonate-rock aquifer or in the basin-fill aquifer at depths greater than 500 feet. It is assumed that basin-fill wells at this depth are in hydraulic connection with the carbonate-rock aquifer (Prudic and others, 1995). In Clark County, 24 wells completed in carbonate rock, 28 wells completed in deep basin-fill deposits, and 5 springs were selected from the USGS NWIS database (table 1) and included in this report.

Table 1. Existing monitoring wells representative of the carbonate-rock and basin-fill aquifers in Clark County, Nevada.

[ID, identifier; USGS, U.S. Geological Survey; NWIS, National Water Information System; mm/dd/yyyy, month/day/year; NGVD 29, National Geodetic Vertical Datum of 1929; CR, carbonate rock; BF, basin fill; —, no data]

Map ID	USGS site ID	USGS NWIS site name	Site type	Well depth (feet)	Hole depth (feet)	Contributing aquifer	Date of water-level measurement (mm/dd/yyyy)	Water level, in feet below land surface	Water-level altitude, in feet above mean sea level (NGVD 29)
1	361816115241301	212 S19 E59 18AAC 1	Well	542	542	CR	09/01/1964	417.00	3,484
2	363500115400001	161 S16 E56 16 1 Indian Springs Sewage Co	Well	550	590	CR	06/01/1963	54.00	3,146
3	362846114495501	216 S17 E64 09DDCD1 CRYSTAL 2	Well	565	565	CR	08/21/2000	254.94	1,815
4	364741114532801	210 S13 E63 26AAAA1 USGS-MX CE-DT-5	Well	628	628	CR	08/13/1999	349.81	1,820
5	360016115361501	163 S22 E57 29DABC1 USBLM NDOT 01	Well	660	660	CR	09/07/2010	306.15	3,917
6	364743114533101	210 S13 E63 23DDDC1 USGS-MX CE-DT-4	Well	669	669	CR	10/15/2015	356.27	1,819
7	363212115240301	212 S16 E58 23DDD 1 USFWS SBH-1	Well	720	720	CR	05/28/2015	575.20	2,891
8	362531114524201	216 S18 E64 07BB 1 WELL (REPORT R50)	Well	793	793	CR	11/29/1956	226.40	1,819
9	355829115150601	212 S23 E60 03DBCB1 TORTOISE CENTER	Well	800	800	CR	03/19/1990	555.00	2,150
10	361736114531601	215 S19 E63 13DCAA1 EBM-3	Well	900	1,241	CR	02/20/2004	578.73	1,810
11	363308114553001	217 S16 E63 09DDAB1 USBLM SHV-1	Well	920	920	CR	10/01/2015	833.69	1,815
12	363332115244001	212 S16 E58 14A 1 USFWS DR-1	Well	930	960	CR	05/28/2015	813.40	2,760
13	364604114471301	219 S13 E64 35DCAD1 USGS-MX CE-DT-6	Well	937	937	CR	11/01/2002	456.00	1,819
14	364830115512601	160 S13 E55 19 1 TW- 3	Well	1,127	1,860	CR	08/25/2015	1,103.00	2,381
15	363407115215301	212 S16 E59 08 2 USGS - Cow Camp	Well	1,403	1,403	CR	07/29/2015	1,330.30	2,856
16	362507114572701	216 S18 E63 05AADB1	Well	1,979	2,007	CR	03/01/2002	755.00	1,811
17	360946115421401	162 S20 E56 33CCAA1 TROUT CANYON 01	Well	718.5	720	CR	01/05/2015	467.30	4,794
18	364451114585001	210 S14 E62 01ADBD1 CSVM-5	Well	1,780	1,783	CR	09/20/2011	1,081.20	2,048
19	362700114564401	216 S17 E63 21DCCC1 HV-1	Well	2,480	2,480	CR	06/20/2000	882.00	1,820
20	361811115404401	212 S19 E56 15ABBD1	Well	660	660	CR	01/26/1981	214.40	8,500
21	364738114534001	210 S13 E63 26AABD1 CSV-RW-2	Well	710	720	CR	09/14/2011	383.40	1,819
22	364728114531001	210 S13 E63 25BDBB1 CSVM-1	Well	1,040	1,060	CR	09/21/2011	341.90	1,819
23	364529114492401	219 S13HE64 33DBBC1 UMVM-1	Well	1,200	1,200	CR	04/22/2003	247.00	1,831
24	363943114552301	210 S15 E63 03BBCC1 CSVM-2	Well	1,400	1,425	CR	09/20/2011	750.70	1,822
25	360201115204701	212 S22 E59 15DAAB1	Well	532	532	BF	03/14/1990	267.21	2,823
26	363201115333801	211 S16 E57 28B 1 Hwy95 Cons 1	Well	550	550	BF	04/22/1963	98.00	3,083
27	360247115224401	212 S22 E59 09CBDB1 HUMANE	Well	570	570	BF	01/21/2009	354.80	2,898
28	363452115405101	161 S16 E56 08BAAC1 USAF Well 3	Well	600	600	BF	07/29/2015	68.00	3,062
29	363447115404601	161 S16 E56 08BAAD1 USAF Well 106-2	Well	604	604	BF	07/29/2015	63.15	3,067
30	363255115515801	161 S16 E54 24BCBA1 Army 2	Well	627	658	BF	08/17/2015	495.20	3,318
31	355015115102601	166 S24 E61 20DDAC1 HIDDEN VALLEY	Well	640	640	BF	12/03/1956	605.00	2,423
32	354454115205401	164A S25 E59 27AACA1 JAIRPORT	Well	650	650	BF	12/11/2008	280.90	2,499
33	361136115101401	212 S23 E61 03BCC 1 Sky Harbor Airport	Well	650	650	BF	04/18/2011	215.36	2,160
34	360941115104801	212 S20 E61 32CDC 1	Well	665	665	BF	04/18/2011	18.47	2,077
35	355923115174201	212 S22 E60 32CB 1	Well	700	700	BF	08/06/1979	460.00	2,420
36	360826115020001	212 S21 E62 10ACAA1 Nevada Power Company	Well	715	715	BF	04/20/2011	21.94	1,683
37	364601114514301	210 S13 E64 31DADA1 USGS CSV-1	Well	765	765	BF	07/31/2009	346.91	1,813
38	361939115154801	212 S19 E60 04DAB 2 NV Division of Forestry	Well	780	780	BF	04/21/2011	77.51	2,376
39	364127114553001	210 S14 E63 28AACD1 USGS CSV-3	Well	780	780	BF	09/20/2011	594.00	1,820
40	355947115163501	212 S22 E60 33BB 1	Well	785	785	BF	12/10/1976	585.00	2,120
41	360931115083802	212 S21 E61 03ABB 2	Well	807	807	BF	04/18/2011	9.08	2,005
42	361843115161001	212 S19 E60 09BCC 1	Well	830	830	BF	04/28/2011	155.76	2,354
43	361233115021501	212 S20 E62 15BBAB1 USAF Nellis 12 (C)	Well	1,000	1,000	BF	04/27/2011	124.71	1,691
44	361346115115901	212 S20 E61 06CBDD1 CNLV Desert Aire	Well	1,000	1,000	BF	04/27/2011	60.72	2,150
45	361400115040901	212 S20 E62 05CAAA1 CNLV Wilshire	Well	1,000	1,000	BF	10/01/2015	62.56	1,806
46	361303115140301	212 S20 E60 11CAAA1 LVVWD W028	Well	1,003	1,003	BF	01/18/2007	202.05	2,085
47	361232115061001	212 S20 E61 13ABDB1 CNLV Diana Terrace	Well	1,230	1,230	BF	10/01/2015	11.83	1,845
48	361626115090701	212 S19 E61 21DDB 1 CNLV Regional Park 1	Well	1,300	1,300	BF	09/01/2015	40.72	2,119
49	360809115252601	212 S21 E58 12DDDD1 RED ROCK WASH	Well	503	503	BF	11/07/2008	400.54	3,288
50	364014114315301	220 S14 E67 31DACD1	Well	387	620	BF	03/19/1987	116.00	1,574
51	364912114041201	222 S13 E71 09BDCA1 PS27	Well	1,450	1,493	BF	07/08/1994	84.00	1,573
52	364044114165201	222 S14 E69 33ABC 1 D & HA	Well	880	880	BF	03/10/1985	37.26	1,341
53	362239114263501	215 S18 E67 12DDAD1 ROGERS SPRING	Spring	—	—	CR	—	—	1,576
54	362321114252601	215 S18 E68 07ABBA1 BLUE POINT SPRING	Spring	—	—	CR	—	—	1,562
55	09419625	CORN CK SPGS AT NATIONAL FISH & WILDLIFE HDQRS, NV	Spring	—	—	CR	—	—	2,930
56	09415910	PEDERSON SPGS NR MOAPA, NV	Spring	—	—	CR	—	—	1,811
57	362450115442001	161 S18 E55 01DACC1 COLD CREEK SPRING	Spring	—	—	CR	—	—	6,324

Drilling, Borehole Geophysical Logs, Lithology, and Well Construction

Groundwater monitoring wells were installed at six locations in Clark County. Criteria for selecting drill sites included (1) the carbonate-rock aquifer was relatively close to the surface, (2) there were no nearby groundwater withdrawals, and (3) access for drilling equipment was possible on existing roads.

Drilling techniques were dependent upon borehole advancement rate and lithology. Mud rotary drilling was predominantly used when drilling through unconsolidated material consisting mostly of sand, gravel, and cobbles. At all sites, the drill penetration rate through unconsolidated material was relatively consistent and progressed rapidly with this technique. When penetration rate slowed in denser rock units, air-hammer drilling was used. A change in drilling method allowed for consistent downward progress and limited drill time and cost.

Spontaneous potential (SP), natural gamma, caliper, and resistivity (borehole, 16- and 64-inch normal) wireline geophysical logs were obtained at each newly drilled borehole. The SP logs measure the voltage between the borehole and an electrode at the surface and are used to identify permeability changes and boundaries between formations at depth. Natural gamma logs show formation radiation intensity, which is generally higher for clay-rich rocks and sediments that tend to emit elevated levels of radiation from natural decay of uranium and thorium to potassium-40. Caliper logs measure borehole diameter and can indicate the presence of fractures along the borehole wall. Resistivity logs record the electrical resistivity of the formation and can indicate higher-porosity transmissive zones. These logs are used together to provide information on the subsurface geology.

Drill cuttings (chips of broken geologic material brought to the surface by drilling fluids) were washed and analyzed. These cuttings, borehole geophysical data, and observations made during drilling provide an indication of the subsurface geologic characteristics at each new drill site. Borehole geophysical logs, drill penetration rate, and subsurface lithology are presented with the study area map.

Wells were constructed of steel or polyvinyl chloride (PVC) well casing ranging from 4.5 to 6.625 inches in diameter. Vertically slotted screens were installed in water-bearing zones interpreted from borehole geophysics. A summary of well-construction information for each of the newly drilled wells is shown in table 2.

Table 2. Summary of well construction information for newly drilled wells in Clark County, Nevada.

[USGS, U.S. Geological Survey; NWIS, National Water Information System; ID, identifier; NDWR, Nevada Division of Water Resources; OD, outside dimension; DCR, depth to consolidated rock; WP, water production; gpm, amount of water pumped from well in gallons per minute; SCH, schedule; PVC, polyvinyl chloride; CR, carbonate rock; BF, basin fill; MR, mud rotary; AH, air hammer; >, greater than; —, no data; NA, not applicable]

Well name	USGS NWIS site ID	Map ID	NDWR log ID	Hole depth (feet)	Well depth (feet)	Diameter of casing (OD), in inches	Screened interval depth: From (feet)	Screened interval depth: To (feet)	Casing material	DCR (feet)	Aquifer completion	Drilling method	Well test data: WP (gpm)	Well test data: Time (hours)
BW-01	364204114454501	A	109838	1,928	1,926	4.500	1,786	1,926	SCH 80 PVC	595	CR	MR/AH	3 to 5	24
LSC-01	362454115270201	B	112697	905	890	6.625	336 808	417 889	SCH 40 steel	65	CR	MR	150	6
	(nested)		—	—	210	2.250	190	210	SCH 80 PVC	—	BF	MR	0 (dry)	0 (dry)
RB-01	362135114285401	C	113526	975	973	6.000	810	952	SCH 40 steel	755	CR	MR/AH	>150	3
BUFPKTS-01	362352114414501	D	114409	1,200	1,198	4.500	988	1,198	SCH 40 steel	221	CR	MR	20	10
IVPH-01	354849115225001	E	115275	1,295	1,290	4.500	1,065	1,275	SCH 40 steel	38	CR	MR/AH	30	10
JM-01	362901115220001	F	121811	1,103	1,080	4.500	200 780	300 1,080	SCH 40 steel SCH 40 steel	NA	BF	MR	50 to 75	50

Table 3. Total dissolved solids and concentrations of major ions in water samples collected from new wells in Clark County, Nevada.

[mm/dd/yyyy, month/day/year; mg/L, milligrams per liter; <, less than; CR, carbonate rock; BF, basin fill]

Well name	Date (mm/dd/yyyy)	Total dissolved solids (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Carbonate (mg/L)	Bicarbonate (mg/L)	Principal contributing aquifer
BW-01	04/30/2010	616	60.8	24.4	101	11.0	56.3	195	< 1.0	264	CR
LSC-01	06/14/2012	249	45.1	28.2	5.0	1.46	2.90	21.4	< 1.0	246	CR
RB-01	04/09/2014	2,980	399	135	272	18.5	312	1,570	< 1.0	145	CR
BUFPKTS-01	04/10/2014	234	7.6	4.8	72.4	5.68	17.9	20.6	8.4	166	CR
IVPH-01	04/11/2014	499	67.1	38.2	53.9	3.33	105	86.4	< 1.0	210	CR
JM-01	03/14/2013	283	35.7	28.5	33.4	1.82	5.85	19.0	< 1.0	299	BF

Water Chemistry

Water-quality samples for major-ion chemistry and the stable isotopes of water (deuterium, δ^2H, and oxygen, $\delta^{18}O$) were collected at each new well site, and results of analysis were compared to existing values from springs and wells near the drill sites. Total dissolved solids (TDS) and concentrations of calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), chloride (Cl), sulfate (SO_4), carbonate (CO_3), and bicarbonate (HCO_3) were measured by the USGS National Water Quality Laboratory (NWQL), in Denver, Colorado (table 3). Deuterium (δ^2H) and oxygen ($\delta^{18}O$) isotopes were analyzed by the USGS Radiogenic Isotope Facility in Denver, Colorado (table 4).

Standard three-well-casing volumes were purged from each well, and water samples were collected with a submersible pump except at two sites (wells IVPH–01 and BUFPKTS–01) where samples were obtained through bailing. A 20-foot-long bailer was used to purge water from the well and collect a representative water sample.

Table 4. Isotopic ratios of deuterium (δ^2H) and oxygen ($\delta^{18}O$) in water samples collected from new wells drilled in Clark County, Nevada.

[δ^2H, deuterium (^2H) to protium (^1H) isotopic ratio relative to VSMOW; $\delta^{18}O$, oxygen-18 to oxygen-16 isotopic ratio relative to VSMOW; VSMOW, Vienna Standard Mean Ocean Water; ‰, per mil (parts per thousand)]

Well name	δ^2H (‰)	$\delta^{18}O$ (‰)
BW-01	–97.49	–12.89
LSC-01	–103.00	–13.98
RB-01	–91.70	–12.38
BUFPKTS-01	–82.50	–11.26
IVPH-01	–92.30	–12.71
JM-01	–95.67	–13.01

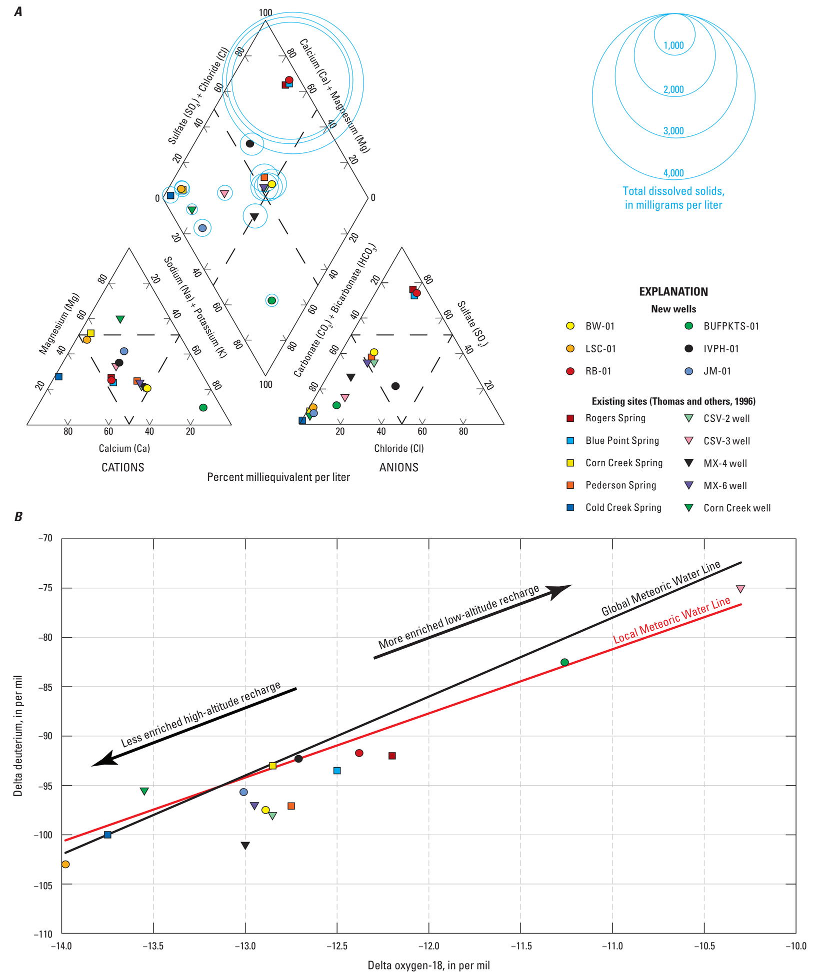

Figure 1. *A*, Total dissolved solids and major-ion concentrations in water samples collected from wells and springs associated with regional groundwater flow, and *B*, isotopic ratios of delta deuterium (δ^2H) and delta oxygen-18 ($\delta^{18}O$) in samples collected from new and reference wells and springs in Clark County, Nevada (Global Meteoric Water Line [$\delta^2H = 8\times\delta^{18}O + 10$; Craig, 1961], and Local Meteoric Water Line [$\delta^2H = 6.5\times\delta^{18}O - 9.7$; Friedman and others, 1992]).

Major-ion chemistry is important to an understanding of the migration of water through a groundwater flow system. A Piper diagram (fig. 1*A*) can be used to evaluate the chemical characteristics of groundwater and the effects of chemical processes occurring between minerals and water. Groundwater samples from newly drilled wells show similar major-ion chemistry to previously sampled wells and springs (Thomas and others, 1996) that are assumed to represent groundwater from the regional carbonate-rock aquifer.

Isotopic ratios of δ^2H and $\delta^{18}O$ in water samples collected from wells drilled for this study and in samples previously collected from wells and springs, are compared to the Global Meteoric Water Line (GMWL) and a Local Meteoric Water Line (LMWL) on figure 1*B*. This plot provides a comparison of recharge from low-altitude and high-altitude precipitation sources to waters from previously published data (Thomas and others, 1996).

Water-Level Information

Water levels from newly drilled wells were measured periodically from 2009 to 2015 and stored in the USGS NWIS database (https://waterdata.usgs.gov/nwis). These data were quality assured, which included evaluating measurements for temporal irregularity and adjustments due to known borehole deviation. Water levels were relatively stable throughout the duration of this project except for well BW-01, which experienced a decline of approximately 3 feet from January 2010 to May 2013, and a subsequent recovery of approximately 1 foot from June 2013 to June 2014.

Variations in borehole direction during drilling (drift) are common and can require corrections to water-level measurements. Borehole drift was monitored, and deviation was measured where drift was detected during the drilling of all new wells. The borehole at well BUFPKTS–01 was the only site that needed correction because borehole drift occurred above the depth of the static water level. The water level for this well was corrected using the equation from Elliott and Fenelon (2010):

$$V_d = \left(M_d - M_{top}\right)\times\left(\frac{\Delta V_{int}}{\Delta M_{int}}\right) + V_{top} \qquad (1)$$

$$V_d = M_d \times 0.993 - 3.45 \qquad (2)$$

where

- V_d is the corrected vertical depth,
- M_d is the measured depth,
- M_{top} is the measured depth to the top of the correction interval,
- ΔV_{int} is the difference in the true vertical depth between the top and bottom of the correction interval,
- ΔM_{int} is the difference in the measured top and bottom of the correction interval, and
- V_{top} is the corrected vertical depth to the top of the interval over which the correction applies.

Regional Potentiometric Surface

Groundwater levels from the six wells drilled for this project and wells fitting the criteria described in the section "Selected Existing Hydrogeologic Data," were compiled and used to construct a groundwater-level map representing the regional potentiometric surface of the upper carbonate-rock aquifer in Clark County, Nevada, in 2009–2015. Data used to construct the potentiometric surface are published separately as a USGS data release (Wilson, 2019). This map is similar to the regional potentiometric surface shown on previous maps by Bedinger and Harrill (2010) and Brooks and others (2014). In general, the potentiometric surface on this map follows the overlying land-surface topography. Higher topographic altitudes typically have higher groundwater altitudes, hydraulic gradients generally are steep near mountain ranges and low (flatten) in basins, and water-level contours parallel and intersect surface-water features.

Area on map	Description
A	In the Las Vegas and Sheep Ranges, and the Spring Mountains, mountain block recharge contributes to and directs regional groundwater flow in Clark County.
B	Water-level contours generally indicate groundwater flow to the east, terminating at discharge points along the Las Vegas Wash in Las Vegas Valley, and the Muddy River near Moapa Valley.
C	A low water-level gradient near Moapa Valley indicates slow groundwater movement toward the Muddy River and Lake Mead.
D	A low water-level gradient in northeast Clark County indicates that groundwater in this area flows toward the Virgin River.

Summary and Conclusions

During 2009 and 2015, the U.S. Geological Survey in cooperation with the Bureau of Land Management installed six new wells in Clark County, Nevada. The wells were installed to address the spatial gaps of wells completed in the carbonate-rock aquifer. This map describes new and existing water-level and hydrologic data used to (1) develop a potentiometric map, and (2) provide additional supporting evidence for the direction of regional groundwater flow in the upper carbonate-rock aquifer in Clark County. Results from this study indicate that the Spring Mountains and the Las Vegas and Sheep Ranges provide primary recharge to the groundwater system in western Clark County. Additionally, potentiometric contours indicate eastward groundwater flow in much of Clark County that terminates at springs along Las Vegas Wash, the Muddy River, and the Virgin River. Previous maps by Bedinger and Harrill (2010) and Brooks and others (2014) show similar water-surface altitudes and gradients. This study introduces new water-level measurement sites that cover data gaps and support previous regional water-surface interpretations. Additionally, comparison of lithologic descriptions, geophysical logs, and groundwater chemistry from the six wells drilled during this study to existing data, substantiates that water levels in the new wells represent the regional carbonate-rock aquifer.

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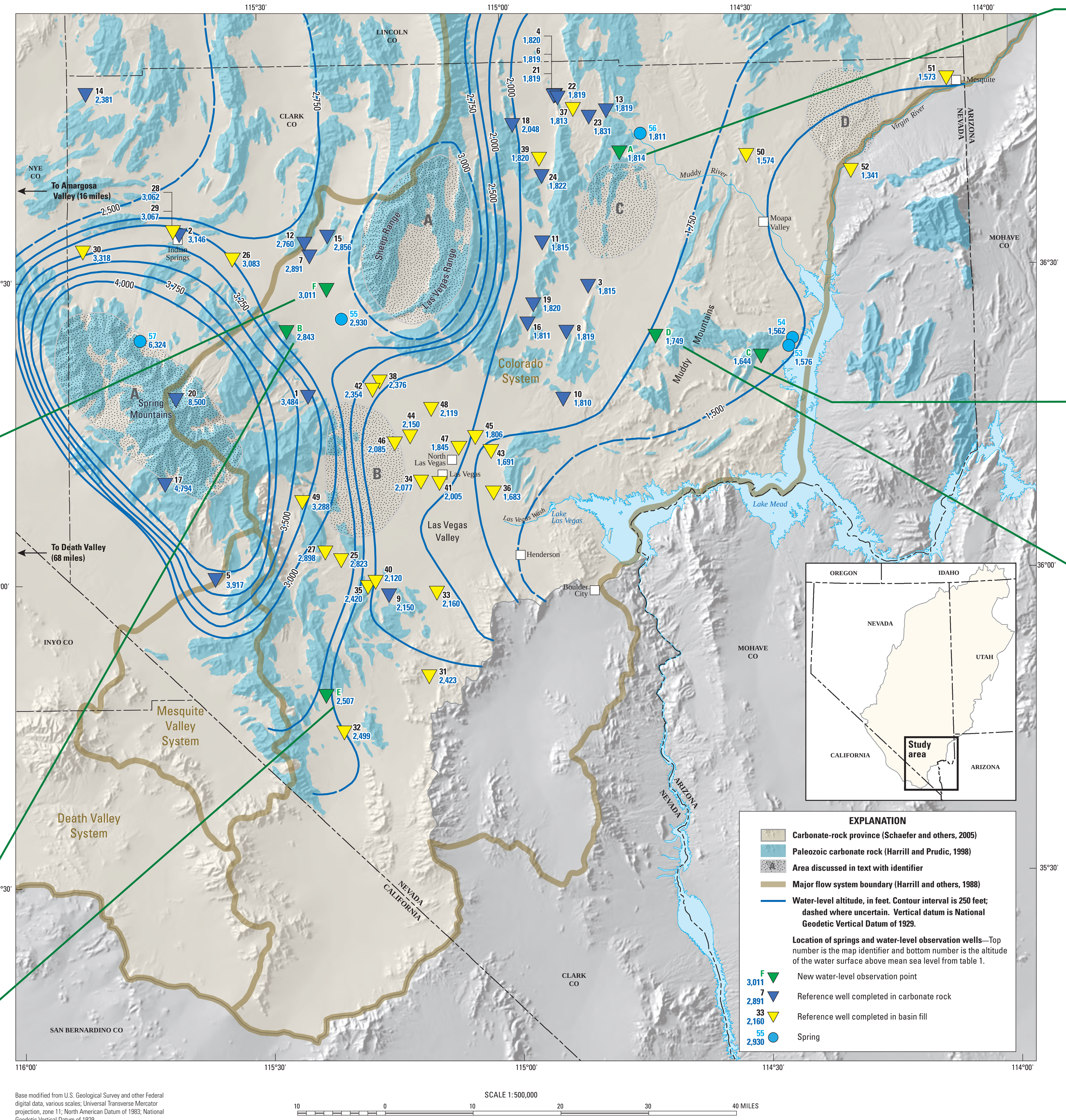

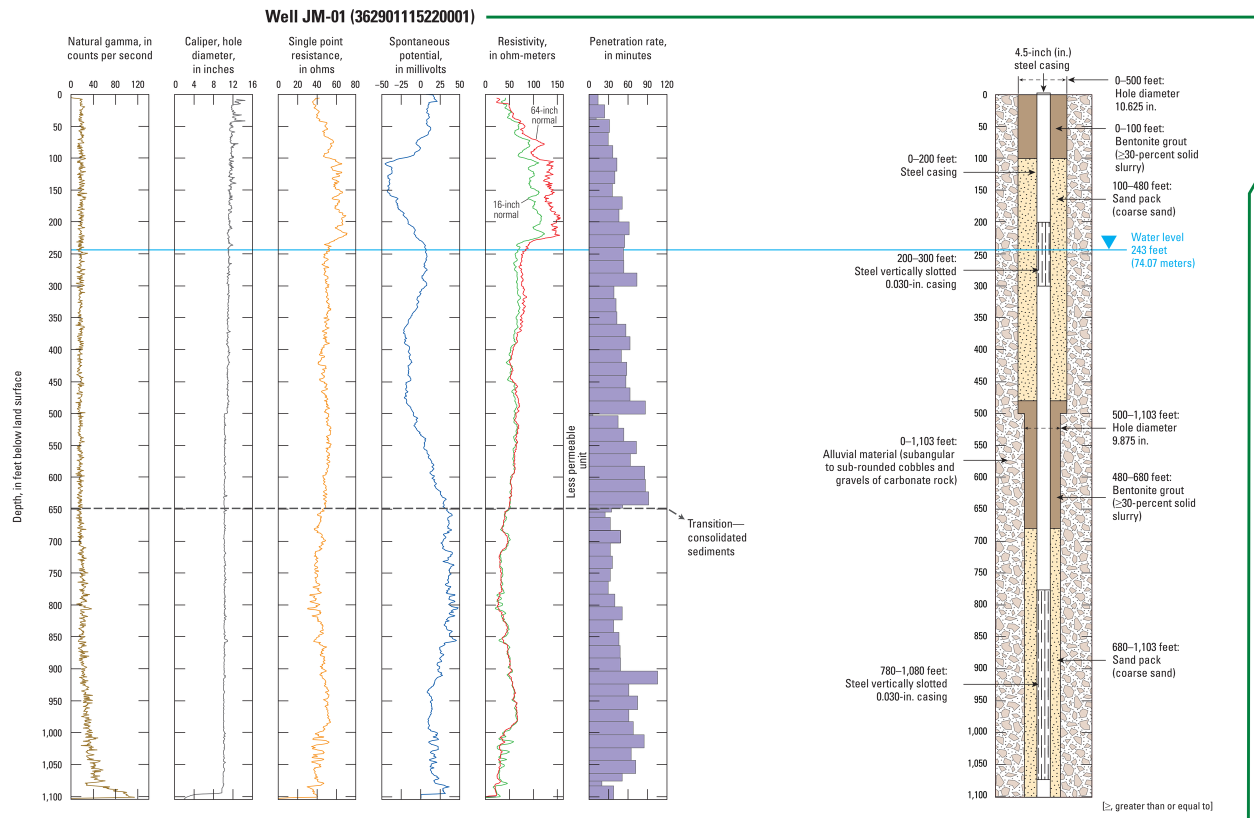

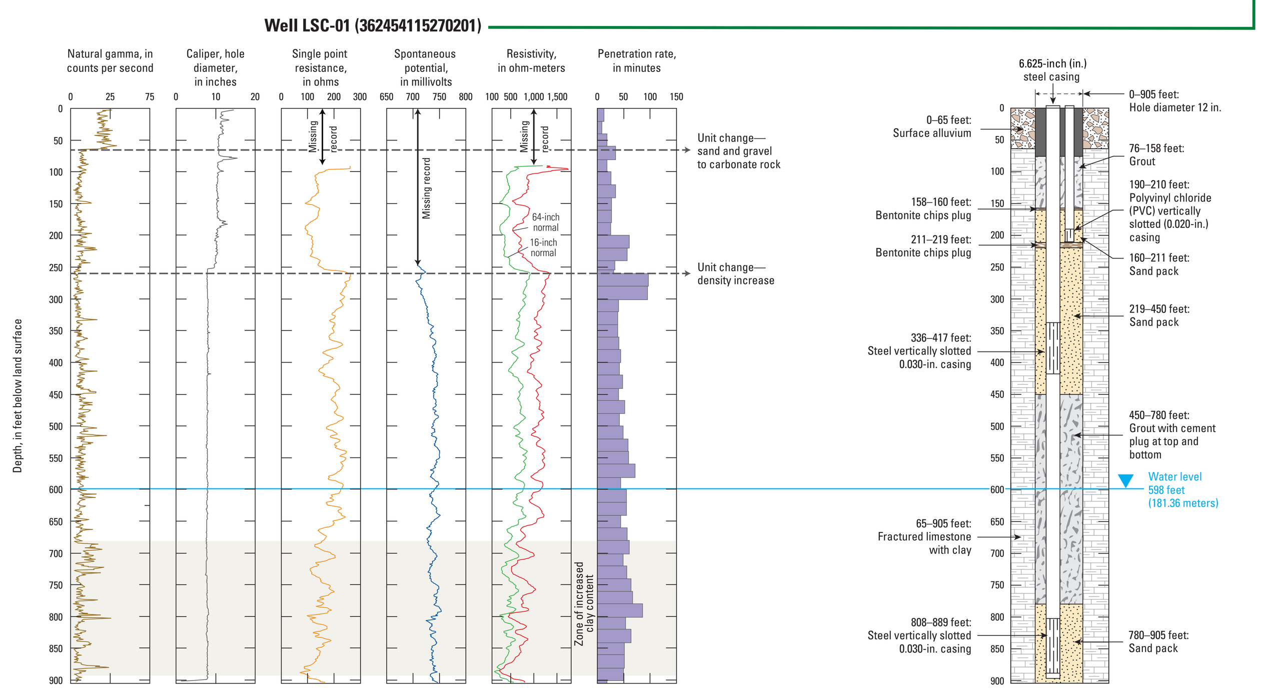

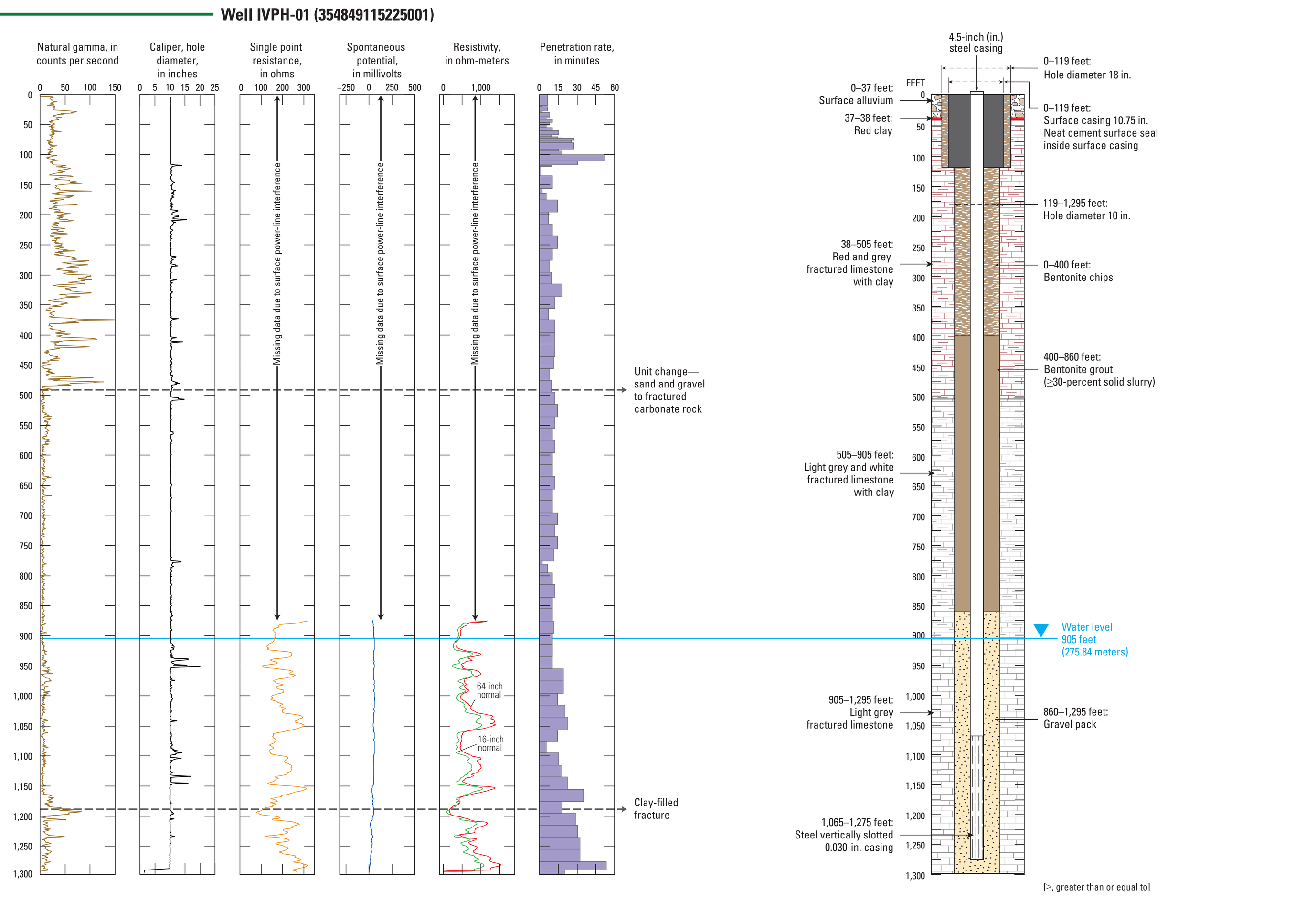

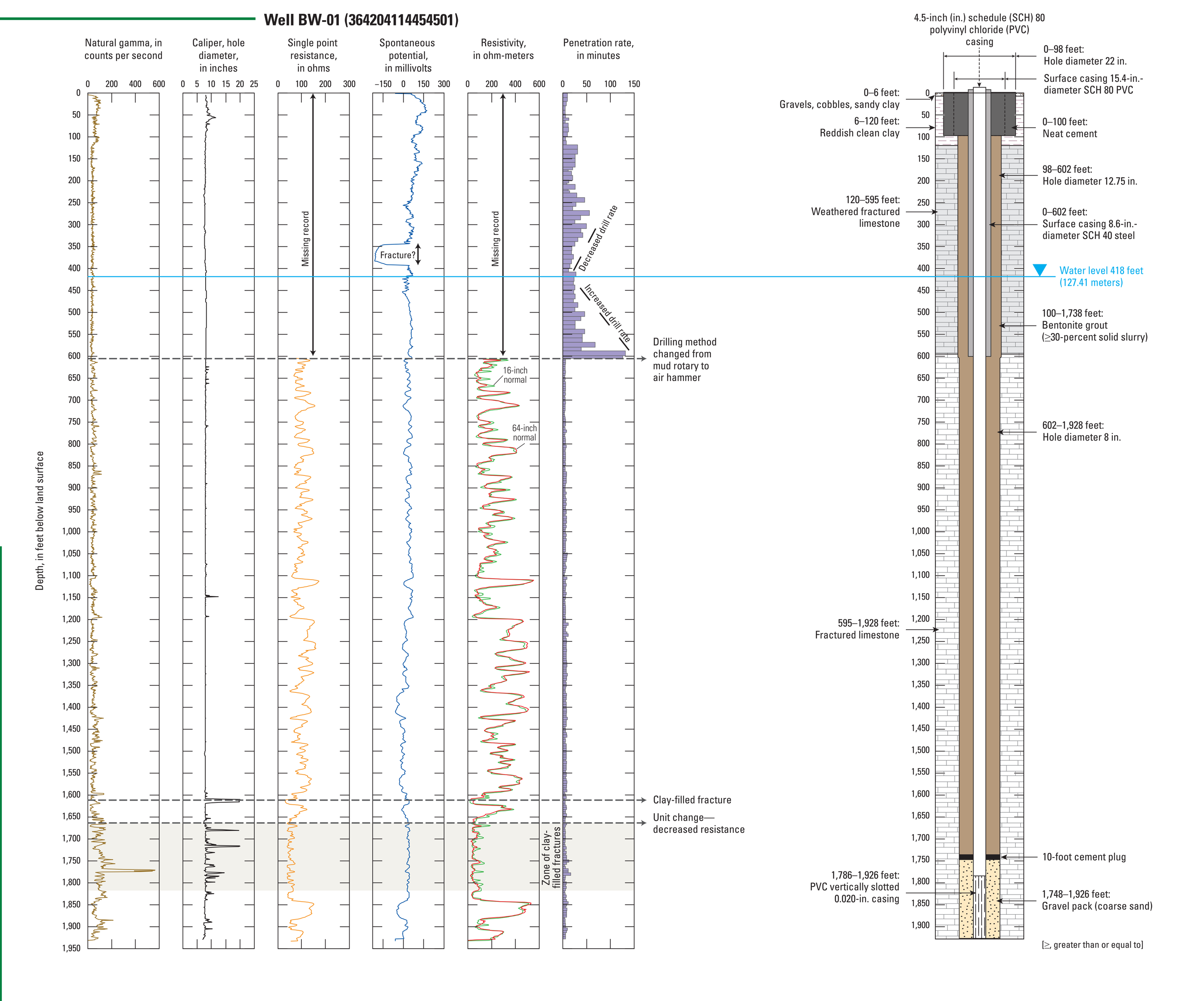

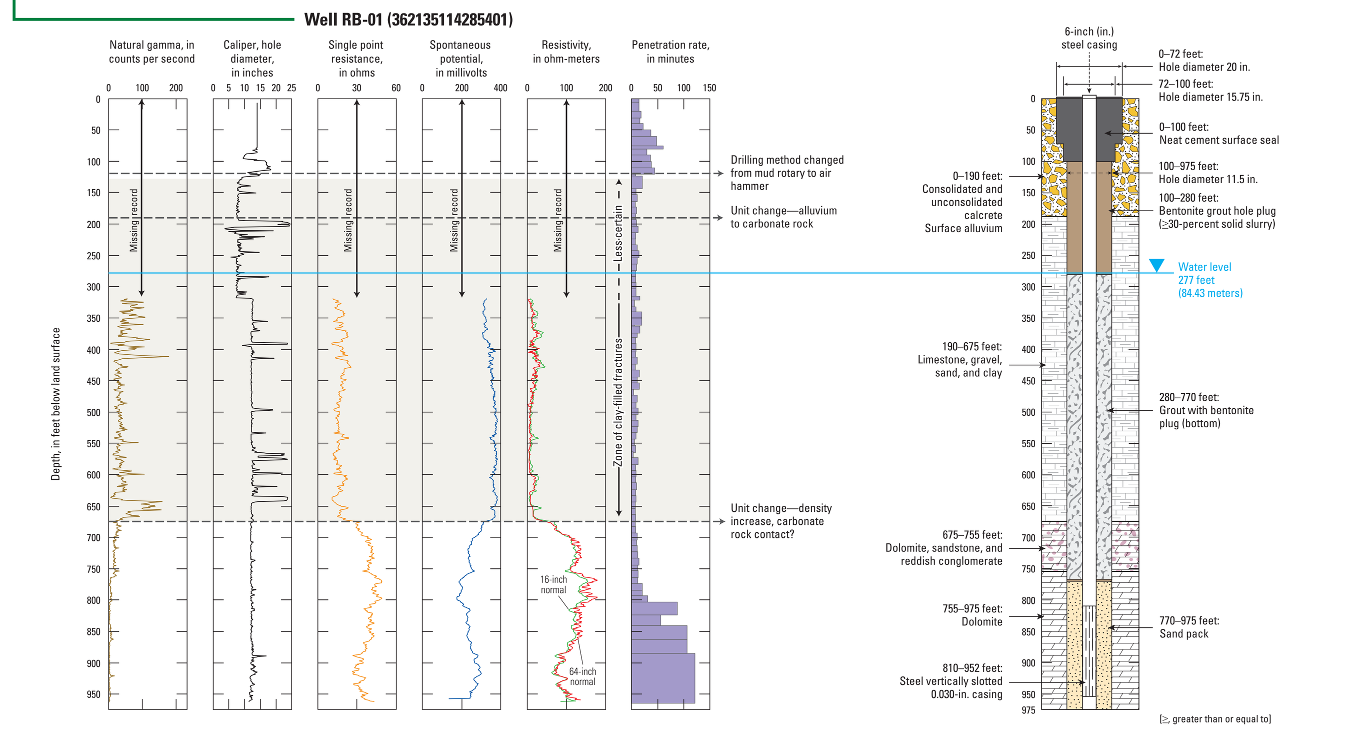

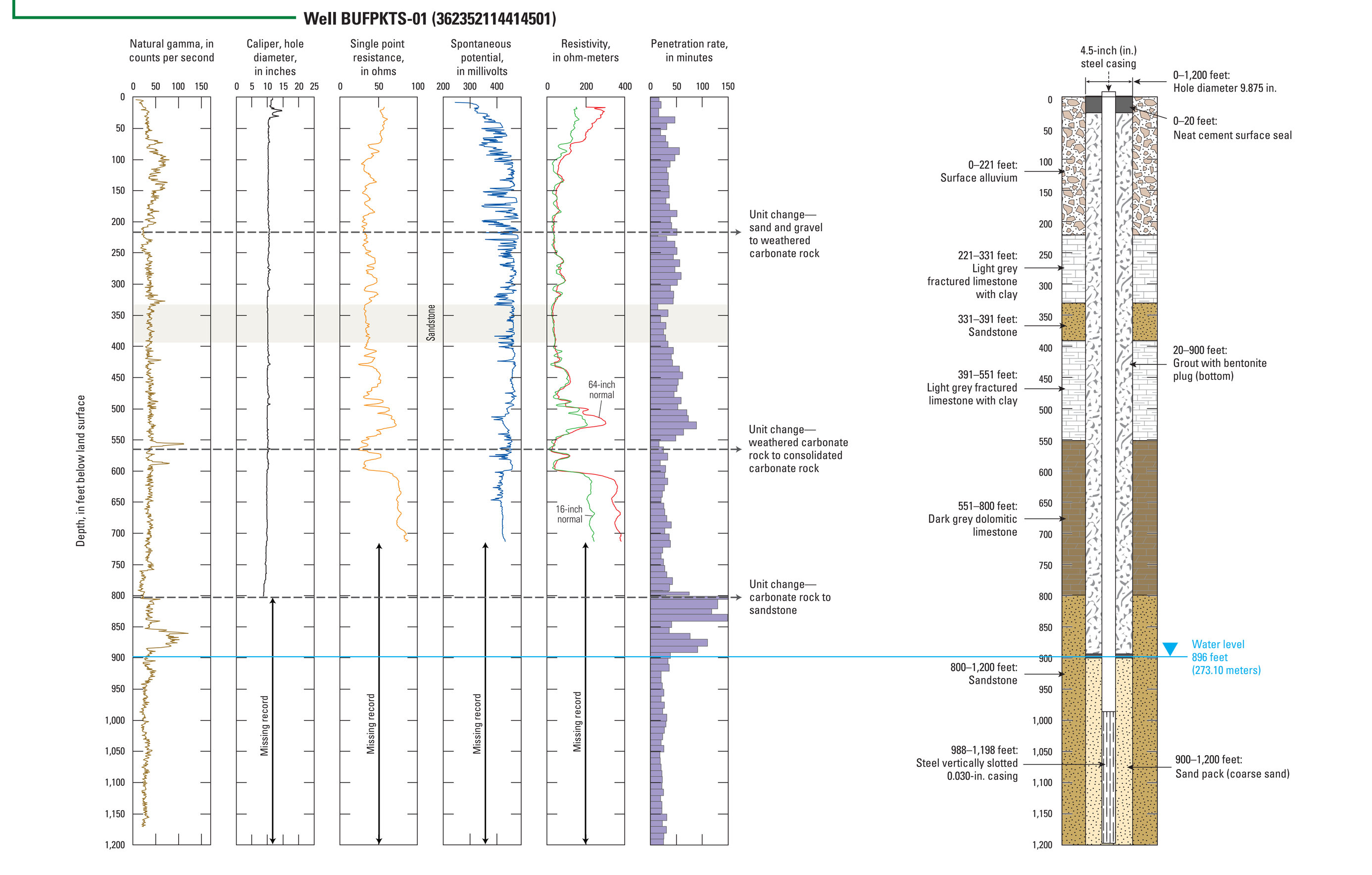

Drilling, Construction, Water Chemistry, Water Levels, and Regional Potentiometric Surface of the Upper Carbonate-Rock Aquifer in Clark County, Nevada, 2009–2015

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