Chapter 4. Affected Environment

Kings Pool at Ash Meadows National Wildlife Refuge

Chapter 4. Affected Environment

This chapter provides a description of the affected environment for the four refuges in the Desert National Wildlife Refuge Complex (Desert Complex) in terms of the physical, biological, cultural, and socioeconomic environments. Section 4.1 provides a regional overview of the environment focusing on southern Nevada. Sections 4.2 through 4.6 provide descriptions of each refuge in the Desert Complex: Ash Meadows National Wildlife Refuge (NWR), Desert NWR, Moapa Valley NWR, and Pahranagat NWR.

4.1 Regional Overview

4.1.1 Physical Environment

Physiography and Climate

The Desert Complex is located in southern Nevada in the southern part of the Great Basin and northern extent of the Mojave Desert in the Basin and Range Province (Figure 4.1-1). The Desert Complex region is bordered by the southern Sierra Nevada Mountains on the west, the Great Basin Desert to the north, the Colorado River to the east, and the San Bernardino Mountains and the Sonoran Desert to the south. The Sierra Nevada Mountains form a massive mountain barrier that markedly influences the climate of the state.

The region is characterized by generally north-trending, linear mountain ranges separated by intervening valleys. The Ash Meadows, Pahranagat, and Moapa Valley NWRs are located within valleys, whereas the Desert NWR consists of both mountain ranges and valleys (Figure 4.1-2).

In the United States, one of the greatest contrasts in precipitation found within a short distance occurs between the western slopes of the Sierra Nevada in California and the valleys just to the east in Nevada. As the warm, moist air from the Pacific Ocean ascends the western slopes of the Sierra Nevada Range, the air cools, condenses, and then falls as precipitation. In contrast, as the air descends the eastern slope of the range, it is warmed by compression and as a result, very little precipitation occurs in the region. The effect of the Sierra Nevada Mountains as a barrier to cooler temperatures and moisture is felt throughout the state, resulting in the desert environment found throughout the lower elevations in Nevada.

Precipitation in Nevada is lightest over the southern portion of the state where the Desert Complex is located. In valleys, the average annual precipitation is less than 5 inches. Average precipitation on the refuges in the Desert Complex range from 4.4 to 6.4 inches in valleys (Western Regional Climate Center [WRCC] 2003). Precipitation in the form of snow also occurs during the cooler months on some of the mountain ranges surrounding the refuges and on the Desert NWR, most commonly at higher elevations of the Sheep Range.

The region is subject to high-intensity storms that can generate high peak surface flows during the late winter and summer months. Runoff from precipitation is practically non-existent during the rest of the year.

In southern Nevada, the summers are long and hot and the winters are short and mild. Long periods of extremely cold weather are rare. The Desert Complex is characterized by strong surface heating during the day and rapid nighttime cooling, which results in wide ranges of daily temperature. The average range between the highest and the lowest daily temperatures is about 30 to 35 degrees Fahrenheit (°F), with more extreme daily temperature ranges occurring in the summer (WRCC 2003). Summer temperatures above 100°F occur frequently in the south and occasionally over the rest of the state. A climatic summary for the Desert Complex is shown in Table 4.1-1.

Table 4.1-1. Climatic Summary for the Desert Complex

Refuge	*Average Temperature (°F)*		*Average Precipitation (inches)*	*Precipitation Peak Months*
	Maximum (July)	*Minimum (December–January)*		
Ash Meadows	103	30	4.5	February–March, August
Desert (Corn Creek Field Station)	102	29	4.4	February–March, July–September
Moapa Valley	105	31	5.1	March, August
Pahranagat	98	26	6.4	March, August

Source: WRCC 2003

The climate of Nevada has been affected by global changes in climate as a result of increased atmospheric concentrations of greenhouse gases over the past century (U.S. Environmental Protection Agency [EPA] 1998). Temperature and precipitation have increased in many areas of the state. In particular, Elko, Nevada, has experienced an average increase in temperature by 0.6°F. Data collected near the Ash Meadows area shows an increase in average precipitation by more than 10 percent. Future trends cannot be accurately predicted, but Nevada's climate is expected to continue to be affected by global climate change.

Increases in precipitation, particularly more rapid snowmelt, could lead to increased flooding and higher potential for flash floods. Water quality of Nevada's waters could be affected by increased flooding as a result of increased erosion and sedimentation and transportation of pollutants into the surface waters, such as Lake Mead.

Figure 4.1-1

Ecoregions

Desert NWR Complex

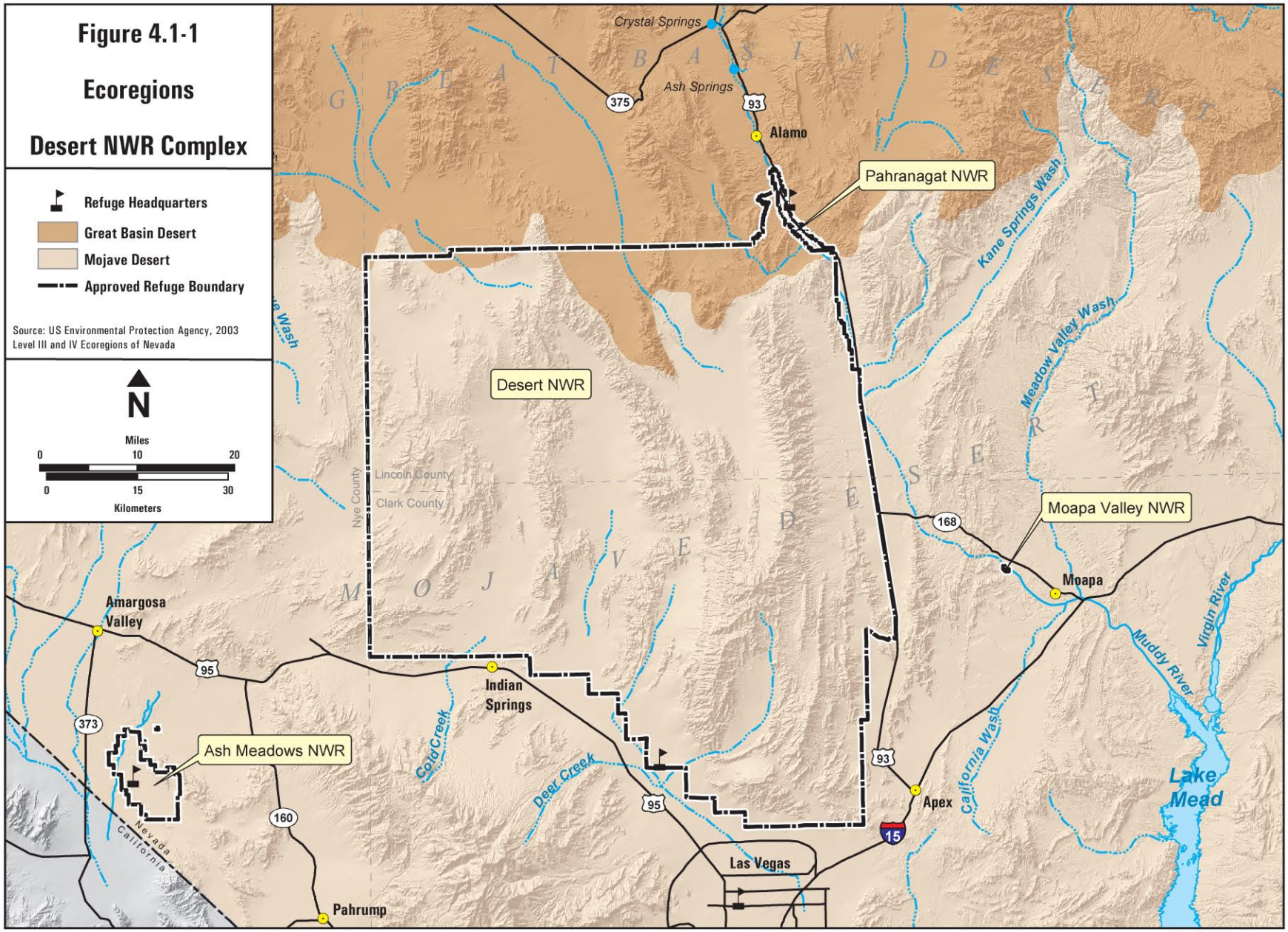

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Figure 4.1-1-complex_ecoregions.mxd

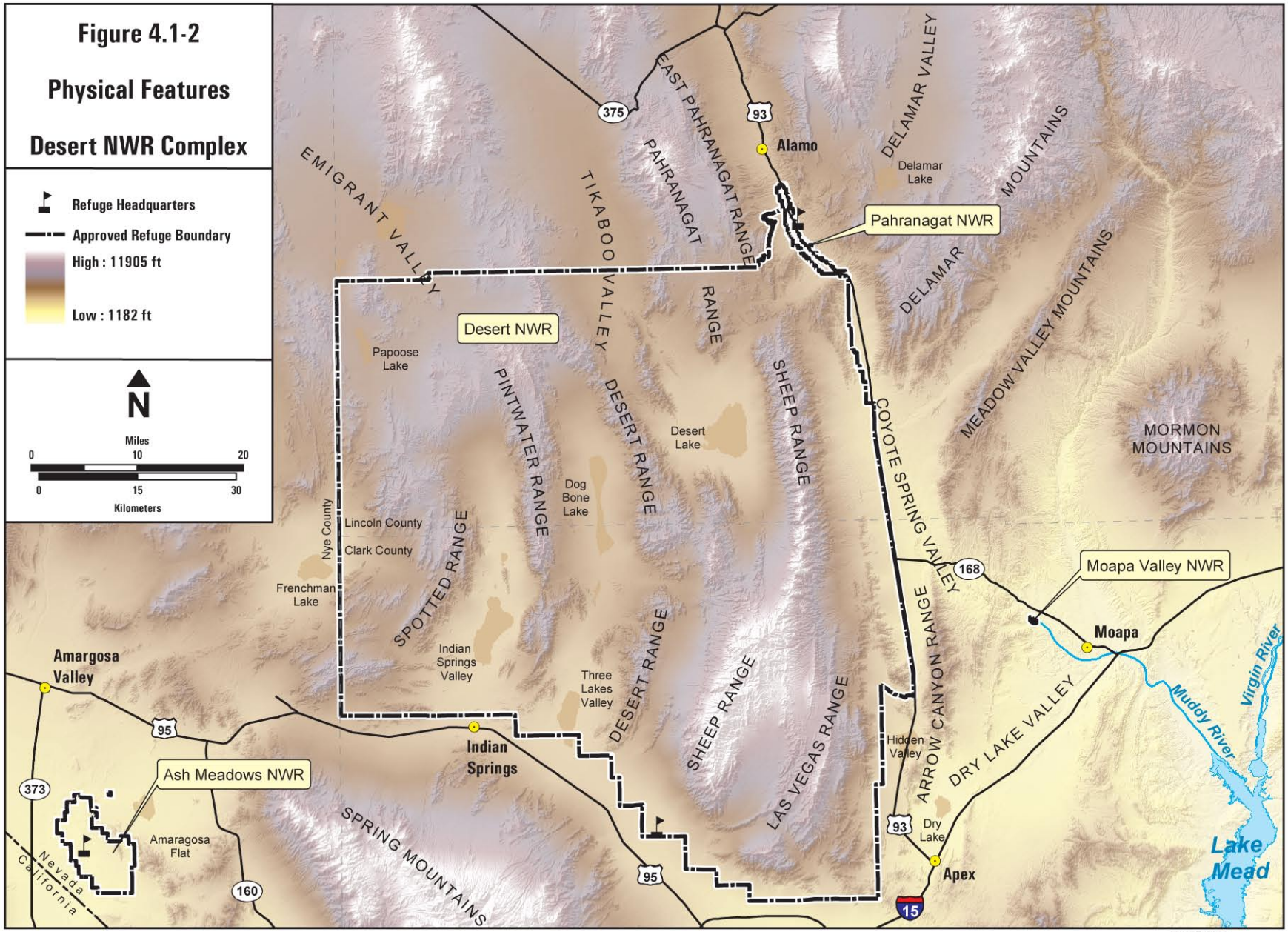

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Figure 4.1-2-complex_physical.mxd

Climate changes could also affect Nevada's forests by altering species composition, geographic range, and health and productivity. Hotter, drier weather could lead to a reduction in forest cover as grasslands and arid lands (deserts) become more dominant. The intensity of the changes is dependent on a variety of factors that require human intervention to control. Specific effects of climate change on each of the refuges have not been evaluated, but changes in climate could affect the special-status species found on the refuges as well as the habitats that support these species.

Geology and Minerals

The geologic structure of the Basin and Range Province, including the area of the Desert Complex, is the cumulative product of multiple episodes of compression and extension of the Earth's crust. During the last 30 million years, extension of the Earth's crust accompanied by other actions resulted in the pattern of elongated mountain ranges and intervening basins or valleys. The estimated total displacement along the major north-trending faults during the last 12 million years ranges from less than 330 feet to more than 1,600 feet (Tschanz and Pameyan 1970).

The presence of or potential for minerals at each refuge is discussed in their respective sections of this chapter.

Paleontological Resources

Each of the refuges in the Desert Complex has potential to contain paleontological resources based on the geologic units that have been mapped. Within the Ash Meadows NWR, spring, playa and lake deposits have high paleontological potential for mollusk shells and isolated deposits of horse, camel, bison, sheep, and deer (Longwell et al. 1965). Paleozoic, Tertiary, and Quaternary deposits within Desert NWR have the potential to contain common types of fossils, such as mollusks, corals, barnacles, algae, and other invertebrates (Tschanz and Pameyan 1970; Longwell et al. 1965). The Quaternary and Tertiary alluvium and Bird Spring Formation within Moapa Valley NWR have high fossil-containing potential for algae, echinoderm, and fusilinid (Longwell et al. 1965). The Panaca Formation surrounding Pahranagat NWR contains gastropods, ostracods, trace fossils, diatoms, plant fossils, and extinct horse remains (Tschanz and Pameyan 1970).

Soils

Nevada, with its wide mix of geologic parent material, has a vast array of different soil types. Differences in climate, parent material, topography, and erosional conditions result in soils with diverse physical and chemical properties. The distribution and occurrence of soils is highly variable and is dependent on a number of factors, including degree of slope, geology, vegetation, climate, and age. Soils in the Desert Complex area are derived mainly from sedimentary and volcanic rocks and alluvium.

The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) has published a Soil Survey Geographic Database (SSURGO) that provides soil association maps for most of Nevada in digital format. SSURGO includes information on soils at Ash Meadows, Moapa Valley, and Pahranagat NWRs (NRCS 2003b). No SSURGO data exist for the Desert NWR; however, soil data are available from the State Soil Geographic (STATSGO) database (NRCS 2003a). These sources were used to describe soil conditions at each refuge; the information is presented in Sections 4.2 to 4.6.

Water Resources

The Great Basin and Mojave Desert are relatively arid and have few large rivers. Each of the four refuges can be characterized by an interaction between springs discharging from the regional carbonate aquifer, groundwater stored in local alluvial aquifers, and surface flow as a result of spring discharge and precipitation. Groundwater originates as high-altitude winter precipitation in the higher mountain ranges (such as the Spring and Sheep Ranges) and can flow great distances through the carbonate rocks that make up the mountain ranges and underlie the valleys (Thomas et al. 1986). The major springs associated with the Desert Complex are part of several large regional groundwater flow systems, including the Death Valley regional groundwater flow system, which consists of multiple interconnected basins that transfer groundwater to and from adjacent basins (Bedinger and Harrill 2004). Regional flow patterns are influenced by topographic relief and relative altitudes of each basin. Groundwater flow patterns are shown in Figure 4.1-3, which are based on various studies of the Death Valley regional flow system. For this reason, surface water resources within each of the four refuges can be affected by uses elsewhere within the same flow systems.

Hazardous Materials

Hazardous materials are defined as any substance that, due to quantity, concentration, physical, chemical, or infectious characteristics, may present substantial danger to public health, welfare, or the environment when released. Hazardous materials are not known to be present on Ash Meadows, Moapa Valley, or Pahranagat NWRs. Solid and hazardous wastes are generated from activities on the Nevada Test and Training Range (NTTR), which overlays a portion of the Desert NWR.

Fire History and Management

Each refuge in the Desert Complex has a Fire Management Plan that identifies and integrates all wildland fire management guidance, direction, and activities required to implement national fire policy. Because each refuge contains different sensitive resources and has different management purposes, refuge-specific fuels management is discussed separately for each refuge.

Figure 4.1-3
Hydrology
Desert NWR Complex

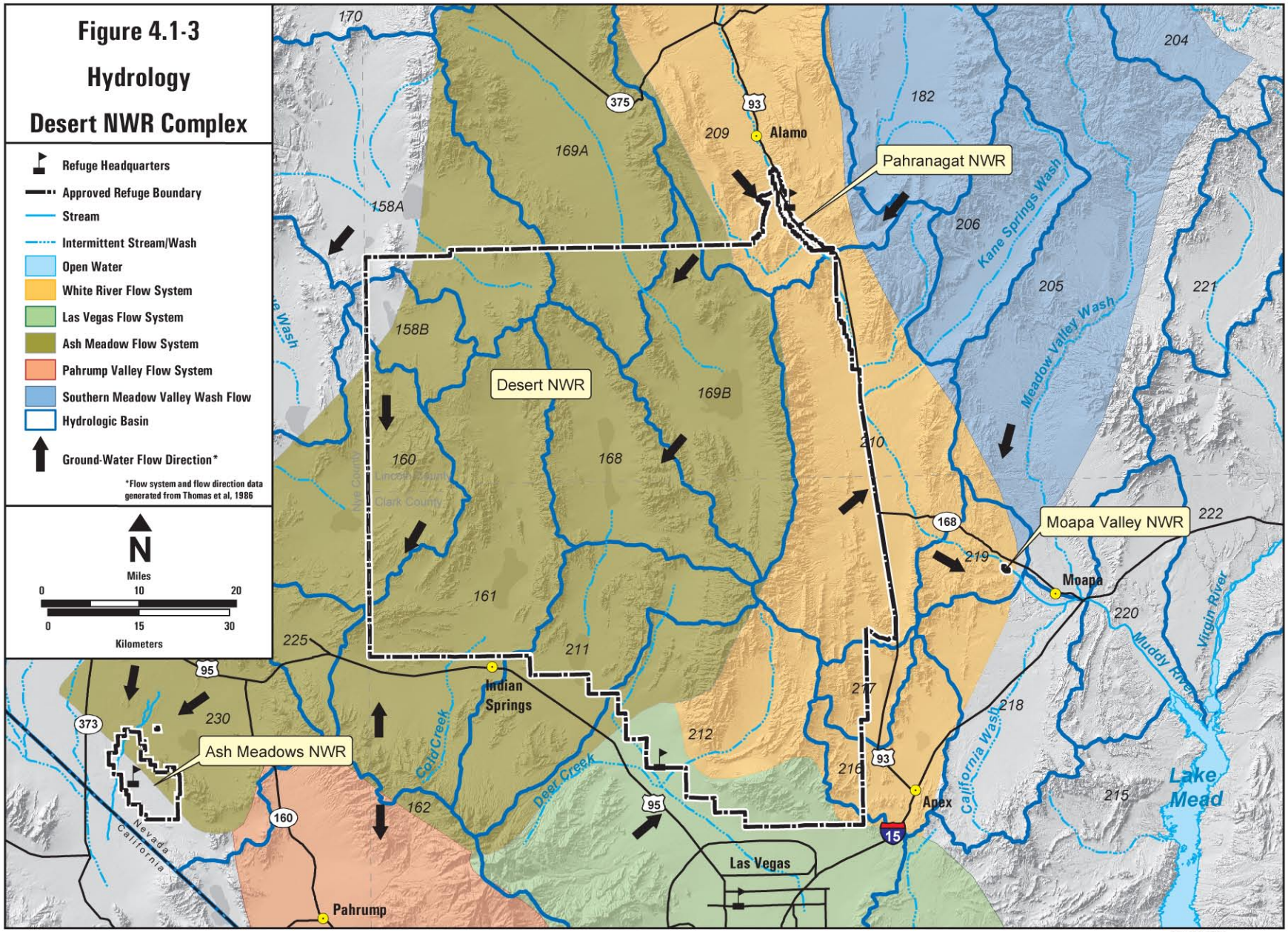

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Figure 4.1-3-complex_hydrology.mxd

Air Quality

Air quality of the four refuges in the Desert Complex can be described in terms of climate, regulatory requirements, and ambient air quality conditions. Climate and meteorology describe the atmospheric conditions, which affect the general air quality. Air quality regulations define the limits and controls on emissions necessary to maintain good air quality within the region. Ambient air quality provides a measure of the ambient concentration of various pollutants that affect air quality. This section defines the regulatory requirements for southern Nevada.

The U.S. Congress has promulgated National Ambient Air Quality Standards (NAAQS) to regulate the ambient air quality through the nation. The pollutants include nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), particulate matter less than 10 microns (PM_{10}), and ozone (O_3). Areas where measured concentrations of these pollutants are above the NAAQS are defined as nonattainment areas. All others are defined as attainment. Local air quality regulations for Nye and Lincoln Counties have been delegated to the Nevada Department of Environmental Protection (NDEP). Clark County air quality is regulated by the Clark County Department of Air Quality Management (CCDAQM).

The four refuges are in a region that has been classified as attainment areas for all pollutants, except for the southern portion of the Desert NWR, which is within the Las Vegas Valley Airshed. The Las Vegas Valley Airshed is considered nonattainment for CO and PM_{10} (Clark County 2000 and 2001, CCDAQM 2003a). As required by the EPA, CCDAQM has developed state implementation plans for CO and PM_{10} to reduce emissions countywide.

The CO State Implementation Plan for Las Vegas Valley Nonattainment Area adopted measures associated with on-road mobile sources to reduce CO emissions (Clark County 2000). The PM_{10} State Implementation Plan developed several new rules to reduce the amount of fugitive dust that enters the atmosphere, with a focus on reducing fugitive dust from construction sites (Clark County 2001).

4.1.2 Biological Resources

Vegetation

The Mojave Desert is the smallest of the four North American deserts, lying primarily in California, but also including the southern quarter of Nevada and small portions of Utah and Arizona (Royo 2002). Unlike the Sonoran Desert, the lower elevations of the Mojave Desert have only one tree, the Joshua tree (*Yucca brevifolia*). This tree-like yucca is endemic to the Mojave Desert and usually grows at elevations of 3,500 feet above mean sea level (msl) and greater. The Mojave Desert also hosts approximately 200 other plants that are not found in the Sonoran or Great Basin Deserts. Although a published flora of the Mojave Desert is incomplete, approximately 2,600 vascular plant taxa are known to occur in the Mojave Desert floristic province (excluding the higher elevations, greater than 8,000 feet above msl, of the Spring, Sheep, and Panamint Mountain Ranges), representing one of the most

diverse floristic regions in the United States (Andre and Knight 1999). Although home to about 200 endemic plant species, the proportion of the Mojave Desert flora comprising special-status taxa is relatively low (10 percent of flora).

Many noxious weeds can be found dominating the areas along Nevada's borders (U.S. Bureau of Land Management [BLM] 1999b), and a variety of invasive species and noxious weeds occur on each of the refuges within the Desert Complex (Appendix H). Noxious weeds mostly occur in riparian and wetland areas. They out-compete native vegetation and can spread quickly in a short time span.

Wildlife

Wildlife species are more abundant in the Mojave Desert than they are in the Great Basin Desert (MacMahon 1992), which may be due to the occurrence of fewer plant species in the Great Basin Desert. Plant communities are home to specific wildlife. For example, the creosote bush community is known to have at least 30 species of reptiles, 33 species of birds (eight of which are permanent residents), and 44 species of mammals (see list of common species in Appendix H). The blackbrush community has fewer species—19 reptiles, 26 birds, and 33 mammals—but it still contains diverse fauna. More than 200 bird species use the wetland habitats in the Mojave Desert, and approximately 20 species of fish and seven amphibians can be found in the desert springs and marshes. Each refuge within the Desert Complex provides important and unique habitat for wildlife, including some endemic species.

Special-status, or sensitive, species occur on each of the refuges. Special-status species are those species that have been listed as endangered or threatened by the U.S. Fish and Wildlife Service (Service), are candidates for listing under the Endangered Species Act (ESA), or are considered sensitive by another federal or state agency or wildlife management plan (Appendix H and Sections 4.2-4.6). Federally listed wildlife species are also protected in the State of Nevada under Nevada Revised Statutes 501 and Nevada Administrative Code Chapter 503.

4.1.3 Cultural Resources

Because the four refuges that make up the Desert Complex are so widely separated within southern Nevada, it is difficult to characterize the prehistoric and historic setting of the region as a whole. The prehistoric people who used the lands that are now part of these four different areas were well adapted to the climate and resources within their homelands. The prehistory and history of southern Nevada is summarized in a variety of major sources. Although there is general agreement on the broad patterns of regional prehistory, many areas of controversy remain, and the data needed to answer some basic research questions are lacking.

Although typically grouped within the Great Basin culture area (D'Azevedo 1986), a number of major culture areas overlap in southern Nevada. The prehistory and history of these areas spans the last 12,000

years or more. Particularly in the period after 500 A.D., Far Western Puebloan, Fremont, Patayan, and Numic traditions overlap in the region.

Cultural resources encompass a wide range of resources that are and have been important to tribes and other indigenous people. These resources include cultural artifacts as well as plants, wildlife, water resources, or other aspects of the environment that are associated with cultural practices or beliefs of a living community that may be rooted in that community's history or are important in maintaining the continuing cultural identity of the community.

Prehistoric Archaeology

Archaeologists believe that native people occupied the southern Great Basin by approximately 12,000 years ago. The limited data from the region suggest these people relied heavily on hunting for subsistence, with a focus upon large game animals that were plentiful in the riparian, marsh, and grassland environments typical at the end of the last Ice Age. Sites dating to the Paleoarchaic are rare in most parts of the southern Great Basin. The best-documented Paleoarchaic sites occur in the Mojave Desert along the shores of Pleistocene Lake Mojave, California (Campbell et al. 1937; Warren and Phagan 1988), and at Fort Irwin, California (Basgall and Hall 1991, 1994). While relatively few of these sites are associated with reliable radiocarbon dates, the consensus is that they date between 11,200 and 7,500 years ago.

In the period following the Paleoarchaic, lakes that contained plenty of water during the ice ages began to dry up as the region became increasingly arid. People broadened their resource base and began to exploit more plants and other kinds of game than during the previous period. Warren (1980) postulates that about 9,000 years ago, people began to cluster around permanent water sources. Several early archaic sites have been investigated in the southern Great Basin, including Pintwater Cave on the Desert NWR.

About 3,000 B.C., a period of increased moisture began in the region. A variety of cultural assemblages have been noted at this time with an increased number of sites. One of the best-known regional sites dating to the later portions of the Archaic is Gypsum Cave (Harrington 1933).

Cultural diversification with strong regional emphases developed after about 500 A.D. While some Indian People took up farming, others continued the Archaic lifestyle of seasonal transhumance typical of earlier times, and some probably used aspects of both. During this time, strong Southwestern influences were evident in southeastern Nevada within the drainages of the Moapa and Muddy Rivers and in the Las Vegas Valley. Far western ancestral puebloan people practiced increasingly intensive agriculture adjacent to reliable water sources, which may have occurred at Corn Creek.

Western Shoshone and Southern Paiute/Chemehuevi still occupied the southern Great Basin and northeastern Mojave Desert when the first Euro-Americans and other ethnic groups entered the area in the 1800s

and earlier. These groups practiced collecting and foraging strategies similar to those of earlier periods in addition to agriculture. Kelly and Fowler (1986) note that the Pahranagat Paiute practiced some forms of agriculture during the Protohistoric Period, including burning areas and scattering an unidentified grass seed, and floodplain agriculture along the edges of the lakes. There is also evidence that the Las Vegas and Moapa Paiute practiced horticulture at springs and rivers.

Historic Archaeology

Southern Nevada has long been a crossroads in the American West: a crossroads of cultures (both prehistoric and historic), a crossroads of economies, and a literal crossroads. The area began as part of the Spanish Empire, became part of independent Mexico, and then joined the United States at the cessation of the Mexican-American War. As part of the historical American West, southern Nevada first was home to Mormon settlers bent on expanding their religious territory and bringing their doctrine to the local native populations. It later became a key link in the western transportation network for Mormons and non-Mormons alike.

The earliest transportation route to traverse southern Nevada was the Old Spanish Trail/Mormon Road. With the coming of the Los Angeles, San Pedro, and Salt Lake railroad in 1905, southern Nevada—and Las Vegas in particular—thrived as a connection in the transportation grid that linked California with Utah and other areas farther east (Myrick 1991).

Mormon influence waned after 1857 when most of the residents of the Las Vegas community returned to Utah. From then on the small Las Vegas Valley community focused on ranching and farming to supply regional mining interests. In the Las Vegas, Moapa, and Virgin Valleys, farming communities continued to develop from the 1850s until the early 1900s. Mining ventures in southern Nevada were typically short-lived, and most of the areas survived as transportation hubs or ranching centers.

4.1.4 Public Access and Recreation

Because of the differences in location, size, habitat, and wildlife of each of the refuges, public access and recreational opportunities are quite different and are therefore discussed in the sections addressing conditions at each refuge.

4.1.5 Social and Economic Conditions

Social and Economic Regional Overview

Southern Nevada is one of the fastest-growing regions in the United States. According to U.S. Census data, the population of the state increased by more than 20 percent between 2000 and 2005 to more than 2.4 million residents (U.S. Census Bureau 2006). The Nevada Development Authority (2004) notes that the Las Vegas metropolitan area accounts for most of the growth. The rapid growth in the Las Vegas Valley is a driving force in the social and economic settings. Increasing growth in the Las Vegas Valley exerts environmental

pressures on the Desert Complex as development moves closer to the largest refuge—the Desert NWR. Development also creates an increased demand for open spaces, which will likely translate into more visitors to the Desert Complex, and increased environmental pressures, such as on the groundwater aquifer.

This rapid growth also means that other more rural and remote communities may experience different pressures, such as more growth as people relocate from the Las Vegas Valley to nearby communities, or possibly declining growth as people move away for the increased economic opportunities elsewhere. The BLM is undergoing a process of land disposal in Clark and Lincoln Counties, which will result in some of these lands being transferred to private ownership and may provide land for development opportunities.

Clark County

The population of Clark County was estimated at about 1.7 million people in 2005, which represents an increase of almost 25 percent since the 2000 Census (U.S. Census Bureau 2006). More than 70 percent of Nevada's population resided in Clark County in 2005. The population is projected to increase to 2,751,082 by the year 2024, an increase of about 60 percent over the 20-year period. Communities in Clark County include larger, rapidly developing cities in the urbanized areas of Las Vegas Valley and Mesquite, as well as those in more rural areas such as Indian Springs, Moapa, Overton, and Logandale.

Lincoln County

Lincoln County's population was estimated at 4,391 people in 2005, an increase of 5.4 percent from the 2000 Census population of 4,165 (U.S. Census Bureau 2006). Most of the population is found in the towns of Alamo, Caliente, Panaca, Pioche (the county seat), and Rachel. Lincoln County's population is expected to increase to 5,292 people by 2024. According to the 2001 Lincoln County Master Plan, future population growth is expected to change and shift to the area near the southern county line shared with Clark County, particularly in the area near Mesquite (Lincoln County 2001).

Nye County

Nye County's population was estimated at 40,477 in 2005, an increase of 24.5 percent since the 2000 Census (U.S. Census Bureau 2006). The communities in Nye County range from rural to urban. While the small town of Amargosa Valley practices traditional farming and mining, the larger, more urban town of Pahrump serves as a major service center, with 73 percent of the county's population in 2000.

Refuge Management Economics

The Desert Complex is managed by a staff located in Las Vegas, and each of the refuges has separate budgets and staff located at the refuges. The current Desert Complex staff consists of six permanent full-time employees. The refuge operations budget for the Desert Complex in 2005 was $432,533. The maintenance budget for the Complex in 2005 was $14,900. There were also funds in the amount of $72,531 for volunteers at the Complex and four refuges. Fire-related

budgets for the Desert Complex and four refuges included $83,481 for fire protection and management services, $50,000 for wildland urban interface services, and $449,735 for burned area emergency restoration. Additional funds for specific projects at each refuge are provided through the Southern Nevada Public Lands Management Act; these funds are allocated separately and are not identified as part of the refuge management budgets.

Environmental Justice

In 1994, the President of the United States issued Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority and Low-Income Populations." The objectives of the EO include developing federal agency implementation strategies, identifying minority and low-income populations where proposed federal actions could have disproportionately high and adverse human health and environmental effects, and encouraging the participation of minority and low-income populations in the National Environmental Policy Act (NEPA) process.

Each of the four refuges in the Desert Complex holds special traditional and cultural significance to the affiliated Native American tribes who inhabited southern Nevada. The same present-day affiliated Native American tribes in southern Nevada and neighboring California and Arizona maintain rich cultural heritage ties to these areas. The affiliated tribes may be considered low-income, minority populations in the vicinity of the refuges.

Regional Land Use

Lands in southern Nevada are primarily managed by federal agencies, with a small portion in private, state, or municipal ownership. The disposal of lands by the BLM throughout Clark and Lincoln Counties is increasing the amount of land that is in private or municipal ownership, which is also increasing the availability of land for development. The following sections provide information on the land owners and managers in the counties where the Desert Complex is located. Figure 1.1-1 (Chapter 1, Introduction) shows an overview of the land ownerships and managers in southern Nevada.

Clark County

Of the 5.12 million acres of land in Clark County, about 4.5 million acres (approximately 90 percent) are administered by seven federal agencies or departments (BLM unknown date). These are:

- Department of Defense (379,961 acres),
- Bureau of Land Management (2,727,406 acres),
- National Park Service (466,746 acres),
- U.S. Fish and Wildlife Service (517,249 acres),
- Forest Service (274,574 acres),
- Bureau of Reclamation (39,998 acres), and
- Bureau of Indian Affairs (78,832 acres).

The remaining 10 percent of lands in Clark County (approximately 500,000 acres) are under private ownership or state and local government ownership.

Lincoln County

Lincoln County is the third-largest county in terms of land area in Nevada, consisting of 6.8 million acres. It is primarily a rural county in which most of the land is under public ownership (Lincoln County 2001). The federal government currently manages more than 98 percent of the land in the county:

- Bureau of Land Management (5.6 million acres),
- Department of Defense (DOD) (771,087 acres),
- U.S. Fish and Wildlife Service (268,698 acres), and
- U.S. Forest Service (29,371 acres).

Only 129,000 acres are privately owned, and a scant 5,700 acres are under state jurisdiction.

Nye County

Of the 11.6 million acres of land in Nye County (including lands within the Department of Energy [DOE]-controlled Nevada Test Site and the DOD-controlled Nevada Test and Training Range [NTTR]), approximately 11.3 million acres (about 97 percent) are administered by the following federal agencies:

- Bureau of Land Management (6.5 million acres; 8,400 acres are jointly managed with the Service),
- U.S. Fish and Wildlife Service (13,700 acres),
- U.S. Forest Service (1.9 million acres),
- Department of Defense (1.8 million acres),
- Department of Energy (863,000 acres),
- National Park Service (107,000 acres), and
- Bureau of Indian Affairs (8,000 acres).

An additional 19,000 acres are under state jurisdiction, and a total of 249,000 acres in Nye County are privately owned.

Aesthetics

Aesthetics, or visual resources, include both natural and man-made physical features and infrastructure that provide a particular landscape its character and importance as an environmental and visual factor. There are different approaches to identify aesthetics of a landscape that have been used by different agencies. Typical features that provide an overall impression of a landscape include the presence or absence of land features, vegetation, water, color, surrounding scenery, and man-made and cultural features. Criteria used for this discussion include scenic quality, distance from selected public viewpoints, and distance from areas of interest.

The overall Desert Complex is made up of four different areas that have unique features within them, but are within an area generally defined as transition between the Mojave Desert and the Great Basin. The topography consists of a series of mountain ranges, generally in a north-south orientation separated by broad valleys. Elevation ranges from 2,200 feet at the desert floor to about 10,000 feet above msl. The mountains consist of side slopes, ridgelines, rock outcrops, and canyons. In the valleys, there are playas, alluvial fans and plains, small hills, intermittent drainages, and occasional volcanic rock formations. There are dry desert lakes as well as isolated perennial springs.

Creosote bush (*Larrea tridentata*) is the dominant plant in the desert shrub habitats, with sagebrush (*Artemisia* spp.), saltbush (*Atriplex* spp.), and blackbrush (*Coleogyne ramosissima*) consistently found throughout the area. Agriculture is limited in the region. Riparian areas and associated vegetation are primarily located within the refuges and are subject to protection and preservation.

The areas surrounding and in the vicinity of the Desert Complex consist of very low density desert and rural lands, scattered with small, rural towns and unincorporated areas. The exception is the Las Vegas metropolitan area, which is south of the Desert NWR and is beginning to encroach on the views to and from the refuge. As both Las Vegas and North Las Vegas develop to the north toward the Desert NWR, the area will become subject to aesthetic impacts, particularly along major roads, such as Interstate 15 (I-15), U.S. Highway 95, U.S. Highway 93, and Clark County 215, due to pollution, traffic, light, and glare.

4.2 Ash Meadows National Wildlife Refuge

4.2.1 Physical Environment

Physiography

The approved boundary of Ash Meadows NWR encompasses approximately 24,000 acres (Figure 1.7-1, Chapter 1, Introduction). The Refuge is located at the southern end of the Amargosa Valley and is bordered to the north, south, and west by the Amargosa Desert and to the east by the Devils Hole Hills.

The valley floor of the Refuge slopes gently to the southwest and has an average elevation of 2,060 feet above msl. The Devils Hole Hills have an elevation of approximately 3,100 feet above msl at the Refuge boundary. A large playa is located at the northwest corner of the Refuge and collects runoff from Rock Valley and adjacent uplands to the north. The playa drains to the south into Death Valley via Carson Slough, which empties into the Amargosa River. A smaller playa is located along the southern boundary and collects runoff from Devils Hole Hills located to the east, from the Resting Spring Range located to the south, and from several springs located along the southeast corner of the Refuge.

Geology and Minerals

The valley floor of the Ash Meadows NWR is underlain primarily by alluvial fan and playa deposits of Quaternary age (1.8 million years ago [mya] to present). Tertiary age (65 to 1.8 mya) sedimentary rocks are exposed near the southwestern boundary and central portion of the western boundary. The alluvial fan deposits consist of gravel and rubble near the highlands and grade downward into sand and silt playa deposits in the valley bottoms (Denny and Drewes 1965; Hess and Johnson 2000). The total thickness of the Quaternary sediments in the Ash Meadows Valley is unknown. Data collected from several water well drilling logs installed at a ranch located a few miles northwest of the Refuge indicate that gravel and clay are encountered to depths in excess of 700 feet (Denny and Drewes 1965).

The eastern boundary of the Refuge is formed of limestone and dolomite ridges from the Cambrian period (545 to 490 mya) (Otis Bay and Stevens Ecological Consulting 2006). This boundary contains carbonate hills and ridges as a result of bedrock being dropped down along the Ash Meadows fault system.

The Ash Meadows NWR is located in the Ash Meadows mining district, which was established in 1917 (Tingley 1998). The Ash Meadows district was once the largest producer of calcium and bentonite in Nevada and is in an area of historic mining interest, primarily for specialty clays and zeolite. In the early 1960s approximately 2,000 acres of marshland in the Carson Slough were disturbed by peat mining (Service 2006a). Although some major oil companies still retain mineral rights in portions of the district, production of bentonite has been at a standstill since the 1930s (Cornwall 1972). A review of Singer (1996) and Lovering (1954) indicates that neither metal nor radioactive ores are present at the Refuge. Twenty-six mining and two mill claims have been reported within the Refuge boundary (Service 1999a); however, more recent records from the BLM indicate there are three active placer claims and five lode claims (BLM 2007). The Service has a mineral withdrawal application pending with BLM covering 9,460 acres of BLM land and 5,360 acres of Service land within the Refuge's approved boundary. No private lands or valid existing mineral rights were affected by the proposed withdrawal (Service 1999a).

Paleontological Resources

Within Ash Meadows NWR, spring, playa and lake deposits have the highest paleontological potential. The deposits in the region are composed of thin horizontal layers of sand, silt, and clay with abundant mollusk shells and isolated deposits of Quaternary vertebrate remains, including horse, camel, bison, sheep, and deer (Longwell et al. 1965). In the Ash Meadows Quadrangle, Denny and Drewes (1965) found no fossils in the spring and playa deposits, but similar deposits in Amargosa Valley where these sediments occur contain Pleistocene mammal remains.

No fossils have been found in the other geological units mapped in Ash Meadows NWR (Denny and Drewes 1965), but those units may overlie other geologic units that contain fossils (Service 2000b).

Soils

A total of 16 soil-mapping units are present on the Refuge, and the soils generally consist of gravelly sandy loam derived from either mixed rock sources or lake deposits (NRCS 2003b). Finer loam soil types (silty clay loam, sand to clayey loam) are derived from or occur near lake deposits, on the distal edges of alluvial fans, or on floodplains.

Water Resources

Surface Water

Ash Meadows NWR lies within the Upper Amargosa hydrologic subbasin, which is characterized by surface water drainage southwest towards Death Valley (Figure 4.2-1). The primary drainage within Ash Meadows is the Carson Slough, a tributary to the Amargosa River. Crystal Spring and Jackrabbit/Big Spring drainages are tributary to the slough and drain large portions of the Refuge. Little to no water exits the Refuge, except during major storm events that produce a large amount of surface runoff (Otis Bay and Stevens Ecological Consulting 2006).

Surface water originates from precipitation and from more than 30 flowing springs that discharge groundwater from the Ash Meadows Flow System (Denny and Drewes 1965). The major springs on the Refuge consist of circular pools 20 to 40 feet in diameter and 5 to 20 feet deep (Denny and Drewes 1965). The total annual discharge of Refuge springs has been estimated at about 17,000 acre-feet per year (afy) (Laczniak et al. 1999). Runoff from the springs feeds the two man-made reservoirs.

Devils Hole, an opening to the carbonate aquifer, is one of the most widely recognized and significant water features within the Refuge boundaries (actually part of Death Valley National Park). Devils Hole is a rectangular opening in a carbonate rock formation that is approximately 10 feet wide by 65 feet long (Hunt and Robinson 1960). The depth of Devils Hole has not been mapped, but the deepest any diver has been is about 436 feet (Riggs and Deacon 2002). Devils Hole is a unique habitat for a species of desert pupfish, which is listed as endangered. The pupfish breed on ledges just a few inches below the water surface.

The stability of water levels within Devils Hole is crucial to maintaining pupfish habitat, and thus the impacts of local groundwater pumping are of major concern. In the late 1960s and early 1970s, groundwater use for local irrigation resulted in declines in the pool level. A U.S. Supreme Court decision in 1976 mandated a minimum water level in the pool and resulted in cessation of local irrigation. Following the Supreme Court decision, water levels improved, although they continue to slowly decline.

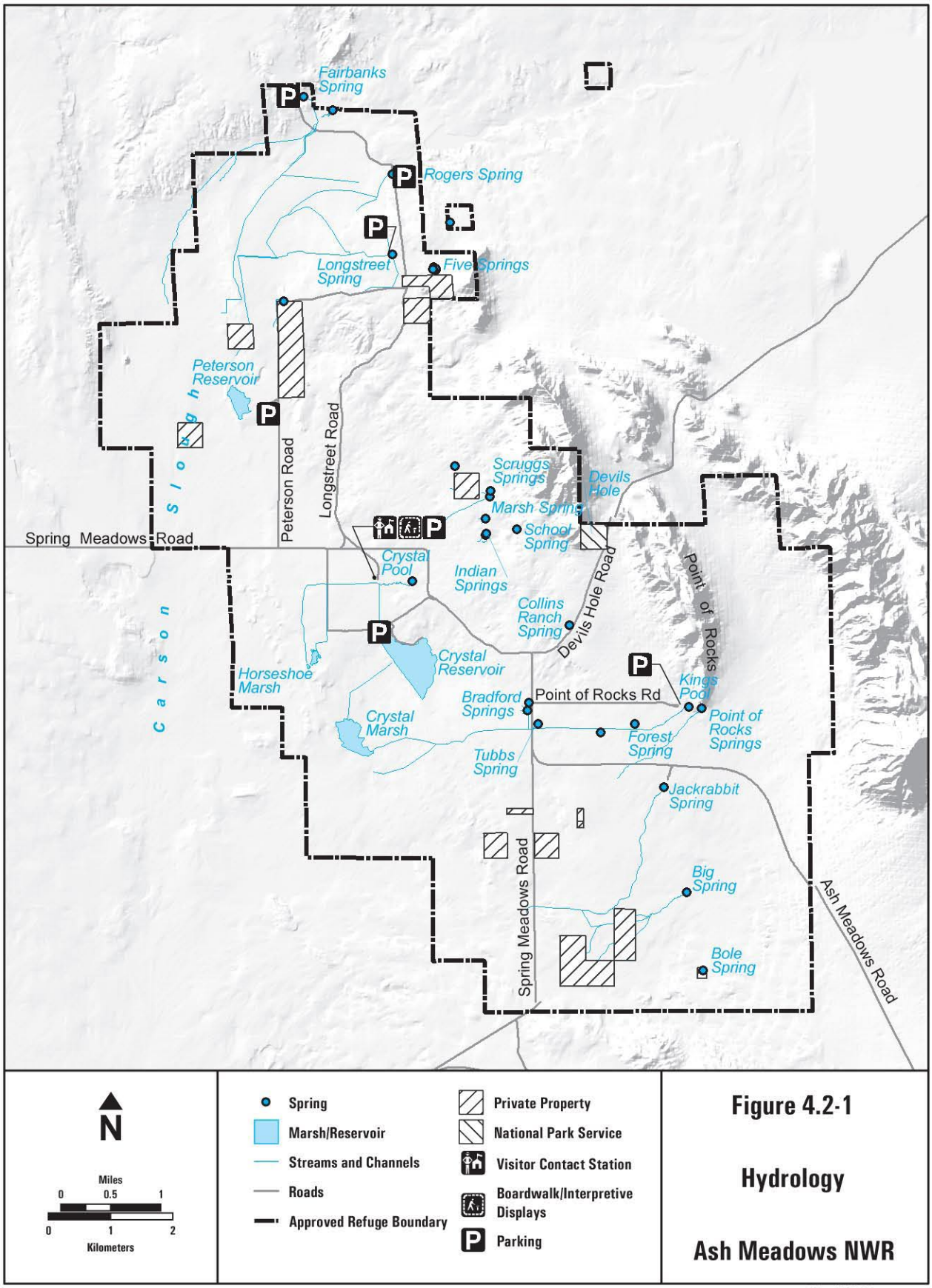

Figure 4.2-1

Hydrology

Ash Meadows NWR

May 14, 2008
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Figure 4.2-1-ashmeadows_hydro.mxd

The Service is currently engaged in restoration of many of the historic stream channels on the Ash Meadows NWR. The Ash Meadows area was previously farmed, and many of the surface water channels were redirected into man-made ditches. Work has recently been conducted at Point of Rocks and Crystal Pool to redirect spring flow into historic flow channels, although this work is not yet complete.

Historic redirection of springs and flow channels for irrigation also had a major impact on Carson Slough, which used to be one of the largest wetland areas in southern Nevada. Carson Slough was drained, mined for peat, and recontoured for farming. Surface flows were redirected into man-made reservoirs: Peterson and Crystal.

Groundwater

Ash Meadows NWR lies within the Amargosa Valley hydrographic basin. The Refuge is underlain by a regional carbonate aquifer and a local valley-fill aquifer (Otis Bay and Stevens Ecological Consulting 2006). The valley-fill aquifer is fed by regional groundwater through direct flows and surface water percolation from springs created by groundwater. Groundwater surfaces along the Ash Meadows fault system, which trends southeast to northwest through the eastern portion of the Refuge; springs are created by groundwater discharge along the fault, such as at Point of Rocks and Crystal Spring. All of the springs discharge carbonate water. At Point of Rocks, springs appear to discharge directly from the carbonate aquifer because of the carbonate rock outcrop. Other springs on the Refuge discharge from the valley-fill aquifer, which is derived from and connected to the carbonate aquifer but is covered by valley-fill sediments.

Warmer springs (greater than 90°F) tend to be found on the eastern side of the Refuge, where the groundwater travels a shorter distance to the surface from the carbonate aquifer (Walker and Eakin 1963). Springs in the central to western portion of the Refuge tend to be cooler (less than 90°F) because groundwater travels through the valley-fill aquifer, which contains lower temperature waters, to reach the surface.

The perennial yield of the Amargosa Valley hydrographic basin is estimated at 24,000 afy (Walker and Eakin 1963). Most of the groundwater yields spring flow (17,000 afy), while the remainder (7,000 afy) remains as subsurface flow and flows towards Death Valley to the west or supports evapotranspiration in the Ash Meadows area. Spring discharge in Ash Meadows has been estimated within a range of 16,500 to 17,500 afy (Otis Bay and Stevens Ecological Consulting 2006).

Water Quality

Water quality from springs generally varies depending on the source area of the spring. Springs connected to regional flow systems have discharge waters containing relatively large concentrations of sodium, potassium, chloride, and sulfate ions. Some springs discharge thermal water warmer than 80ºF. These waters have been in transit for thousands of years and thus have small concentrations of tritium, which is a result of radioactive fallout from nuclear testing in the 20th century. Water derived locally, instead of from regional flow systems,

would have smaller concentrations of ions, larger concentrations of tritium, and lower temperatures (U.S. Geological Survey [USGS] 1999). Water quality from major springs within Ash Meadows NWR is consistent with water from the regional flow system, rather than local precipitation and runoff. Water quality is fair overall. Levels of dissolved solids are approximately 450 milligrams per liter (mg/L), which is below the recommended level for potable water of 500 mg/L.

Water Use

Within the Refuge, groundwater is a complex interaction between springs discharging from the regional flow system and groundwater in the aquifers. Dewatering of the aquifers likely occurred as a result of historic pumping in the area (Dudley and Larson 1976). Since cessation of local pumping, water levels appear to have stabilized or recovered in some areas of the Refuge, although the lack of historic water level information makes it difficult to fully analyze the conditions.

Since the Nevada Division of Water Resources (NDWR) began maintaining records in 1982, annual groundwater pumping from the Amargosa Valley has varied between 4,000 afy and nearly 16,000 afy (NDWR 2003). In general, groundwater use between 1982 and 1992 was between about 4,000 and 10,000 afy; beginning in 1993, water use increased and now fluctuates between 12,000 and 15,500 afy. Agriculture still accounts for the bulk of water use. Industrial use has ranged from generally less than 1,000 afy in the 1980s to about 2,500 afy in the 1990s. Commercial use began a sharp increase from 10 to 20 afy prior to 1995 to over 1,000 afy in 2000. Domestic uses were in decline in the 1980s, reaching an average of about 100 afy from 1986 to 1996, but more recently rising to about 370 afy. Development of surface and groundwater resources on private inholdings is limited and regulated by the Nevada State Engineer.

Groundwater levels within the Refuge may also be affected by groundwater development elsewhere in the Amargosa Valley hydrographic basin. The largest source of concern is pumping from agricultural areas north of the Refuge and groundwater users located within 5 miles of the Refuge, including the Amargosa Dairy and the American Borate mining facilities (recently closed). Water levels in the agricultural area have been in decline. The hydrologic connection between the agricultural pumping and water levels within Ash Meadows NWR is unclear, but at this time, water levels within the Refuge do not exhibit a similar decline. Recent water use of the dairy and mining facilities averages approximately 1,500 afy and 700 afy, respectively; however, the potential for these groundwater users to affect groundwater resources at Ash Meadows NWR is also unknown. The area is being studied by various agencies and private groups as a key indicator of long-term hydrologic, geologic, and climatologic change in southern Nevada due to its proximity to the proposed Yucca Mountain nuclear waste repository, which is located approximately 20 miles north of the Refuge.

Because 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. Currently, upgradient uses include DOE wells in Frenchman and Yucca Flat (DOE 2002). In Frenchman and Yucca Flat, DOE peak historic water demand is 530 and 912 afy, respectively. In Yucca Flat, this amount of pumping has likely exceeded the perennial yield of the basin and may have decreased downgradient subsurface flow by decreasing underground storage.

Water Rights

There are few current uses of groundwater within Ash Meadows NWR. Domestic uses of groundwater within the Refuge do not require a water right. According to records from the NDWR (2003), the Service has filed for 57 water rights on the Ash Meadows NWR (55 rights for spring flow, two rights for wells). All rights have been certified by the Nevada State Engineer. The total quantity of water rights held by the Service is approximately 17,674 afy for the Ash Meadows NWR (Mayer 2006).

Development of water rights within the Amargosa Valley hydrographic basin has the potential to affect groundwater levels and spring flow on the Refuge. Within the basin, more than 56,000 afy of water rights have been certified, including both groundwater and surface water rights. Groundwater rights within the basin amount to approximately 28,000 afy. However, only about 12,000 to 15,500 afy of this amount are currently pumped (NDWR 2003).

Hazardous Materials

Ash Meadows NWR is largely undeveloped land with no history of development other than agriculture and homesteads. The only past mining activity on the Refuge was bentonite mining, which took place in the early 1900s. A review of Lovering (1954), Garside (1979), and Singer (1996) indicates that neither metal nor radioactive deposits are present on the Refuge.

Fire History and Management

Ash Meadows NWR currently lacks the site-specific histories of fire and forest structure that are necessary for scientifically based land-management planning in the region (Service 2004b). Site-specific fire histories provide the physical evidence of historical conditions that are critical to assessing the need for active management of specific watersheds, e.g., mechanical fuel treatment, prescribed fire or wildland fire use, and justifying such management actions within agencies and to the public. In general, fire regimes varied across space in response to variation in factors such as topography and climate. Although archival records reveal the modern factors such as fuel structure through fire exclusion, the influence of factors on past fire regimes is not fully understood. Extrapolating historical fire regimes across Nevada is further hampered by the nearly complete lack of information on historical fire regimes in any watershed in this region.

Fire occurrence in the desert areas of Ash Meadows has been historically infrequent (Service 2004b). However, fire frequencies may increase, due both to increased human-caused fires and to increased continuity of fine fuels caused by the growing dominance of introduced annual grasses.

Ash Meadows NWR is managed as part of the Ash Meadows Fire Management Unit (FMU); this unit consists of both the Refuge and the surrounding Ash Meadows Area of Critical Environmental Concern (ACEC), which is managed by the BLM. Records from the BLM for the Ash Meadows FMU, which covers about 52,600 acres, indicate an average of 0.3 ignitions per year between 1980 and 2002, with an average of 63 acres burned per year (Service 2004b). Fires ranged in size from 0.3 to 1,100 acres, and 71 percent were less than 100 acres in size. The median wildfire size was 206 acres, with an average of approximately 628 acres burned per decade. Fires generally occurred from April through October. Human-caused ignitions accounted for 86 percent of all fires, with the remaining 14 percent attributed to lightning. Most wildfires in this FMU occurred in tamarisk-infested areas. Typically, these fires are wind driven and are of moderate to high intensity. Small, low-intensity wildfires in tamarisk are less common but do occur.

Approximately two-thirds of the Ash Meadows FMU is riparian and marsh vegetation (Service 2004b). In undisturbed areas of this habitat, saltgrass is the carrier fuel and will burn at moderate intensity and spread. The remainder of the FMU (the surrounding ACEC) is predominantly creosote bursage and saltbush, with scattered stands of mesquite/acacia. Wildfires in this portion of the FMU are rare and generally depend upon ephemeral buildups of red brome and other introduced fine fuels.

The riparian/marsh portion of this FMU is infested with tamarisk, mainly along a series of irrigation channels (Service 2004b). These introduced nonnative fuels allow transport of fire into the interior of the marsh system. Tamarisk and other undesirable plant species also promote wildfires of larger size and intensity, versus the historical norm for this ecosystem.

Most wildfires in this FMU occur on the Refuge and generally involve tamarisk as the carrier fuel (Service 2004b). Although not typical, tamarisk fires in this FMU tend to be fuel driven, rather than wind dependent. Aside from tamarisk, the other vegetative type that is prone to fire within this FMU consists of scattered stands of mesquite/acacia woodland. Tamarisk fires here have exhibited high intensity and spread, whereas fires in the mesquite/acacia are usually single tree. The large fires in this FMU have been human-caused ignitions.

A recent example of a wildfire on the Refuge is the Longstreet Fire, which was caused by lightning and started on August 1, 2004 (Service 2004b). The fire was controlled on August 4 at 1,670 acres (1590 USFWS, 80 BLM). The origin was 0.5 mile southeast of private land near Cold Spring. Fuels consisted of annual grasses, perennial grasses,

tamarisk, and mesquite. The fire was considered extreme, and a single-engine airtanker was initially used to combat it; however, this method was not effective due to heavy accumulation of annual and perennial grasses. A variety of methods were considered, and indirect attacks using existing roads were found to be the most effective. Fuel breaks at the ownership boundary of private land were effective in having an established anchor point to proceed with burn-out operations.

Only one known prescribed fire has occurred on the Refuge. In 1990 an old cotton field was burned (Service 2004b). Recent fire history at Ash Meadows suggests that a component of prescribed fire would be desirable to maintain the diversity necessary to protect existing threatened and endangered species. Prescribed burns could also be used as part of a program to control noxious and exotic plants.

Air Quality

Ambient air quality is not currently measured at Ash Meadows NWR. It is expected that low ambient concentrations of criteria pollutants would occur in this area based on nearby uses. Fugitive dust may occasionally produce high amounts of pollutants from nearby activities related to the American Borate facility closure, as well as traffic on nearby dirt roads. The nearest development sources of emissions are in Pahrump (approximately 22 miles to the southeast) and the Las Vegas area (approximately 80 to 90 miles to the southeast). Due to synoptic wind patterns and the overall distance from these cities, these sources are not expected to have an impact on this region. The NDEP has operated a PM_{10} ambient monitor in Pahrump since 2001. Although the data indicate that there have been exceedances of the 24-hour PM_{10} standard, these conditions were eliminated from the attainment determination due to naturally occurring emissions, which are a reoccurring problem in Amargosa Valley (NDEP 2003).

4.2.2 Biological Resources

Vegetation

Habitat Types

In 2006, the Service completed a coarse-scale vegetation mapping effort that involved identifying and describing the different habitat types on the Ash Meadows NWR and creating geographic information system (GIS) data and maps of the habitat types (Figure 4.2-2). This effort was part of the Geographic and Biological Assessment that also included management recommendations for the Refuge (Otis Bay and Stevens Ecological Consulting 2006). The habitat types described and mapped for the Ash Meadows NWR include wetlands (emergent vegetation), riparian woodlands and shrublands (mesquite bosque and tamarisk), meadows (alkali wet meadow), alkali or saltbush shrub, creosote bush shrub, and nonnative oldfields. More than 350 plant species are known to occur on the Refuge, 15 of which are special-status species. More than 60 invasive species and 10 species of noxious weeds have been observed on the Refuge (Service 2006b). Because Ash Meadows NWR was historically developed as agricultural lands, the distribution of the native vegetation has been altered. Thousands of

acres were affected by Spring Meadows Ranch, Inc., during the early 1970s for alfalfa farming and cattle grazing (Service 1990a).

For purposes of managing the various habitats, the Service has established multiple management units on the Refuge. These units were established based on the hydrologic features of the Refuge and encompass the surrounding habitats. The major units on the Refuge include Warm Springs, Jackrabbit/Big Springs, Upper Carson Slough, and Crystal Springs. Other smaller units encompass the various springs and their habitats. Descriptions of the habitats found throughout the Refuge are provided below.

Wetland habitat at Ash Meadows NWR has been isolated for thousands of years, which has prevented several plant species from expanding their range outside the Refuge boundaries (Service 1990). Many of these plants have become distinct from others in the region and are now endemic to Ash Meadows NWR. Due to their limited range, these species are considered sensitive and are protected by the Service and the State of Nevada. A further discussion of the sensitive species found at Ash Meadows NWR is provided in the Sensitive Species section.

Approximately 30 seeps and springs provide high-quality habitat for many wildlife species. Emergent vegetation occurs around these water sources and around some of the reservoirs. Emergent vegetation is frequently or continually inundated and consists of herbaceous plants that are adapted to saturated conditions, such as cattails (*Typha* spp.) and rushes (*Juncus* spp.). Common species at the Refuge include southern cattail (*Typha domingensis*), rush, spikerush (*Eleocharis* spp.), bulrush (*Scirpus* spp.), and wetland grasses (*Sporobolus* spp. and *Distichlis* spp.) (Otis Bay and Stevens Ecological Consulting 2006). Emergent vegetation covers approximately 132 acres of the Refuge, which is about 0.5 percent of the total area.

Riparian woodland and shrubland habitat types occur along drainages or outflow channels throughout the Refuge and around springs. Riparian habitat includes mesquite bosques, which cover approximately 2,000 acres or 8 percent of the Refuge, and tamarisk, which covers approximately 1,200 acres or 5 percent of the Refuge (Otis Bay and Stevens Ecological Consulting 2006). Common overstory species associated with riparian habitat on Ash Meadows NWR include mesquite (*Prosopis pubescens* and *P. glandulosa*), Fremont cottonwood (*Populus fremontii*), willow (*Salix* spp.), and the invasive tamarisk (*Tamarix* spp.). Common understory species include saltbush (*Atriplex* spp.), saltgrass (*Distichlis spicata*), arrowweed (*Pluchea sericea*), and coyote willow (*Salix exigua*). Seasonal flooding is common in mesquite bosques, and annual flooding or high water tables are common in areas with tamarisk. Restoration efforts are currently under way to remove tamarisk and restore native mesquite bosques and other habitat on the Refuge.

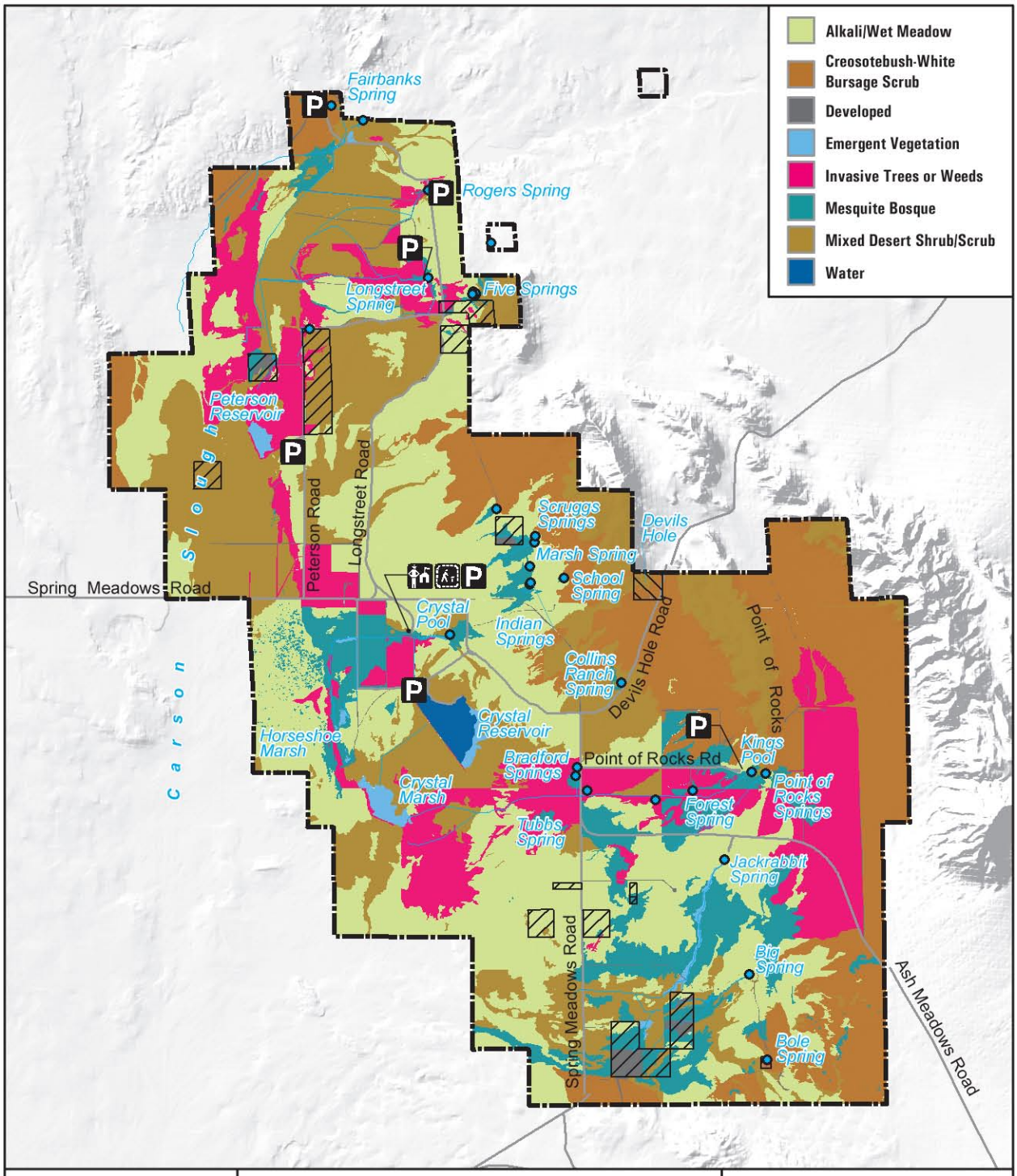

Figure 4.2-2

Vegetation Types

Ash Meadows NWR

May 15, 2008
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Figure 4.2-2-ashmeadows_veg.mxd

Alkali meadows are the dominant habitat type on the Refuge; they currently occupy approximately 7,900 acres or 33 percent of the Refuge (Otis Bay and Stevens Ecological Consulting 2006). Alkali meadows occur throughout the Refuge, with the largest contiguous meadows in the southern and central portions at lower elevations. Common vegetation in the alkali meadow habitat includes Baltic rush (*Juncus balticus*), mesquite, desert isocoma (*Isocoma acradenia*), alkali sacaton (*Sporobolus airoides*), saltgrass, and velvet ash (*Fraxinus velutina*).

Alkali meadows tend to provide habitat for rare species, and at Ash Meadows, they provide the largest habitat for Ash Meadows ivesia (*Ivesia eremica*) and the spring loving centaury (*Centauriam namophilum*). Alkali meadows are reliant on shallow groundwater, which is critical to the characteristics species found in the habitat. Areas where groundwater has lowered tend to become dominated by alkali shrub or saltbush species.

Alkali shrub is the second most common habitat type on the Refuge; it occupies approximately 5,000 acres or 21 percent (Otis Bay and Stevens Ecological Consulting 2006). Saltbush species, such as big saltbush (*Atriplex lentiformis*), fourwing saltbush (*A. canescens*), and shadscale (*A. confertifolia*) dominate the habitat. Other common species include rabbitbrush (*Chrysothamnus* spp.), greasewood (*Sarcobatus vermiculatus*), and inkweed (*Suaeda moquinii*). Alkali shrub is frequently intermixed with alkali meadows.

Groundwater pumping in the area and vegetation manipulation may have resulted in the conversion of alkali meadows to alkali shrub due to the lowering of the groundwater table; however, the extent of this conversion is unknown. In some areas, alkali shrub occurs on mounds within alkali meadow habitat.

Alkali shrub is most common in the northern portion of the Refuge, in the Carson Slough area. The Carson Slough was historically the largest wetland in southern Nevada (Service 1990). Approximately 2,000 acres of marshland in Carson Slough were destroyed when it was drained and mined for peat during the 1960s (Service 1990). Today, the Carson Slough is an ephemeral channel in the northwestern portion of the Refuge that contains alkali shrub habitat, some riparian woodlands dominated by the nonnative tamarisk, and some alkali meadows.

The creosote bush shrub or creosote–white bursage (*Larrea tridentata-Ambrosia dumosa*) scrub alliance is one of the most common habitat types in the Mojave Desert. This habitat type occurs on approximately 4,500 acres or 19 percent of the Refuge (Otis Bay and Stevens Ecological Consulting 2006). Creosote bush and white bursage are the codominants in this habitat. Other common species include fourwing saltbush, desert holly (*Atriplex hymenelytra*), brittlebrush (*Encelia farinosa*), wolfberry (*Lycium* spp.), and beavertail (*Opuntia basilaris*). The herbaceous layer is sparse, but seasonally abundant after rain events. Creosote bush shrub habitat occurs primarily along the eastern, southern, and extreme northwestern boundaries of the

Refuge. The habitat is relatively undisturbed, except for an area east of Point of Rocks Spring that has been leveled, irrigated, and furrowed.

Nonnative oldfields occur throughout the Refuge adjacent to native habitats. They occupy approximately 2,000 acres or 8 percent of the Refuge. The Refuge's history of land and water manipulation for various purposes has resulted in the establishment of nonnative plants, and in some areas (i.e., the oldfields), nonnative plants have become the dominant species. Typical species in the oldfields include Russian knapweed (*Acroptilon repens*), star thistles (*Centaurea* spp.), other thistles (*Cirsium* spp.), Bermuda grass (*Cynodon dactylon*), tansy mustards (*Descurania* spp.), and tamarisk. In some areas, native species, such as creosote bush and mesquite, are recolonizing where nonnative species or agricultural fields previously occurred. Native species may continue to recolonize previously disturbed areas, but the presence of noxious weeds (e.g., Russian knapweed and tamarisk) currently prevents native species from reestablishing.

On steep upland hillslopes and dry ridgetops, creosote bush and bursage disappear, and succulents dominate the shrub layer. This habitat type is sparse on the Refuge, occurring on approximately 900 acres or 4 percent of the Refuge. Common succulent include beavertail cactus, cottontop (*Echinocactus polycephalus*), and cholla (*Opuntia* spp.). Common herbaceous species include fluff grass (*Erioneruon pulchellum*), buckwheat (*Eriogonum* spp.), and phacelia (*Phacelia* spp.).

Sensitive Plant Species

There are 15 sensitive plant species found at Ash Meadows NWR (Appendix H). Nine of these species are endemic to Ash Meadows. One is federally endangered, Amargosa niterwort (*Nitrophila mohavensis*), and six are federally threatened: Ash Meadows milkvetch (*Astragalus phoenix*), spring-loving centaury (*Centaurium namophilum*), Ash Meadows sunray (*Enceliopsis nudicaulis* var. *corrugata*), Ash Meadows gumplant (*Grindelia fraxino-pratensis*), Ash Meadows ivesia (*Ivesia eremica*), and Ash Meadows blazing star (*Mentzelia leucophylla*).

The other plant species are considered sensitive by other organizations, such as the State of Nevada or the Nevada Natural Heritage Program (NNHP). Six plants are on Nevada's "At Risk" list (NNHP 2004): white bearpoppy (*Arctomecon merriamii*), alkali mariposa lily (*Calochortus striatus*), Ash Meadows lady's tresses (*Spiranthes infernalis*), Tecopa birdsbeak (*Cordylanthes tecopensis*), Death Valley blue-eyed grass (*Sisyrinchium funereum*), and St. George blue-eyed grass (*Sisyrinchium radicatum*). Three others are considered sensitive by the NNHP: Darin buckwheat (*Eriogonum concinnum*), Parish's phacelia (*Phacelia parishii*), and Death Valley sage (*Salvia funerea*).

A recovery plan for 12 endangered and threatened species at Ash Meadows NWR has been approved and is being implemented by the Service (1990). The recovery plan describes each species and its habitat in detail, along with recovery goals and objectives.

Noxious Weeds

Sixty-three nonnative species have been identified on Ash Meadows NWR, of which 10 are considered noxious.

The Service prepared an Integrated Pest Management (IPM) Plan in 2006 and is beginning to implement strategies to manage invasive species (Service 2006b). The IPM Plan describes a variety of methods that include a combination of biological, mechanical, chemical, and cultural controls. The use of chemical and mechanical controls on Ash Meadows NWR is limited by the presence of sensitive species. Removal of weeds must be combined with revegetation and restoration techniques to avoid adverse effects to these sensitive species. The IPM Plan outlines herbicide methods, specific time frames, adaptive management, and cost estimates for control of invasive, nonnative plants, especially the noxious weeds.

Wildlife

Ash Meadows NWR is a haven for wildlife, especially rare fish, plants, snails, and insects, many of which are found nowhere else on earth (See Appendix H for a species list). Water bubbles up from underground sources into clear spring pools as silvery blue and grayish green pupfish dart between swaying strands of algae. Pebbled streams gurgle from small hillside springs, sheltering tiny beetles and snails. The water is warm and the air moist, in contrast to the surrounding Mojave Desert.

Ash Meadows NWR has a greater concentration of endemic species than any other local area in the United States, and it has the second greatest concentration in North America. Five of these species are fish, one is a mammal, at least 12 are aquatic snails, and two are aquatic insects. Several of these species are considered sensitive. One fish, at least one snail, and possibly one mammal have become extirpated from the Refuge in the past century due to habitat loss related to human activities, particularly agricultural, municipal, and mining development.

Amphibians and Reptiles

Five amphibians and 20 reptiles are known to occur on the Ash Meadows NWR. Reptiles and amphibians are most visible during the spring and fall. Toads are most visible right after spring and summer rains, when they become very active feeders and breeders. Snakes are also observed more often during the spring and early fall because they become more nocturnal during the heat of mid-summer (Service 2006a). Horned lizards (*Phrynosoma platyrhinos*) are present at the Refuge and are commonly collected for personal and commercial uses.

Bullfrogs (*Rana catesbeiana*) were introduced into the wetlands and natural springs sources on the Refuge (Service 1994b). Bullfrogs prey on native fish, including their eggs and young, and thus adversely affect recovery efforts. Following completion of an Environmental Assessment for frogging activities (Service 1994b), the Service has allowed bullfrog harvesting by Refuge staff, Nevada Department of

Wildlife (NDOW) staff, and permitted members of the public to protect native fish species.

Birds

More than 239 different species of birds have been recorded within Ash Meadows NWR. The greatest diversity and numbers of birds occur during migration periods from the Pacific Flyway migration route. Spring migration usually occurs during April and May, and fall migration occurs from mid-August through September, when Ash Meadows supports thousands of pass-through migrants fattening up for the coming breeding season or for wintering in the tropics. It appears to be a very important stop-over site for migrant landbirds. During the winter, marshes and reservoirs support a large variety of water birds.

Mesquite and ash tree groves throughout the Refuge harbor resident and migratory birds year-round. Several species of migrants and residents that occur at Ash Meadows are listed on the Service list of Birds of Conservation Concern and as conservation priorities in the Partners in Flight bird conservation plan for Nevada. Some of these priority bird species include eared grebe (*Podiceps nigricollis*), western grebe (*Aechmophorus occidentalis*), Franklin's gull (*Larus pipixcan*), black tern (*Chlidonias niger*), snowy egret (*Egretta thula*), marbled godwit (*Limosa fedoa*), snowy plover (*Charadrius alexandrinus*), long-billed curlew (*Numenius americanus*), white-throated swift (*Aeronautes saxatalis*), Arizona Bell's vireo (*Vireo bellii arizonae*), southwestern willow flycatcher, western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), and canvasback (*Aythya valisineria*) (see Appendix H for more species and the habitats the species occur in on the Refuge).

A few pairs of endangered southwestern willow flycatchers have been documented using Ash Meadows as breeding habitat from June through August each year (Service 2006a). Two endangered species success stories, the peregrine falcon and bald eagle, also use Ash Meadows seasonally as a migration stop-over.

Mammals

More than 30 species of mammals have been observed on the Refuge. Desert bighorn sheep are occasionally observed at Point of Rocks Spring and Devils Hole (Service 2006a). Small game species also occur on the Refuge, such as cottontail rabbit (*Sylvilagus* spp.) and jackrabbits (*Lepus* spp.).

Aquatic Species

Four of the 10 species of fish present in Refuge waters are endangered; the other six are introduced exotic species (Service 2006a). Nonnative species such as largemouth bass (*Micropterus salmoides*), mosquitofish (*Gambusia affinis*), and sailfin molly (*Poecilia latipinna*) are being removed by the Service, as they are harmful to the native fish by competing for the same limited resources, preying on native fish, and introducing nonnative parasites (Service 1990). Crystal Reservoir provides favorable spawning habitat for nonnative species and is a source for these predatory nonnative species

that threaten native fish populations in the springs and channels upstream.

Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) can be observed year-round at all the major springs and streams on the Refuge, but they are most visible at Point of Rocks Spring. Male pupfish take on a bluish cast during the spring and summer breeding season, whereas females remain olive green year-round. Warm Springs pupfish (*Cyprinodon nevadensis pectoralis*) can be found in a wide variety of habitats, including shallow and deep streams flowing from springs. The Ash Meadows speckled dace (*Rhinichthys osculus nevadensis)* were historically located in numerous springs and streams on the Refuge, but these populations were extirpated except at Bradford and Jackrabbit Springs. The Devils Hole pupfish occurs in a small, water-filled cavern called Devils Hole (Figure 4.2-3). Devils Hole is the most restricted habitat in the world containing the entire population of a vertebrate species (Service 1980). The National Park Service (NPS) manages the habitat and species of pupfish at this location. The Refuge also supported two refugia populations of the pupfish, one at Point of Rocks (currently online) and a second refugium at School Springs (currently offline).

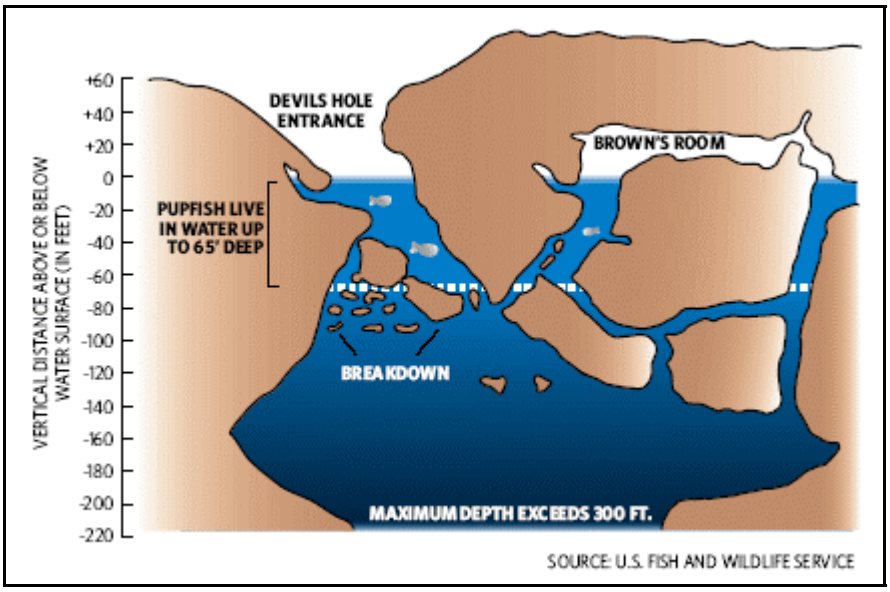

Figure 4.2-3. Devils Hole Pupfish Habitat

Like many of the endemic species on the Refuge, aquatic invertebrates have become isolated from other similar populations due to their specialized habitat requirements. Their ancestors tend to resemble species found in South America and southern latitudes in North America (Service 1990). The Ash Meadows naucorid (*Ambrysus amargosus*) is endemic to Ash Meadows. Other aquatic invertebrates endemic to Nevada with habitat or known occurrences on the Refuge include the Devils Hole warm spring riffle beetle (*Stenelmis calida calida*), sportinggoods tryonia (*Tryonia angulata*), Point of Rocks tryonia (*T. elata*), minute tryonia (*T. ericae*), median-gland Nevada spring snail (*Pyrgulopsis pisteri*), Fairbanks spring snail (*P.*

fairbanksensis), and other spring snails (*Pyrgulopsis* spp.) (Otis Bay and Stevens Ecological Consulting 2006).

Mollusks and crustaceans, such as spring snails and crayfish, occupy the spring pools and immediate outflows of most of the local springs and seeps on the Refuge. The nonnative Malayan trumpet snail (*Melanoides tuberculata*) is found in Refuge springs. The nonnative Louisiana crayfish (*Procambarus clarkii*) preys on native fish in the springs and streams of Ash Meadows NWR. Crayfish were likely introduced through the release of live bait, and they have spread into streams and spring habitats throughout Nevada. Active crayfish trapping programs are implemented on the Refuge to control this species; however, crayfish continue to threaten native aquatic species.

Sensitive Wildlife Species

Fifty-three sensitive wildlife species have the potential to occur at Ash Meadows NWR. These species are federally listed as threatened or endangered or are considered sensitive by the NNHP or state of Nevada (Appendix H). Of these species, two are reptiles, 16 are birds, 13 are mammals, four are fish, and 18 are invertebrates. Species accounts for the federally listed species are provided in Appendix H. Some details on the fish and birds are described above.

All of the sensitive fish species are endemic to Nevada, as are several of the invertebrates and one of the mammals. The endangered and threatened species include: southwestern willow flycatcher, Yuma clapper rail, bald eagle (*Haliaeetus leucocephalus*, delisted August 8, 2007, being monitored), Devils Hole pupfish, Ash Meadows Amargosa pupfish, Warm Springs pupfish (*Cyprinodon nevadensis pectoralis*), Ash Meadows Speckled Dace, and the threatened Ash Meadows naucorid.

A Recovery Plan for the Endangered and Threatened Species of Ash Meadows has been approved and is being implemented by the Service (1990). The recovery plan describes each species, its habitat needs, and its recovery goals in detail.

4.2.3 Cultural Resources

Introduction

Water was a key resource for prehistoric and historic-period people attempting to survive in a harsh desert environment. The plant and animal habitat at the springs provided sustenance for these groups and allowed them to thrive despite the harsh surroundings. Most of the Ash Meadows NWR has been recently investigated through archaeological reconnaissance surveys.

Prehistoric Archaeology

Nearly 300 prehistoric and/or historic sites are known to exist on the Refuge that reflect short-term, limited types of activities, and some are extensive campsites representing a variety of activities over several thousand years. At the sites determined to be eligible for listing on the National Register of Historic Places (NRHP), diagnostic artifacts, hearths, and fire-affected rock are often found, and a variety of

grinding tools are common. Ceramics associated with the Southern Paiute and Shoshone as well as Far Western Puebloan groups have also been recorded.

Historic Archaeology

Historic sites are those sites that resulted from use of the region by Euro-Americans or other groups after contact with native peoples. They document interactions between Euro-Americans and Native Americans. For many portions of southern Nevada, this happened during the mid-1800s. On the Ash Meadows NWR, a smaller percentage of historic sites relate to mining and ranching activities in the area. These generally consist of modest structural remains and associated historic debris scatters or trash dumps. Buildings on the Refuge include a cabin made of railroad ties and others made of rock and wood. Some of the buildings are evident only through observation of piles of fallen bricks. One important historic site is the Charles King homestead. It was the first Anglo homestead at Ash Meadows established as a modest ranch to supply the miners near Death Valley with beef. The site includes King's house and associated historic-period debris. The Jack Longstreet cabin is associated with an extensive lithic and pottery scatter that documents his close association with many of the Paiutes living in Ash Meadows. He was married to a Southern Paiute woman and befriended other Paiutes on occasion in dealing with other Anglo-Americans in the area. Both of these sites have characteristics that make them eligible for listing on the NRHP. There is also an Indian Cemetery within the Refuge that tribal descendants still visit that reflects the long, continued use of the Ash Meadows area.

4.2.4 Public Access and Recreation

Public Access

Ash Meadows NWR is open daily to the public year-round from sunrise to sunset; access is free of charge. The public is encouraged to visit the Refuge and experience this valuable and unprecedented example of desert oases that are now extremely uncommon in the southwestern United States.

The southern entrance to Ash Meadows NWR can be accessed from Pahrump, Nevada, by traveling west on Bell Vista Road (aka Bob Rudd Memorial Highway) and turning north onto Spring Meadows Road (Figure 1.7-1). Access to the western portion is via Nevada State Route (SR) 373/Highway 127 from Death Valley Junction. None of the roads on the Refuge are paved, and many are inaccessible during and following inclement weather. Refuge roads are subject to closure in the wet winter months due to high clay content on native roads. Because of the sensitivity of many of the listed species and their habitats, vehicles are restricted to major roads. The entire Refuge, including roads, is closed to off-highway vehicle use by the public. Vehicle parking is restricted to existing parking areas (Service 2000a).

The Refuge receives visitors from the local areas of Amargosa Valley, Pahrump, and Las Vegas, as well as from numerous other states and foreign countries. A visitor sign-in sheet is located at the Refuge office, and visitors are asked for comments and the number of people in their

group. Traffic counters are located on the access roads to track the number of cars entering the Refuge. Based on recent estimates, Ash Meadows NWR receives approximately 65,000 visitors annually.

Recreation

The Refuge is a day use area, open sunrise to sunset, with numerous recreational opportunities. Wildlife-dependent activities include wildlife observation, photography, environmental education, interpretation, and hunting. Non–wildlife-dependent activities include picnicking, recreational boating, and virtual geocaching. Wildlife observation, picnicking, and hunting are the more popular activities enjoyed by Refuge visitors (Service 2006a).

The Refuge administrative office serves as a visitor contact station. The office is open Monday through Friday from 8:00 a.m. to 4:00 p.m. as staffing permits. The visitor contact station is currently closed on weekends. Brochures, maps, and fact sheets are available at the visitor contact station. The Crystal Springs Interpretive Boardwalk Trail and an interpretive kiosk are located near the visitor contact station. The boardwalk offers a unique opportunity for visitors to view the restored spring system and associated wildlife. Picnic tables and restrooms are located at the visitor contact station, and one picnic table and portable toilet are located at the Point of Rocks parking area. The planning and design for a loop boardwalk in the Point of Rocks/Kings Pool area with interpretive panels, improved parking, and restrooms are currently under development. Power, phone service, and running water are available at the administrative offices and at select locations on the Refuge for maintenance purposes.

Nature trails, kiosks, and the administrative office/visitor contact station are the primary facilities used by visitors (Service 2006a). During fiscal year (FY) 2002, almost 8,000 people stopped at the contact station, about 4,000 people visited the kiosks, and 14,000 visitors hiked the nature trails and paths.

Wildlife-Dependent Recreation

Wildlife photography and observation opportunities are available throughout the Refuge, with the best places being near bodies of water and at Carson Slough. The presence of riparian vegetation and open water attracts numerous birds to the area and makes bird-watching a popular activity. The National Audubon Society performs surveys for birds at Ash Meadows NWR, and bird lists generated from the Refuge have been included in the Nevada Breeding Bird Atlas. A bird list is available at the Refuge headquarters and online at the Ash Meadows NWR Web site. The Refuge is also internationally known as a top birding spot because of its classification as a Wetland of International Importance (Ramsar Convention 2004) and is designated as a Nevada Important Bird Area (IBA).

Opportunities for observing the endangered Ash Meadows pupfish exist at all major springs, but are best at Kings Pool, located at Point of Rocks. Devils Hole, home of the endangered Devils Hole pupfish, is managed by the NPS and is part of Death Valley National Park.

Educational opportunities are available on and off the Refuge. Ash Meadows NWR has a partnership with Death Valley National Park to educate the community about the Devils Hole pupfish. During FY 2002, 1,125 visitors participated in environmental education opportunities (Service 2006a). Less than half of these visits were staff-conducted tours, with students and teachers as the primary participants. Off-site educational outreach opportunities include group presentations and exhibits. Ash Meadows NWR had an estimate of 30 visits to environmental education exhibits and 201 visits to interpretation exhibits during FY 2005. Other special events to promote the Refuge include news releases and radio or television spots. Many of these activities have decreased in the past three years due to limited funding and staff; however, Refuge visitors have increased more than three-fold since 2000.

An active volunteer program provides additional opportunities for the public to enjoy the Refuge and interact with the staff. 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. Internships are also available for students to earn college credits. Some of the volunteer projects include tree-planting and habitat restoration. The Ash Meadows NWR is extensively used by students and professionals for environmental ecosystem research, including endangered and threatened species studies, groundwater modeling, groundwater chemistry studies, and habitat conservation. College classes occasionally take field trips to the Refuge.

The Desert Complex hosts events for National Wildlife Refuge Week and Migratory Bird Day, and the Refuge had a ribbon-cutting ceremony for the restored Jack Longstreet cabin in 2005. The Desert Complex staff also attends local events to promote environmental education about Ash Meadows NWR. Such events include the Clark County Fair, Clark County ECOJAM (Earth Day event), Gran Fiesta (September 2002), and Boy Scout Day Camp (May 2003). Desert Complex staff or Refuge staff also attended the Governor's Conference on Tourism, Dia de los Niños, and Las Vegas Chamber of Commerce Preview, depending on staff availability and funding.

Hunting for waterfowl, dove, and quail is allowed on the Refuge where posted and in accordance with state regulations (Service 2000a) (Figure 4.2-4). Waterfowl hunting generally occurs at Peterson Reservoir, the southern portion of Crystal Reservoir, and Lower Crystal Marsh. During the migratory waterfowl hunting season, only nonmotorized boats or boats with electric motors can be used. Target practicing is not allowed at any time. In FY 2002, 2,900 visitors participated in hunting activities (Service 2006a).

Fishing is not currently allowed on the Refuge. The largemouth bass was introduced into most Refuge waters in the 1960s. This nonnative fish is considered a threat to the native endangered fish and is being removed from Refuge waters (Service 2000a).

Non–Wildlife-Dependent Recreation

Hiking is available along designated roads and trails. No camping or overnight parking is permitted (Service 2000a). Due to the presence of waterfowl and sensitive species, swimming is prohibited in all spring pools. Only boats without motors, or with electric-powered motors (no gas-powered) are allowed on Crystal and Peterson Reservoirs and Lower Crystal Marsh. Off-road vehicle use is also prohibited on the Refuge. Virtual geocaching is allowed with permission from the Refuge Manager.

Picnicking opportunities are currently available at the visitor contact station and at the Point of Rocks Spring area. The visitor contact station also has picnic tables and restrooms. Point of Rocks Spring has picnic tables and a portable toilet.

4.2.5 Social and Economic Conditions

Refuge Management Economics

The current Refuge staff consists of four full-time employees, one non-funded biologist, and one non-funded outdoor planner and laborer. The refuge operations budget for 2005 was $235,000. The maintenance budget for the Refuge was $58,175.50.

NWRs contribute funds to local counties through revenue-sharing programs that are intended to cover costs for either lands purchased in fee title or lands reserved from the public domain. For FY 2003, Nye County received payment in the amount of $21,895 from the federal government under this revenue-sharing program.

Environmental Justice

The Ash Meadows NWR is located within an area once occupied by Western Shoshone, particularly the Timbisha Shoshone, the Pahrump Paiute Tribe, and the Las Vegas (*Tuh'du Ningwoo*) Paiute band (Kelly 1934; Kelly and Fowler 1986; Martineau 1992; Steward 1997; Department of Interior [DOI] and Timbisha Shoshone Tribe 2000). The Timbisha Shoshone reservation currently includes approximately 10,600 acres throughout southwestern Nevada and eastern California. The Timbisha Shoshone also co-manage 300,000 other acres within Death Valley National Park. In 2000, the Timbisha Shoshone Homeland Act (Public Law [PL] 106-423) identified the potential for a cooperative agreement between the affiliated tribe and the Service.

The communities of Pahrump and Amargosa Valley are located within 10 miles of the Refuge. Both communities indicate that the Hispanic or Latino population is the largest minority group, approximating 10 percent of the total population (U.S. Census Bureau 2000). The communities may also be considered low-income communities based on the median family income, which is approximately $10,000 less than the state median family income, although it is comparable to the county's median family income at around $40,000.

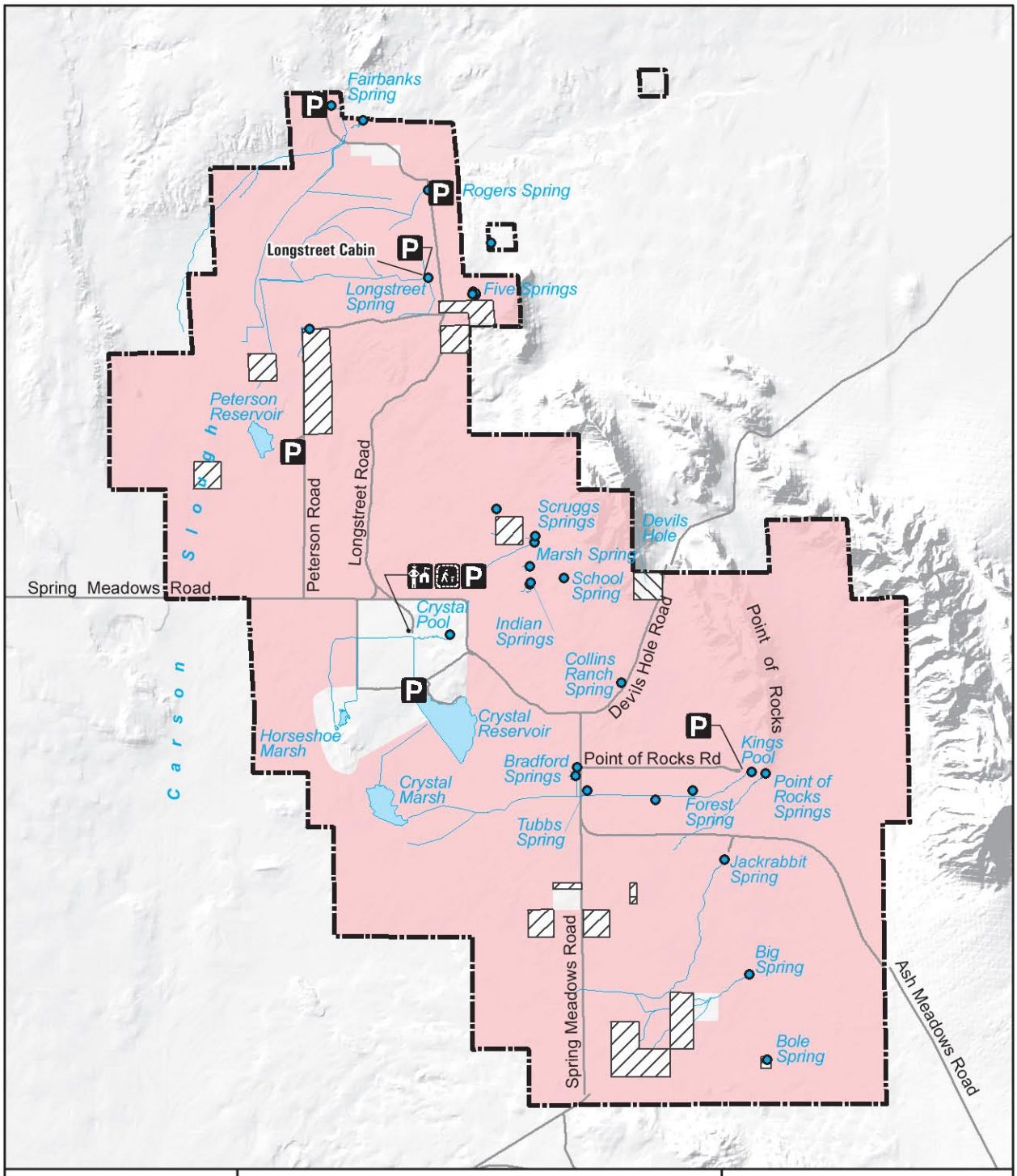

Figure 4.2-4

Visitor Services

Ash Meadows NWR

March 25, 2008
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Figure 4.2-4-ashmeadows_hunt_rec.mxd

Land Use

Land surrounding Ash Meadows NWR is a rural setting with a low population density and a relatively small number of ranches, farms, and mining enterprises (Service 1987a). From 1980 to 1983 municipal development activities disturbed 12,654 acres of private land, which are now within the Refuge boundary (Service 1984b).

The land was subsequently purchased by The Nature Conservancy (TNC) and resold to the Service to establish the Ash Meadows NWR (Service 1990). Since establishment of the Refuge on June 18, 1984, the Service has undertaken restoration activities throughout the Refuge.

Of the 24,000 acres within the approved Refuge boundary, the Service manages approximately 22,729 acres (including BLM lands), the NPS manages 40 acres around Devils Hole, and the rest are privately owned (approximately 676 acres) (Figure 1.7-1). Private lands are mostly unoccupied and consist of residences, a clay processing plant, and a private landing strip. The Service has a Cooperative Management Agreement with the BLM to manage BLM-administered lands within the Refuge. The NPS manages and monitors Devils Hole to protect and research the Devils Hole pupfish.

The entire boundary is surrounded by BLM lands that were designated as the Ash Meadows ACEC. This area has been set aside for the protection of the endemic species of Ash Meadows.

Aesthetics

Ash Meadows NWR consists of more than 24,000 acres of spring-fed wetlands and alkaline desert uplands and provides excellent views of the night sky for stargazers due to the lack of light sources in the vicinity. The Refuge provides habitat for at least 25 plants and animals found nowhere else in the world and provides a unique visual quality opportunity.

The Refuge is a major discharge point for a large underground aquifer system stretching 100 miles to the northeast. Water-bearing strata come to 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.

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 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. The Refuge is currently in the habitat restoration stage and will likely

remain so for years to come. The overall goal of the Refuge is to restore the area to its natural historic condition by re-directing spring outflows back into former natural channels, restoring wetlands, removing nonnative species, restoring native riparian and upland vegetation, and removing unnecessary structures such as roads, fences, dams, levees, and power lines. Once this is accomplished, visual quality will be improved.

4.3 Desert National Wildlife Refuge

4.3.1 Physical Environment

Physiography

The boundary of the Desert NWR encompasses approximately 1.6 million acres. The Desert NWR consists of typical basin and range topography—a series of narrow north/south-trending mountain ranges separated by wide valleys. Desert NWR is bordered to the north by Emigrant Valley, Desert Mountain Range, Tikaboo Valley, Pahranagat Range, East Pahranagat Range, and the Pahranagat NWR; to the east by the Delamar Mountains, Coyote Spring Valley, and Hidden Valley; to the south by Las Vegas Valley; and to the west by Frenchman Flat and the Halfpint Range (Figure 4.1-2).

Six primary mountain ranges are located within the Desert NWR and consist of, from west to east, the Spotted Range, the Pintwater Range, the Desert Mountain Range, the East Desert Range, the Sheep Range, and the Las Vegas Range. The Papoose Range, a relatively small mountain range, occurs in the northwest corner of Desert NWR. Most of Desert NWR consists of closed hydrographic basins (basins that have interior drainage). Exceptions are the east side of the Sheep Range, where drainage flows east toward Coyote Spring Valley, and the east side of the Las Vegas Range, where drainage flows east toward Hidden Valley. In addition, drainage from the western side of the Spotted Range flows west towards Frenchman Lake, which is a large playa that covers most of Frenchman Flat.

Elevations of Desert NWR extend from approximately 3,500 feet above msl in the valleys to 9,950 feet above msl in the Sheep Range. The elevations of both mountains and valleys are lower in the western half of Desert NWR.

Geology and Minerals

Desert NWR is characterized by a series of north/south-trending mountain ranges separated by wide valleys. Mountains consist mostly of carbonate rocks dating from the Paleozoic period from 543 mya to 248 mya (Tschanz and Pameyan 1970). Some mountains also contain Precambrian (more than 543 mya) and Tertiary (65 to 1.8 mya) rocks. Valleys contain deposits of Tertiary and Quaternary (1.8 mya to present) alluvium derived from erosion of adjacent mountain ranges.

Several faults cross through the mountain ranges on the Refuge. The larger faults run north to south parallel to the ranges (Tingley et al. 1993). Some of these faults include Wildhorse Pass Fault, Mormon Pass Fault, Sheep Basin Fault, and Gass Peak Thrust. Other faults

that run southwest to northeast along the mountain ranges in the northeast portion of the Refuge include Maynard Lake Fault, Buckhorn Fault, and Arrowhead Mine Fault.

Both nonmetallic (mostly construction materials) and metallic minerals such as zinc, silver, lead, gold, and uranium are found in the Desert NWR (Tingley et al. 1993). Although the Desert NWR probably contains large amounts of material that would be suitable for construction aggregate, under current market conditions, aggregate production from the Desert NWR is not economically competitive due to high transportation costs (Tingley 1998). Review of Tingley (1998) and Tschanz and Pameyan (1970) indicates that there were six mining districts within the Desert NWR: Papoose, Southeastern, Slate, Joe May Canyon, White Caps, and Gass Peak. These mines were active during the early 20th century but are no longer in operation.

In 1994, the BLM withdrew 769,543 acres of public mineral estate from location and entry under the mining laws to protect the Desert NWR (BLM 1994). The land has been and will remain open to mineral leasing.

Paleontological Resources

A number of geologic units in Desert NWR have the potential to contain fossils. In general, Paleozoic, Tertiary, and Quaternary deposits have the potential to contain fossils in the region, while Precambrian rocks and igneous or molten rocks are of low potential. Common types of fossils found in those units include primarily sea creatures, such as mollusks, corals, barnacles, algae, and other invertebrates (Tschanz and Pameyan 1970; Longwell et al. 1965). Horse and other vertebrate fossils may also be present.

Mammoth and bison fossils have been found on the Refuge and have been dated to approximately the Pleistocene era (Hallman 1998). Fusulinid fossils have also been found in the Arrow Canyon and Las Vegas Ranges on the Refuge (Langenheim et al. 1977). These fossils are indicator fossils because of their abundance. They have formed entire limestone formations in some areas and date to the Mississippian Period. Brachiopod fossils have also been found in the Wamp Spring area of the Las Vegas Range (Mills and Langenheim 1987).

Soils

Soil mapping and classification has not been completed for the Desert NWR. However, STATSGO data are available from the NRCS (2003a). General soil characteristics are described below for each major vegetative community (Service 1994a).

Soils are generally silty loam within the saltbush community. Soils within the creosote bush community are commonly sandy loams developed from alluvial deposits. In many places there is an overlapping of desert pavement or cobblestone. Soils common to the blackbrush community have developed from the older alluvium deposited on the upper slopes and the rocky soils of the lower

mountains. This desert soil is slightly darker and contains more organic material than the soil in the creosote bush community.

Soils associated with the pinyon-juniper community tend to be deep sandy loams with some development of distinct soil horizons. Soils in the fir-pine community are higher in organic content than those in the pinyon-juniper community. There is a well-developed soil horizon, and the surface is commonly covered by conifer needles and other ground litter. Soils are shallow and fragile in the bristlecone pine community, which is restricted to steep slopes and ridges at the highest elevations of the Sheep Range.

Water Resources

Surface Water

Surface water on Desert NWR is comprised primarily of direct runoff from precipitation, with the exception of Corn Creek Springs and seeps and springs at higher elevations. Precipitation flows into playa lakes that have no external drainage, including Frenchman Flat, Papoose Lake, Desert Lake, and Dog Bone Lake. Like the springs at Ash Meadows NWR, Corn Creek Springs is a perennial water source that contains discharge from a regional carbonate flow system. The high elevation seeps and springs collect water from precipitation and runoff and provide a small, but important, source of surface water for wildlife. Other surface waters that the Service has rights to include Sand, Tim, Indian Spring Canyon, and Quartz springs within the NTTR overlay.

A variety of artificial rainwater catchments have also been built on Desert NWR to expand the quantity and distribution of water for wildlife. There are currently at least 27 functional catchments in scattered locations (Service 1994a). Artificial catchments of two types are used on Desert NWR. Guzzlers use an impermeable surface of sheet metal, fiberglass, or polyethylene to collect rainwater. Slickrock developments use a small concrete dam to collect rainwater/runoff from a smooth, up-canyon rock surface. Water collected by both types is piped to one or more enclosed tanks with storage capacities from 1,000 to 6,600 gallons. Water from the tanks is piped to float-regulated troughs for wildlife use. There are also two natural water catchments, known as tinajas, which are of value to desert bighorn sheep and other wildlife.

Groundwater

Corn Creek Springs spring flow is typical of regional groundwater because the springs are relatively high yielding, have warmer temperatures, and do not display seasonal variability. Spring flow is suspected to derive largely from precipitation falling in the Sheep Range on the eastern edge of the Refuge that is forced to the surface through faults (Thomas et al. 1996). Compared to the Ash Meadows NWR, Corn Creek Springs are relatively small, with an annual discharge of about 200 afy. Groundwater information is sparse for the Refuge, and only general inferences about groundwater flow paths in carbonate and alluvial aquifers can be made.

In addition to Corn Creek Springs, there are 35 other known springs on the Refuge, many of which are shown in Figure 4.3-1 (Service 1994a). Instead of being fed by the deep carbonate aquifer system (such as Corn Creek Springs), these springs are local springs that receive water from precipitation. Twenty-nine of the springs are typical small mountain springs with flows derived from nearby areas of higher altitude.

Local springs typically have small, variable flow rates ranging from several gallons per minute to only a few gallons per hour. Discharges are seasonably variable, with highest flows occurring during or immediately after spring runoff and storm events and then diminishing or ceasing in late summer or early fall. Discharge from the springs usually travels only a short distance because much of the flow is lost to evapotranspiration.

Water catchments with float-regulated troughs, or drinkers, have been strategically located and constructed across the Refuge. Several thousand gallons of water can be stored in large reservoirs at these mountainous sites where precipitation is seasonally or severely reduced during dry conditions. Thirty springs have been improved, and 26 water troughs have been constructed and maintained.

Though derived from local precipitation, Coyote Spring, on the east side of the Sheep Mountains, is also reported to be relatively high yielding. Recharge from the Sheep Mountains flows eastward, discharging from an alluvial, water-bearing zone in the bluffs on the west side of the White River channel.

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.

Water Quality

With the exception of Corn Creek Springs, little is known about the groundwater quality in the majority of springs on Desert NWR. Water from Corn Creek Springs is quite similar to that from springs at Ash Meadows NWR with respect to dissolved solids (418 mg/L). In contrast, water sampled from other springs is of poorer quality, with concentrations of dissolved solids as high as 3,700 mg/L (Thomas et al. 1996).

Water Use

Primary water use on Desert NWR is by wildlife from springs and catchments, with some domestic water use at Corn Creek Field Station. Groundwater pumping occurs in the Las Vegas Valley for domestic uses, and about 58,000 acre-feet of water were pumped in 2001 (NDWR 2001).

Water Rights

Water rights within the main undeveloped hydrographic basins that comprise Desert NWR total approximately 22,000 afy. About 1,300 afy of groundwater rights are held within 6 miles of Corn Creek Springs, primarily by the U.S. Air Force (USAF) and the Las Vegas Paiute Tribe. The SNWA was recently granted water rights in Three Lakes and Tikaboo Valleys.

According to records from the NDWR (2003), the Service has filed for 34 water rights on Desert NWR (32 rights for spring flow, two rights for wells). Most of these rights are either vested or federal reserved rights. The remaining water rights include a vested water right of 71.5 acre-feet at Corn Creek Springs. Fourteen rights were documented in the Las Vegas Artesian Basin Decree (December 23, 1999 Findings of Fact). Federal reserved rights are not quantified, but generally allow the use of enough water to allow the reserved lands to fulfill their planned use.

Hazardous Materials

The Desert NWR is located in the South Range of the NTTR. Solid and hazardous wastes are generated on the South Range. Trash disposal areas, exploded ordnance disposal sites, practice and live ordnance ranges, and electronic countermeasures sites are typical examples. In addition, depleted uranium from munitions testing; residues from bomb testing, spills, and aircraft crashes; and radiation testing have also presented environmental concerns on the Desert NWR. Site and facility assessments conducted by the USAF on the NTTR overlay of the Refuge concluded that buried solid waste does not have the potential to cause adverse environmental effects, and the use of depleted uranium rounds on one target complex of the NTTR does not appear to pose a hazard to public health or create an environmental hazard (BLM 2001).

The USAF implements measures to contain hazardous materials and prevent environmental impacts. Hazardous wastes are stored on designated sites for up to 90 days prior to being picked up by a contractor and transported to appropriate off-site disposal facilities. The waste materials are typically stored in drums or other containers that are sealed, labeled, and placed on spill containment pallets or wooden pallets and covered with a tarp or hard Apoly shell. At hazardous waste accumulation points, containers are housed within locked and ventilated hazardous waste containment buildings or within other appropriate facilities. The wastes are isolated from the ground with asphalt, concrete, or bermed concrete surfaces. The accumulation site locations are fenced. Underground storage tanks on the NTTR are removed or replaced when they are found to be leaking (BLM 2001).

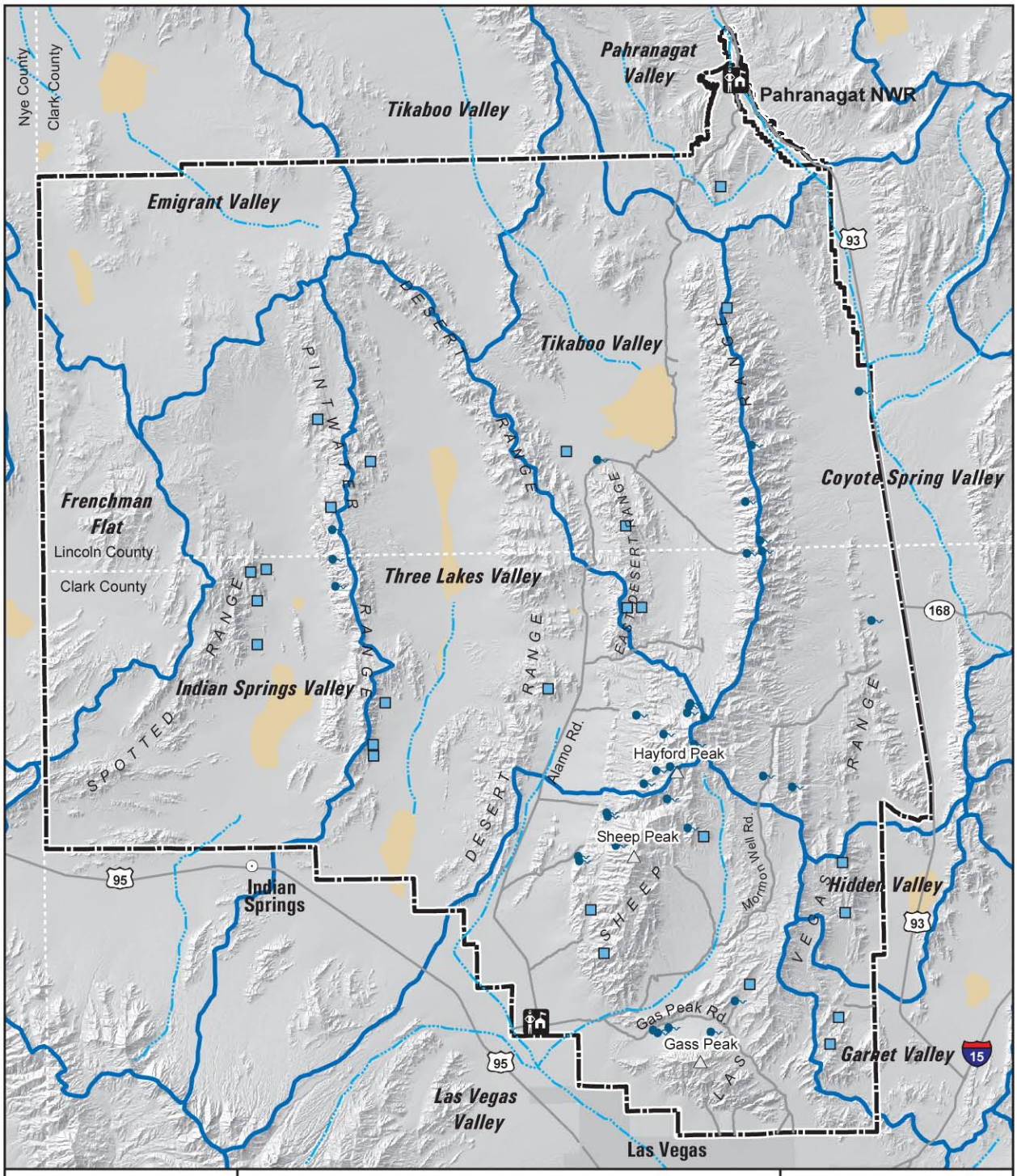

Figure 4.3-1

Hydrology

Desert NWR

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Figure 4.3-1-desert_hydro.mxd

Fire History and Management

Desert NWR's fire history generally revolves around naturally ignited fires occurring at higher elevations of the Refuge. Generally, most natural ignitions occur on the Refuge from June to October (Service 2004c). In lower-elevation portions of the Refuge, the fuels are not continuous and fire size is limited. In higher elevations, lightning-caused fire likely played a key role in maintaining an open stand structure. The fire frequency of pinyon-juniper woodlands varies with the abundance of fine fuels, but they generally burn every 50 to 100 years when fuels are sparse. It is unkown what role Native Americans had in fire ignitions.

Fire exclusion probably began with the establishment of the Corn Creek Ranch in the early 1900s (Service 2004c). At present, the burning season (including human-caused ignitions) is primarily April through September. Current fire history shows an average of three fires per year for a total of 10 acres. These data are not accurate due to remoteness and lack of observed fire activity. Most fires are caused by lightning and occur during the monsoonal season, usually from July through September.

Fire occurrence on the Refuge has a higher incidence than what is recorded because of the remoteness of the area and difficulties with detection. Numbers of detected fires per year vary from zero to usually fewer than 10. Most fires occur on the Sheep Range as a result of lightning. The largest fire in the pinyon-juniper habitat from records dating back to 1946 was 100 acres. Fires in the low desert shrub fuel type have burned in excess of 1,000 acres, e.g., the Pinenut Fire of 1994. More recent fires have burned even larger areas of the Refuge. In most instances, fires are extinguished by rain or lack of adjacent fuels rather than suppression efforts.

There is no recorded recent prescribed fire history on the Refuge.

Air Quality

Currently, ambient air quality is not measured at Desert NWR, and the nearest major sources of emissions are in the Las Vegas area. It is expected that low ambient concentrations of criteria pollutants would occur in most of this area. The nearest air quality sampling station is located less than 5 miles south of the Desert NWR boundary at Bemis Road and Craig Road. This station is located in an area where new construction is occurring and measurements of concentrations are likely higher than in non-construction areas. Although these concentrations may be representative of the southern boundary of the Desert NWR, the concentrations are expected to be significantly lower as one moves further north of the developed areas (CCDAQM 2003b).

The regional air quality section (Section 4.1.1) provides additional information on air quality protection and regulatory measures in Clark County.

4.3.2 Biological Resources

Vegetation

Habitat Types

Desert NWR is located in a transition zone between the Mojave and Great Basin Deserts and contains diverse flora and fauna found over a wide elevation range that are representative of both deserts (Figure 4.3-2). The Refuge contains more than one-third of the 75 different ecological systems mapped in Nevada (USGS 2004). The predominant communities are desert shrubland and montane (Ackerman 2003). Corn Creek consists of a small amount of riparian, wetland, and aquatic habitats. Ackerman (2003) identified 702 plant species in 80 families within the Desert NWR. Of the species identified, 52 are introduced or nonnative species. Most of the introduced species (31 species) occur in the Corn Creek Field Station and vicinity. Ackerman also discovered three plants endemic to the Desert NWR: Ackerman milkvetch (*Astragalus ackermanii*), remote rabbitbrush (*Chrysothamnus eremobius*), and pygmy poreleaf (*Porophyllum pygmaeum*). A description of each habitat type is provided in the following paragraphs.

Corn Creek Field Station contains the main aquatic habitat on the Desert NWR. Corn Creek Springs are part of the field station and consist of three main springs. Water from the springs flows down a common channel toward the Desert NWR's main reservoir, which is about 400 feet west of the springs. Water is pumped from the reservoir to irrigate the pasture. Dense vegetation can be found along the length of the channel and surrounding the springs and pond. This vegetation consists of riparian woodlands and shrublands and mesquite bosques. The riparian woodlands consist of nonnative deciduous trees, such as black locust (*Robinia pseudoacacia*) and Russian olive (*Elaeagnus angustifolia*). Native species include honey mesquite (*Prosopis glandulosa*) and willow (*Salix* spp.) and ash species. Common reed (*Phragmites australis*) and southern cattail occur in and around the springs and ponds. Numerous migratory birds and other wildlife use habitat at the Corn Creek Field Station.

At low elevations on the Refuge, grassland, steppe, and shrubland habitats dominate. The grassland habitat contains primarily perennial bunch grasses and drought-tolerant plants and occurs on dry plains and mesas. This habitat is dominated by invasive species, such as brome (*Bromus* spp.) and Mediterranean grass (*Schismus barbatus*). The steppe habitat occurs on alluvial fans and flats and consists mostly of graminoids, or grass-like plants, with an open shrub layer.

The salt desert scrub habitat consists of various saltbush species found in saline basins on valley floors and around playas. Areas with low nocturnal temperatures and very high soil salinity are common in these basins and support most of this habitat. This habitat, including playas, encompasses about 200,000 acres on the Desert NWR (Service 1977). The typical elevation range for the salt desert scrub habitat in the Mojave Desert is 3,000 to 5,600 feet, but on the Desert NWR, it is found mostly at lower elevations (DOE 2002). At the higher elevations, salt desert scrub often mixes with the creosote–white bursage alliance.

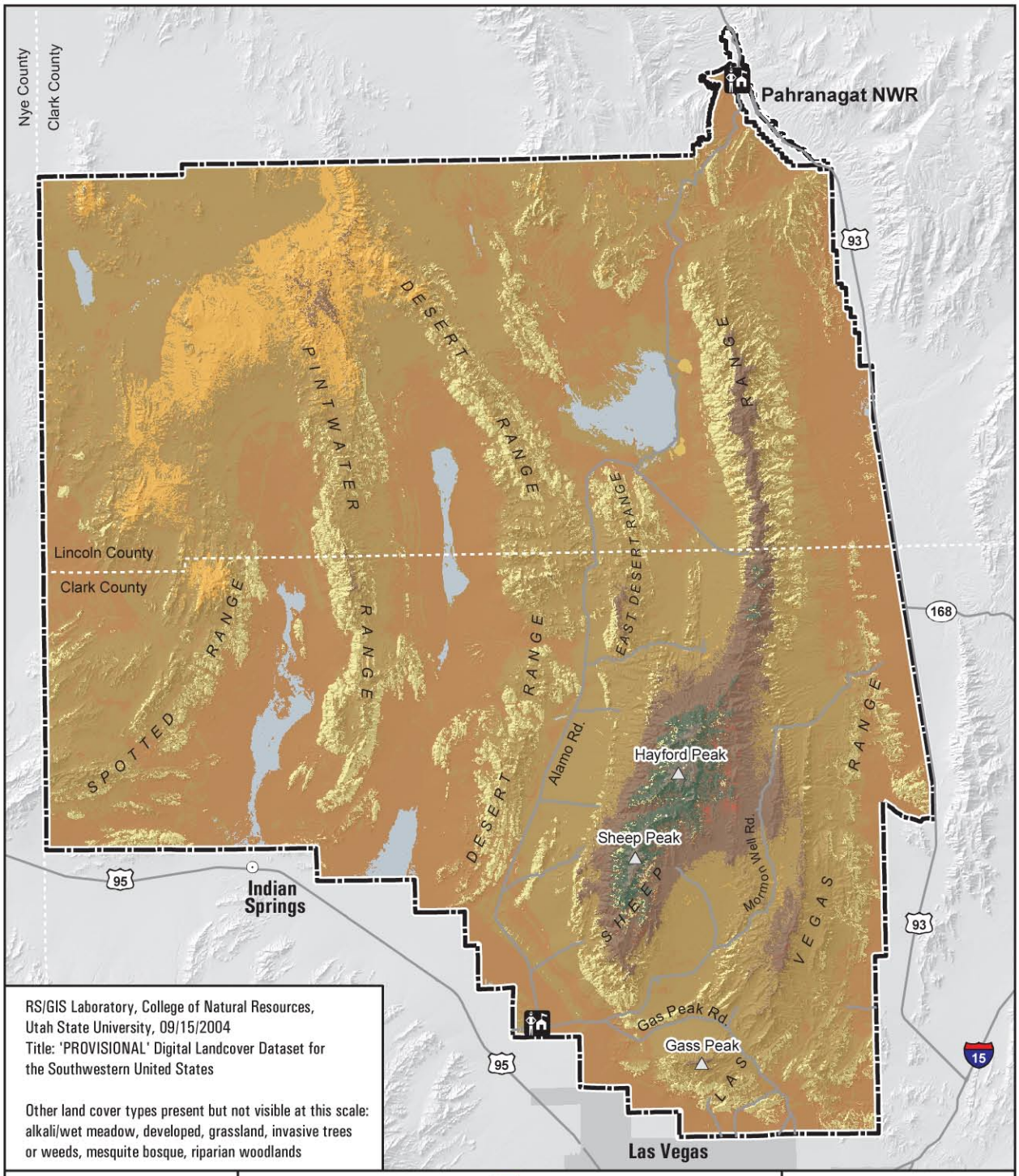

Figure 4.3-2

Vegetation Types

Desert NWR

April 28, 2008
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Figure 4.3-2-desert_veg.mxd

The creosote–white bursage scrub alliance occurs in broad valleys, lower bajadas, plains and low hills. This alliance is characterized by widely spaced shrubs and succulents averaging 2 to 8 feet tall, with 2 to 50 percent cover (Holland 1986; Rowlands et al. 1982; Vasek and Barbour 1977). Creosote bush and white bursage are the codominants in this habitat. Mojave yucca and Joshua tree comprise the overstory. The herbaceous layer is sparse, but seasonally abundant after rain events. The creosote–white bursage scrub alliance occupies about 600,000 acres of the Desert NWR (Service 1977).

Creosote–white bursage scrub transitions to mixed desert scrub at elevations near 4,000 feet above msl. The replacement of white bursage by blackbrush (*Coleogyne ramossissima*) typically demarcates this boundary (Holland 1986; Rowlands et al. 1982; Vasek and Barbour 1977). This habitat covers about 530,000 acres of the Desert NWR (Service 1977). Plant species found in this habitat are very similar to those in the creosote–white bursage alliance, but they typically consist of intricately branched shrubs that range from 1.5 to 3 feet tall (Holland 1986). This community often integrates with mixed sagebrush shrublands, Joshua tree woodlands, and pinyon-juniper woodlands. Mojave yucca and Joshua tree are very common throughout the mixed desert scrub habitat (BLM 1990).

Mixed sagebrush and big sagebrush shrublands occur above the mixed desert scrub habitat. Big sagebrush shrublands occur on broad basins between mountain ranges, on plains, and on foothills. The dominant species is big sagebrush (*Artemisia tridentata*). Juniper species (*Juniperus* spp.), other sagebrush (*Artemisia* spp.), small shrubs and herbaceous vegetation are also found with big sagebrush. The mixed sagebrush shrublands occur on dry flats, plains, alluvial fans, rolling hills, rocky slopes, saddles, and ridges. They are typically exposed to wind and consist primarily of shrubs with a sparse herbaceous layer of bunch grasses. The dominant species include black sagebrush (*Artemisia nova*) and little sagebrush (*A. arbuscula*).

Chaparral habitats occur on sideslopes as a transition zone from low elevations to woodlands. They consist primarily of evergreen shrubs, such as bearberry (*Arctostaphylos* spp.) and scrub oak (*Quercus* spp.).

At higher elevations, the Desert NWR consists of woodlands, coniferous forests, and alpine habitats. The pinyon-juniper woodland occurs on warm, dry sites on slopes mesas, plateaus, and ridges, typically at elevations between 6,000 and 7,500 feet (Ackerman 2003). The dominant species on the Desert NWR are Utah juniper (*Juniperus osteosperma*) and single-leaf pinyon pine (*Pinus monophylla*).

The understory consists mainly of shrubs, such as sagebrush species. Ponderosa pine (*Pinus ponderosa*) and white fir (*Abies concolor*) are common at the upper extremes of the habitat. The pinyon-juniper woodland covers about 183,000 acres of the Desert NWR (Service 1977).

Mixed coniferous forest and woodlands occur above the pinyon-juniper habitat and exist on all aspects of the mountain ranges. Temperature, moisture, and successional stages define the composition and structure of this habitat. A Ponderosa pine–white fir alliance covers about 70,000 acres of the Desert NWR (Service 1977) and occurs between elevations of 7,500 and 9,000 feet above msl (Ackerman 2003). Ponderosa pine exists mostly in canyon bottoms and on protected slopes. White fir is more abundant at higher elevations.

The limber–bristlecone pine (*Pinus flexilis–P. longaeva*) alliance occurs at high elevations on ridges and rocky slopes above the coniferous forests and woodlands. Harsh conditions due to the short growing season limit plant growth, and the understory contains a sparse shrub and herbaceous layer. The alliance covers about 3,000 acres of the Desert NWR (Service 1977) and is generally restricted to the Sheep Range at elevations between 7,600 ft and 9,000 feet (Ackerman 2003).

Alpine wet meadows can be found at high elevations, primarily on the Sheep Range. The wet meadow is associated with snowmelt and occurs in flat areas, on gentle slopes, or in valleys around open water. Dominant species are graminoids, but varieties of black sagebrush may also occur at high elevations on the Refuge. It covers approximately 200 acres of the Desert NWR (Service 1977) on the south and west facing slopes of Hayford and Sheep Peaks above 9,500 feet (Ackerman 2003).

Other cover types on the Refuge include playas, cliffs and outcrops, desert pavement, dunes, and volcanic rockland. These covers are mostly unvegetated (less than 10 percent). Playas, or dry lakes, are subject to intermittent flooding and occur adjacent to the salt desert scrub habitat. Salt-tolerant species often form vegetation rings around the playas. Dry lakes include Papoose Lake, Desert Lake, Three Lake, and two other unnamed lakes. Desert pavement is found in flat basins and is coated with a “desert varnish.” Desert pavement is typically less than 2 percent vegetated with forbs.

Cliffs and rock outcrops occur on steep slopes, ridges, and cliffs in the mountain ranges at elevations between 5,000 feet and 9,000 feet. Vegetation found on cliffs and outcrops includes succulents, holly-leaved goldenbush (*Hazardia brickellioides*), desert snowberry (*Symphoricarpos longiflorus*), and mountain-mahogany (*Cercocarpus* spp.).

Dunes and sandy areas are typically a result of spring mounds and support woody species, such as woolly bursage (*Ambrosia eriocentra*), sticky-leaved rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*), Kearny buckwheat (*Eriogonum nummulare*), and Thurber penstemon (*Penstemon thurberi*), and annual species, which are often more productive in years with adequate moisture (Ackerman 2003).

Desert washes also occur on the Desert NWR. These are intermittently flooded washes or arroyos associated with rapid sheet and gully flow. They often consist of linear or braided strips within desert scrub or shrublands and grassland habitats.

Sensitive Plant Species

There are no federally listed plant species found on the Desert NWR. However, 21 sensitive species may occur on the Desert NWR (Appendix H). Halfring milkvetch (*Astragalus mohavensis* var. *hemigyrus*) and Las Vegas bearpoppy (*Arctomecon californica*) are listed as critically endangered by the State of Nevada. Appendix H provides a list of sensitive plant species that may occur.

Noxious Weeds

Desert NWR does not currently have an IPM Plan to manage the control of invasive species within its boundaries. Lincoln County and Clark County have treated some areas for the spread of tall whitetop (*Lepidium latifolium*) (Noxious Weed Action Committee 2001). On the Refuge, the Weed Sentry program surveys and treats noxious weeds near public roads and in areas of regular public use, and Southern Nevada Public Land Management Act funding provides a means to treat noxious and invasive weeds and restore sites with native vegetation.

Species common in Clark and Lincoln Counties are likely to occur on the Refuge. Appendix H provides a list of the noxious weeds that may occur or are known to occur at Desert NWR. Common invasive species known to occur on the NTTR are tumbleweed or Russian thistle (*Salsola tragus*), red brome (*Bromus rubens*), and cheat-grass (*Bromus tectorum*). Red brome has adapted to desert climates, but cheat-grass is more prominent in cooler steppe environments (Air Warfare Center 1999).

Wildlife

The Desert NWR is home to many species of wildlife that are supported by its wide variety of habitats over a large elevation range. The various habitats provide food and/or shelter for indigenous mammals, birds, reptiles, amphibians, and invertebrates. Habitat quality varies widely between locations, as do species diversity and richness. Some species are restricted to a particular habitat type, while others may occur in different habitats.

Approximately 320 bird species, 53 mammal species, 35 reptile species, and four amphibian species have been identified in the different communities on the Desert NWR (See Appendix H for a list of species). The majority of wildlife species found on the Desert NWR are non-game species.

Amphibians and Reptiles

Amphibians are not very common on the Desert NWR because they have a high water requirement for survival, and only the Corn Creek Springs and isolated mountain springs provide suitable habitat. In the Mojave Desert–Great Basin Region, only 24 amphibian species are

known to occur (Brussard and Dobkin 1996). The more common species, such as bullfrogs and toads, are more likely to occur on the Refuge.

Reptiles found on the Desert NWR include various species of lizards and snakes, the threatened desert tortoise, and the sensitive Gilbert's skink. Populations of some reptiles potentially occurring on the Desert NWR are threatened by pet collectors, who illegally remove these species from their environment to sell as pets to the public (Brussard and Dobkin 1996). Chuckwallas (*Sauromalus obesus*) are among the most popular reptiles collected. Desert tortoise, western banded gecko (*Coleonyx variegatus*), banded Gila monster (*Heloderma suspectum cinctum*), and other reptiles known to occur in southern Nevada are also threatened with collection (NDOW 2005a).

Birds

More than 300 different species of birds have been recorded on the Refuge. Many of these are migratory songbirds and waterfowl that are attracted to the wetland and riparian habitats at Corn Creek Field Station. Numerous raptors are also found on the Desert NWR and are most commonly viewed on the Refuge during the summer. Corn Creek is a desert oasis used by thousands of landbird migrants each year. The bald eagle (delisted on August 8, 2007) and peregrine falcon (delisted in 1999) occur on the Refuge, as well as several birds of special concern, including northern goshawk, ferruginous hawk, burrowing owl, and phainopepla.

The Sheep Range IBA provides important breeding habitat for flammulated owl, gray flycatcher, black-throated gray warbler, Grace's warbler, and other songbirds (National Audubon Society 2004). It also represents the northern limit of the Mexican whip-poor-will (McIvor 2005). Small seeps and springs provide much needed surface water for birds.

Because of the large variety of habitats present on the Refuge, a wide variety of bird species use the Refuge for breeding, foraging, resting, and during migration periods, including various high-priority management bird species (see Appendix H). Some of these species include eared grebe, western grebe, Franklin's gull, black tern, snowy egret, Bendire's thrasher (*Toxostoma bendirei*), white-throated swift, pinyon jay, Arizona Bell's vireo, southwestern willow flycatcher, black-chinned sparrow (*Spizella atrogularis*), flammulated owl (*Otus flammeolus*), and western yellow-billed cuckoo (see Appendix H for additional species and the habitats they occur in on the Refuge).

Management of these birds and their habitats is considered a priority by the Nevada Working Group of Partners in Flight (1999) and the Great Basin Bird Observatory (2005). For example, bighorn sheep management would also consider pinyon jays and gray vireos because they use similar habitats. Pinyon jays require large, cone-bearing pinyon trees (75 years or older) in patches of at least 18 square kilometers (Balda and Bateman 1971) in mature pinyon-juniper woodlands or monotypic pinyon stands. Gray vireos require open,

mature pinyon-juniper woodlands with shrubby understory on moderate, rocky slopes.

Mammals

Bats are common on the Desert NWR, and six of the potentially occurring bat species are sensitive (BLM 2001). Bats are important to the Refuge because they help regulate insect and invertebrate populations, and some help pollinate plants. Most bats are commonly observed during evening hours. A study of bats at a desert spring (White Hot Spring) in southern Nevada revealed the presence of several species of bats throughout the year (O'Farrell and Bradley 1970). Western pipistrelle (*Pipistrellus hesperus*), California myotis (*Myotis californicus*), and pallid bat (*Antrozus pallidus*) were encountered year-round; the first two are the most active, even in winter months. Activity tends to peak during warmer periods of the day and year.

Many mammal species are found in the creosote bush scrub habitat. Rodents are very common and often make their homes at the bases of shrubs. The six mountain ranges of Desert NWR provide habitat for predatory mammals, desert bighorn sheep, and mule deer (*Odocoileus hemionus*).

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). Figure 4.3-3 shows suitable habitat on the Refuge for the sheep. 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 four to six months. Females live with their young, and males live apart from both during most of the year.

Desert bighorn sheep use habitat within the Refuge along all of the major mountain ranges: Las Vegas, Sheep, East Desert, Desert, Pintwater, and Spotted (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 water troughs, have been improved to maintain a permanent water source.

Table 4.3-1 provides an estimate of the 2007 bighorn sheep populations in each of the mountain ranges on the Refuge and is based on the 2006 estimates obtained during NDOW surveys of mountain ranges throughout Nevada (NDOW 2007a). Figure 4.3-4 shows the bighorn sheep count trends, based on data collected by NDOW, for each of the subpopulations (mountain ranges) on the Refuge.

Table 4.3-1. Desert Bighorn Sheep Population Estimates [2007]

Mountain Range	*Sheep Count*
Las Vegas Range	140
Sheep Range	190
Desert Range	80
Pintwater Range	140
Spotted Range	90

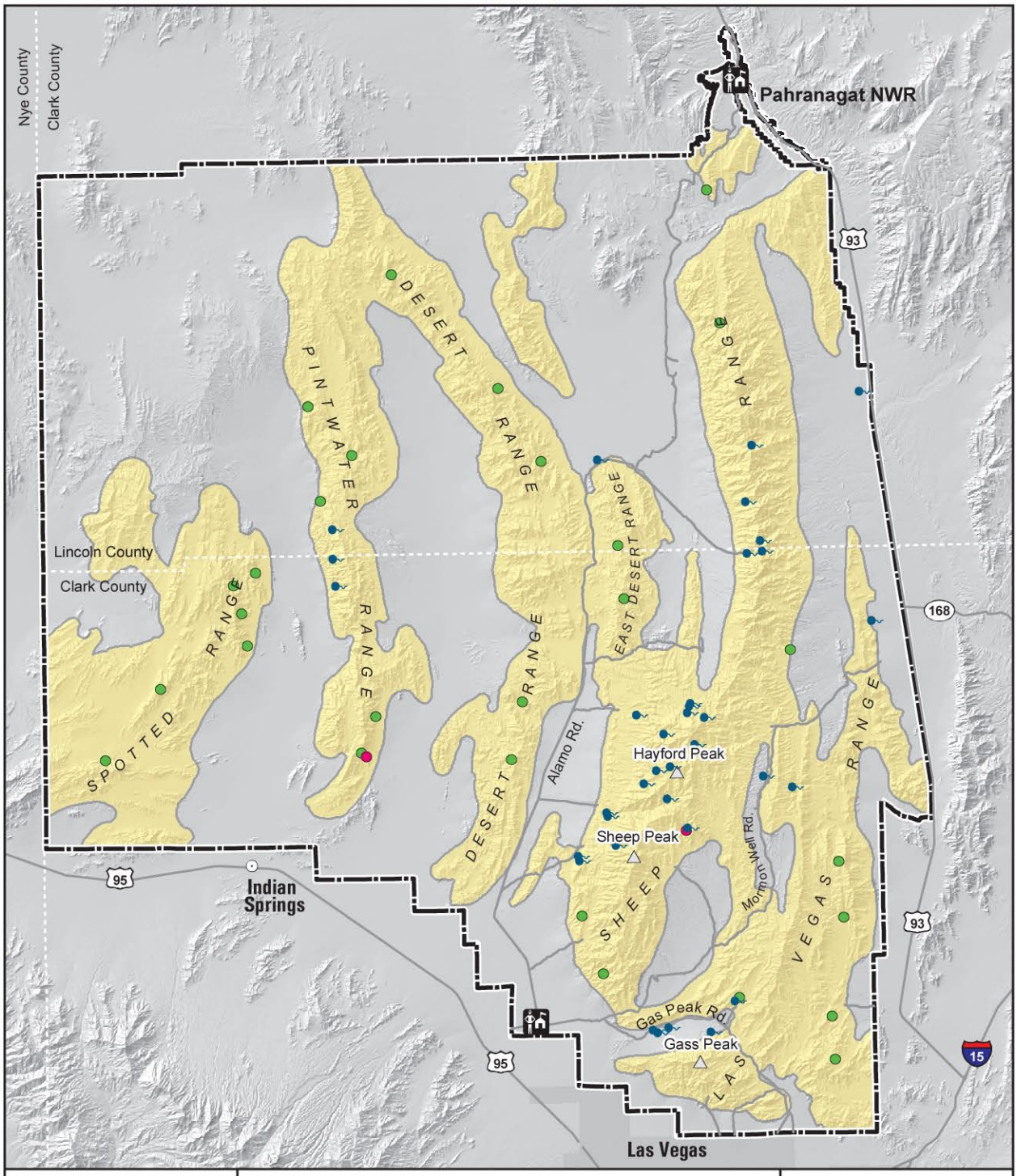
Source: NDOW 2007a

Bighorn sheep populations have declined since the 1980s, and the primary threats to their populations include disease, low lamb survival rates, and predation (NDOW 2005b, 2006; Appendix J). Population trends for bighorn sheep in the mountain ranges of the Desert NWR are provided in Figure 4.3-4 for the years 1974 to 2005. Data were not available for each year in all of the ranges; however, the general trend of population estimates shows the decline of sheep numbers since the 1970s and 1980s, particularly in the Sheep Mountain Range.

Wild burros occasionally wander onto the Desert NWR, but they have not yet established a territory there. Wild horse and burro Herd Management Areas (HMAs) are located east and south of Desert NWR, but none have been designated on the Refuge. The closest one is located in the Spring Mountains along Wheeler Pass (BLM 2002). HMAs were created by the Wild Free-Roaming Horse and Burro Act, and in Clark County they are managed by the Las Vegas BLM Field Office.

Aquatic Species

Springs are the primary water source on the Desert NWR. Desert NWR spring resources likely support an important and unique aquatic invertebrate (mollusk) diversity, especially spring snails. Nonnative fish species and a few species of amphibians are present primarily at Corn Creek. Introduced species include goldfish (*Carassius auratus*) and crayfish, which are the most common.



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Miles
0 5 10
0 10 20
Kilometers

- Approved Refuge Boundary
- Visitor Contact Station
- Spring
- Man-made Water Catchment
- Natural Water Catchment
- Bighorn Sheep Habitat

Figure 4.3-3

Desert Bighorn Sheep Habitat

Desert NWR

May 27, 2008
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Figure 4.3-3-desert_bighorn_hunt.mxd

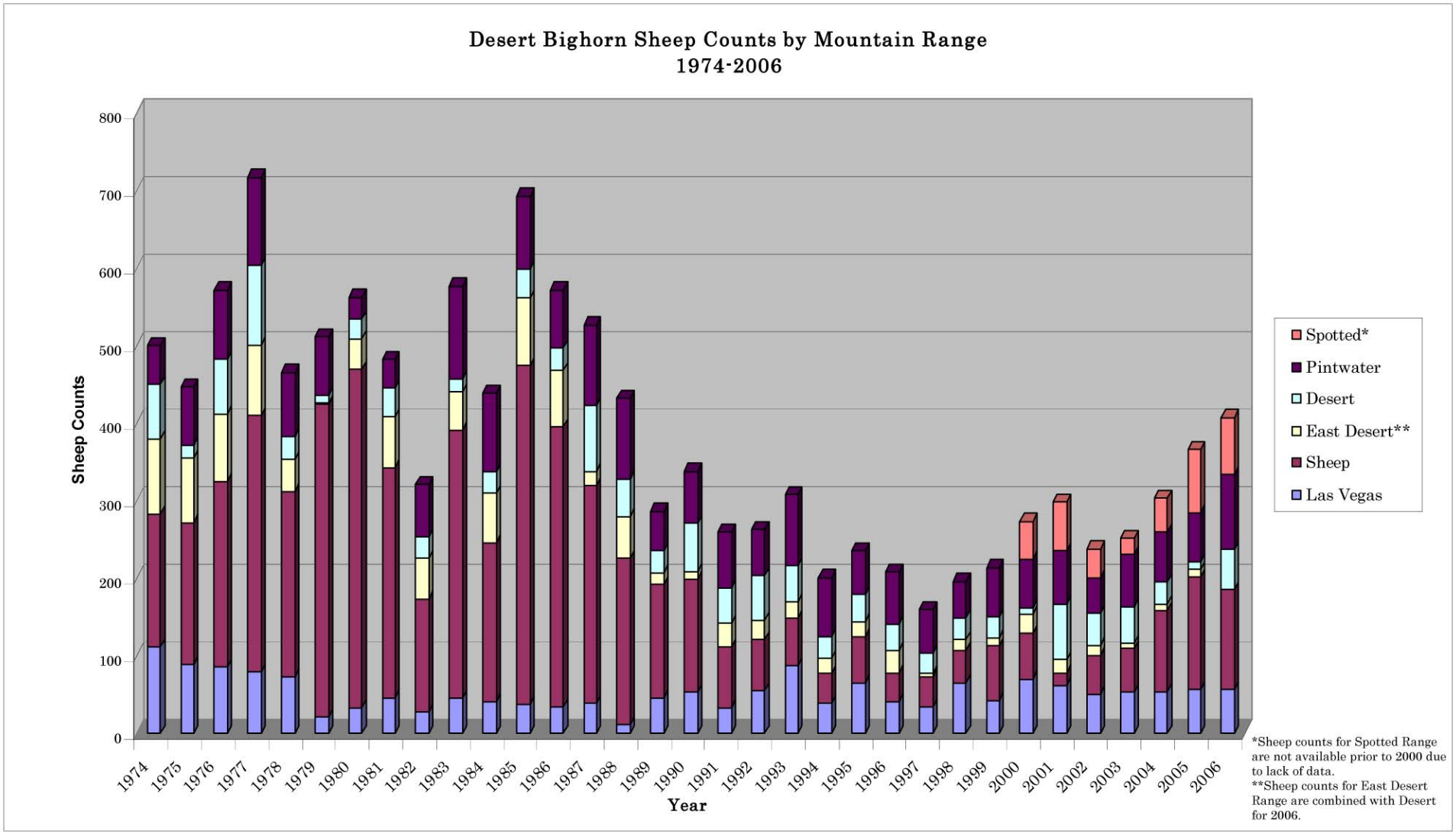

Figure 4.3-4. Desert Bighorn Sheep Counts by Mountain Range 1974-2006

In the 1970s, Pahrump poolfish (*Empetrichthys latos*) were transplanted to three locations in Nevada, including Corn Creek Springs. At this time, the poolfish was near desiccation in its only known natural habitat at Manse Spring due to groundwater pumping. The species persisted in the ponds at Corn Creek until the late 1990s, when the population of poolfish was lost to illegally introduced nonnative crayfish. In June 2003, a refugium for the Pahrump poolfish was completed at Corn Creek, and the fish was reintroduced. This refugium is designed to provide a safer habitat for the fish, so that it can recover and become stable enough to be reintroduced into the wild. The poolfish refugium is an important recovery tool that will provide fish for introduction into the existing population in the ponds and outflow channels at Corn Creek. The poolfish population at Corn Creek is one of only three populations extant globally (Sjoberg 2006). The 2005 population estimate for the Pahrump poolfish was 180 individuals, with approximately 90 per tank at the refugium (Sprunger-Allworth 2006).

In addition to the fish at Corn Creek, the Corn Creek pyrg (*Pyrgulopsis fausta*) is an endemic snail present in the main outflow system at Corn Creek (Otis Bay 2003). Habitat modification and competition with crayfish are potential threats to the survival of the species.

Sensitive Wildlife Species

Three federally listed wildlife species, one federal candidate species, and 34 sensitive species have the potential to occur on the Desert NWR (Appendix H). The desert tortoise is the only threatened species that is known to occur on the Refuge, and the Pahrump poolfish, an endangered species, occurs only in a refugium at Corn Creek. The desert tortoise and its habitat are threatened by trespass vehicle use along the southern boundary.

4.3.3 Cultural Resources

Introduction

Approximately 47,885 acres (3.2 percent) of the Desert NWR has been investigated through archaeological reconnaissance surveys. Given the acreage of the Desert NWR, the total amount of archaeological reconnaissance conducted is small. Most archaeological work on the Desert NWR has been driven by demands of DOD undertakings.

Prehistoric Archaeology

There are approximately 450 recorded prehistoric sites on the Refuge; many of these are on lands administered by the USAF. 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). Many of these sites have not been evaluated for NRHP eligibility. Six prehistoric sites are eligible for NRHP listing, and more than 40 are located within the Sheep Mountain Archaeological District, listed on the NRHP in 1974. The large archaeological district encompasses approximately 617,788 acres. It was never intensively

surveyed, so the nomination was based on the presence of certain kinds of cultural resources known to occur within the area; however, many have not been field verified or recorded. Other kinds of sites found in the district include all sizes of lithic scatters resulting from seasonal campsites or specific task activities, rock shelters, rock art, and trails. Many other features that are tied to traditional Paiute stories and use areas are yet to be documented.

The Corn Creek Campsite National Register Archaeological District located at the field station was accepted to the NRHP in 1975 and includes roughly 800 acres of significant prehistoric and historic deposits and features. Investigations have revealed that this location has been inhabited and manipulated by humans for more than 5,000 years either on a permanent or continued reuse basis. It is an extremely important location for the Southern Paiute. Its archaeological importance is enhanced due to the discovery of evidence of a pit house village dating to the Far Western Puebloan Basketmaker Period of A.D. 530–710 (Roberts and Ahlstrom 2003) in the greater Las Vegas Valley.

Historic Archaeology

Historical sites on the Refuge include sites primarily associated with historic trails, bootlegging, livestock grazing, ranching, mining, logging, the Civilian Conservation Corps, and early Refuge management of the Corn Creek Field Station. The Conservation Corps men stationed at Corn Creek from 1939 to 1941 made grazing improvements, such as water troughs, impoundments, and corrals as well as improving or constructing most of the roads on the Desert NWR. The Mormon Well Road route roughly follows an earlier American Indian trail that passed between Moapa and Las Vegas and extended further west. It was followed by early explorers and Mormon settlers. The Southern Paiute currently call this route the "Indian Honeymoon Trail," as it was commonly used for men obtaining wives from adjacent groups (Stoffle et al. 2002). They considered this route an area important for religious and spiritual activities as well as for hunting and gathering.

The historic aspects of the Corn Creek Campsite National Register Archaeological District are primarily associated with human activities from the turn of the 19th century. These include trails and roads stopping at the springs and connecting the major valleys and springs, bootlegging, ranching, and the Civilian Conservation Corps. It also includes the historic aspects of the early Service management of the Desert NWR that was established in 1936.

4.3.4 Public Access and Recreation

Public Access

The eastern half of the Desert NWR is open to the public year-round, but the western half is closed to the public because access to the area is restricted by the USAF. The NTTR lands were closed to public access under PL 106–65, Military Lands Withdrawal Act of 1999. The basis of access restriction is three-fold: to protect the public from injury due to

ordnance hazards, to ensure national security is not compromised, and to ensure that military programs can be conducted without disruption.

Four access roads lead to the eastern portion of the Desert NWR (Figure 1.6-2). Principal public access is from U.S. Highway 95 at a point approximately 23 miles northwest of Las Vegas. A sign on the east side of the highway marks the 4-mile gravel road to Corn Creek Field Station. From the Field Station, access to the eastern portion of the Desert NWR is via either Mormon Well Road or Alamo Road. Alamo Road travels from Corn Creek Field Station to Pahranagat NWR, while Mormon Well Road leads to U.S. Highway 93, just south of its intersection with SR 168. A portion of Alamo Road (at the dry Desert Lake) is currently off-limits to the public due to unsafe driving conditions. Access to the south end of the Refuge is via Gass Peak Road. These roads, as well as several smaller roads into the Sheep Range, are in primitive condition, and four-wheel drive vehicles are recommended. All vehicles must remain on the designated roads, and access to remote areas is only by foot or on horseback.

The Desert NWR receives visitors from the Las Vegas area as well as numerous other states and foreign countries. Visitation information is gathered in two ways at Desert NWR: a traffic counter at the entrance and a sign-in sheet at Corn Creek Field Station. Between 1998 and 2000, visitation to the Desert NWR increased from 43,086 to 47,412 (CH2M Hill 2002). From October 2000 to September 2003, records maintained by the Service show that visitation ranged from approximately 60,000 to 68,000 per year (Le'au Courtright 2006).

Recreation

Corn Creek Field Station serves as the Desert NWR's visitor contact station and headquarters (Figure 4.3-5). The visitor contact station is open for a few hours Friday through Sunday and holidays, from Labor Day through Memorial Day. Several facilities are available to the public at the Field Station, including an interpretive kiosk, restrooms, shade structures, potable water, and a horse barn. An interpretive trail with signs provides access to visitors for wildlife viewing at Corn Creek Springs. Public use near springs and other sources of water is closely regulated to avoid conflicts with wildlife.

The Desert NWR offers the opportunity for a unique and solitary desert experience. Primitive camping, picnicking, backpacking, and hiking are some of the non-wildlife–dependent recreational opportunities available on the Desert NWR (Service 2006a). Wildlife-dependent recreational opportunities include wildlife observation, photography, and hunting. Fishing is not allowed on the Desert NWR, and limited environmental education and interpretation opportunities are available.

Kiosks, nature trails, and the visitor contact station are the most important facilities available to visitors on the Desert NWR. In FY 2002, 1,800 visitors stopped at the visitor contact station, more than 50,000 visitors viewed the kiosk, and more than 45,000 hiked along nature trails (Service 2006a).

Wildlife-Dependent Recreation

Wildlife observation and photography opportunities are available throughout the Desert NWR. Corn Creek Field Station provides the best opportunity to view the widest variety of birds. A bird list is available at the Desert NWR headquarters and online.

Environmental education opportunities are available on and off the Desert NWR. No staff-guided tours are conducted on the Desert NWR. During FY 2002, however, 2,160 non–staff-conducted tours occurred. Off-site educational outreach opportunities include group presentations and exhibits. Desert NWR had an estimated 700 visits to environmental education exhibits and 210 visits to interpretation exhibits during FY 2005. Other special events to promote the Desert NWR included news releases, radio or television spots, and other special events. Educational outreach and environmental education for the Desert NWR have increased in the past three years as a result of increased interest from the public (Service 2006a).

An active volunteer program provides additional opportunities for the public to enjoy the Desert NWR, and students may be able to earn college credits through internships. 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. Volunteers help staff the visitor contact station.

The Desert Complex hosts events for National Wildlife Refuge Week and Migratory Bird Day. In FY 2004, the staff hosted events for National Wildlife Refuge Week. Other attended events include the Clark County Fair, Clark County ECOJAM (Earth Day event), Gran Fiesta (September 2002), and Boy Scout Day Camp (May 2003). Refuge staff or Desert Complex staff also attended the Governor's Conference on Tourism, Dia de los Niños, Las Vegas Chamber of Commerce Preview, depending on staff availability and funding.

The hunt program on Desert NWR is administered by NDOW. The majority of the Refuge is contained within six hunt units (280, 281, 282, 283, 284, and 286). Permits for hunting bighorn sheep are issued on an annual basis depending on the size of the herd; when sheep counts are low, no permits are issued. NDOW is responsible for determining how many permits can be issued. Hunting is permitted for a 15-day period on the co-managed lands in hunt units 280, 281, and 282. 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 issued on average statewide each year.

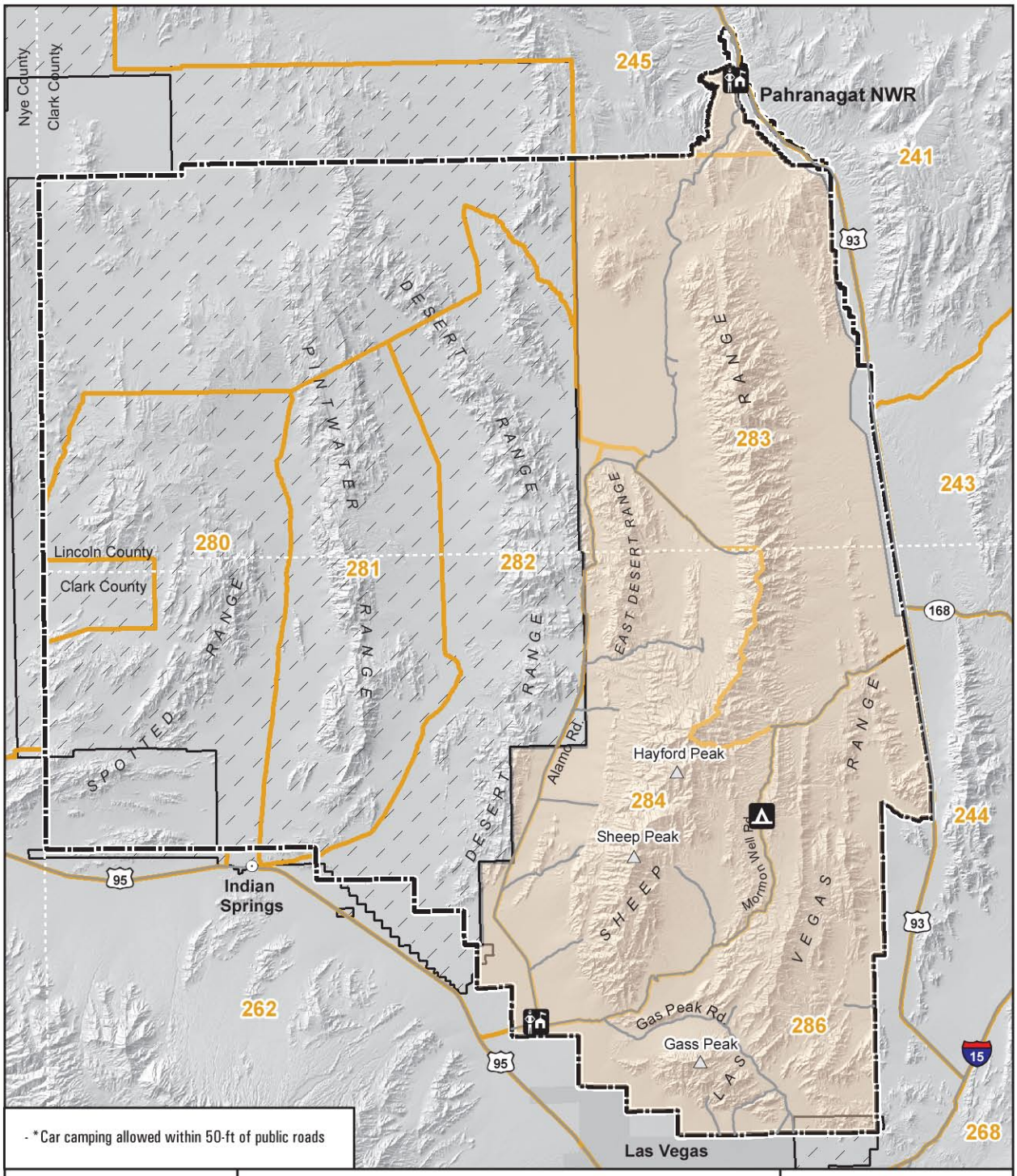

Figure 4.3-5

Visitor Services

Desert NWR

May 27, 2008
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Figure 4.3-5-desert_visitor_services.mxd

Non–Wildlife-Dependent Recreation

Camping, backpacking, hiking, and horseback riding are permitted with certain restrictions year-round (Service 2006a). Picnicking is permitted along designated roads and in picnic areas. The primitive Desert Pass Campground also contains picnic tables, fire pits, and pit toilets for public use. Car camping is allowed within 50 feet of existing roads, and back country camping is allowed throughout the backcountry (outside of the NTTR). Horseback riding is allowed east of Alamo Road (outside the NTTR) in support of other uses.

Illegal off-highway recreational vehicle use along the southern, northern, and eastern boundaries has become a concern because it destroys habitat and disturbs wildlife. The proximity of the cities of Las Vegas and North Las Vegas increases this threat along the southern boundary.

An increasing nonpermitted activity is geocaching. This activity is similar to treasure hunting and involves use of geographic positioning systems (GPS) to locate specific points on the Desert NWR. At these points, people leave either coordinates for a new point or a small treasure, and the treasure hunter replaces the treasure with something new at the end of the search. Fossil hunting and pine nut gathering for Native American use also occur on the Desert NWR.

4.3.5 Social and Economic Conditions

Refuge Management Economics

The current Refuge staff consists of six permanent full-time employees, and one vacant part-time seasonal employee position. The refuge operations budget for FY 2005 was $210,000. The maintenance budget for the Refuge was $58,175.50.

NWRs contribute funds to local counties through revenue-sharing programs that are intended to cover costs for either lands purchased in fee title or lands reserved from the public domain. For FY 2003, Clark County received payment in the amount of $19,095 from the federal government under this revenue-sharing program.

Environmental Justice

The Desert NWR is located in closest proximity to Las Vegas, Indian Springs, and North Las Vegas. These cities are predominantly white (70–88 percent). Las Vegas and North Las Vegas have median family incomes that are comparable to the state and county estimates at around $50,000 (U.S. Census Bureau 2000); however, Indian Springs is below the state and county average at close to $40,000. The Las Vegas Paiute Tribe also has approximately 3,850 acres of tribal land south of the Refuge on U.S. Highway 95 in Clark County. The population of the tribe reported on tribal lands in 2000 was 108 people, which represents a minority (Native American) population. The median family income for the Las Vegas Paiute Tribe was generally above $57,000 in 2000 (U.S. Census Bureau 2000).

Land Use

Desert NWR is bounded on the north and west by the NTTR, a complex assemblage of lands managed or regulated by several federal, state, and local agencies, including the DOD and the DOE (Figure 1.7-2). It also shares portions of its northern, eastern, southern, and western borders with BLM-managed lands that are interspersed with county- and city-managed lands as well as private property. Adjacent land uses include military activities on the NTTR overlay, encroaching (within the 15-year life of the CCP) commercial and residential development along the southern and eastern boundaries, industrial development (mineral extraction/processing and power development/transmission) along the southeast border at Apex, and resort/tourism facilities development at the Las Vegas Paiute Indian Reservation along the southwestern boundary.

The NTTR overlay consists of 846,000 acres on the western portion of the Refuge and has been used since 1940 for testing armament and for training pilots in aerial warfare. PL 106–65 authorizes the USAF to use the NTTR (A) as an armament and high hazard testing area; (B) for training for aerial gunnery, rocketry, electronic warfare, and tactical maneuvering and air support; (C) for equipment and tactics development and testing; and (D) for other defense-related purposes consistent with the purposes specified above. Use of this area is subject to the terms of a Memorandum of Understanding (MOU) between the Secretary of the Interior and the Secretary of the Air Force. The first MOU was signed in 1949. Under the MOU, the Service is the federal agency with primary responsibility for the welfare and management of the land. The USAF controls access to the areas affected by the MOU, including the airspace. In 1986 and 1999, certain military lands were withdrawn to be co-managed by the Service and USAF.

In 1974, approximately 1,323,000 acres of land within Desert NWR were proposed for wilderness designation under the Wilderness Act of 1964. Since that time, those portions of the Refuge have been managed as de facto wilderness (Service 2006a; see Appendix I). Also, five Research Natural Areas (RNAs) have been designated within the Desert NWR, but these are not currently managed as RNAs due to lack of staff and funding. The purpose of an RNA is to provide baseline information to compare with actively managed areas, such as areas burned for habitat enhancement. Management actions are not typically implemented in RNAs, but surveys of resources are conducted and compared with surveys of managed areas to document long-term trends and effects on the resources. The RNAs on the Desert NWR include Basin, Hayford Peak, Deadhorse, Pinyon-Juniper, and Papoose Lake.

As part of the Clark County Conservation of Public Land and Natural Resources Act of 2002 (PL 107–282), approximately 26,433 acres of BLM-managed land have been transferred to the Service for inclusion in the Desert NWR. The Lincoln County Conservation, Recreation, and Development Act of 2004 (House of Representatives 4593) also modified the lands managed by the Service. As part of the act, approximately 8,382 acres of land managed by the Service were transferred to the BLM. This land is located along the west side of U.S.

Highway 93 and forms the eastern boundary of the Desert NWR. In addition, 8,503 acres of land managed by the BLM were transferred to the Service to be managed as part of the Desert NWR. This land is located at the northern boundary of the Desert NWR and encompasses a large block of land that also abuts the western boundary of Pahranagat NWR.

Aesthetics

The Desert NWR contains six major mountain ranges, the highest rising to nearly 10,000 feet above msl, and multiple intervening valleys, with the lowest elevation on the Refuge at 2,500 feet above msl. The Refuge is populated with a diversity of wildlife and plants; bighorn sheep and numerous other wildlife species are found throughout. Plant communities and wildlife vary with altitude and climate. Most of the plant species can be seen while driving the Mormon Well Road. The desert shrub community occurs in the hottest, lowest elevations of Desert NWR. Above the valley floor, Mojave yucca and cactus become abundant. At the upper edge of the desert shrub communities, blackbrush and Joshua tree become dominant. Beyond the blackbrush community, forests become predominant.

From many areas within the Refuge, the background views are of the many mountain ranges that dominate the area, along with the valleys. The diversity of the ranges in terms of elevation and vegetation provides a character that is diverse and largely unobstructed. On the southern portion of the Refuge, lights from the Las Vegas area may obstruct viewing of the night sky.

4.4 Moapa Valley National Wildlife Refuge

4.4.1 Physical Environment

Physiography

Moapa Valley NWR occupies approximately 116 acres in the upper Moapa Valley, upstream from the town of Moapa (Figure 1.7-3). The Refuge is bordered to the north and east by the Muddy River, to the south by the Dry Lake Valley, and to the west by the foothills of the Arrow Canyon Range. Several springs are located along the eastern half of the Refuge, and several east-flowing ephemeral washes bisect the Refuge. The ephemeral washes convey runoff from the Arrow Canyon Range to the Muddy River.

Moapa Valley NWR is located on the Muddy River floodplain at elevations ranging from approximately 1,700 feet above msl near the eastern boundary to approximately 1,800 feet above msl to the western boundary (USGS 1983). The Muddy River drains from the northwest to southeast and receives its flows from the Muddy River springs, which discharge perennially (NRCS 1980).

Geology and Minerals

Moapa Valley NWR is underlain by thick deposits of Pleistocene (1.8 mya to present) alluvium that consists of silt, sand, and gravel. A small section of the Pennsylvanian to Permian (350 to 248 mya) Bird Spring Formation outcrops along the extreme southeastern end of the Refuge (Hess and Johnson 2000; Tschanz and Pameyan 1970).

A review of Tingley (1998) and Tschanz and Pameyan (1970) indicates that there is no recorded history of mining at the Refuge. Although the Refuge probably contains large amounts of material that would be suitable for construction aggregate, under current market conditions, aggregate production is not economically competitive due to high transportation costs.

Paleontological Resources

The county geologic map shows two geologic units within the Refuge: Quaternary (1.8 mya to present)/Tertiary (65 to 1.8 mya) alluvium and the Bird Spring Formation (Hess and Johnson 2000). The marine Bird Spring Formation typically contains abundant fossils and is considered to have high fossil-containing potential. Typical fossils are marine and consist of algae, echinoderm, and fusilinid (Longwell et al. 1965 and Service 2002a).

Soils

The Moapa Valley NWR is located on the floodplain of the Muddy River and is flanked by a series of low alluvial fans, terraces, and benches that grade into higher alluvial fans (NRCS 2003b). A total of six soil-mapping units are present on the Refuge, and the soils generally range from gravelly fine sand to silty clay. The gravelly fine sand soil types are derived from or occur near the proximal edges of alluvial fans. The silty clay soil types are derived from or occur near lake deposits or floodplains.

Water Resources

Surface Water

The Moapa Valley NWR is composed of a portion of the Muddy River Springs, a series of springs that arise alongside and feed the Muddy River. More than 20 spring orifices occur within the Refuge, including the Plummer and Apcar stream/spring systems (Figure 4.4-1). Flow from the combined springs forms a network of pools and small streams that flows northward beyond the property boundaries.

Just downstream from the Refuge, but within the hydrographic basin, USGS operates the Moapa stream gauge on the main stem of the Muddy River. Flow in the Muddy River has been declining since the early 1960s (Mayer and Van Liew 2003; LVVWD 2001). 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.

Figure 4.4-1

Hydrology

Moapa Valley NWR

May 15, 2008
5683_138\FIGURES\AD_EIS_20080501
Figure 4.4-1_moapa_hydro.mxd

The USGS, in cooperation with the SNWA, currently collects data from a number of gauges on streams fed by 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.

Groundwater

Underground flow through the carbonate-rock aquifer in southern Nevada provides the primary source of water for the Muddy River Springs. The source of the underground flow is unknown, but is expected to come from the Sheep Range, the White River Flow System, the Meadow Valley Flow System, or a combination of these sources (Thomas et al. 1996). Predevelopment spring discharge from the Muddy River Springs was relatively constant at 36,000 afy (Eakin and Moore 1964). 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.

Water Quality

Little water quality information exists within the Refuge. Based on available information, water discharged from the Muddy River Springs is similar in nature to that derived from the regional carbonate aquifers, with dissolved solids concentrations of about 550 mg/L (Service 1984a).

Water Use

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.

Primary use of water in the Muddy River Springs area is for power production and municipal supplies to areas downstream. Local irrigation and domestic uses account for a small portion of water consumption. Groundwater production has increased over time, with a significant increase in the 1980s and 1990s and the largest increase in recent years (beginning in 1999).

Records for surface water diversions are not as complete as those for groundwater pumping. In general, since 1990, Nevada Power Company has diverted 2,300 to 3,600 afy from the Muddy River downstream of the Refuge (NDWR 2003). Within the Refuge, MVWD diverts water from Jones Springs, with annual diversions ranging from 687 to 1,509 acre-feet (Buqo 2002).

Within the Refuge, historic uses of the spring pools and the surrounding landscape included recreation and agriculture. Prior to acquisition by the Service, the area was developed and operated as a resort with thermal spring-fed swimming pools, waterslides, bathhouses, a snack bar, and recreational vehicle hook-ups. 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.

Water Rights

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).

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 approximately 1.4 afy of well water. Water from the springs is also adjudicated to downstream landowners.

Hazardous Materials

Moapa Valley NWR was formerly developed as a recreational resort. No mining activity is known to have been conducted at the Refuge. A review of Lovering (1954), Garside (1979), and Singer (1996) indicates that neither metal nor radioactive deposits are present on the Refuge.

Fire History and Management

The historic role of fire at Moapa Valley is generally unknown. Fire likely had a minor to limited role in the Refuge's ecosystems (Service 2004a). Before the area was developed into a resort setting, the area most likely saw long fire return intervals typical of desert vegetation. Due to the lack of continuity of fuels in a desert setting, fire probably did not reach significant size.

Fire season is generally from April through October in the desert fuel types (Service 2004a). The Warm Springs riparian area has a palm tree component fuel type that can burn in any month. These fuels have a history of burning about every 10 years. It is unknown when fire suppression and exclusion began in the area.

Records from the BLM for the Moapa-Overton Fire Management Unit, which covers about 89,000 acres, indicate an average of one ignition per year between 1980 and 2002, with an average of 8 acres burned per year (Service 2004a). Fires ranged in size from 0.1 to 140 acres, and 96 percent were less than 100 acres in size. An average of approximately 80 acres burned per decade. Fires generally occur in late spring through September, but can occur year-round. Human causes accounted for 73 percent of all fires, with the remaining 27

percent attributed to lightning. Most wildfires in this FMU occur in the tamarisk-infested portions of the Muddy River riparian corridor. Typically, these fires are wind driven and are of moderate to high intensity. Small, low-intensity wildfires in tamarisk are less common but do occur.

The Refuge has experienced two larger fires. In 1994 a lightning-caused fire of 40 acres began on the Refuge and minimally spread to private lands. In 2003, a human-caused fire of 47 acres burned adjacent to the Refuge and threatened residences in the area.

No prescribed fires or pile burns have occurred on the Refuge.

Air Quality

Ambient air quality is not currently measured at Moapa Valley NWR. It is expected that low ambient concentrations of criteria pollutants would occur for this area. The nearest sources of emissions are in the Las Vegas area, approximately 20 to 30 miles to the southwest and the Apex industrial complex, located approximately 10 miles to the southwest. Due to the variation in airshed basins for the three regions, it is anticipated that emissions from the Las Vegas and Apex regions would not affect the Moapa Valley NWR (CCDAQM 2003b).

4.4.2 Biological Resources

Vegetation

Habitat Types

Moapa Valley, located in northeastern Clark County, Nevada, is one of the few areas of the Mojave Desert with a perennial river. The Muddy River, which is also known as the Moapa River, originates at the Muddy River Springs. These springs are a part of the Warm Springs thermal springs complex in which the Moapa Valley NWR occurs (Service 1983). Moapa Valley NWR encompasses more than 20 springs from this complex. These springs provide high-quality habitat for numerous wildlife species. They also support a variety of vegetation within a narrow elevation range of 1,700 to 1,800 feet above msl (Figure 4.4-2).

Riparian and aquatic habitats on the Refuge consist of three adjacent, but visually distinct units: Plummer, Pedersen, and Apcar (Figure 4.4-2). Each unit has a separate stream system supported by the steady and uninterrupted flow of several springs that come to the surface at various points throughout the Refuge.

Historically, willow (*Salix* spp.) and screwbean mesquite were the dominant riparian species along the streams in the area. Due to habitat alteration and modification, the riparian habitat is now dominated by invasive palm trees (*Washingtonia filifera*). These palm trees can be detrimental to aquatic wildlife and habitats. The palm trees out-compete native species, and although it is used by some species, it does not generally provide high-quality habitat for wildlife. In comparison to native plants, palm trees use much more water, use more nutrients that would otherwise be available for fish, and accumulate salt at its base.

Following a fire on the Pedersen Unit in 1994, several hundred palm trees were removed from riparian habitats, allowing many native species to become reestablished in the riparian and aquatic habitats within this unit (Service 2006a). Aquatic plants, such as muskgrass (*Chara* spp.), spike rush (*Eleocharis* spp.), water nymph (*Najas* spp.), and watercress (*Rorippa* spp.), are abundant in the spring pools and other slack water areas.

The presence of salt grass as ground cover has provided suitable conditions for the reestablishment of native trees, such as ash, cottonwood, willow, and mesquite.

Riparian habitat on the Plummer and Apcar Units continues to bear the scars of the 1994 fire and is still dominated by palm trees. Nonnative tape grass (*Vallisneria americana*) is also present on the Plummer Unit (Service 2006a).

The salt desert scrub and creosote–white bursage scrub habitats dominate the surrounding Mojave Desert and occur primarily on the western and southern portions of the Refuge. The salt desert scrub habitat consists of various saltbush species, such as fourwing saltbush (*Atriplex canescens*) and big saltbush (*A. lentiformis*), found in saline basins on valley floors and around playas. Areas with low nocturnal temperatures and very high soil salinity are common in these basins and support most of this habitat.

The creosote–white bursage scrub alliance occurs in lower bajadas, plains, and low hills. This alliance is characterized by widely spaced shrubs and succulents averaging 2 to 8 feet tall, with 2 to 50 percent cover (Holland 1986; Rowlands et al. 1982; Vasek and Barbour 1977). Creosote bush and white bursage are the codominants in this habitat. Mojave yucca and Joshua tree comprise the overstory. The herbaceous layer is sparse, but seasonally abundant after rain events.

Sensitive Plant Species

Parts of the Moapa Valley have been ranked by the NNHP as the highest-priority conservation sites in Nevada (NNHP 2000). Highest-priority conservation sites may need new actions to prevent the loss of one or more extremely sensitive species, which could happen within the immediate future if no species-specific management actions are implemented. Moapa Valley NWR is a part of the Moapa Valley macrosite, which includes Logandale, Overton, Moapa, and the Moapa Valley springs.

Although the Moapa Valley is a sensitive area, there are no federally listed plant species that potentially occur at Moapa Valley NWR. There is, however, one sensitive plant that may occur at the Refuge: the Virgin River thistle (*Cirsium virginense*).

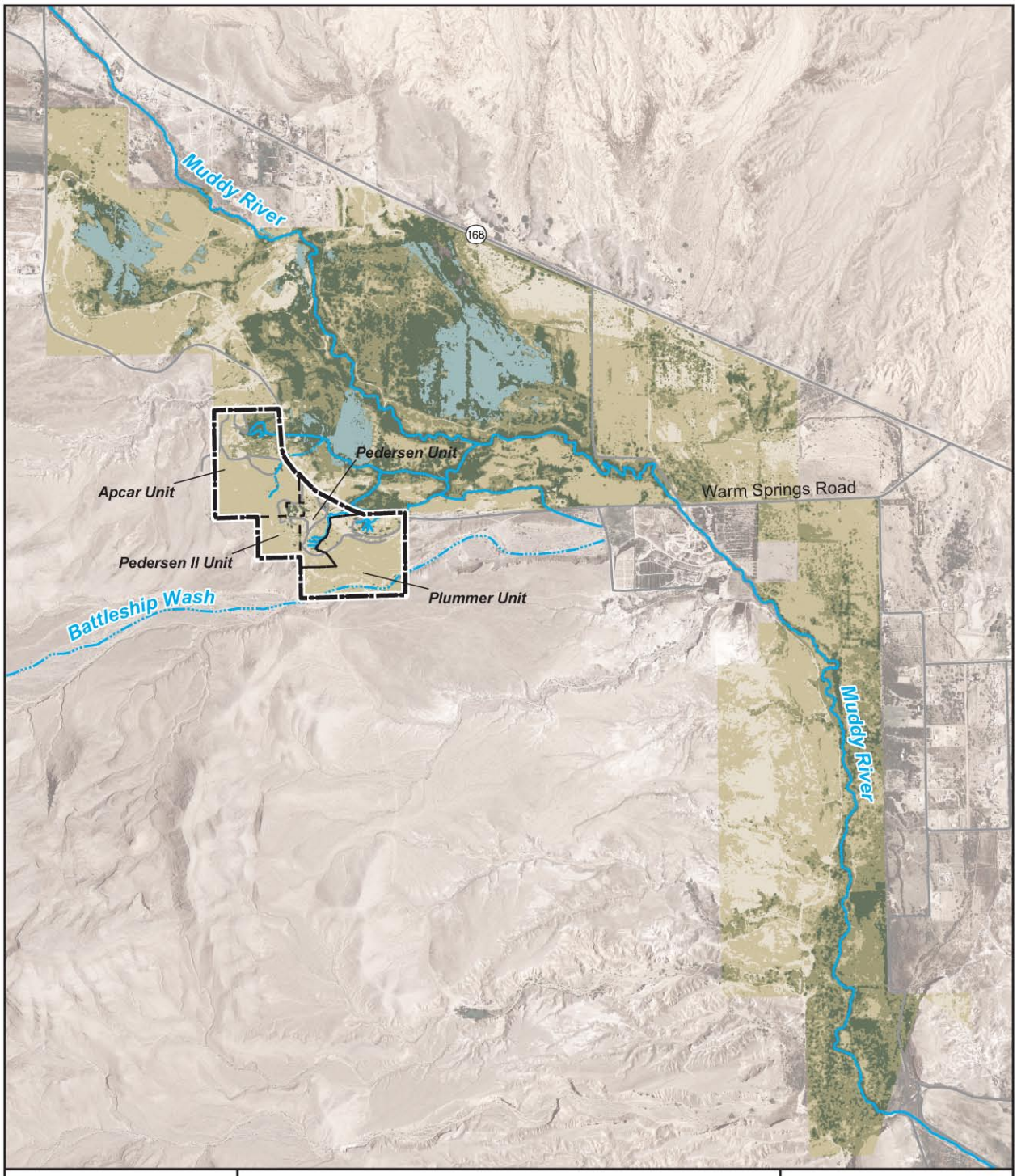

Figure 4.4-2

Vegetation Types

Moapa Valley NWR

May 15, 2008
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Figure 4.4-2_moapa_veg.mxd

Invasive Species and Noxious Weeds

Invasive species are common at Moapa Valley NWR due to the Refuge's extremely moist habitat and disturbed conditions. The construction of recreational facilities in the past removed much of the native vegetation and destroyed suitable habitat for their reestablishment. The lack of competition with native species set the stage for several invasive species to dominate the area. Some of these species include palm trees, Russian thistle, eel grass, salt cedar, oleander and pampas grass. Many of these species were introduced to the area as ornamentals and have become well-established on the Refuge, especially in areas where the old resort/recreational facilities have been removed. Tape grass, an invasive aquatic weed, is significantly affecting aquatic habitats on or adjacent to the Refuge.

Although several invasive species are present, only three noxious weeds, as defined by the State of Nevada, are known to occur at Moapa Valley NWR (L. Miller 2003). These are Russian knapweed, salt cedar, and Malta starthistle. Tall whitetop also potentially occurs at Moapa Valley NWR. Appendix H provides a list of the noxious weeds that may occur or are known to occur at Moapa Valley NWR.

Wildlife

Although the Moapa Valley NWR encompasses only 116 acres, there is an abundance of wildlife that uses the area on a seasonal basis or year-round (see Appendix H for a list of species). These species are adapted to the desert riparian and upland communities, and many are drawn to the area by the abundant water supply.

Amphibians and Reptiles

Native amphibians inhabiting riparian and aquatic areas of the Warm Springs area include the California tree frog (*Hyla regilla*) and the red-spotted toad (*Bufo punctatus*). Nonnative species include the bullfrog (*Rana catesbeiana*) and the spiny soft-shelled turtle (*Trionyx spiniferus*).

Common native reptiles of the Warm Springs area include yellow-backed spiny lizard (*Sceloporus uniformis*), side-blotched lizard (*Uta stansburiana*), coachwhip (*Masticophis flagellum*), and Great Basin whiptail (*Aspidoscelis tigris*). The banded Gila monster and chuckwalla, sensitive species, occur in rocky upland habitat and may occur on the Refuge. The chuckwalla was observed on the Refuge in 1999 (Goodchild 2004). Desert tortoise may also use upland habitat on the Refuge. The refuge is also within the historic distribution of the relict leopard frog (*Rana onca*), and Refuge lands may play an important role in conservation for the frog (Sjoberg 2006).

Birds

Approximately 230 bird species have been identified along or adjacent to the Muddy River (Lund 2002). Of these, 162 may be categorized as year-round residents. The others are mostly migratory birds passing through along the Pacific Flyway migration route. The Refuge is an important stop-over site for migrant landbirds. Approximately 68 of the 230 bird species have been observed infrequently or were recorded

in habitats adjacent to the Muddy River. An estimated 86 birds use woodland habitat, of which nine have been documented as using palm tree fruit as a food source. Riparian shrubland habitat is used by about 79 species, and 13 species are associated with marsh habitat.

Several residents and migrants are on the Service's list of Birds of Conservation Concern and are priorities for conservation in the Partners in Flight bird conservation plan for Nevada. Some of these species include eared grebe, western grebe, Franklin's gull, black tern, snowy egret, Bendire's thrasher, Arizona Bell's vireo, southwestern willow flycatcher, western yellow-billed cuckoo, and canvasback (see Appendix H for additional species and the habitats they occur in on the Refuge).

Mammals

Twenty-three species of bats are known to occur in Nevada, 15 of which have been documented in the Muddy River drainage (Williams 2002). Six of these bats are designated as Nevada sensitive species. Extensive studies of bat species have not been conducted along the Muddy River; however, the western yellow bat (*Lasiurus xanthinus*) has been documented as a year-round resident on the Refuge. This area is the only known Nevada location for this bat, which is a palm obligate species.

Aquatic Species

The Moapa Valley supports four species of native fish: Moapa dace, Virgin River chub (*Gila seminuda*), Moapa White River springfish, and the Moapa speckled dace (*Rhinichthys osculus moapa*). In addition, thirteen nonnative species of fish have been documented in the Muddy River system.

The Moapa dace is endemic to approximately 9.5 km (6 miles) of stream habitats in five thermal headwater spring systems and on the main stem of the upper Muddy River. Moapa dace are dependent upon the link between the upper river and its tributaries (Scoppettone et al. 1992). Cooler water temperatures in the middle and lower Muddy River are likely a natural barrier to downstream movement of Moapa dace (La Rivers 1962).

The Virgin River chub is found in the middle Muddy River, and high water temperatures of the upper Muddy River system are believed to preclude adult chubs (Service 2004a). The Moapa speckled dace co-occurs with the Virgin River chub. The Moapa White River springfish is found in the upper Muddy River and spring tributaries. It is adapted to slower water than the Moapa dace and is fairly common throughout suitable habitat.

Nonnative fish present in the upper Muddy River and tributaries include blue tilapia (*Oreochromis aurea*), shortfin molly (*Poecilia mexicana*), mosquitofish (*Gambusia affinis*) and rarely, common carp (*Cyprinus carpio*). The Service, NDOW, and other collaborators have been conducting a program to eradicate blue tilapia from the Muddy River system and control other nonnative populations in order to

facilitate recovery of Moapa dace and restore Moapa White River springfish to historic population levels.

More than 100 species of aquatic invertebrates are known from thermal springs at the source of the Muddy River (Sada 2002). The abundance of populations along the river is believed to be seasonal, with peak populations occurring during spring and lowest populations occurring during the winter months. This diversity of species includes several endemic invertebrates, including two mollusks and four aquatic invertebrates (Service 2004a).

The Moapa pebblesnail (*Fluminicola avernalis*) occurs on pebbles, cobble, concrete, and submerged vegetation at or downstream of springs. The pebblesnail has been considered locally abundant in the Warm Springs area. The grated tryonia (*Tryonia clathrata*) occurs within algae and detritus throughout the Warm Springs system. The Moapa Warm Springs riffle beetle (*Stenelmis moapae*) occurs in the Warm Springs area in outflow streams immediately downstream of the spring source. They have also been found in the upper Muddy River and in marsh habitat connected to spring sources. The Amargosa naucorid (*Pelocoris shoshone shoshone*) occurs in the Warm Springs area on vegetation in pools or reaches of stream with lower velocities, often associated with overhanging banks near marshy habitats.

Two endemic aquatic invertebrates are also present on the Refuge: the Moapa naucorid (*Usingerina moapensis*) and a water strider (*Rhagovelia becki*) (Service 1996). Current population size, distribution, and potential threats to these two species are largely unknown. The naucorid occurs in warm stream pebble beds, and the water strider occurs in swift riffles (Usinger 1956).

Sensitive Wildlife Species

Three federally listed wildlife species, one federal candidate species, and 36 sensitive species have the potential to occur at the Moapa Valley NWR (Appendix H). The southwestern willow flycatcher, Yuma clapper rail, and Moapa dace are the only endangered species that potentially occur on the Refuge. Both the flycatcher and the yellow-billed cuckoo (*Coccyzus americanus*) breed in the adjacent Muddy River drainage. In addition, the Yuma clapper rail is known to have occurred in the Muddy River area near Moapa in the past.

The Moapa Valley NWR was established to protect and secure habitat for the Moapa dace. This species' habitat is restricted to the headwaters of the Muddy River due to its narrow temperature requirements. Habitat modifications and the presence of introduced fish species make the habitat further downstream unsuitable for the dace. A species account for the dace is provided in Appendix H.

Recovery plans for the endangered and rare aquatic species of the Muddy River ecosystem have been approved and are being implemented by the Service (Service 1983, 1996). A recovery plan for the southwestern willow flycatcher has also been approved and implemented (Service 2002b). The recovery plans describe each

species, its habitat needs, and specific recovery goals for the de-listing or downlisting of the species.

4.4.3 Cultural Resources

Because most of the area making up the Moapa Valley NWR was privately held until recently, considerable alteration to the character of the landscape has occurred and any sites that may have been present are likely buried or destroyed as part of resort development. Approximately 17 acres or about 16 percent of the Moapa Valley NWR has been investigated through archaeological reconnaissance surveys.

Prehistoric Archaeology

While numerous sites have been recorded in the surrounding region, only one site has thus far been recorded within the boundaries of the Moapa Valley NWR (Fergusson and DuBarton 2003). It was a small lithic scatter that was recorded in 1979 by a non-professional archaeologist. No surface evidence remains due to land disturbances in the area of the spring. Sites in the immediate vicinity of the Refuge include pit houses and surface structures of Far Western Puebloan design, rock shelters, and large open sites with lithics and both Far Western Puebloan and Numic ceramics. Local tradition suggests other sites exist in the region, but many have never been formally recorded.

Historic Archaeology

No historic sites have yet been recorded within the Moapa Valley NWR.

4.4.4 Public Access and Recreation

Public Access

Moapa Valley NWR is located on 116 acres in northeastern Clark County and is approximately 60 miles north of Las Vegas, Nevada. Currently, due to its small size, fragile habitats, ongoing restoration work, and construction activities related to the removal of unsafe structures, the Refuge is closed to the general public. It is anticipated that the Refuge will be open to the public in the future to provide recreational opportunities once the restoration work is complete. Staff-conducted tours are currently being offered for interpretation and nature observation. In FY 2002, 65 visitors participated in staff-conducted tours (Service 2006a).

Access to the Refuge is via SR 168, which can be reached from I-15 or from U.S. Highway 93. From SR 168, access is via Warm Springs Road, which runs along the northeast boundary of the Refuge. Average daily traffic counts on SR 168 were 1,200 per day in 2004 (Nevada Department of Transportation [NDOT] 2004). Several unpaved roads on the Refuge are currently used for restoration efforts and administrative access.

Recreation

Recreational opportunities at Moapa Valley NWR include wildlife observation, photography, environmental education, and outreach. These activities are very limited because the Refuge is currently closed to the public, except through special arrangement (Figure 4.4-3).

The Service does not currently have an environmental education program for the Refuge; however, environmental education opportunities have been provided by TNC in the past. Schools may also visit the Refuge if they schedule a tour in advance with the Refuge Manager. During FYs 2000 and 2001, 78 and 45 people, respectively, visited the Refuge for educational activities (Service 2006a). All of these were staff-conducted tours for teachers and/or students.

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. Volunteers and student interns receive environmental education and provide much-needed assistance with Refuge projects. They are often able to complete work that Refuge staff would otherwise be unable to do. The hours and work assignments are tailored to meet the needs of both the Refuge staff and the volunteer or intern. Volunteer projects may include conducting biological surveys, providing clerical assistance in the office, general maintenance of facilities and equipment, photography and artwork, habitat restoration activities, and visitor interaction. College students may be able to earn college credits while gaining valuable work experience as an intern at the Refuge. Internships are available year-round.

Educational outreach currently consists of exhibits only, but in 2000 and 2001, exhibits and group presentations were offered to the public. News releases about the Refuge were also used to inform the public about the Refuge in 2002.

The Desert Complex hosts events for National Wildlife Refuge Week and Migratory Bird Day. In FY 2004, they hosted a few events for National Wildlife Refuge Week. Other events that Desert Complex staff have attended include the Clark County Fair, Clark County ECOJAM (Earth Day event), Gran Fiesta (September 2002), Boy Scout Day Camp (May 2003), and Moapa Day (2003). Refuge staff or Desert Complex staff also attended the Governor's Conference on Tourism, Dia de los Niños, Las Vegas Chamber of Commerce Preview, and National Public Lands Day, depending on staff availability and funding.

4.4.5 Social and Economic Conditions

Refuge Management Economics

The Refuge is not currently staffed on a regular basis. The manager for the Desert NWR is also the manager for the Moapa Valley NWR. The refuge did not have a maintenance or operations budget in FY 2006.

NWRs contribute funds to local counties through revenue-sharing programs that are intended to cover costs for either lands purchased in fee title or lands reserved from the public domain. For FY 2003, Clark County received payment in the amount of $10,310 from the federal government under this revenue-sharing program.

Environmental Justice

Communities closest to the Refuge include the rural areas of Moapa Valley, the town of Moapa, and the city of North Las Vegas. These communities are predominantly white (74 percent) and have median family incomes comparable to the state and county estimates of about $50,000 (U.S. Census 2000). These communities as a whole would not constitute low-income, minority populations.

The Moapa Valley NWR lies within the aboriginal territory of the Moapa (Mou'paw) Paiute Band (Kelly 1934; Kelly and Fowler 1986; Martineau 1992). Although comprised of a small area, the Moapa Valley NWR is culturally significant to the Moapa Paiute people. The reservation of the Moapa Paiute Band is found within the Moapa Valley, south of the Refuge. According to the 2000 Census, the population of the reservation was 206 people. The band's median family income was estimated at $22,000 in 1999, which is substantially lower than the Clark County and Nevada estimates of about $50,000. The Moapa Paiute Band is considered a low-income, minority population.

Land Use

Moapa Valley NWR is bounded on the north and west by private land holdings, including the pending Southern Nevada Public Land Management Act lands, and to the south and east by BLM-managed lands (Figure 1.6-3). The Mormon Mesa ACEC, established for the protection of the desert tortoise, is located to the north of the Refuge. At least one currently occupied private residence is directly adjacent to the Refuge. The Moapa River Indian Reservation lies to the southeast.

The Refuge was established September 10, 1979, to secure habitat for the endangered Moapa dace. Prior to acquisition, the Pedersen and Plummer Units had been developed and operated as resorts. The primary management objectives of the Refuge are to restore these units to as near a natural condition as possible and to optimize available stream habitat for recovery and downlisting of Moapa dace.

Aesthetics

The Moapa Valley NWR consists of stream channels supported by six thermal springs emerging near the center of the Refuge. Generally, the area surrounding the Refuge consists of riparian habitat and agriculture to the north and creosote vegetation to the south. There is little change in elevation and very little light pollution that would affect viewing of the night sky.

Figure 4.4-3

Visitor Services

Moapa Valley NWR

May 27, 2008
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Figure 4.4-2_moapa_visitor_services.mxd

The Refuge is comprised of three adjacent, but visually distinct units. Prior to acquisition, both the Pedersen and Plummer Units had been developed and operated as resorts. Restoration efforts are under way at the Pedersen Unit and Plummer Unit, where only native fish remain in the Pedersen stream channels and pools. However, restoration work is still required on the Apcar Unit. Until the restoration is completed, the man-made structures located on the site remain part of the visual experience.

4.5 Pahranagat National Wildlife Refuge

4.5.1 Physical Environment

Physiography

Pahranagat NWR occupies approximately 5,380 acres in the southern reach of Pahranagat Valley, along a narrow, approximately 11-mile long corridor of the former White River (Figure 1.6-4). The Refuge is bordered to the north by Pahranagat Valley, to the east by Delamar Valley and the Delamar Mountains, to the south by the foothills of the Sheep Range, and to the west by the East Pahranagat Range.

Upper Pahranagat Lake and North Marsh are located at the northern tip of the Refuge and cover approximately 450 acres, while Lower Pahranagat Lake is located near the southern end and covers approximately 365 acres (Lincoln County Conservation District 1980). Pahranagat NWR is a closed basin; no surface water flows from it. Surface water comes from Ash and Crystal Springs, which are located approximately 9 and 15 miles, respectively, north of the Refuge.

Elevations of Pahranagat NWR range from approximately 3,020 feet above msl at Lower Pahranagat Lake to approximately 3,600 feet above msl along the valley walls formed by the Sheep Range at the extreme southeast corner of the Refuge.

Geology and Minerals

Thick sections of Pleistocene (1.8 mya to present) alluvium, deposited by the ancestral White River, underlay the Pahranagat NWR. The ancestral river channel eroded older Tertiary (65 to 1.8 mya) gravels, lakebed deposits, and volcanic sediments. Remnants of the river channel are exposed in the valley outside the ancestral floodplain. A small section of the Cambrian Highland Formation (part of the Paleozoic carbonate rocks, 543 to 490 mya) outcrops along the extreme southern end of the Pahranagat NWR (Hess and Johnson 2000; Tschanz and Pameyan 1970). The Pahranagat Shear Zone, which is a subparallel, northeast-striking fault, occurs at the southern edge of the Refuge (Sweetkind et al. 2004). The shear zone may provide throughflow for the groundwater flow system in the Pahranagat Range that recharges the Tikaboo Valley (Faunt et al. 2004).

Mining production has not been recorded from locations within the Refuge (Tingley et al. 1993; Tingley 1998; Tschanz and Pameyan 1970). The East Pahranagat Range District occurs northwest of the Refuge and contains small, isolated gold and uranium prospects. Mining production has not been recorded from this district. Although the

Refuge may contain material that would be suitable for construction aggregate, under current market conditions, aggregate production is not economically competitive due to high haulage costs.

Paleontological Resources

Within the Pahranagat NWR, the Lincoln County geologic map shows five geologic units: two volcanic units, an older gravel unit, older lake beds, and younger alluvium (Tschanz and Pameyan 1970). Volcanic rocks are not fossiliferous and have a low paleontological potential. In Lincoln County, no fossils have been found in older gravels. Reworked older alluvium and lacustrine sediments have a low potential for fossils because of the additional erosion and transportation. However, younger alluvium may overlay potentially fossiliferous geologic material.

In southern Nevada, the Panaca and Muddy Creek Formations have a high potential to contain fossils. The Muddy Creek Formation has the potential to produce significant fossils (BLM 1990). Blair and Armstrong (1979) document the occurrence of gastropods, ostracods, trace fossils, diatoms, and plant fossils in the upper member of the Muddy Creek in the Lake Mead area. In addition, in Lincoln County, the Panaca Formation has yielded extinct horse remains (*Pliohippus* sp.) (Tschanz and Pameyan 1970). The occurrence of fossils in this formation within Pahranagat NWR is unknown, but based on observations of similar rocks in nearby areas, the potential for significant fossils is high.

Soils

The ancestral White River has left an ancient, well-preserved river channel that is generally 0.25 to 0.5 mile wide in Pahranagat Valley (NRCS 1968). The channel and its associated floodplain and adjacent terraces are cut into the alluvial fans shed from the surrounding mountain ranges of the Pahranagat hydrographic basin. The Pahranagat NWR occupies a part of the ancient floodplain that has been strongly modified by runoff. A total of 11 soil-mapping units are present on the Refuge, and the soils generally range from coarse sandy loam to silty loam (NRCS 2003b). Coarse sandy loam soil types have been washed from higher elevations and occur near the proximal edges of alluvial fans. The silty loam soil types are derived from or occur near lake deposits, on the distal edges of alluvial fans, or on floodplains.

Water Resources

Surface Water

Pahranagat NWR receives surface water solely through the White River channel north of the Refuge boundary, which is fed by springs north of Alamo (Ash and Crystal Springs) that discharge a measured 26,000 afy (Burbey and Prudic 1991). After consumptive use of spring discharge from agriculture, approximately 6,500 afy of water enters the Refuge annually into Upper Pahranagat Lake (Service 1999b). The majority of water is received during the winter months (less than 20–30 cubic feet per second [cfs]), with only minimal flows during the summer (< 0.5 cfs).

Water is seasonally released from Upper Pahranagat Lake to irrigate the downgradient meadows and to flood a series of small impoundments and Lower Pahranagat Lake. During most years, Lower Pahranagat Lake serves as the terminal lake in the Crystal and Ash Springs subbasin. However, when adequate water is available, water may be released to Maynard Lake, the southernmost wetland in Pahranagat Valley (Service 1999b). Maynard Lake is alternately wet and dry, depending on the availability of water.

The three principal springs that feed the White River channel are Hiko, Crystal, and Ash, which are located north of the Refuge (Figure 4.5-1). These are thermal springs that flow at a fairly constant rate and are derived from regional carbonate aquifers (Lincoln County Conservation District 1980). Crystal Springs, the northernmost spring in the Crystal and Ash Springs subbasin, is located just south of Frenchy Lake, approximately 15 miles north of Pahranagat NWR. Crystal Springs consists of at least two springs that discharge a combined volume between 4,000 and 7,000 afy.

The outflow from Crystal Springs is used mostly for pasture and crop irrigation during the irrigation season. Pastures are irrigated using flood irrigation, and a few wells have been set up with center pivot irrigation (Wurster 2007). In the off-season, surface flows from Crystal Springs merge with outflow from Ash Springs, located approximately 4 miles to the south, and forms White River. Ash Springs consists of at least seven springs that discharge a combined volume of 10,000 afy. Outflow from Ash Springs enters a remnant of the historic White River and eventually provides irrigation water to much of the agricultural land between Ash Springs and Pahranagat NWR. Outside of the irrigation season, water also enters the historic river channel and extends to the Refuge. Pahranagat NWR is the lowest elevation in the valley, so runoff from irrigation or storm events that is not lost to evaporation eventually reaches the Refuge.

Upper Pahranagat Lake is actually a storage reservoir, formed in the mid-1930s by construction of a large containment levee that reaches across the valley. During irrigation season, very little water flows into the reservoir because it is diverted upstream for agricultural uses (Ducks Unlimited 2002).

Groundwater

Groundwater flow through Pahranagat Valley is generally from north to south, parallel to the drainage. Pahranagat Valley is underlain by two groundwater aquifers, a large regional carbonate aquifer and a local basin-fill aquifer. Depth to groundwater in Pahranagat Valley is at or near surface from the regional springs south to the end of the valley. Outflow from Pahranagat Valley may enter the regional carbonate aquifer of the Ash Meadows Flow System or may partially recharge the White River Flow System in northern Coyote Spring Valley (Thomas et al. 1996 and Dettinger 1989).

Groundwater level monitoring data on the Refuge is scarce. One well has historical measurements back to 1952 (USGS 2003b and 2003c). The total depth of the well is 92 feet, so it is likely that the well monitors alluvial aquifer water levels. The water level shows much fluctuation, and until 1991, measurements were only recorded in late winter–early spring (February and March). Alluvial aquifer water levels are likely highly dependent on nearby pumping, upgradient surface water diversions, recharge from surface water and/or local precipitation, and recharge from the regional carbonate aquifer system.

There are also several smaller springs located within the boundaries of the Refuge. These include Cottonwood Spring, Cottonwood Spring North, Lone Tree Spring, L Spring, and Maynard Lake Upper and Lower Springs. Three of the spring outflows (Cottonwood Spring, Cottonwood Spring North, and Lone Tree Spring) have been dredged or trenched to varying degrees.

Water Quality

Discharge from Crystal and Ash Springs make up the bulk of surface water and therefore contribute significantly to the overall water quality of the valley. The practice of flushing salts and alkali from agricultural fields, along with evaporative concentration, contributes to an increase in dissolved solids as water flows from its source through agricultural lands to Upper Pahranagat Lake (Service 1999b). Because of increased evaporation rates and the lack of inflow to downgradient wetlands, dissolved solids concentrations are greatest during late summer. Dissolved solids have been estimated to exceed 6,000 mg/L in terminal wetlands within the Refuge, which is 12 times the recommended potable water limit of 500 mg/L. By contrast, Crystal and Ash Springs have averaged approximately 350 mg/L dissolved solids.

Water Use

Water use within the Pahranagat Hydrographic Basin is primarily for irrigation. During the irrigation season (March 15 through October 15), spring discharge is used to irrigate agricultural fields (Service 1999b). To a very minor extent, wells are used to supplement irrigation. Only one farming operation in the vicinity relies solely on well water for irrigation. That operation is a farm that irrigates 120 acres near Crystal Springs.

The flow of thermal springs during the five winter months is not used by agriculture in the valley, but is adjudicated to the Refuge. From 1991 to 1994, the USGS measured the amount of water reaching the Refuge from the regional springs. The average annual flow for the four water years was 6,500 afy. The Refuge has never had excess water or received more water than it was able to use (Service unknown date). The Refuge currently uses water to maintain reservoir levels for recreation and to maintain wildlife habitat.

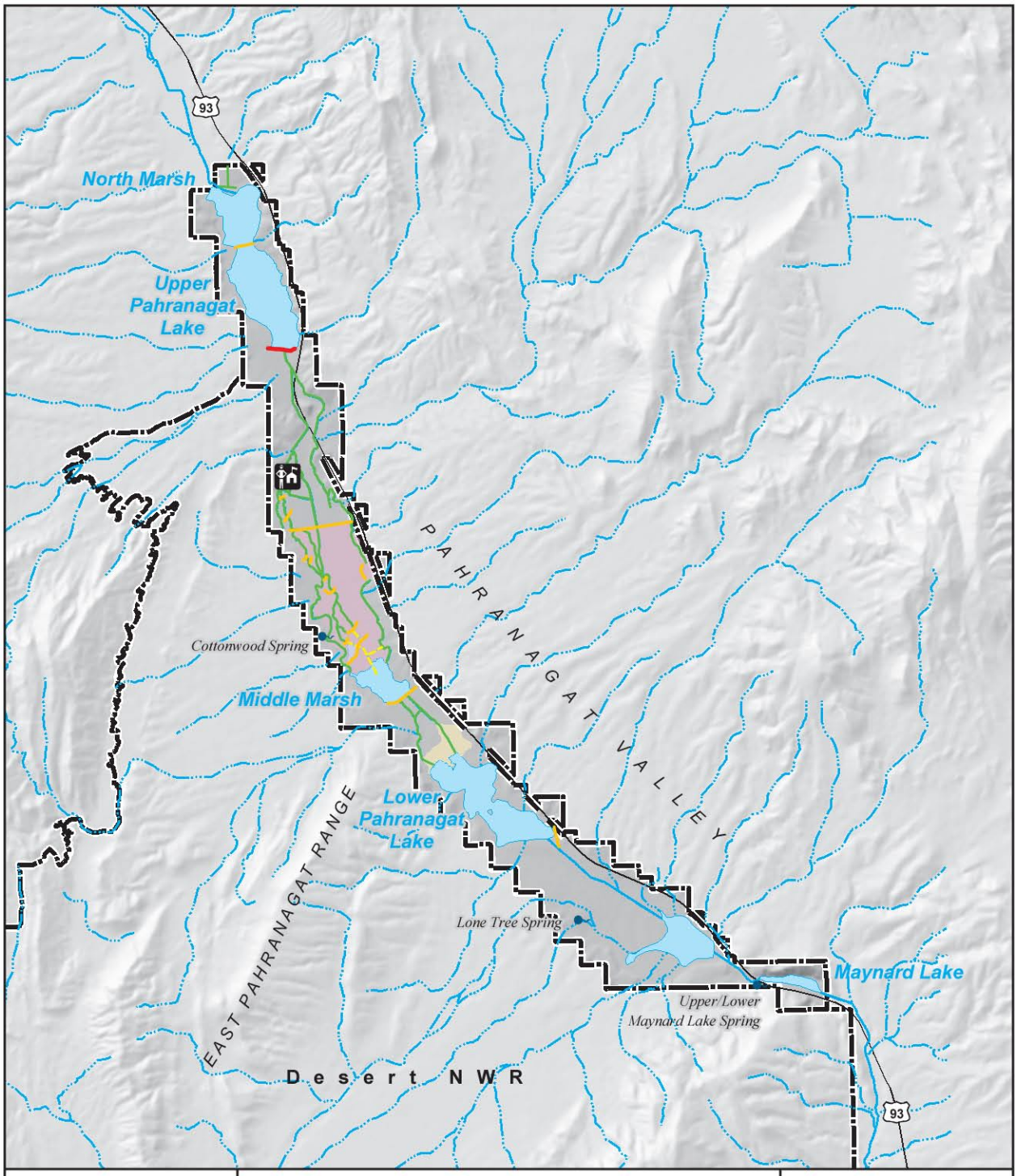

Figure 4.5-1

Hydrology

Pahranagat NWR

May 15, 2008
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Figure 4.5-1-pahranagat_hydro.mxd

The Service has had difficulties with water conveyance and distribution at the Refuge. The previous distribution system did not allow Refuge personnel to selectively convey water to various areas for habitat benefit. The Service is currently partnering with Ducks Unlimited to develop a surface water delivery system that would move water from the upper riparian areas to drier parts of the system, thus enhancing habitat and hunting opportunities. A new system was installed in 2001 to allow conveyance of water to specific areas of the Refuge. The new system was expected to have capacity to convey and/or dissipate relatively high flows without significant damage. At present, portions of the conveyance system (concrete ditch) are not functional due to faulty construction.

Water Rights

Water in the Pahranagat Valley is used primarily for irrigation of pasture-land, quasi-municipal purposes, and domestic water supply. Three large springs discharging from the regional carbonate aquifer are the principal sources of surface water used for irrigation in the valley. Use of these springs' water was adjudicated in the 1926 Pahranagat Lake Decree and amended later in 1965. Water rights identified in the Decree pre-date Nevada Water Law and carry priority dates ranging from the 1880s to 1900. The Service holds some of these water rights, which allow irrigation of lands on Pahranagat NWR using Ash and Crystal Springs water stored in Upper Pahranagat Lake. Users upstream of the Refuge have right to use winter flows to flush salts from the agricultural fields.

In addition, the Service holds several water rights that are junior to the Pahranagat Lake Decree for waters stored in both Upper and Lower Pahranagat Lakes. Many of these water rights were obtained by the original owners of the Pahranagat NWR property. The Service filed applications with the NDWR to change the Refuge's water rights to reflect the Service's ownership and adjust the purpose of water use from irrigation to wildlife purposes. In addition, the Refuge filed new applications for water from three small springs on the Refuge (Cottonwood, North Maynard, and South Maynard). The applications were submitted to the NDWR in 1996 and are currently classified as "ready-for-action but protested."

Hazardous Materials

In 1995, the Service conducted a study to identify and quantify potential human-induced environmental contaminate impacts to the Pahranagat Valley (Service 1999b). Specific objectives included:

- Identification and characterization of contaminant source areas;
- Identification and characterization of environmental contaminants on Service lands;
- Assessment of contaminant concentrations in abiotic and biotic habitat components, fish, and migratory bird eggs;
- Characterization of the toxicity of water; and
- Identification and quantification of contaminant threats to endangered species and migratory birds.

Total dissolved solids, pH, and concentrations of some soluble trace elements in water increased substantially between the spring sources and lakes on Key Pittman Wildlife Management Area and the Pahranagat NWR. Agricultural practices appeared to contribute to the mobilization of the contaminants from agricultural soils and the transport to downgradient lakes. Reduced water inflow and high rates of evapotranspiration contributed to the concentration of dissolved solids and trace elements in one or more of these lakes, which exceeded Nevada water quality standards for applicable beneficial uses and/or concentration associated with adverse effects to aquatic invertebrates, fish, and birds. The highest concentrations were found in both the Upper and Lower Pahranagat Lakes. Pesticides did not appear to represent a threat to fish and wildlife on the Refuge. Arsenic, mercury, and selenium were found at concentrations of concern in water, sediment, or biological tissues collected from areas occupied by endangered fish. Detection of mercury and selenium in samples collected from spring source pools suggest that these elements are, at least in part, originating from the carbonate-rock aquifer (Service 1999b).

Review of Lovering (1954) and Garside (1979) indicates that radioactive minerals have not been mapped on the Refuge.

Fire History and Management

Fire, either wild or prescribed, is a fairly infrequent event on the Pahranagat NWR. The plant communities characteristically have adapted to a very arid climate (7 inches of annual precipitation) (Service 2001). When the communities are in good condition, shrubs are the dominant vegetative feature, and prior to Euro-American settlement, fine fuels were limited. Areas with less than about 8 inches of rainfall rarely support enough vegetation to carry a fire. Fire occurrence in areas receiving more than about 8 inches has been influenced by introduced grasses. Shrub cover is generally widely spaced with large amounts of bare ground between individuals. Most species in this plant community are either somewhat fire-resistant or are vigorous re-sprouters after disturbance. Pre-settlement fire in such a community was likely a rare event, dependent upon extreme conditions of weather and prolonged periods of drought.

Due to expanses of standing water and lack of naturally occurring ignitions, historic natural fire in the Pahranagat NWR wetlands likely was also a rare event (Service 2001). It is quite feasible, however, that Native Americans regularly burned portions of the wetlands prior to Euro-American settlement to enhance resource availability and quality.

Historical overutilization of the shrub community through cattle and sheep grazing has led to declines in range condition and serious reduction of normally sparse native grass species, while allowing the introduction of exotic annuals (Service 2001). In recent years, exotic native annuals have invaded increasingly large areas of the salt desert community, including portions of the Pahranagat NWR. In particular, cheat-grass has become co-dominant in some areas. This invasion can dramatically alter fire return intervals in this ecosystem from a rare

event to one in often less than 10 years. When fire is applied to the desert-shrub community with few or no perennial plants and an exotic annual component present in the understory, the post-fire community will very likely be dominated by annuals.

Prescribed burns have been used on the Refuge since 1985, based on available data (Service 2001).

Air Quality

Ambient air quality is not currently measured at Pahranagat NWR. It is expected that low ambient concentrations of criteria pollutants would occur for this area. The nearest major sources of emissions are in the Las Vegas area, approximately 80 miles to the south. Minor sources from automobile traffic and campfires on the Refuge may result in very localized increases in ambient concentrations.

4.5.2 Biological Resources

Vegetation

Habitat Types

Pahranagat NWR contains 5,380 acres of marshes, lakes, meadows, springs, and riparian habitat (Service 2006a). Most of the Refuge landscape was used for agricultural practices in the past, so several areas still contain remnant signs of these agricultural uses. Many of the historically cultivated agricultural fields have naturally become re-vegetated and now consist of wetland or riparian vegetation (Figure 4.5-2). Management efforts are ongoing to establish native wetland and upland habitats.

Thermal springs along the flood plain provide water to the various ponds, lakes, and marshes found throughout Pahranagat Valley (Service 2006a). The floodplain was formed by an ancient perennial stream, White River, which flowed from the north and was a tributary of the Colorado River. The flood plain it created is well-defined but very narrow. This floodplain is ancestral and has been dry for thousands of years, except for a small creek running down the center that is fed by thermal springs.

Four main water impoundments are found on the Refuge, including North Marsh, the Upper and Lower Pahranagat Lakes, and Middle Pond/Marsh (Figure 4.5-2). Water draining from Ash and Crystal Springs (about 15 miles north of the Refuge) flows along Pahranagat Creek and spills into Upper Pahranagat Lake and North Marsh (Service 1998b). Open water habitat covers approximately 640 acres of the Refuge.

Upper Pahranagat Lake and North Marsh only receive water during winter months when the upgradient agriculture fields and ranches are not using water from Pahranagat Creek for irrigation. North Marsh and Upper Pahranagat Lake also receive and store quantities of water from the thermal springs just north of the Refuge (Service 2006a). Water in the lake is released by Gardner Dam, on the south side of Upper Pahranagat Lake, throughout the year to create and enhance the marsh, wetland, and grassland habitats farther south. Middle

Marsh captures the released water and creates habitat for many wildlife species.

Lower Pahranagat Lake is used to store water from Middle Marsh, and water flowing through Middle Marsh is released toward Lower Pahranagat Lake. Lower Pahranagat Lake is the last storage unit for the Refuge and captures all excess water from the other three impoundments. The lake, wetland, and marsh areas provide lush habitat for various species of birds, mammals, fish, and other wildlife. The southernmost lake on the Refuge and the southernmost wetland in Pahranagat Valley is Maynard Lake. This lake receives water from the main storage impoundments only when adequate water is available. The releases of water can create habitat for many resident and migratory wildlife species.

The vegetation types at Pahranagat Refuge range from lakes, riparian woodland, wetlands, wet meadows, and springs to uplands, alkaline playas, and rocky outcroppings. Although the riparian woodland is very limited in size, it is the rarest and most irreplaceable of the vegetation communities found at the Refuge.

The riparian woodlands consist of Gooddings willows (*Salix gooddingii*), Fremont cottonwoods (*Populus fremontii*), and coyote willows (*Salix exigua*). At the northern edge of Upper Pahranagat Lake, the mature gallery forest of towering Gooddings willows provides critical habitat for the endangered southwestern flycatcher and other songbirds. This forest covers approximately 100 acres of the Refuge. Small stands of cottonwoods can be found around the perimeter of Upper Pahranagat Lake. Isolated stands of cottonwoods or individual cottonwoods are also found at each spring and in patches of better soils.

Emergent wetlands grow at the margins of all permanent ponds and lakes in the Refuge. Emergent vegetation consists of tules and cattails (*Schoenoplectus maritimus* and *Typha domingensis*). Mats of floating aquatic plants (*Polygonum amphibium*) are found only at the northern end of Upper Pahranagat Lake. The spring habitats are characterized by lush stands of American bulrush (*Schoenoplectus americanus*) and are generally dominated by massive cottonwoods. A wet meadow supporting a dense mixture of Baltic rush (*Juncus balticus*) and yerba mansa *(Anemopsis californica*) extends downstream of Lone Tree spring but Cottonwood spring currently supports only cottonwoods and a small patch of emergent American bulrush.

Middle Marsh is composed of wet meadows, grassy meadows, and scattered wetlands. In the most alkaline soils, saltgrass and alkali sacatone dominate. In the drier portions of Middle Marsh, nonnatives such as quackgrass (*Elytrigia repens*) and tall wheatgrass (*Elytrigia pontica*) are abundant and can even form monocultures, excluding all other vegetation. The wet meadows support dense stands of yerba mansa (*Anemopsis californica*) and Baltic rush (*Juncus balticus*).

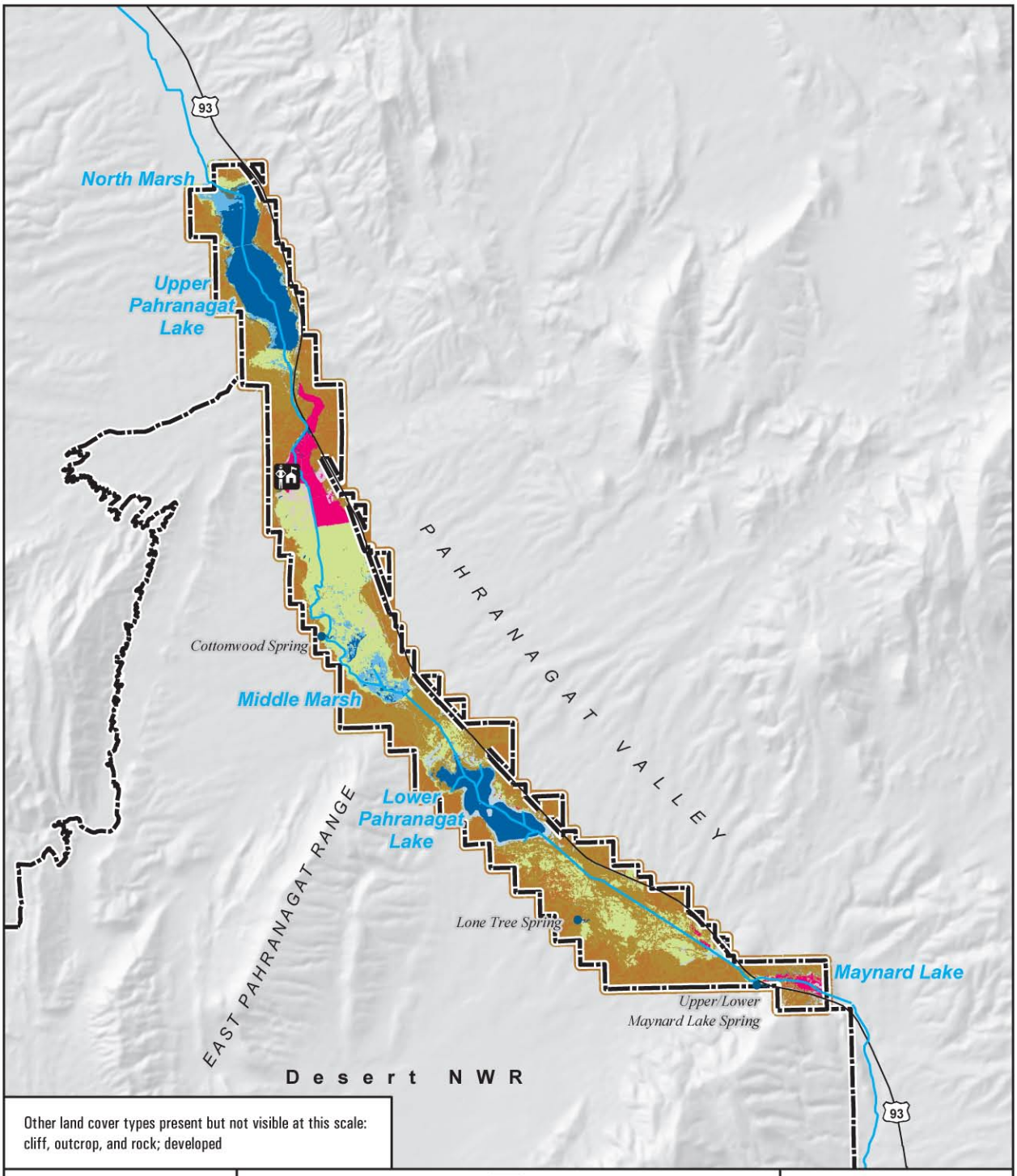

Figure 4.5-2

Vegetation Types

Pahranagat NWR

May 20, 2008
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Figure 4.5-2-pahranagat_veg.mxd

Small patches of Indian hemp (*Apocynum cannabinum*), bulrushes (*Schoenoplectus maritimus* and *Schoenoplectus americanus*), cattails (*Typha domingensis*), spikerushes *(Eleocharis* spp.), and sedges (*Carex* spp.) are also scattered within the wet meadow complexes. Wet meadow habitat covers approximately 700 acres, and alkaline wet meadow habitat covers approximately 350 acres of the Refuge. Emergent wetland habitat at Middle Marsh covers approximately 400 acres.

Upland vegetation communities change according to subtle variations in topography and salinity. The salt desert scrub habitat consists of various saltbush species found in saline basins on valley floors and around playas. Areas with low nocturnal temperatures and very high soil salinity are common in these basins and support most of this habitat. Salt desert scrub habitat at the Refuge is dominated at the lowest elevations by green rabbitbrush (*Ericameria nauseosus*), often mixed with saltbushes (*Atriplex* spp.). At slightly higher elevations, greasewood (*Sarcobatus vermiculatus*) is more abundant and is often found with four-winged or big saltbush (*Atriplex canescens, Atriplex lentiformis*). Traveling up the sides of Pahranagat Valley, widely spaced creosote bushes (*Larrea tridentata*) come to dominate the upland vegetation. Joshua trees (*Yucca brevifolia*) appear among the creosote bushes as the topography continues to rise. This habitat forms the creosote–white bursage alliance.

The creosote–white bursage scrub alliance occurs in broad valleys, lower bajadas, plains, and low hills. This alliance is characterized by widely spaced shrubs and succulents averaging 2 to 8 feet tall, with 2 to 50 percent cover (Holland 1986; Rowlands et al. 1982; Vasek and Barbour 1977). The herbaceous layer is sparse, but seasonally abundant after rain events. Creosote–white bursage scrub transitions to mixed desert scrub at the highest elevations on the Refuge. The mixed desert scrub habitat is dominated by the blackbrush shrub. Plant species found in this habitat are very similar to those in the creosote–white bursage alliance, but they typically consist of intricately branched shrubs that range from 1.5 to 3 feet tall (Holland 1986). Mojave yucca and Joshua tree are very common throughout the mixed desert scrub habitat (BLM 1990).

Rocky outcroppings are also present in the upland portion of the Refuge. These areas are dominated by the invasive red brome grass (*Bromus madritensis* var. *rubens*), but various species of cactus (*Opuntia* spp.) can be found as well as woody shrubs such as Mormon tea (*Ephedra nevadensis*) and indigo bush (*Psorothamnus fremontii*).

Other cover types on the Refuge include playas and desert washes. Playas are mostly unvegetated (less than 10 percent) and are subject to intermittent flooding. Salt-tolerant species often form vegetation rings around the playas. Desert washes are intermittently flooded washes or arroyos associated with rapid sheet and gully flow. They often consist of linear or braided strips within desert scrub or shrublands and grassland habitats. The desert washes of Pahranagat are characterized by dense growths of rabbitbrush, interspersed with alkali sacatone and patches of saltgrass.

Sensitive Plant Species

No federally listed plant species are known to occur on Pahranagat NWR. One sensitive plant, Nye milkvetch (*Astragalus nyensis*), has potential to occur on the Refuge (Appendix H).

Noxious Weeds

The Refuge is located in Lincoln County, Nevada, which is a part of the Tri-County Weed Control Program. Lincoln County treated some areas for tall whitetop (*Lepidium latifolium*) invasions during 2001 (Noxious Weed Action Committee 2001). Many other invasive weeds have become established at the Refuge. Salt cedar forms dense thickets around the southern half of Lower Pahranagat Lake, and Russian olive spreads rapidly in wet meadows. Russian knapweed (*Acroptilon repens*) and various pigweeds (*Amaranthus* spp.) form monocultures in disturbed areas such as the previously cultivated fields of Black Canyon or the Maynard Lake area. The red brome invasive grass is widespread in the drier uplands, while quack grass and tall wheatgrass are locally abundant in the grassy meadows. The constructed ponds near Headquarters are home to a wide variety of weeds that colonized moist disturbed areas, such as bindweed (*Convolvus* spp.), Johnson grass (*Sorghum halepense*), sunflowers (*Helianthus* spp.) and foxtail barley (*Hordeum jubatum*). Appendix H provides a complete list of the noxious weeds that may occur on the Refuge.

Wildlife

More than 230 species of migratory birds and other wildlife use the wetland habitats found on the Refuge (see Appendix H for a list of species). Numerous non-game migratory birds use habitat on the Refuge during the fall and spring migrations. They visit during the fall on their flight south and again in the early spring on their way back north. Some species nest in the dense riparian areas. The riparian areas, marshes, open water, croplands, and native grass meadows attract and support hundreds of species and thousands of individual birds and other wildlife annually. The majority of the wildlife species found on the Refuge are non-game species, and some of them are considered sensitive.

Amphibians and Reptiles

The Refuge's lakes and marsh habitat provide suitable habitat for a variety of amphibians. The relict leopard frog (*Rana onca*), thought to be extirpated from most of Nevada, may occur in Maynard Lake Spring. Other amphibians that likely occur on the Refuge include bullfrog, Pacific chorus frog, western toad, plains leopard frog (*Rana blairi*), and northern leopard frog (*Rana pipiens*).

Reptiles are more common in Nevada than amphibians. They occur in the drier, upland communities on the Refuge. Common reptiles include Gila monster, collared lizard (*Crotaphytus collaris*), coachwhip, common kingsnake (*Lampropeltis getulus*), western shovel nose (*Chionactis occipitalis*), gopher snake (*Pituophis catenifer*), western rattlesnake (*Crotalus viridis*), and Mojave rattlesnake (*Crotalus scutulatus*). At the northern extreme of its range, the threatened

desert tortoise occurs in desert upland habitats of the Refuge at unknown densities.

Birds

Pahranagat NWR was established to provide habitat for migratory birds, especially waterfowl. The Refuge is located within the Pacific Flyway, as are the other refuges in the Desert Complex. Many migratory birds are found on the Refuge, including shorebirds, grebes, herons, egrets, and many other non-game birds that use wetland habitat. Many of the waterfowl species found on the Refuge are residents because of the permanent water supply in the valley. Some use the habitat for a short period of time and continue on their migration path.

Pahranagat NWR is considered to be highly important to migratory birds, waterfowl, and songbirds because of its historic geological and hydrological setting on the edge of the Mojave Desert and Great Basin physiographic regions in southern Nevada. In 1999, the American Bird Conservancy designated Pahranagat NWR as a "Continentally Important Bird Area." Approximately one-half of Refuge acreage contains lakes, marshes, springs, and associated riparian habitat. These wetlands are important to the survival of migratory waterfowl and songbirds as well as resident wildlife.

Some of the management priority bird species include eared grebe, western grebe, American white pelican (*Pelecanus erythrorhynchos*), Franklin's gull, black tern, snowy egret, marbled godwit, snowy plover, long-billed curlew, white-throated swift, pinyon jay, Arizona Bell's vireo, southwestern willow flycatcher, black-chinned sparrow, western yellow-billed cuckoo, and canvasback (see Appendix H for more species and the habitats they occur in on the Refuge).

Surveys conducted in the past eight years have confirmed the presence of the federally endangered southwestern willow flycatcher on the Refuge. They use a stand of large cottonwoods and willows at the north end of the Refuge for nesting. Yellow-billed cuckoos have been observed in similar Refuge habitat.

American peregrine falcons are known to use the Refuge for foraging and probably nest on adjacent cliffs. Small numbers of bald eagles use the Refuge for foraging and roosting during winter migration.

Approximately 2,000 of the Lower Colorado River population of greater sandhill cranes (almost 25 percent of this declining population) have used the Refuge as a migrational staging area.

Fall duck migration to the Refuge usually begins in late August with the arrival of several hundred mallards, pintails, and green-winged teal. Peak waterfowl use on the Refuge for the year usually occurs near the end of October. The average duck population on the Refuge in late October for the last five years is approximately 10,000 birds. Pintails and green-winged teal each make up about 40 percent of the population, and mallards and American wigeon share most of the remaining 20 percent. Refuge populations decrease in December as

ducks migrate farther south, leaving usually fewer than 1,000 for the remaining winter months.

The Refuge holds a wintering population of tundra swans each year averaging approximately 250 birds. They generally arrive in November and depart north in January.

The paucity of riparian and wetland habitat in Southern Nevada underscores the importance of the Refuge in providing migratory and nesting habitat for passerines. Well over 100 species of perching birds can be found on the Refuge that use both desert uplands and riparian/wetland habitats.

Mammals

The following sensitive mammals can be found on the Refuge: Desert Valley kangaroo mouse, Pahranagat Valley montane mole, Townsend big-eared bat, Allen's big-eared bat, small-footed myotis, long-legged myotis, and Yuma myotis.

The Pahranagat Valley montane vole is endemic to the Pahranagat Valley; according to refuge records, it has been captured as recently as 2007 (NDOW 2007b) and is known to be reproducing on the Refuge (Service 2001). Very little is known about this small, herbivorous mammal that inhabits moist meadow habitats. Trapping efforts have captured voles in several areas of the Refuge, all with good grass cover, and the montane vole is part of a continuing genetic study on the Refuge. These areas include east and north of the North Marsh, the northern portion of the Middle Marsh unit, and just north and west of the Middle Marsh Pond.

Bats are very common on the Refuge, and nine of the potentially occurring bat species are sensitive. Bats are important to the Refuge because they help regulate insect and invertebrate populations, and some help pollinate plants. Most bats are commonly observed during evening hours.

According to the 1992 Annual Narrative Report, cottontail rabbits, a game species, are found in low densities (Service 1992). Black-tailed jackrabbits and white-tailed antelope squirrels are also common.

Mule deer are found in low numbers on the Refuge, but they are not hunted on the Refuge. The 1992 Annual Narrative Report estimated that about 20 deer used the Refuge throughout the year; however, six of them were killed in 1992 from vehicle collisions. The current population is estimated at about 120 deer using the Refuge (Maxwell 2007). Deer crossing signs were erected in late 1992 at each end of the Refuge along U.S. Highway 93 to promote safer driving conditions and reduce the number of roadkills.

Aquatic Species

Several fish species can be found at the Refuge. Pahranagat speckled dace (*Rhinichthys osculus velifer*) is endemic to springs in Pahranagat Valley. Three other endemic fish species are listed as endangered: Pahranagat roundtail chub (*Gila robusta jordani*), White River

springfish (*Crenichthys baileyi baileyi*), and Hiko White River springfish (*Crenichthys baileyi grandis*). Two other endemic fish have become extinct: desert sucker (*Catastomus clarki* ssp.) and Pahranagat spinedace (*Lepidomeda altivelis*). Water quality of the Pahranagat Valley has been considered a factor limiting the range of these fish (Service 1999b).

Several game fish occur in Upper Lake, North Marsh, and Middle Pond. The main sport fish are largemouth bass and bullhead catfish (*Ameiurus nebulosus*). Approximately 15,000 largemouth bass were stocked in May of 1992 from a hatchery in New Mexico (NDOW 2002). Common carp (*Cyprinus carpio*) also occur on the Refuge and are detrimental to other fish populations because of the competition for limited resources. In 1996, an attempt to eradicate carp from Upper Pahranagat Lake appeared successful, but carp were later found in North Marsh and Upper Pahranagat Lake. The percentage of fish in Upper Pahranagat Lake in 1999 was 39 percent bass, 28 percent bullhead, 18 percent green sunfish (*Lepomis cyanellus*), and 15 percent carp. Carp populations are expected to be continually increasing.

Sensitive Wildlife Species

The southwestern willow flycatcher, an endangered species, is known to occur in the cottonwood-willow riparian habitat on the Refuge. In 2005, 29 southwestern willow flycatchers were recorded at the Refuge, nesting in a total of 21 territories (Koronkiewicz et al. 2006). In 2006, 29 resident, breeding flycatchers were recorded at the Refuge, nesting in a total of 15 territories (McLeod et al. 2007). All of the observed nests were found in coyote or Gooddings willows and cottonwood; no nesting was observed in salt cedar habitat. The Refuge's nesting population is considered one of the largest nesting populations in the Colorado River Basin.

The Pahranagat roundtail chub, also an endangered species, is not known to occur on the Refuge, although it was present historically. Bald eagle (delisted), desert tortoise, and yellow-billed cuckoo have the potential to occur on the Refuge. An additional 44 sensitive species have the potential to occur on the Refuge. Appendix H provides a list of the endangered and threatened species and sensitive species that may occur at the Pahranagat NWR.

4.5.3 Cultural Resources

Introduction

The Pahranagat NWR area is an extremely important cultural landscape to many tribal people, especially the Southern Paiute, Western Shoshone, Owens Valley Paiute, and Mohave, as it is a shared use place of sacred power and origins. The natural and cultural resources in the area are all physically and spiritually interrelated. There was extensive historic use of the area for habitation, resource gathering, hunting, fishing, agriculture, and ceremonies prior to Euro-Americans entering the area. In the late 1800s, when non-Indians began to move into the greater Pahranagat Valley vicinity, confrontations occurred, followed by multiple accounts of Paiute and

Shoshone Indians being massacred by solders, miners, and settlers. No specific locales for these atrocities have been yet been identified or recorded on the Refuge. In fact, very little systematic archaeological reconnaissance has been conducted in the Pahranagat Valley. Approximately 185 acres or 3.44 percent of the Pahranagat NWR has been investigated through archaeological reconnaissance surveys (Fergusson and DuBarton 2003).

Prehistoric Archaeology

Although more exist, there are currently only 21 recorded prehistoric sites on the Refuge, and these early official site records typically contain very limited information. Cultural resources in the Pahranagat Valley include campsites, lithic scatters, rock shelters, rock art, quarries, special activity sites, multi-component sites, and historic sites. For many of the sites, it is impossible to define temporal characteristics without further investigation. Some of the most well-known sites are rock art, which have attracted public interest.

Sites that may date to the Archaic period around 3,000 B.C. include rock art, stone rings, and lithic scatters found within the Black Canyon National Register District within the Pahranagat NWR. Because the District has not yet been thoroughly investigated, it is impossible to determine if the sites can be assigned to this period or to earlier ones. This petroglyph complex includes several sites featuring unique anthropomorphic figures that are unique to the Pahranagat area (Stoffle et al. 2002). A professional recordation of the complex and coordination with the Moapa Band of Paiutes and other affiliated tribes that associate with this important area would benefit the Refuge's management of the complex.

Other prehistoric resources identified within the Refuge include the Red Tail Hawk origin spot (Maynard Lake) and Coyote's Jar (Origin spot for Paiutes in the area) (Stoffle et al. 2002). Two Southern Paiute villages were also reported to occur in the area, consisting of approximately 300 people who practiced complex horticulture using an extensive network of irrigation. Rock art sites in the area also identify the area as a Water Baby site (supernatural beings who protect the water).

Historic Archaeology

Historic sites are those sites that resulted from use of the region by Euro-Americans or other groups after contact with native peoples. For many portions of southern Nevada, this happened during the mid-1800s. Only four historic sites have thus far been recorded on the Pahranagat NWR. One historic "Walden House" was nominated to the NRHP, but the process has not yet been completed. The Service has improved the house so the building could be used as part of the headquarters complex. Other historic sites on the Refuge include a historic road around Maynard Lake and features associated with historic habitations and ranching.

4.5.4 Public Access and Recreation

Public Access

Pahranagat NWR is open to the public year-round. The public is encouraged to visit the "valley of many waters" to enjoy a variety of recreational opportunities and experience the desert oasis.

Principal public access to Pahranagat NWR is from U.S. Highway 93, about 71 miles north of its junction with I-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 4 miles north of the headquarters road, an unpaved road leads to the North Marsh and Upper Pahranagat Lake and provides access to the campsites. Vehicles must remain on the designated roads. All-terrain vehicles are prohibited on the Refuge.

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. Between 1999 and 2001, approximately 21,500 vehicles visited Pahranagat NWR (CH2MHill 2002). 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 35,000 visitors per year (Le'au Courtright 2006).

Recreation

The Refuge administrative office also 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 the staff is available. An outside contact station with interpretive kiosk is located at the north end of the Refuge in the camping area. A dike at Upper Pahranagat Lake serves as a fishing and observation pier (Service 2006a). A hunting and observation platform is available at Middle Marsh. Campsites are available along the eastern shore of the Upper Pahranagat Lake. Picnic tables and grills are available at the campsites. Non-flush toilets and dumpsters are provided in the campground area. Parking is available in several places along designated roads.

The nature trails and fishing pier are the most common facilities used by the public. In FY 2002, more than 10,000 people visited the Refuge to fish, and more than 3,000 people hiked along the nature trails. The platform was used by more than 600 visitors, and 1,500 visitors stopped at the kiosk. The administrative office/visitor contact station was visited by 500 people in 2002. More than 20,000 people visited the Refuge for other recreational opportunities, such as camping and picnicking.

Numerous recreational opportunities are available at Pahranagat NWR (Figure 4.5-3). Wildlife-dependent activities include wildlife observation, photography, fishing, hunting, environmental education, and interpretation. Camping, boating, and picnicking are common non–wildlife-dependent activities.

Wildlife-Dependent Recreation

Wildlife observation, fishing, and hunting are the more popular activities enjoyed by Refuge visitors (Service 2006a). Wildlife observation is available throughout the Refuge, and a bird list is available at the Refuge 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.

Educational opportunities about Pahranagat NWR are available on and off the Refuge. During FY 2002, 261 visitors participated in environmental education activities (Service 2006a). Half of these (132) were staff-conducted tours for students, while the remaining half (129) were non–staff-conducted tours. Exhibits are the only off-site educational outreach opportunities offered to the public, and the Refuge had 520 visits to environmental education exhibits and 165 visits to interpretation exhibits in 2005. Other special events to promote the Refuge in 2002 included news releases and other special events.

An active volunteer program provides additional opportunities for the public to enjoy the Refuge, and student interns may be able to earn college credits through an internship at the Refuge. 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. Recent research at Pahranagat NWR has primarily centered on activities that directly support reconstruction/restoration efforts of select habitat areas, including enumeration of wildlife populations, surveying of vegetative habitats, GIS-related data gathering and analysis, and routine baseline monitoring of air and water quality.

The Desert Complex hosts events for National Wildlife Refuge Week and Migratory Bird Day. In FY 2004, they hosted a few events for National Wildlife Refuge Week. Other events that Desert Complex staff have attended include the Clark County Fair, Clark County ECOJAM (Earth Day event), Gran Fiesta (September 2002), and Boy Scout Day Camp (May 2003). Refuge staff or Desert Complex staff also attended the Governor's Conference on Tourism, Dia de los Niños, and Las Vegas Chamber of Commerce Preview, depending on staff availability and funding.

Fishing opportunities are available at Upper Pahranagat Lake. Species in the lake include largemouth bass, catfish, and carp. The NDOW and the Service signed a cooperative agreement to establish and maintain the warmwater sport fishery on the Refuge. The Service was tasked with maintaining the level of the Upper Pahranagat Lake at 4.0 on the staff gauge at the outlet structure, and NDOW was tasked with stocking the lake, North Marsh, and Middle Pond with game fish.

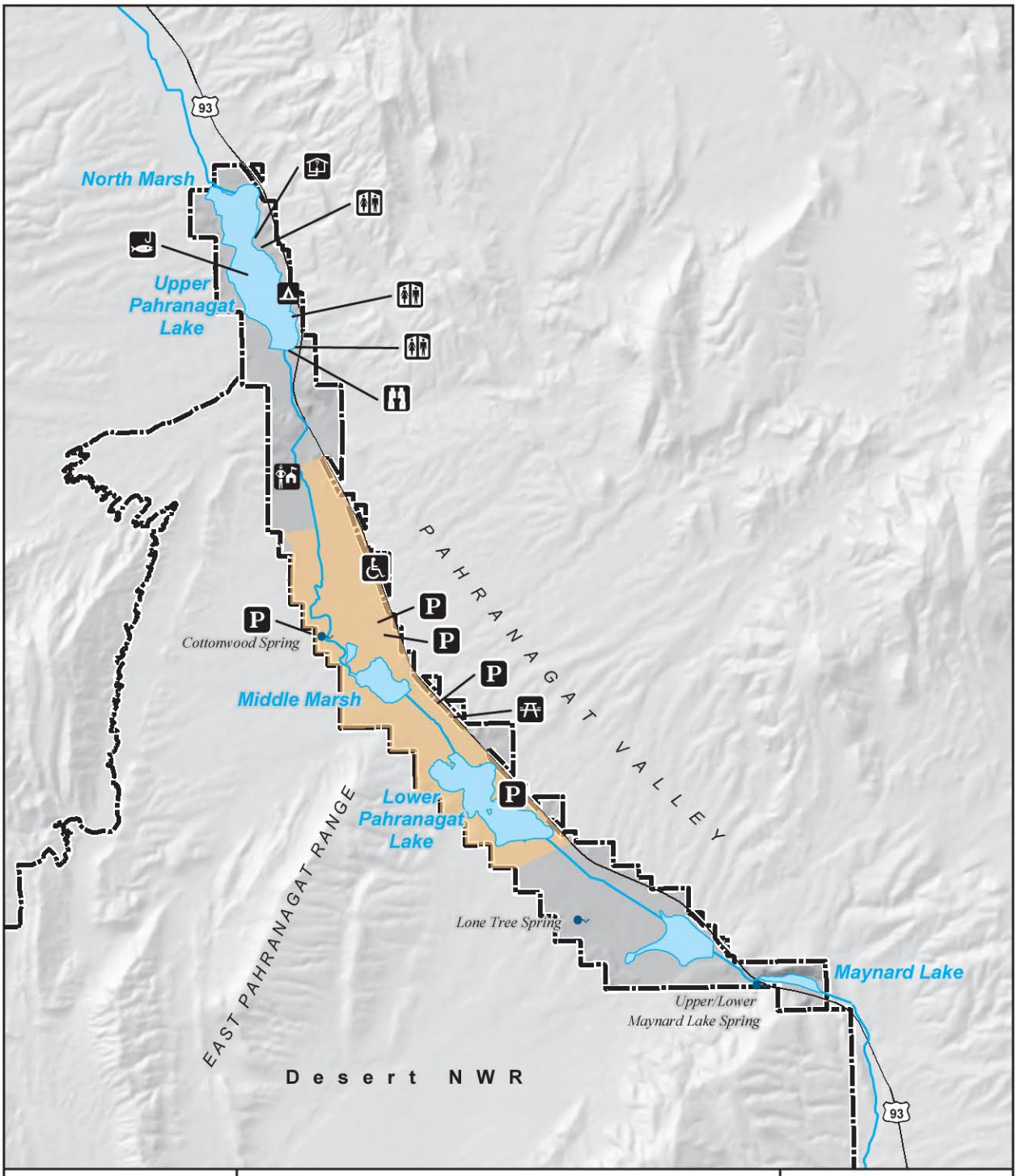

Figure 4.5-3

Visitor Services

Pahranagat NWR

May 16, 2008
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Figure 4.5-3-pahranagat_visitor.mxd

Hunting is available on the Refuge south of the Refuge headquarters (Figure 4.5-3). An accessible hunting blind is available near the Refuge headquarters. During FY 2002, 1,081 hunters visited the Refuge (Service 2006a). Geese, ducks, coots, moorhens, snipe, and doves are the only migratory birds allowed to be hunted on the Refuge. Species hunted on the Refuge in 2002 included waterfowl (423 hunters), other migratory birds (516 hunters), and upland game (284 hunters). More than 10,000 people visited the Refuge to fish in 2002. Hunting and fishing are subject to all applicable state, federal, and Refuge regulations. Hunting opportunities are also available north of the Refuge at a state-managed hunting area. Hunting opportunities are offered alternately between each location to reduce stress on waterfowl.

Non–Wildlife-Dependent Recreation

Camping and picnicking are permitted along the eastern shoreline of Upper Pahranagat Lake in the designated campground. Hiking is permitted on designated trails and roads. Off-highway vehicles are not permitted on the Refuge. Swimming is not allowed at any of the water bodies. Boat launching facilities are unimproved and accommodate only small craft, and only non-motorized boats, float boats, or boats with electric motors are permitted on Upper Pahranagat Lake and Lower Pahranagat Lake. No boats, rafts, or any other types of flotation devices are allowed at North Marsh.

4.5.5 Social and Economic Conditions

Refuge Management Economics

The current Refuge staff consists of two permanent full-time employees, and one vacant part-time seasonal employee position. The Refuge Manager lives on the Refuge, with an office at the Refuge headquarters. The refuge operations budget for FY 2005 was $160,000. The maintenance budget for the Refuge was $44,246.

NWRs contribute funds to local counties through revenue-sharing programs that are intended to cover costs for either lands purchased in fee title or lands reserved from the public domain. For FY 2003, Lincoln County received payment in the amount of $6,640 from the federal government under this revenue-sharing program.

Environmental Justice

The closest town to Pahranagat NWR is the small, unincorporated town of Alamo. The population of Lincoln County is predominantly white (92 percent); Hispanics/Latinos are the largest minority group, representing about 6 percent of the population (U.S. Census Bureau 2006). Lincoln County has a median family income of about $45,000, which is slightly below the average estimate for Nevada ($50,000). The Alamo community is not considered a low-income, minority population.

Land Use

The Pahranagat NWR is bounded on the north by privately held and BLM-managed lands, to the east and west by BLM-managed lands, and to the south by the Desert NWR (Figure 1.7-4). The NTTR is approximately 12 miles to the west.

Present-day commercial/industrial activities include open ditch irrigation development and management, operation of a landing strip/airfield by Lincoln County, basic tourist facilities, and a wastewater treatment plant. Radio and cell towers can be seen on the slopes of the east Pahranagat Range (BLM-managed) to the west of the Refuge. Future proposed uses in the vicinity include industrial park development, residential development at Alamo and Coyote Springs, and groundwater development in neighboring valleys (Delamar and Dry Lake), which could affect management of the Refuge.

Aesthetics

The Refuge encompasses a 10-mile stretch of Pahranagat Valley and associated desert uplands at an elevation of slightly less than 4,000 feet above msl. The White River is dry for many miles upstream and downstream from Pahranagat Valley, but there is water in the valley that originates from large springs to the north of the Refuge. Various types of wetland habitats exist, which support many plants that provide habitat for more than 230 species of migratory birds and other resident wildlife.

The Refuge is located along U.S. Highway 93 in a rural area. The road is a major man-made feature and is a major travel route. The surrounding area consists primarily of creosote bush scrub and some blackbrush in the distance. There is little elevation variation in the vicinity of the site, but mountain ranges to the west and east provide a natural background for visitors. Light pollution is scarce in the vicinity of the Refuge due to a lack of large cities.