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TECHNICAL STAFF REPORT

Revised Water Quality Standards for Surface Waters of the Antelope Hydrologic Unit

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1. Introduction

The California Regional Water Quality Control Board, Lahontan Region (Water Board) is the California state agency responsible for setting and enforcing water quality standards in about 20 percent of the state including the eastern Sierra Nevada and northern Mojave Desert. Water quality standards and control measures for surface and ground waters of the Lahontan Region are set forth in the *Water Quality Control Plan for the Lahontan Region* (Basin Plan). Basin Plan amendments to adopt or revise water quality standards for surface waters in California must be approved by the Lahontan Water Board, the California State Water Resources Control Board (State Water Board), the California Office of Administrative Law, and (for new and revised standards for surface waters of the United States) the U.S. Environmental Protection Agency, Region IX (USEPA). Opportunities for public participation in the plan amendment process are provided at the Regional and State Water Board levels.

This staff report provides the technical justification for proposed Basin Plan amendments to establish site-specific standards (beneficial use designations and water quality objectives for ammonia toxicity) for Amargosa Creek, Piute Ponds and associated wetlands, and Rosamond Dry Lake, within the Lancaster Hydrologic Area in Los Angeles and Kern Counties (Figure 1). The lower reach of Amargosa Creek and downstream waters are within the boundaries of Edwards Air Force Base (EAFB).

The revised site-specific standards will be implemented through the Water Board's existing permitting and enforcement authority for point and non-point sources, and in particular, through Waste Discharge Requirements for the Los Angeles County Sanitation District No.14 (LACSD No. 14) Lancaster Wastewater Reclamation Facility. Lower Amargosa Creek and the Piute Ponds and associated wetlands are effluent dominated waters that currently receive disinfected secondary effluent from LACSD No. 14. Note: the spelling "Piute" is used in the plan amendments and supporting documents because of its use in U.S. Geological Survey topographic maps. The alternate spelling "Paiute" is used for the ponds in some publications, and in direct quotes from such publications in this staff report.

Preliminary drafts of earlier versions of the draft Basin Plan amendments and this staff report were reviewed by two external scientific peer reviewers in 2004, pursuant to Health and Safety Code Section 57004. The peer review drafts included site-specific objectives (SSOs) for ammonia toxicity that were developed by LACSD's consultants. The peer review drafts also assumed that LACSD would continue discharging secondary effluent to lower Amargosa Creek and the Piute Ponds and wetlands. Both peer reviewers were critical of the toxicity bioassays used to develop the preliminary draft SSOs. Because of the reviewers' comments, and because LACSD has committed to maintain the ponds

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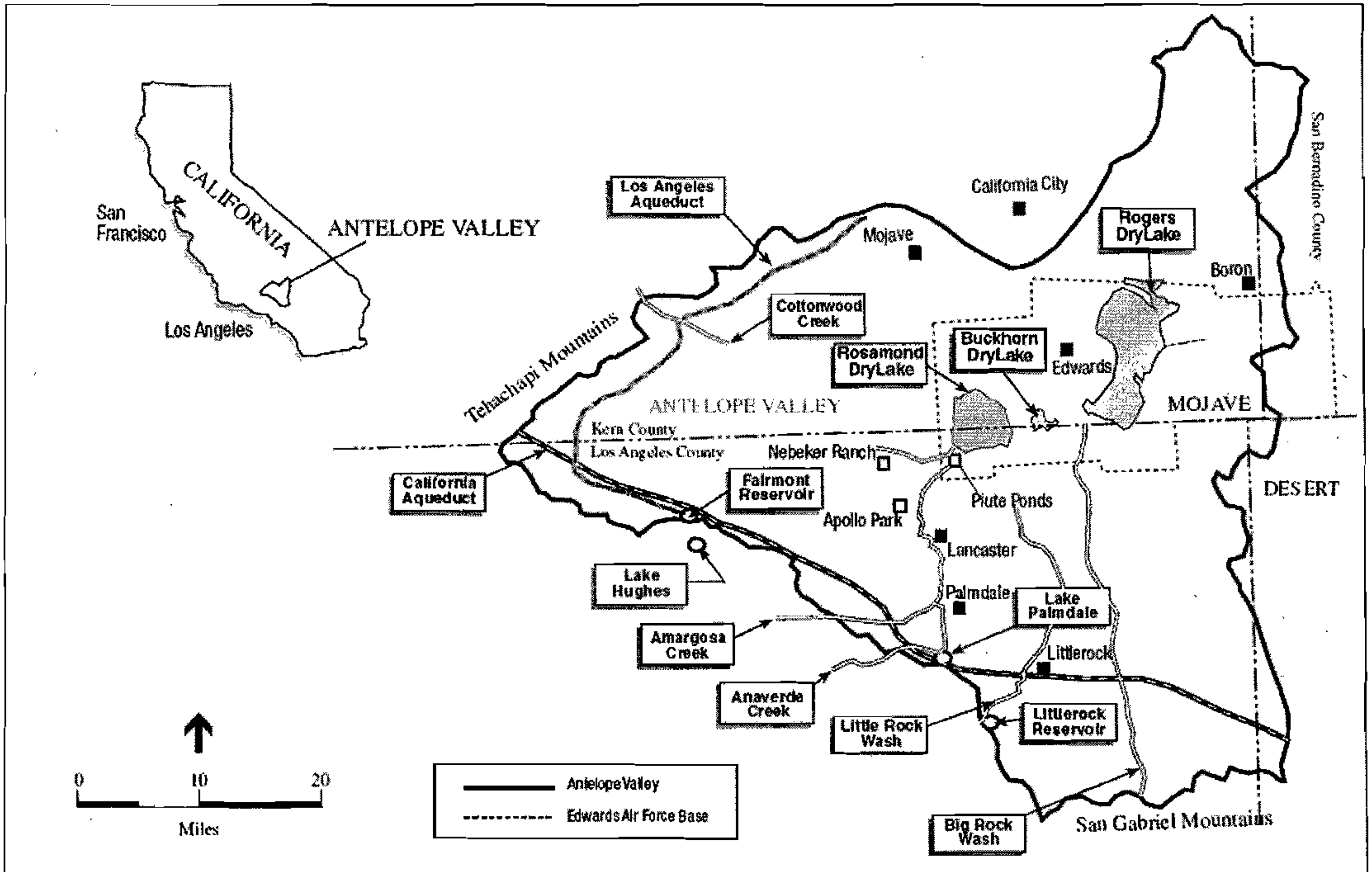

SOURCE: Environmental Science Associates

LWRP 2020 Plan EIR / 200481

Figure 4.3-1

Figure 1. Map of Antelope Hydrologic Unit. Source: ESA, 2004.

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and wetlands with tertiary rather than secondary effluent, more stringent ammonia toxicity SSOs are now being proposed. As explained in Section 5,below, these SSOs incorporate the USEPA's 1999 freshwater ammonia criteria for waters with salmonids absent and fish early life stages present. Responses to the 2004 peer review comments will be included in the administrative record of the Basin Plan amendments.

The environmental and socioeconomic impacts of the proposed amendments are addressed in a separate substitute environmental document that meets requirements of the California Environmental Quality Act (CEQA). The Water Board's planning program has been certified by the California Secretary for Resources under Public Resources Code Section 21080.5. This certification allows the Board to prepare substitute environmental documents rather than Environmental Impact Reports (EIRs).

Copies of the draft Basin Plan amendments, the substitute environmental document, this staff report, and the existing Basin Plan will be available online at: http:// www.waterboards.ca.gov/lahontan.

2. Scope of the Proposed Amendments

A. Current water quality standards

Water quality standards in California include designated beneficial uses, narrative and numeric water quality objectives (equivalent to the federal term "criteria") for protection of designated uses, and a non-degradation policy. The USEPA has also promulgated California standards for certain toxic pollutants as explained below. Existing state standards for the waters affected by the plan amendments are contained in Chapters 2 and 3 of the Basin Plan. The proposed changes in beneficial use designations may change the applicability of some existing water quality objectives to specific water bodies. Except for these changes and the proposed ammonia SSOs, water quality standards (including regionwide narrative water quality objectives) that are not specifically proposed for change will continue to apply to all of the water bodies affected by these amendments.

The U.S. Army Corps of Engineers (USACE) has determined that the waters of the Amargosa Creek watershed, and other surface waters within the boundaries of EAFB, are not "waters of the United States" (USACE, 2002). Therefore, the federally-promulgated standards for "priority pollutants" that apply to most surface waters of California under the National Toxics Rule (NTR, 40 CFR 131.36) and California Toxics Rule (CTR, 40 CFR 131.38) do not apply to waters within EAFB and the Amargosa Creek watershed. The CTR and NTR standards apply to all other surface waters of the Antelope HU for which no federal jurisdictional determination has been made. Water Board staff will continue to use federal criteria documents for priority pollutants and the State Water Board's Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays and Estuaries of California (Resolutions 2000-015 and 2005-0019) as technical references in the development of permit conditions for the protection of beneficial uses in the waters affected by the amendments.

Table 2-1 of the existing Basin Plan lists designated beneficial uses for specific surface waters and for categories of minor surface water bodies. Amargosa Creek, Piute Ponds and the associated wetlands, and Rosamond Dry Lake are not currently mentioned by name in Table 2-1, but have designated beneficial uses under the categories of "Minor Surface Waters" and "Minor Wetlands" of the Antelope Hydrologic Unit (HU No. 626.00) and the Lancaster Hydrologic Area (HA No. 626.50).

The current ammonia toxicity standard for surface waters of the Antelope HU is the regionwide narrative water quality objective of the Basin Plan, supplemented by Tables 3-1 through 3-6. The objective is based on the USEPA's 1986 freshwater ammonia criteria document, as revised in 1992. It includes equations for determining allowable 1-hour and four-day average concentrations of un-ionized and total ammonia, under a variety of temperature and pH conditions.

B. Summary of Proposed Amendments

The complete text of the proposed amendments is contained in a separate document (California Regional Water Quality Control Board, Lahontan Region, 2007). The amendments include:

Editorial Clarification of Existing Beneficial Use Designations. The proposed amendments would change Basin Plan Table 2-1 to clarify that the Cold Freshwater Habitat (COLD) and Commercial and Sportfishing (COMM) beneficial use designations apply to the "Minor Surface Waters" category in each of the eight Hydrologic Areas within the Antelope Hydrologic Unit as well as to the "Minor Surface Waters" category for the Hydrologic Unit as a whole. This is an informational rather than a regulatory change. The rationale for the change is provided in Section 5A below.

Site-Specific Beneficial Uses. The proposed Basin Plan amendments would establish site-specific beneficial uses for the affected surface waters by adding new rows to Table 2-1. Site-specific beneficial uses would include the current categorically designated uses for Minor Surface Waters and Minor Wetlands of the Lancaster HA, with the following changes:

- Removal of the categorical Municipal and Domestic Supply (MUN), Water Contact Recreation (REC-1), Cold Freshwater Habitat (COLD), and Commercial and Sportfishing (COMM) beneficial use designations, where

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they now apply, from all surface waters downstream of the LACSD No. 14 discharge point.

- Removal of the Agricultural Supply (AGR) use from Rosamond Dry Lake.

- Addition of new beneficial use designations for Piute Ponds and the associated wetlands, including Freshwater Replenishment (FRSH), Rare, Threatened, and Endangered Species Habitat (RARE), and Preservation of Biological Habitats of Special Significance (BIOL).

- Addition of the Inland Saline Water Habitat (SAL) beneficial use designation for the ephemeral surface waters of Rosamond Dry Lake.

Site-Specific Water Quality Objectives (SSOs) for Ammonia Toxicity. The proposed amendments to Basin Plan Chapter 3 would add site-specific water quality objectives for total ammonia concentrations to prevent acute (1-hour) and chronic (30-day average) toxicity in Piute Ponds, the associated wetlands, and the reach of Amargosa Creek affected by effluent discharges. The proposed SSOs are based on the USEPA's 1999 freshwater ammonia criteria. They will include a narrative objective with equations for calculating ammonia limits, and new tables of ammonia limits under specific temperature and pH conditions. The existing regionwide ammonia toxicity objectives will continue to apply to other surface waters in the Antelope HA, including the segment of Amargosa Creek upstream of the LACSD No. 14 discharge. The rationale for the proposed changes is discussed in Section 5.C., below.

Informational Update of the Description of LACSD No. 14 Facilities in Chapter 4. The facilities description in the Basin Plan dates from 1994 and is out of date with respect to LACSD No. 14's current (2004) facilities plan. The current description will be replaced with a summary of the major elements in the 2004 facilities plan, including the use of tertiary effluent to maintain the Piute Ponds and wetlands.

Miscellaneous editorial changes including corrections of typographical errors, and updates of the "Record of Amendments" page, Table of Contents, List ofTables, List of Figures, Index, Bibliography, and page numbers to reflect the amendments.

The update of Chapter 4 and miscellaneous editorial changes described above do not require technical justification, and most of them will not be discussed further in this staff report.

C. Purpose of and Need for Proposed Amendments

The amendments are needed to facilitate ongoing Water Board permitting of LACSD No. 14's discharge to surface waters. The editorial changes to Table 2-1 are needed to clarify the applicability of current beneficial use designations to hydrologic areas within the Antelope HU. The proposed site-specific beneficial use designations would reflect the existing uses of the waters in question more accurately than some of the current categorically designated uses. The proposed SSOs for ammonia toxicity would be more easily attainable in effluent dominated waters, while protecting aquatic life and wildlife uses.

*D. Issues **Not** Addressed in Currently Proposed Amendments*

No changes are proposed to the designated beneficial uses of Amargosa Creek and its tributaries upstream of the LACSD No. 14 discharge or to the applicability of the regionwide ammonia toxicity objective above the discharge. Available information and data are insufficient to justify such changes.

SSOs for ammonia toxicity are not proposed for the ephemeral surface waters of Rosamond Dry Lake. The existing regionwide ammonia toxicity objectives, based on freshwater criteria, are not really appropriate for Rosamond Dry Lake. However, the USEPA's (1989) saltwater ammonia criteria document states that its criteria do not apply to salt lakes, and recommends the development of SSOs. Further study, including toxicity tests on inland saline water organisms would be necessary to develop meaningful SSOs for Rosamond Dry Lake.

The scope of these amendments does not include adoption of the 1999 USEPA freshwater ammonia toxicity criteria as regionwide water quality objectives for surface waters. As discussed in Section 5.C. of this staff report, the 1999 USEPA criteria are less protective of trout than the existing regionwide ammonia toxicity objectives. Basin Plan amendments to adopt less protective objectives would require additional technical justification and analysis of their environmental impacts throughout the region, especially in the Sierra Nevada. The surface waters affected by the currently proposed amendments do not support trout, and the USEPA criteria are deemed protective of warm water aquatic organisms.

3. Sources of Information and Data

The scientific background for the proposed Basin Plan amendments includes reports by consultants to LACSD No. 14, other information provided by District staff, reports on biological and geological surveys by the USACE and U.S. Geological Survey, and additional scientific literature and water quality criteria documents reviewed by Water Board staff. Water Board staff did not perform or contract for any water quality sampling or other field or laboratory studies as part of this project. The two references used most extensively for background information on beneficial uses, including summaries of water quality data, are reports by Environmental Science Associates (2004) and Camp, Dresser & McKee (2003). For brevity, these sources are abbreviated as "ESA" and "CDM" in citations throughout this staff report.

Most of the historical ambient water quality data cited in this staff report were collected under the discharger self-monitoring program associated with LACSD No. 14's Waste Discharge Requirements (WDRs), and these data meet the Water Board's quality assurance and quality control requirements. Receiving water quality can be expected to change once LACSD No. 14 discharges tertiary rather than secondary effluent to lower Amargosa Creek and the Piute Ponds and wetlands. However, CEQA requires environmental analyses to be done in relation to the existing environment, which in this case includes ambient water quality influenced by current and historical secondary effluent discharges.

It should be noted that the available historical data on ambient water quality have not been collected frequently enough to characterize diurnal, seasonal and annual variation for most chemical and physical parameters in most of the waters affected by the amendments. The proposed amendments reflect Water Board staff's interpretation of the limited available data. The Water Board staff do not necessarily agree with all of the conclusions in the documents cited in this staff report. The public draft amendments and supporting documents reflect Water Board staff's independent judgment.

4. Environmental Setting

The following is an overview of the environmental setting of the Antelope HU with emphasis on the Lancaster HA, the area most affected by the proposed amendments. Additional information about the environmental setting and water quality of specific water bodies is provided in the discussions of beneficial uses below.

A. Antelope Hydrologic Unit

The Antelope HU (Figure 1) includes portions of Los Angeles, Kern, and San Bernardino Counties. The HU corresponds to the Antelope Valley basin, a closed topographic basin with an area of about 2,400 square miles. It is bounded by the Tehachapi Mountains and Garlock Fault Zone to the north and west, and the San Gabriel Mountains and San Andreas Rift Zone to the south and west. The eastern watershed boundary consists of buttes and hills that roughly parallel the San Bernardino County line. Crest elevations are about 8000 feet above sea level (asl) for the Tehachapi Mountains and 9400 feet asl for the San Gabriel Mountains. Lower Amargosa Creek, Piute Ponds, and Rosamond Dry Lake are at an approximate elevation of 2300-2400 feet asl. The lowest point in Antelope Valley is Rogers Dry Lake at approximately 2300 feet asl (Meyer and Bowers, 2002; Sanitation Districts of Los Angeles County, 2004; ESA, 2004).

Soils in Antelope Valley are derived from loess and alluvial materials, mainly from granitic rock sources along the eastern slopes of the Tehachapi and San Gabriel

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Mountains. Soils are moderately to highly alkaline, and considerable areas are saline. Except where they have been affected by agricultural practices, soils lack substantial amounts of organic matter and have relatively low inherent fertility. Antelope Valley is a seismically active region, and in addition to the San Andreas Fault, it includes a number of other faults that could produce damaging earthquakes (Londquist, 1994; ESA, 2004; Sanitation Districts of Los Angeles County, 2003).

Antelope Valley has a semiarid climate. Air temperatures can be as low as 3° F in winter, and summer temperatures can exceed 110° F. Average annual precipitation ranges from about 20 inches in the mountains to less than 4 inches on the valley floor. Ninety percent of precipitation occurs in winter and spring. Approximately half of the precipitation at Edwards Air Force Base falls as snow. Summer precipitation includes convectional thunderstorms and "tropical storms" associated with hurricanes off the west coast of Mexico. The evaporation rate (about 114 inches per year) greatly exceeds annual precipitation (USACE, 1998; CDM, 2003; Meyer and Bowers, 2002, ESA, 2004).

Due to the high regional evaporation rate, permanent surface waters are rare in the Antelope HU. Ephemeral streams and washes flow toward three large ephemeral desert playa lakes, Rosamond Dry Lake, Buckhorn Dry Lake, and Rogers Dry Lake. Perennial surface waters include Piute Ponds, the Apollo Park lakes (maintained with tertiary effluent from LACSD No. 14) and smaller ponds within the boundaries of EAFB. The surface waters of EAFB also include ephemeral clay pan pools in the dune fields surrounding the three large playa lakes. Under the California Department of Water Resources mapping system used in the Lahontan Basin Plan, the Antelope Hydrologic Unit (HU) includes eight Hydrologic Areas (HAs): Chafee, Gloster, Willow Springs, Neenach, Lancaster, North Muroc, Buttes, and Rock Creek. The boundaries of surface water HAs correspond generally to those of ground water basins, whose general locations are shown in Figure 2. Most of the specific water bodies affected by the proposed Basin Plan amendments are located within the Lancaster HA.

Ground water in the Antelope Valley originates primarily from infiltration of surface water runoff from the San Gabriel and Tehachapi Mountains. Average annual recharge has been estimated at 40,000 to 81,000 acre-feet. Pumping of ground water for irrigation began in the early 20th Century and peaked in the 1950s. After this time, use began to decline because of declining water levels, increased energy costs, and the availability of imported water. Ground water levels have declined in some areas by more than 100 feet since the early 1950s. Land subsidence was first reported in the 1950s, and by 1967 it was as much as two feet over an area of about 200 square miles. Between 1961 and 1991, up to four feet of subsidence occurred within the City of Lancaster (Londquist, 1994). Additional information on ground water in Antelope Valley is included in the discussion of the Ground Water Recharge beneficial use below.

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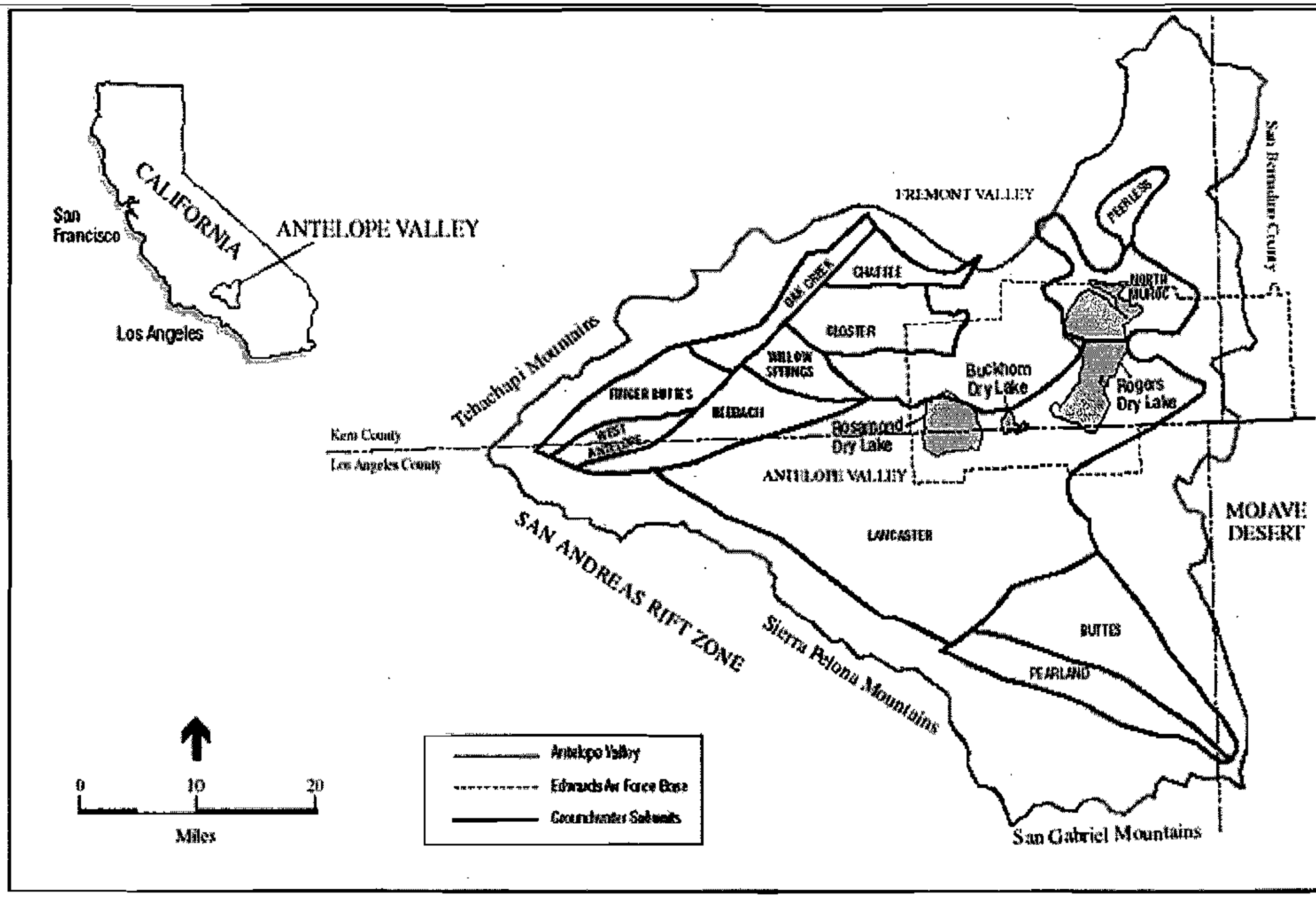
Figure 2. Approximate Locations of Hydrologic Areas Within the Antelope Hydrologic Unit



SOURCE: Environmental Science Associates

LWRP 2020 Plan EIR / 200481

Figure 4.3-2
Lancaster Groundwater Subbasin

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Due to variations in topography, microclimate and water supply, the Antelope HU supports a variety of biological communities, including a number of threatened, endangered, or otherwise sensitive species. Discussions of the biological resources of the Antelope Valley are provided in connection with the discussions of specific beneficial uses related to aquatic life, wildlife, and recreation in Section 5B below.

Two different Native American groups, the Kitanemuk and the Tataviam originally occupied Antelope Valley. There are over 250 recorded archaeological sites in the valley, with dated occupation back to 5000 years before the present. Because of the scarcity of water, most permanent settlement sites are found near existing or former water sources (Sanitation Districts of Los Angeles County, 2004).

European settlement of the Lancaster area began in the mid-1800s. Historically, the availability of abundant ground water supplies at relatively shallow depths led to widespread farming (primarily alfalfa and grains) in Antelope Valley. Cattle ranching and orchards were important at higher elevations. By 1940, Lancaster was a farm trade center with a population of 4,500. Population grew in the 1940s and 50s due to the establishment and expansion of what became EAFB, and associated aerospace and defense industries, and has continued to increase due to factors including employment opportunities and the availability of relatively affordable housing. In 1999, almost a third of the employed residents of Antelope Valley commuted to jobs elsewhere in southern California (Sanitation Districts of Los Angeles County, 2004; ESA, 2004).

EAFB is currently the largest single employer in the area and more than 90 percent of the manufacturing jobs in Antelope Valley are related to the aerospace and defense industries. The estimated total daytime population of the Base, including military and civilian employees and dependents, is approximately 15,980; the resident population is about 5900. EAFB has support of aircraft research as its primary mission, and activities at the base include development and testing of aircraft, rockets, and rocket fuels, aircraft operation and maintenance, and bombing range use (Agency for Toxic Substances and Disease Registry, 2003; Sanitation Districts of Los Angeles County, 2004). Before military use began in 1933, the EAFB area was used for ranching, agriculture and mining. The currently developed areas of EAFB are located in Kern County, near Rogers Dry Lake. Compared to these areas, Rosamond Dry Lake and the surrounding area are relatively undisturbed.

B. Wastewater Treatment and Disposal

LACSD No. 14 serves a large part of the City of Lancaster as well as portions of the City of Palmdale and adjacent unincorporated areas. Its treatment plant is located in a relatively undeveloped area about 5 miles north of Lancaster. The District's 2020 facilities plan, based on Southern California Association of

Governments (SCAG) and City of Lancaster population projections, forecasts that the District will increase in size and absorb the entire area north of the existing service area boundaries to the Kern County line. The population of the LACSD No. 14 service area is expected to increase to 252,248 by 2020, more than doubling the 2001 population of 122,548 (ESA, 2004).

Most of LACSD No 14's effluent has historically received secondary treatment, and about two-thirds of it has been disposed to Piute Ponds. Some of the secondary effluent is disposed to the Nebeker Ranch for irrigation of alfalfa. A small amount of effluent currently receives tertiary treatment and is used to maintain the Apollo Lakes, recreation lakes in a park in Lancaster.

LACSD's adopted 2020 Facilities Plan calls for replacement of the existing facilities by new tertiary treatment facilities, and phased expansion of the new facilities to a treatment capacity of 26.0 million gallons per day (mgd) to accommodate the projected 2020 municipal and industrial wastewater flows. Most of the tertiary effluent will be used for agriculture, urban landscape watering, and industrial purposes. During the winter, it will be held in new storage reservoirs until the irrigation season. The facilities plan includes the construction of six reservoirs. The existing treatment and storage ponds may also be converted for storage of recycled water after the new facilities begin operation. The District is acquiring land for management of recycled water through agricultural reuse, and began conveying tertiary treated wastewater to the Eastern Agriculture Site for irrigation in December 2006. (Sanitation Districts of Los Angeles County, 2006; California Regional Water Quality Control Board, Lahontan Region, 2007c).

Upon completion of LACSD's new treatment facilities, Piute Ponds and the associated wetlands will be maintained with tertiary effluent at the historical wetted area (about 400 acres). However, the volume of effluent discharged to the ponds will be reduced in order to prevent overflow from the ponds to Rosamond Dry Lake (ESA, 2004; CDM, 2003). LACSD No. 14 estimates that about 760 million gallons per year (an annual average of 2 million gallons per day) will be provided to Piute Ponds once overflows cease, in order to replenish water lost through evaporation and percolation, compared to more than 3000 million gallons per year discharged in recent years (Sanitation Districts of Los Angeles County, 2006).

The Lahontan Water Board permits the LACSD No. 14 discharge to Amargosa Creek and the Piute Ponds and wetlands through WDRs (Board Order R6V-2002-053, as amended). WDRs are state permits issued under the California Water Code. The discharge is not under a federal National Pollutant Discharge Elimination System (NPDES) permit because the receiving waters have been determined not to be waters of the United States.

The WDRs include a discharger self-monitoring program. LACSD monitors and reports to the Water Board on the quality of its effluent and receiving waters. Table 1, below, compares the quality of LACSD No. 14's secondary effluent with the estimated quality of tertiary effluent from planned new facilities.

The tertiary effluent quality summarized in Table 1 is considered a rough estimate. According to LACSD No. 14 staff, the quality of the recycled water cannot be determined until after the operation of the tertiary treatment facility has begun (LACSD No. 14 plans to add ammonia in its disinfection process). The District estimates that ammonia will be below detection levels in undisinfected effluent and that the total ammonia concentration in effluent discharged to lower Amargosa Creek and the Piute Ponds and wetlands will be 1 milligram per liter (mg/L). Estimates of relative concentrations of ammonia and other forms of nitrogen are based on the performance of Southern California wastewater treatment plants operating in nitrification/denitrification mode, and on the assumption of negligible effects from evaporation, algal nitrogen fixation, and ammonia volatilization during treatment or storage (Sanitation Districts of Los Angeles County, 2006).

Table 1. Comparison of Secondary and Tertiary Effluent Quality. Figures for average undisinfected secondary effluent are from ESA (2004). Estimated quality of tertiary effluent from the new activated sludge/nitrification-denitrification facilities is from Table 4 in Sanitation Districts of Los Angeles County (2006).

Constituent	Historical Secondary Effluent Quality	Estimated Tertiary Effluent Quality
Soluble Biochemical Oxygen Demand (BOD), mg/L	18	<4
pH (pH units)	8.0	7.5
Dissolved oxygen (mg/L)	8.2	7.5
Total dissolved solids (mg/L)	546	550
Total suspended solids (mg/L)	89	<2
Total nitrogen (mg/L)		10
Total Kjeldahl nitrogen (mg/L)	24.5	2
Nitrate nitrogen (mg/L)	0.83	
Nitrate plus nitrite (mg/L)		8
Ammonia nitrogen (mg/L)	13.1	1
Sulfate (mg/L)	67	80
Chloride (mg/L)	141	140
Total hardness (mg/L)	143	
Total phosphate (mg/L)	12.5	
Total organic carbon (mg/L)	55.8	<10
Turbidity (Nephelometric Turbidity Units or NTU)		0.8
Chlorine (mg/L)		<0.1
Boron (mg/L)		0.5

Figure 3. Aerial Photograph of Waters Historically Affected by LACSD Discharge. (Source: Larry Walker Associates, 2003).

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Table 2 describes the District's ambient water quality monitoring stations. Tables 4, 5 and 6 summarize historical water quality for these stations. Note that some stations have been sampled more frequently than others have. Table 7 summarizes the results of a single "priority pollutant" scan. Ambient water quality data from these tables are used in the discussions of specific beneficial uses, below

C. Water Bodies Affected by the Proposed Basin Plan Amendments

Figure 1 is a map of the Antelope Valley watershed, showing the locations of specific water bodies discussed below. The figure does not show all of the surface waters, including springs and ephemeral streams, that are shown in U.S. Geological Survey topographic maps. However, all surface waters of the Antelope HU have designated beneficial uses as shown in Basin Plan Table 2-1. Figure 2 shows the approximate locations of the Hydrologic Areas (roughly corresponding to groundwater basins) within the Antelope HU. These are the hydrologic areas affected by the proposed editorial changes to Basin Plan Table 2-1. Figure 3 is an aerial photograph showing the locations of LACSD's facilities, the affected segment of Amargosa Creek, the Piute Ponds wetlands, and the area of Rosamond Dry Lake that has historically been affected by overflows from the ponds.

Aside from LACSD No 14's receiving water monitoring data, collected since about 1998, there are few available data on the historical or current water quality of most surface waters of the Lancaster HA. In particular, there are no data for lower Amargosa Creek or Rosamond Dry Lake prior to the beginning of the wastewater discharge. Tables 4 through 14 of this staff report summarize available water quality data and compare them to criteria for protection of specific beneficial uses. Additional information on these water bodies is included in the discussions of specific beneficial uses, below

Amargosa Creek

Amargosa Creek originates in the San Andreas Rift Zone on the northeastern slope of the San Gabriel Mountains. Its headwaters are within Angeles National Forest, but only about 11% of its watershed is publicly owned (Stephenson and Calcarone, 1999). It flows southeast within Leona Valley for approximately 19 miles and then northward through the Palmdale/Lancaster area for about 25 miles before reaching its natural terminus in Rosamond Dry Lake. The creek is ephemeral for most of its length, but has intermittent surface water in Leona Valley.

The upper Amargosa Creek watershed, including Leona and Anaverde Valleys, is within a proposed San Andreas Rift Zone "Significant Ecological Area" under the Los Angeles County General Plan Update. North-facing upper slopes are vegetated with chaparral, juniper woodland and Joshua tree woodland; while south-facing slopes support a mixture of scrub and chaparral communities. Amargosa and Anaverde Creeks support riparian plant communities including southern cottonwood-willow riparian forest, freshwater marsh, alkali marsh, and alluvial wash (floodplain sage scrub) communities. Upper Amargosa Creek serves as an east-west wildlife movement corridor (Los Angeles County Department of Regional Planning, no date).

Anaverde Creek, the largest tributary of Amargosa Creek, collects runoff from the Sierra Pelona mountains and flows east through Anaverde Valley, then north onto the U.S. Air Force Base Flight Production Center (USAF Plant 42), where it is held in a retention basin. Water that overflows this basin eventually reaches Amargosa Creek. Amargosa Creek has also undergone significant hydromodification for flood control within Antelope Valley. In addition to physical hydromodification, ground water overdraft and the resultant soil compaction have probably affected the frequency of surface flows in Amargosa and Anaverde Creeks within Antelope Valley.

The reach of Amargosa Creek affected by the effluent discharge is about 0.6 miles long. Orme (2004) states that the creek near Rosamond Dry Lake has been so greatly modified that it is difficult to reconstruct former drainage patterns from surviving field evidence, but that it is likely that some natural wetlands previously existed here. Orme also states that a "complex of distributaries related to Amargosa Creek occurs in and around the Piute Ponds."

Piute Ponds and Piute Ponds Wetlands

The "Piute Ponds" are perennial ponds created by the impoundment of Amargosa Creek and the disposal of effluent from LACSD No. 14. The "Piute Ponds Wetlands" entry proposed for addition to Basin Plan Table 2-1 includes the wetlands surrounding these ponds and additional ephemeral ponds/wetlands created by Ducks Unlimited and supplied by effluent (see Figure 3). The amount of surface water in the ponds and wetlands varies seasonally depending on surface runoff and evaporation, but the total area is currently about 400 acres. The maximum depth of the perennial ponds is over 5 feet, but most of the wetted area is no more than 3 feet deep (unpublished bathymetric data from LACSD No. 14). Pond depth may decrease when the volume of effluent discharged is reduced under the approved facilities plan. The ponds and wetlands are located in an unincorporated portion of Los Angeles County about 6 miles north of Lancaster and are entirely within the boundaries of EAFB.

LACSD No. 14 began disposing effluent to Amargosa Creek in 1959. In response to EAFB's concerns about the impacts of ponded effluent on the use of Rosamond Dry Lake for emergency aircraft landings, a dike (the "C-dike", about 1.3 miles long) was constructed to impound the effluent in 1961. Effluent ponded behind the dike, and natural succession processes led to the evolution of a perennial pond/marsh system supporting emergent vegetation, aquatic life, and wildlife. By 1981, the California Department of Fish and Game (DFG) recognized the ecological importance of the ponds and designated them as a regionally significant wildlife habitat. In 1981, LACSD No. 14, EAFB, and DFG entered into an agreement under which the District agreed to discharge effluent at a rate sufficient to maintain 200 wetted acres of ponds. In 1988, Ducks Unlimited expanded the area of the ponds to accommodate higher effluent flows and to support wildlife and recreational uses. In 1991, Ducks Unlimited constructed additional impoundments to the southeast of the main ponds, known informally as the "duck ponds" (AMEC, 2003; CDM, 2003).

In 2002, about 6.64 mgd of effluent was discharged into the ditch that leads to Amargosa Creek and then to Piute Ponds. About 0.26 mgd of effluent was discharged to the "duck ponds" from November 1 to April 15. No discharge is allowed to the "duck ponds" before November 1 or after April 15, unless approved by EAFB. Consequently these impoundments are ephemeral and are dry during much of the year (ESA, 2004; CDM, 2003).

The volume of effluent discharged to the ponds has increased over time, along with increases in the population of the LACSD No. 14 service area. Higher winter pond elevations, together with stormwater inflows, have led to overflows from the ponds to Rosamond Dry Lake for up to nine months of the year (ESA, 2004). Ponding on the lake occurs naturally during years of high runoff. However, effluent overflows increase the duration of ponding and, consequently, the risk to aircraft landings. The Water Board has agreed with EAFB that the overflows are a potential nuisance as defined in Section 13050(m) of the California Water Code, and the 2002 revised WDRs direct LACSD No. 14 to end the overflows.

Occasional overflows from the ponds will continue to occur due to storm events. CDM (2003) noted the expectation that "as the Lancaster area continues to develop, flood control developments will ultimately result in increased concentrated storm flows to Piute Ponds." Stormwater overflows from Piute Ponds may occur on an average of once every two or three years; during a prolonged drought, no overflows may occur for over five years. LACSD No. 14 has expressed concern that without occasional "flushing" of the ponds by overflows, total dissolved solids (TDS) concentrations will increase due to evaporation. The TDS concentration in LACSD No. 14's tertiary effluent is expected to be about the same as that of secondary effluent (Table 1).

Piute Ponds and the associated wetlands are situated among sand dunes located over a prehistoric lakebed. The substrate is mixed sand and small gravel with underlying clay. The sediment at Station RS2 is "very fine, soft and thick" (CDM, 2003, AMEC, 2003).

The upland vegetation near Piute Ponds is halophytic phase saltbush scrub. Narrow-leaved cattail (*Typha latifolia*) and tule (*Scirpus acutus*) dominate vegetation in the ponds and wetlands. Fremont cottonwood, willows and saltcedar grow along the pond edges. Other common plant species include dock (*Rumex crispus*), pondweed (*Potamogeton pectinatus)*, nettle (*Urtica holosericea)*, tarweed (*Hemizonia pungens*), and saltgrass (*Distichlis spicata*) (ESA 2004).

Rosamond Dry Lake

Rosamond Dry Lake is a desert playa lake and is approximately 5 miles in diameter with an area of about 21 square miles. It is located in Los Angeles and Kern Counties and has ephemeral tributary streams in both counties. It receives over 43 percent of the surface runoff in Antelope Valley (USACE, 1998). Playas of the arid southwestern United States are defined as "the flat and generally lower portions of arid basins with internal drainage that periodically flood and accumulate sediment" (Brostoff *et al.*, 2001).

California desert playas are classified on a scale from "hard" or "dry" playas to "soft" or "moist" playas; there are many intergradations between the two extremes. Brostoff *et al.* (2001) identified Rosamond Dry Lake as a hard playa with a dry, compact, generally smooth surface with little or no accumulation of evaporite salts. Hard playas do not have significant ground water input and are inundated by runoff or direct precipitation. In contrast, soft playas are fed by ground water and their surfaces have a puffy appearance from the deposition of evaporite minerals. Hard playa lakes generally "exhibit high turbidity, contain organic matter exceeding 5 percent of total solids, have anions dominated by bicarbonate-carbonates, and have relatively low total dissolved solids concentrations." Their salinities range from 100 to 10,000 micromhos/cm, and resident aquatic invertebrates are typical of low to intermediate salinity waters (Kubly and Cole, 1979).

A USACE study (Lichvar *et al.*, 2002) on the frequency and duration of ponded water on the playas of EAFB noted that the duration of flooding depends on the magnitude and location of precipitation and ambient climatic conditions over the lakes; significant flooding is associated with El Nino conditions. Between 1942-2001, the playas are estimated to have ponded with a frequency of 0.51, or every other year. The estimated weeks of inundation ranged from 1 to 32 weeks over a six year period, in a linear relationship with precipitation.

Rosamond Dry Lake is a remnant of prehistoric Lake Thompson. Lake Thompson once rose about 17 meters (55 feet) above the current surface elevation of Rosamond and Rogers Dry Lakes. The deep lake began to dry after 17,000 years before the present. Lacustrine sediments from Lake Thompson underlie Piute Ponds and much of the Lancaster area.

The interruption of stream flows by human activities and the drawdown of artesian waters during the past century have significantly decreased the volume of inflow to the dry lakes. In the 1950s, surface subsidence, sinkholes and dessication cracks began causing problems for military and aerospace operations on Rogers Dry Lake; they were attributable to aquifer compaction following excessive ground water extraction without adequate recharge (Orme, 2004).

There is relatively little information on the impacts of wastewater constituents on the natural characteristics of the ephemeral ponds on the lakebed. The USACE (1998) stated that the area of Rosamond Dry Lake north of and adjacent to Piute Ponds has a soft surface, similar to that of soft playas and springs. The extent of this "mudflat" habitat will be reduced after the elimination of overflows from Piute Ponds due to effluent disposal.

5. Justification for Proposed Amendments

A. Clarification of Existing Beneficial Use Designations for Minor Waters Categories

The proposed amendments would add "Xs" in the "COLD" and "COMM" beneficial use columns of Basin Plan Table 2-1 for the "Minor Surface Waters" categories of each of the eight Hydrologic Areas (HAs) within the Antelope Hydrologic Unit (HU). These changes would clarify that the Cold Freshwater Habitat (COLD) and Commercial and Sportfishing (COMM) beneficial uses are already designated uses for minor surface water bodies in each of these hydrologic areas. The proposed changes are editorial corrections rather than new regulations, and they do not require detailed technical justification. Their purpose is to resolve an apparent internal inconsistency in the plan.

The inconsistency arises from an editorial oversight during final formatting of the 1995 Basin Plan, when information from the beneficial use table in the 1995 South Lahontan Basin Plan (California Regional Water Quality Control Board, Lahontan Region, 1975b) was combined with a newly adopted table of wetland beneficial uses from a study by Curry (1993). In the opinion of the Water Board's legal counsel, the beneficial uses designated for the minor waters categories of the Antelope HU as a whole are designated for the same categories within each of the HAs, whether or not they are shown in Basin Plan Table 2-1.

The minor waters categories for the Antelope HU account for all of the surface waters in the HU that are not listed by name in Basin Plan Table 2-1. These include streams, springs, small playas, claypan pools such as those near Rosamond Dry Lake, etc. The COLD and COMM beneficial uses may not be appropriate for all of the waters for which they are categorically designated. However, site-specific information would be needed to justify their removal.

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B. Site-Specific Beneficial Uses

General Considerations

Previous Water Board actions to designate or remove beneficial uses for specific surface waters have used USEPA guidance such as the Water Quality Standards Regulation (40 CFR 131.10) and the *Water Quality Standards Handbook* (USEPA, 1994). Since the waters affected by the proposed amendments are no longer considered waters of the United States, the federal guidance is not mandatory. However, California has not yet developed comprehensive state guidance regarding beneficial uses of "isolated, non-navigable" surface waters of the state. Until state guidance is adopted, Water Board staff will use the federal regulations as guidance for recommending changes to beneficial uses of such waters. This approach will avoid the need to develop interim guidance for the Lahontan Region and provide consistency with past and future Water Board revisions of beneficial uses for waters of the U.S.

The following is a summary of provisions of 40 CFR 131.10 that could be considered as direction for the current amendments:

States may remove a designated use that is not an existing use if the state can demonstrate that attaining the designated use is not feasible because:

- Naturally occurring pollutant concentrations prevent the use
- Natural, ephemeral, intermittent or low flow conditions or water levels prevent the use
- Human-caused conditions or sources of pollution prevent the use and cannot be remedied
- Dams, diversions or other types of hydrologic modifications preclude attainment of the use and it is not feasible to restore the water body to its original condition or to operate the modification(s) in a way that would result in attainment of the use
- Physical conditions related to natural features of the water body (lack of proper substrate, cover, flow, depth etc.) prevent the use
- Controls would require in substantial and widespread economic and social impacts.

Beneficial uses cannot be removed from waters of the United States if they are existing uses, unless a use requiring more stringent criteria is added. Beneficial uses also cannot be removed if they can be attained by implementing effluent

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limits for point sources or cost effective and reasonable best management practices for nonpoint sources. When proposing to remove a beneficial use designation from a water of the United States, a state must justify the removal through a "Use Attainability Analysis" (UAA) meeting USEPA requirements.

For waters of the United States, existing uses are defined as "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." There is no specific date beyond which uses of waters of the state that are not waters of the U.S. are considered "existing." However, the 1968 Nondegradation Policy (State Water Board Resolution 68-16) is one possible threshold.

California's beneficial use definitions are broad. Although the Clean Water Act slogan refers to "fishable/swimmable" goals, California's aquatic life uses include **all** types of aquatic plants, animals and microorganisms as well as fish. The Basin Plan recognizes that some beneficial uses of surface water may occur only temporarily, but does not specifically designate seasonal uses.

The presence or absence of a formal beneficial use designation does not necessarily prevent the water from being put to the associated use. For example geothermal energy development has occurred in several parts of the Lahontan Region using waters that are not specifically designated for the Industrial Service Supply (IND) use. The proposed removal of the Municipal and Domestic Supply use from waters affected by the LACSD No.14 discharge would not preclude them from being used for municipal supply in the future if public attitudes toward potable reuse of wastewater change and treatment is technologically and economically feasible.

In most cases, the Basin Plan does not explicitly associate specific narrative or numeric water quality objectives with protection of specific beneficial uses. Many objectives are protective of multiple uses. For example, numeric objectives for nutrients (particularly those for Sierra Nevada lakes and streams) are generally based on historical background quality. By preserving initially high water quality, numeric nutrient objectives maintain aquatic life, wildlife, and human recreational uses of water. Many of the currently proposed site-specific beneficial use designations will not make a difference in the applicability of water quality objectives to Amargosa Creek, the Piute Ponds system, and Rosamond Dry Lake, because most objectives do not reference specific beneficial uses. Changes in the applicability of specific water quality objectives are noted in the "Consequences" section under each beneficial use heading below. The changes in beneficial use designations and in applicable water quality objectives will be reflected in future new or revised Water Board permits for discharges to the affected waters.

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Specific Recommendations

Specific beneficial uses are discussed below in the left-to-right order used in Basin Plan Table 2-1. Definitions of beneficial uses are quotes from the Basin Plan. Several of the discussions of specific uses include tables summarizing LACSD's ambient monitoring data. For reference in those discussions, Table 2 describes the locations of LACSD's ambient water quality monitoring stations. The locations of these stations are also shown in Figure 3.

The historic monitoring data document ambient water quality influenced by secondary effluent. Ambient water quality should improve with the change to tertiary effluent for parameters such as biochemical oxygen demand, ammonia and total nitrogen (see Table 1). However, the salinity of tertiary effluent will be about the same, and ambient water quality will continue to be influenced by constituents of secondary effluent (e.g., phosphorus) that are stored in and may be released from the sediment. Because of this and other factors such as lack of public access, the change to tertiary effluent should not affect the attainability of the beneficial uses that are proposed for removal.

Table 2. Descriptions of LACSD No. 14 Ambient Water Quality Monitoring Stations. Sources: Larry Walker Associates (2002), CDM (2003).

Station No.	Station Description
RS1	Located in Amargosa Creek upstream of the LACSD No. 14 discharge. [Data for this station in the tables below reflect a stormwater event.]
RS2	Located at a concrete spillway approximately 150 feet (0.25 miles) downgradient of the LACSD No. 14 discharge.
RS3	Located near the middle of Piute Ponds off Avenue C (about 0.35 miles downstream of discharge).
RS4	Located in Piute Ponds at the historic spillway to Rosamond Dry Lake, about 0.5 miles downstream from the discharge.
RS5	Ephemeral ponds on the surface of Rosamond Dry Lake created by historic overflow from Piute Ponds, about 1 mile downstream from the discharge point.

Municipal and Domestic Supply (MUN)

Definition: "Beneficial uses of waters used for community, military or individual water supply systems including but not limited to, drinking water supply."

Current Application: The MUN use applies categorically to Amargosa Creek, Piute Ponds and the associated wetlands, Rosamond Dry Lake, and all minor

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surface waters and wetlands of the Antelope HU. Ground waters of the Antelope Valley basin are also designated for the MUN use.

Proposed Changes: The proposed amendments would remove the MUN use from the segment of Amargosa Creek below the LACSD No. 14 discharge point, from surface waters of Piute Ponds and the associated wetlands, and from surface waters of Rosamond Dry Lake. The MUN use would continue to apply to Amargosa Creek and its tributaries upstream of the LACSD No. 14 discharge and to minor surface waters and wetlands of the Lancaster HA. No change is proposed in the MUN use of the Antelope Valley ground water basin.

Consequences: LACSD No. 14 would not need to ensure that California Department of Health Services (DOHS) drinking water standards (Maximum Contaminant Levels or MCLs) are met in the surface waters affected by its discharge. California MCLs apply to ambient surface waters with the MUN use under the regionwide water quality objectives for "Chemical Constituents," "Pesticides" and "Radioactivity." The discharge prohibition and notification requirements of Proposition 65 (the Safe Drinking Water and Toxic Enforcement Act of 1986) would not apply to the waters without a MUN use. Protection of a potential MUN use would not need to be considered in any future Water Board permitting or enforcement activities for discharges to the affected surface waters.

Discussion: The 1975 South Lahontan Basin Plan designated MUN uses only for waters that were actually being used for domestic supply. In 1989, the Water Board amended the South Lahontan Basin Plan to designate MUN uses for almost all surface and ground waters. This action resulted from the State Water Board's adoption of the "Sources of Drinking Water Policy" (Resolution 88-63) and its direction to Regional Water Boards that all surface and ground waters of the state should be considered suitable or potentially suitable for municipal supply unless they meet specific criteria. The rationale for the Water Board's broad designation of the MUN use in 1989 was that, because of the scarcity of water supplies within much the Lahontan Region, there might someday be an incentive to treat and use even poor quality waters for municipal supply. The MUN designations in the amended 1975 plan were carried over to the 1995 Lahontan Basin Plan.

To Water Board staff's knowledge, none of the surface waters of the Amargosa Creek watershed are currently being used for municipal and domestic supply. Before regional ground water overdraft occurred, surface flows in Amargosa Creek may have been greater due to ground water input, and some domestic use of the creek by Native Americans and 19^{th}-early 20^{th} century European settlers may have occurred. However, the creek's name ("amargosa" is Spanish for "bitter") suggests that its waters were considered unpalatable.

The Los Angeles County Waterworks District No. 40 (Region 4, Lancaster) reported that during 2002, about 60 percent of the water served in the Lancaster region consisted of treated surface water, and the remaining 40 percent was supplied by ground water. The Waterworks District purchases treated surface water from the Antelope Valley-East Kern Water Agency (AVEK). AVEK in turn imports water from the Sacramento/San Joaquin Delta. EAFB also obtains part of its water supply from AVEK and part from onsite wells. The Waterworks Districts' December 2001 source water assessment detected nitrates, arsenic and total chromium in the water supply. Arsenic and chromium are said to occur naturally in the region, while the occurrence of nitrates is probably due to past agricultural practices. Table 3 summarizes data on several constituents in the domestic water supply for the Lancaster area for comparison with concentrations in LACSD No. 14 effluent and ambient water quality.

Table 3. Quality of Domestic Water Supply in the Lancaster Area. Source: Los Angeles County Waterworks District No. 40, Region 4 (no date). Concentrations in ppm (parts per million) and ppb (parts per billion) are equivalent to mg/L (milligrams per liter) and μg/L (micrograms per liter), respectively.

Constituent	Treated (Imported) Surface Water Concentration	Chlorinated Ground Water Concentration
Aluminum	maximum 0.05 ppb	
Arsenic		mean 8.88; range nondetectable to 43.38 ppb
Chromium		mean 5.47 ppb; range nondetectable to 42.5 ppb
Manganese		maximum 70 ppb
Nitrate	mean 7.72 ppm	mean 2.06; range nondetectable to 19.8 ppm
Sodium	mean 60.2 ppm	mean 59.35 ppm
Sulfate	mean 55.9 ppm; range 43.9-62.2	mean 45.51; range nondetectable to 277 ppm
Total Dissolved Solids	mean 300 mg/L ; range 296-300 ppm	mean 270.3, range 160-849 ppm

The Sources of Drinking Water Policy allows surface waters to be excluded from the MUN use under specific circumstances. The following criteria from the policy apply to one or more of the surface waters of the Antelope HU:

1. *The total dissolved solids (TDS) concentration exceeds 3000 milligrams per liter (mg/L) and the water body "is not reasonably expected by Regional Boards to supply a public water system."*

Based on the limited data available, this criterion applies to the ephemeral surface waters of Rosamond Dry Lake. LACSD No. 14's ambient monitoring Station RS5 is on the Rosamond Dry Lake bed below the "C-dike" and represents the quality of historic overflows from Piute Ponds mixed with salts dissolved from the lakebed. The "average" TDS value for Station RS5 (2168 mg/L) is below the Sources of Drinking Water Policy threshold. Table 14 summarizes data from different parts of Rosamond Dry Lake, including salinity values of 0 to 14 ppt (parts per thousand), equivalent to 0 to 14,000 mg/L. TDS and salinity are measured differently (see the discussion in connection with the Inland Saline Water Habitat (SAL) beneficial use below). However, the maximum "salinity" values are high enough to qualify the lake as saline rather than fresh water. Extreme seasonal and annual variability in the concentrations of TDS and other constituents is typical of California desert playa lakes (California Regional Water Quality Control Board, Lahontan Region, 2000).

2. *"There is contamination, either by natural processes or by human activity (unrelated to a specific pollution incident), that cannot be reasonably be treated for domestic use using either Best Management Practices or best economically achievable treatment practices."*

There have historically been multiple violations of drinking water MCLs and other human health criteria at all of LACSD No. 14's ambient monitoring stations (see Tables 7 and 8). The major source of some chemical constituents such as aluminum and chloroform is probably the wastewater treatment process. Other constituents such as arsenic are probably from natural sources, including chemicals dissolved from former playa lakebed soils beneath the ponds. In addition to the criteria exceedances documented in other tables, all of the "average" sodium values in Table 4 exceed the USEPA Health Advisory value of 20 mg/L sodium in drinking water for persons who should restrict their sodium intake to prevent high blood pressure (hypertension). Although the effluent discharged to lower Amargosa Creek and Piute Ponds is disinfected to meet California Department of Health Services recycled water requirements, the use of the ponds and wetlands by large numbers of birds leads to high concentrations of fecal coliform bacteria (see the discussion of the Water Contact Recreation use below). A public health study of EAFB by the federal Agency for Toxic Substances and Disease Registry (2003) cites an ambient thallium level of 18 parts per billion (micrograms per liter) in Piute Ponds; this is significantly higher than the current state MCL of 2 micrograms per liter. Thallium is used in the aerospace industry, and the thallium in the ponds may have come from past industrial wastewater discharges, or from atmospheric deposition from industrial sources in the region. (LACSD No. 14 now requires pretreatment of industrial wastewater influent.)

LACSD's consultant (CDM, 2003) states that indirect municipal reuse of effluent (or water from Piute Ponds) through ground water injection, "may be feasible from technical, regulatory and scientific perspectives" but it is unlikely to be publicly acceptable. Indirect reuse would also not be cost effective:

> *"The wholesale cost of potable water in the Lancaster area currently ranges from approximately $100 per acre-foot (AF) for groundwater to approximately $300 per AF for State Water Project water. The cost to treat the Lancaster WRP [Wastewater Reclamation Plant] effluent to a*

level that would be usable for indirect MUN use (advanced treatment, likely microfiltration, reverse osmosis and ultraviolet [UV]) would be approximately $1,000 per AF. This may not include the cost of any imported water necessary for dilution in either a storage reservoir project or a groundwater project (at a key well) or the cost associated with brine disposal."

LACSD No. 14 is now part of a collaborative stakeholder group, including local governments and water purveyors, that is developing an Integrated Regional Water Management Plan (IRWMP) for the Antelope Valley region. The draft plan (Los Angeles County Department of Public Works, 2006) includes the intent to reuse 100 percent of the recycled water produced in the region by 2035. This could include groundwater recharge, and thus indirect reuse of recycled water for drinking.

Given the unpredictability of ponding on Rosamond Dry Lake, the variable amounts of water involved, the location of the water within EAFB, and the availability of other municipal water sources, it is unlikely that there would be any future demand to treat and use the surface waters of Rosamond Dry Lake for a public water supply.

If public attitudes change and/or severe water shortages make treatment and potable reuse of water from Piute Ponds or Rosamond Dry Lake desirable, the lack of a designated MUN use for these waters would not prohibit or preclude treatment and reuse.

3. *The water is in systems designed or modified to collect or treat municipal or industrial wastewaters . . . or stormwater runoff, provided that the discharge is monitored to assure compliance with all relevant water quality objectives . . ."*

The Piute Ponds were created by the modification of Amargosa Creek to collect treated wastewater and prevent it from ponding on Rosamond Dry Lake. While the ponds and wetlands were not specifically designed as "treatment wetlands," they do provide some additional treatment as discussed in connection with the "Water Quality Enhancement" (WQE) beneficial use below. The discharge and ambient receiving waters are monitored through LACSD No. 14's discharger self-monitoring program under WDRs from the Water Board.

In summary, the proposed amendments to remove MUN uses are appropriate because the waters in question are not existing sources of drinking water and are unlikely to be in demand for municipal supply in the future, and because each of these waters meets one or more Sources of Drinking water policy criteria for exclusion from the MUN use.

Table 4. Historic Water Quality at LACSD No. 14 Monitoring Stations.
Source: Larry Walker Associates (2002). Station locations are described in Table 2.

Constituent	Units	RS1 [1]	RS2 [2]	RS3 [3]	RS4 [2]	RS5 [4]
Average pH	pH units	8.8	8.1	7.9	8.8	9.7
Average Temperature	Degrees C	10.7	14.1	12.8	14.1	19.2
Average Dissolved Oxygen	mg/L	9.6	7.1	6.2	8.8	9.4
Average Total Suspended Solids	mg/L	908	76.0	48.8	86.7	88.8
Average Total Dissolved Solids	mg/L	439	569	687	850	2168
Average Ammonia as N	mg/L	< 0.3	10.6	12.8	5.2	0.7
Average Sulfate	mg/L	352	77.8	77.3	98.2	409
Average Chloride	mg/L	33.7	135	164	238	711
Average Chlorine Residual	mg/L	< 0.05	5.9	0.6	0.6	
Average Alkalinity	mg/L CaCO3	NA	188	230	287	551
Average Hardness	mg/L CaCO3	310	122	129	148	163
Average Calcium	mg/L	91.0	34.4	37.9	38.6	37.2
Average Magnesium	mg/L	65.5	8.1	10.3	14.8	28.1
Average Potassium	mg/L	30.0	13.2	15.1	20.4	30.0
Average Sodium	mg/L	86.5	127	168	246	732

[1] Averages calculated from samples collected in 2000 and 2001
[2] Averages calculated from samples collected in 1998,1999 and 2002
[3] Averages calculated from samples collected in 1998 and 1999
[4] Averages calculated from samples collected in 1999.

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Table 5. 2005 Monitoring data for Piute Ponds Station RS2 (Source: County Sanitation Districts of Los Angeles County, 2006; based on 10 samples)

Parameter	Mean	Maximum	Minimum
pH (standard units)	8.08	9.13	7.17
Temperature °C	15.8	23.2	7.0
Dissolved Oxygen (mg/L)	7.1	10.9	5.4
Total Dissolved Solids (mg/L)	647	898	492
Ammonia (mg N/L)	10.2	21.8	0.6
Kjeldahl Nitrogen (mg N/L)	25.4	47.0	10.9
Nitrate (mg N/L	<1.21	7.74	0.03
Nitrite (mg N/L)	<0.18	0.641	<0.02
Total Hardness as calcium carbonate, mg/L	146	216	110

Table 6. 2005 Monitoring Data for Piute Ponds Station RS4 (Source: County Sanitation Districts of Los Angeles County, 2006; based on 10 samples)

Parameter	Mean	Maximum	Minimum
pH (standard units)	8.76	9.37	8.16
Temperature (°C)	16.5	25.6	8.1
Dissolved Oxygen (mg/L)	9.6	18.8	4.6
Total Dissolved Solids (mg/L)	807	1267	415
Ammonia (mg N/L)	<4	12.7	<0.1
Kjeldahl Nitrogen (mg N/L)	11	15.4	5.76
Nitrate (mg N/L)	<0.18	0.37	<0.03
Nitrate (mg N/L)	<0.08	0.241	0.005
Total Hardness as calcium carbonate, mg/L	148	173	112

Table 7. Comparison of Historic Monitoring Data to Drinking Water MCLs. Source: CDM (2003.) All units are micrograms per liter ($\mu g/L$). Only constituents with ambient values above detection levels are included.

Constituent	California MCL	Secondary Effluent (2001)	RS1	RS2	RS3	RS4	RS5
Acrolein	NA	<10.00	ND	10.8	5.0	4.4	10.0
Aluminum	200	ND	89.0	633.3	433.3	3,533.3	9,200.0
Antimony	6	0.7	0.7	1.5	1.3	1.9	1.7
Arsenic	50[1]	3.3	6.9	7.3	8.5	16.8	128.4
Barium	1000	20.0	0.32	23.3	20.0	43.3	70.0
Beryllium	4	<2.5	3.5	<5.0	<5.0	<5.0	<5.0
Chloride	250,000	133,000	18,000	127,750	164,000	232,400	711,000
Chloroform	NA	<1.0	ND	10.7	2.0	<0.5	<0.5
Copper	1000	<20.0	9.0	<10.0	<10.0	<10.0	<10.0
Iron	300	ND	885.0	803.3	750.0	3783.3	8700.0
Lead	None	<10.0	40.0	<20.0	<20.0	<20.0	<20.0
Manganese	50	20.0	1089.0	113.0	81.0	210.0	295.0
MBAS	500	20.0	<20.0	192.5	207.5	182.0	110.0
Nickel	100	<20.0	60.0	<20.0	<20.0	<20.0	<20.0
Nitrate + Nitrite	10,000	ND	739.0	ND	ND	ND	ND
Nitrate Nitrogen	45,000	ND	700.0	1626.4	273.6	330.8	23.3
Nitrite Nitrogen	1,000	ND	39.0	258.1	39.5	106.3	24.3
Sulfate	250,000	96,500	28,000	69,950	77,325	92,740	409,350
Toluene	150	<1.0	ND	5.3	0.7	<0.3	<0.3
Total Dissolved Solids	500,000	ND	227,000	553,545	687,000	825,909	2,167,667
Zinc	5,000	90.0	320	60.0	16.7	20.0	75.0

[1] Note: The California Department of Health Services plans to revise the arsenic MCL to 10 $\mu g/L$ to conform with the current federal MCL.

Table 8. Historic Exceedances of Human Health Criteria at LACSD No. 14 Ambient Monitoring Stations. Sources: CDM, 2003; California Regional Water Quality Control Board, Central Valley Region [database retrieval 3/29/04]

Station No.	Constituent	Criterion Exceeded	Criterion Value	Ambient Value
RS1	Aluminum	USEPA Secondary MCL (taste and odor)	50 μg/L	89.0 μg/L
RS1	Arsenic	USEPA Primary MCL	10 μg/L	6.9 μg/L
RS1	Arsenic	California Public Health Goal	0.004 μg/L	6.9 μg/L
RS1	Beryllium	California Public Health Goal	1 μg/L	3.5 μg/L
RS1	Manganese	California State Action Level (Dept. of Health Services)	500 μg/L	1089 μg/L
RS2	Acrolein	USEPA IRIS Reference Dose as a drinking water level	3.5 μg/L	10.8 μg/L
RS2	Aluminum	USEPA Secondary MCL (taste and odor)	50 μg/L	633.3 μg/L
RS2	Arsenic	USEPA Primary MCL	10 μg/L	7.3 μg/L
RS2	Arsenic	California Public Health Goal	0.004 μg/L	7.3 μg/L
RS2	Chloroform	Cal/EPA Cancer Potency Factor as a drinking water level	1.1 μg/L	10.7 μg/L
RS2	Chloroform	National Academy of Sciences Health Advisory	0.26 μg/L	10.7 μg/L
RS2	Total Dissolved Solids (TDS)	USEPA National Ambient Water Quality Criteria	250,000 μg/L	553,545 μg/L
RS3	Acrolein	USEPA IRIS Reference Dose as a drinking water level	3.5 μg/L	5.0 μg/L
RS3	Aluminum	USEPA Secondary MCL (taste and odor)	50 μg/L	433.3 μg/L
RS3	Arsenic	California Public Health Goal	0.004 μg/L	8.5 μg/L
RS3	Chloroform	Cal/EPA Cancer Potency Factor as a drinking water level	1.1 μg/L	2.0 μg/L
RS3	Chloroform	National Academy of Sciences Health Advisory	0.26 μg/L	2.0 μg/L
RS3	TDS	USEPA National Ambient Water Quality Criteria	250,000 μg/L	687,000 μg/L
RS4	Acrolein	USEPA IRIS Reference Dose as a drinking water level	3.5 μg/L	4.4 μg/L
RS4	Aluminum	USEPA Secondary MCL (taste and odor)	50 μg/L	3,533.3 μg/L
RS4	Arsenic	USEPA Primary MCL	10 μg/L	16.8 μg/L
RS4	Arsenic	California Public Health Goal	0.004 μg/L	16.8 μg/L
RS4	TDS	USEPA National Ambient Water Quality Criteria	250,000 μg/L	825,909 μg/L
RS5	Acrolein	USEPA IRIS Reference Dose as a drinking water level	3.5 μg/L	10.0 μg/L
RS5	Aluminum	USEPA Secondary MCL (taste and odor)	50 μg/L	9,200 μg/L
RS5	Arsenic	USEPA Primary MCL	10 μg/L	128.4 μg/L
RS5	Arsenic	California Public Health Goal	0.004 μg/L	128.4 μg/L
RS5	TDS	USEPA National Ambient Water Quality Criteria	250,000 μg/L	2,167, 667 μg/L

Agricultural Supply (AGR)

Definition: "Beneficial uses of waters used for farming, horticulture, or ranching, including, but not limited to, irrigation, stock watering, and support of vegetation for range grazing."

Current Application: AGR is currently a categorically designated use of all minor surface waters and minor wetlands in the Antelope HU and the Lancaster HA. It is thus a designated use of Amargosa Creek, the Piute Ponds system, and Rosamond Dry Lake. AGR is also a designated use for ground waters of the Antelope Valley ground water basin.

Proposed Changes: The amendments would remove the AGR use from Rosamond Dry Lake but retain it as a site-specific use for other surface water bodies. If future management scenarios for the Piute Ponds do not include agricultural diversions, the Water Board may consider removing the AGR use from the ponds and wetlands at a later date. No changes are proposed to the designated AGR use of ground water

Consequences of Change: The provisions of the regionwide water quality objective for "Chemical Constituents" affecting waters designated for the AGR use would not apply to the surface waters of Rosamond Dry Lake and would not be a consideration in any future Water Board permitting or enforcement activities for discharges to the lake. Specifically, the water quality objective states: "Waters designated as AGR shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses (i.e., agricultural purposes)."

Discussion: The extent of past agricultural use of water from Amargosa Creek and its tributaries is unknown. Cattle ranching was important in Leona Valley in the mid-19th century, and surface sources were probably used for stock watering. Past and present irrigated agriculture in the Lancaster/Palmdale area has depended on ground water pumping. The surface waters of Rosamond Dry Lake have probably not been historically used for agriculture due to their ephemeral nature and relatively high salinity (Table 14). The Piute Ponds and wetlands are not currently used for agriculture, although LACSD No. 14 has considered diversion of water for irrigation use as a means of "flushing" the ponds to prevent salt accumulation. District staff has expressed concern that water from the ponds, being more saline than effluent due to concentration by evaporation, would be unsuitable for agriculture (Raymond Tremblay, personal communication).

Effluent from LACSD No. 14 is currently used for irrigation of alfalfa at the Nebeker Ranch, and the District will increase agricultural use of its effluent under its 2020 Facilities Plan (ESA, 2004). Nebeker (2001) estimated that irrigation with effluent currently keeps approximately 1 billion gallons (4000 acre-feet) per year from flowing onto Rosamond Dry Lake. ESA (2004) cites studies in 2001 of Nebeker Ranch soils to document the effects of irrigation with secondary effluent. Concentrations of metals regulated under CCR Title 22 and agronomic parameters such as nitrates, sodium and chloride were similar to those of background samples from sites adjacent to Nebeker ranch. Metal concentrations were substantially less than maximum contaminant levels for soils in Title 22. "The results of the soil sampling indicate that after 15 years of irrigation with secondary treated water, no discernible degradation to soils has occurred that could pose a public health or soil quality impact."

LACSD No. 14 plans to use tertiary effluent to irrigate fodder crops such as oats, Sudan grass, and alfalfa at its District-owned agricultural site. The site would be irrigated at rates 10 to 20 percent below typical agronomic rates. These rates will reduce deep percolation and threats to ground water quality, without substantial loss in crop yield. The nitrogen content of the tertiary effluent is not expected to be sufficient to meet the crops' nitrogen demand, and fertilizer will be added to crops that do not fix their own nitrogen (Sanitation Districts of Los Angeles County, 2006.)

Table 9 compares historic data from LACSD No 14's ambient surface water monitoring stations with the United Nations Food and Agriculture Organization's Agricultural Water Quality Goals for irrigation water. One or more goals are exceeded at each station, particularly at Station RS5 on the bed of Rosamond Dry Lake.

The higher salinity levels in Rosamond Dry Lake (ranging from 0 to 14 parts per thousand (0 to 14,000 mg/L); see Table 14) also make the water unsuitable for livestock. Bagley *et al.* (1997), citing National Academy of Sciences guidelines for drinking water quality for livestock, state that water with a total soluble salts content of less than 1,000 mg/L "should present no serious burden to any livestock or poultry." As salt content increases, the risk of temporary diarrhea increases for livestock unaccustomed to the water source. Waters with 3,000 to 4,999 mg/L salts are considered poor quality for poultry, often causing watery feces and, at high levels, increased mortality and decreased growth. Waters with 7,000 to 10,000 mg/L salts are unfit for poultry and should in general be avoided for livestock. For waters with more than 10,000 mg/L soluble salts, the risks "are so great that they cannot be recommended for use under any conditions." Using these criteria, the water quality of Piute Ponds is currently suitable for livestock watering, but that of Rosamond Dry Lake is not.

It is appropriate to remove the AGR use from Rosamond Dry Lake because it is not an existing use, it cannot feasibly be attained due to the ephemeral nature and relatively high salinity of the surface waters, and (at least during some times of the year) it is too saline to meet agricultural criteria. Retention of AGR as a site-specific use for Amargosa Creek and Piute Ponds is appropriate for the present. There is no definite information available on the historic or existing use

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of the creek for irrigation or stock watering. In addition, no water quality data are available for the intermittent reaches of the creek in its upper watershed. The Nebeker Ranch studies indicate that LACSD's secondary effluent is suitable for irrigation of alfalfa. Water from Piute Ponds, with higher concentrations of TDS and other constituents than effluent at certain times of the year, may or may not be suitable.

Table 9. LACSD No. 14 Ambient Monitoring Data Compared to United Nations Food and Agriculture Organization Agricultural Water Quality Goals. (Ambient data from CDM, 2003; FAO criteria from Central Valley RWQCB, 2004, and Ayers and Westcot, 1985.)

Station	Constituent	FAO Agricultural Water Quality Goal	Ambient Concentration
RS1	Manganese	200 µg/L	1089 µg/L
RS2	Chloride	106,000 µg/L	127,750 µg/L
RS2	Total Dissolved Solids	450,000 µg/L	553,545 µg/L
RS3	Chloride	106,000 µg/L	164,000 µg/L
RS3	Total Dissolved Solids	450,000 µg/L	687,000 µg/L
RS4	Chloride	106,000 µg/L	232,400 µg/L
RS4	Manganese	200 µg/L	210 µg/L
RS4	Total Dissolved Solids	450,000 µg/L	825,909 µg/L
RS5	Aluminum	5,000 µg/L	9,200 µg/L
RS5	Arsenic	100 µg/L	128.4 µg/L
RS5	Chloride	106,000 µg/L	711,000 µg/L
RS5	Iron	5000 µg/L	8700 µg/L
RS5	Manganese	200 µg/L	295 µg/L
RS5	Total Dissolved Solids	450,000 µg/L	2,167,667 µg/L

Ground Water Recharge (GWR)

Definition: "Beneficial uses of waters used for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers."

Current Application: The GWR use is a categorically designated use for the "Minor Surface Waters" and "Minor Wetlands" of the Antelope HU and Lancaster HA.

Proposed Changes: The current categorical GWR use would continue to be designated as a site-specific use for both reaches of Amargosa Creek, Piute Ponds and the associated wetlands, and Rosamond Dry Lake.

Consequences: Protection of the MUN and AGR uses of ground water from the impacts of effluent discharges will continue to be a concern in Water Board permitting and enforcement activities. Drinking water standards will continue to apply to all ground water in the Lancaster HA under the regionwide water quality objectives for bacteria, chemical constituents, radioactivity, and taste and odor. (Ground water in some areas may not meet Sources of Drinking Water Policy criteria for designation of the MUN use, but site-specific studies and Basin Plan amendments would be required to remove the MUN designation from specific aquifers.)

Discussion: Together with imported water, ground water is one of the two major sources of drinking water in Antelope Valley. Ground water extraction is important for agricultural as well as municipal use. The designated beneficial uses of ground waters of the Antelope Valley Basin (see Basin Plan Table 2-2) are MUN, AGR, Industrial Service Supply (IND), and Freshwater Replenishment (FRSH). The FRSH use is defined and discussed below. The IND use is defined (in Basin Plan Chapter 2) in terms of industrial activities that do not depend primarily on water quality, such as cooling water supply and fire protection. Designation of the GWR use for surface waters implies (1) that ground water recharge from surface sources occurs, and (2) that surface water quality should be protected so that no adverse impacts on ground water quality and beneficial uses occur as a result of recharge.

Ground water movement in the Antelope Valley basin is generally northwesterly from the foothills of the San Gabriel and Sierra Pelona Mountains toward Rosamond Dry Lake. Natural recharge occurs via infiltration of surface water; the primary recharge areas are alluvial fans in the southern reaches of Amargosa Creek, Anaverde Creek, Little Rock wash, and Big Rock wash. The flow direction is disturbed in areas of intense ground water extraction, particularly within the cities of Lancaster and Palmdale. The Lancaster subbasin is the largest subunit of the Antelope Valley ground water basin and the source of most ground water pumped and consumed in the valley. It consists of a "principal" aquifer and a deep alluvial aquifer. The principal aquifer is assumed to be unconfined and to overlie lacustrine deposits. The deep aquifer is assumed to be confined (ESA, 2004).

There were formerly "widespread artesian water reserves held in fluvial sands and gravels beneath what are now recognized as mostly impermeable lake beds" in Antelope Valley (Orme, 2004). As noted above, ground water overdraft has significantly lowered the water table, leading to soil compaction, land subsidence, and cracking of playa surfaces. Near Rosamond Dry Lake, ground water is now between 50 to 100 feet below the ground surface. Near municipal extraction wells, depth to ground water is over 300 feet. After heavy rains or in areas that are heavily irrigated, ground water may be at depths less than 25 feet (ESA, 2004).

LACSD No. 14 staff requested that the GWR use be removed from the Piute Ponds and wetlands based on studies summarized in CDM (2003) regarding the extent of separation of shallow and deep aquifers beneath the ponds. During preparation of the 2002 WDRs, Water Board staff disagreed with LACSD's earlier conclusions regarding ground water beneath the ponds, and the adopted WDRs require additional ground water monitoring and reporting. LACSD recently submitted a report by Geochemical Technologies Corporation (2006) to Water Board staff and requested that it be considered during the Basin Plan amendment process.

If removal of the GWR use were to be added to the scope of the currently proposed plan amendments, they would likely require additional scientific peer review, causing further delays in the amendment process. Removal of the use is not proposed at this time, but it could be considered in the future as a separate plan amendment topic, based on review of all available data. Additional study would be needed to justify changes in the GWR use for any other waters in the Antelope HU.

Freshwater Replenishment (FRSH)

Definition: "Beneficial uses of waters used for natural or artificial maintenance of surface water quantity or quality (e.g., salinity)."

Current Application: The FRSH use currently applies categorically the wetlands associated with Piute Ponds as minor wetlands of the Lancaster HA and to ground water of the Antelope Valley Basin.

Proposed Change: FRSH would be designated as a site-specific use for the two segments of Amargosa Creek in Basin Plan Table 2-1 and for Piute Ponds and the associated wetlands.

Consequences: There are no specific water quality objectives associated with the FRSH use; no changes in permit conditions are expected to be necessary as a result of the designation.

Discussion: The Lahontan Basin Plan states (page 2-4), "In the 1975 Basin Plans, the 'Freshwater Replenishment' (FRSH) designation was used only for ground waters. This Plan adds this designation for all surface waters in the Region that flow to saline lakes. For example, FRSH has been added to the Susan River which is tributary to Honey Lake." In spite of this statement, the FRSH use was not added to Table 2-1 in the 1995 Lahontan Basin Plan for all surface waters of the Antelope HU that flow to its saline lakes. There is evidence that FRSH is an existing use of Amargosa Creek and the Piute Ponds and wetlands, and it is appropriate to make it a designated use of these waters.

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The 3000 mg/L Total Dissolved Solids threshold in the State Board's "Sources of Drinking Water Policy" is a commonly used threshold between fresh and salt water in the scientific literature (California Regional Water Quality Control Board, Lahontan Region, 2000). Using this threshold and the limited available data, stormwater in lower Amargosa Creek qualifies as fresh water, as do LACSD No. 14's effluent and Piute Ponds (Table 5). The "average" reported TDS concentration at monitoring station RS5 on the surface of Rosamond Dry Lake is 2168 mg/L (Table 5), qualifying these ponds as fresh at the time of sampling. Salinity values from a study of different areas on Rosamond Dry Lake range from 0 to 14,000 mg/L; the maximum values qualify the lake's waters as saline (Table 14).

FRSH was an historic use of Amargosa Creek and its associated wetlands, because they provided fresh water to Rosamond Dry Lake. Although the creek has been impounded, periodic overflows to the dry lake have historically occurred as a result of storm flows from the creek to Piute Ponds. Occasional overflows due to stormwater will continue to occur once overflows of effluent are controlled, and these should be considered freshwater replenishment for Rosamond Dry Lake. Dilution by stormwater also helps to prevent salt buildup in the Piute Ponds and wetlands. Based on these factors, designation of a site-specific FRSH beneficial use for Amargosa Creek, Piute Ponds, and the associated wetlands is appropriate.

Water Contact Recreation (REC-1)

Definition: "Beneficial uses of waters used for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, and use of natural hot springs."

Current Application: The REC-1 use applies categorically to Amargosa Creek, the Piute Ponds system, Rosamond Dry Lake, and minor surface waters and wetlands of the Lancaster HA.

Proposed Application: The REC-1 use would be removed from the reach of Amargosa Creek affected by the LACSD No. 14 discharge, from the Piute Ponds system, and from Rosamond Dry Lake. It would remain a designated use for Amargosa Creek and its tributaries upstream from the LACSD No. 14 discharge, and for minor surface waters and wetlands of the Lancaster HA.

Consequences: Assuming that the MUN use is also removed from effluent-affected waters, drinking water standards, including bacteria MCLs would not need to be met. The Water Board's regionwide water quality objectives for bacteria would continue to apply, and LACSD No. 14 would still need to meet

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California Department of Health Services disinfection criteria for restricted recreational impoundments.

Discussion: ***Extent of historic or existing water contact use.*** No information is available on the extent to which water contact recreation occurs, or has historically occurred, in the intermittent reaches of upper Amargosa Creek, or (during wet years) in the hydromodified reaches of the creek in urban areas. There is also no information on the extent of water contact recreation in the ephemeral waters of Rosamond Dry Lake before the lake's inclusion within a military base.

Recreational users of the waters within EAFB include hunters, bird watchers, and students. CDM (2003) states that Piute Ponds appears to have been used as a hunting destination since its creation. As of about 1989, 46 hunting blinds were in use; there were about 5000 hunter hours during the 1987-1988 waterfowl hunting season. Hunters are typically EAFB personnel. EAFB does not keep records on the number of permits per year but estimates about 120 permits annually for waterfowl hunting.

There is some ambiguity in the evidence for the extent of water contact and the risk of ingestion associated with hunting at the Piute Ponds and wetlands. Hunters may wade in the ponds, and wading is included in the definition of the REC-1 use. However, hunting is among the activities listed in the definition of the REC-2 (Non-contact Water Recreation) beneficial use. CDM (2003), a consultant to LACSD No. 14, states:

> *"Wading in Paiute Ponds is an activity conducted by hunters, but they use boats and impermeable waders, which prevent direct body contact with the water. These hunters are EAFB personnel and are familiar with the fact that they are not to have unrestricted body contact with the water. Although it cannot be ruled out that hunters may fall by accident in the water, these incidents would be strictly accidental and by definition exposure would be infrequent and of short duration."*

EAFB publicizes bird watching through its bird checklist, available on the Internet. The introduction to the checklist states: "Excellent bird watching areas are found at Piute Ponds, South Sewage Pond, Branch Pond, three lake beds and many clay pans .... The active wet season for the dry lakes and pans coincides with Spring migration." The recent identification of EAFB (as a whole, including the dry lakes) by Audubon California as an "Important Bird Area" (Cooper, 2004) is likely to increase public interest in bird watching. (See the discussion of the RARE and BIOL uses below for further information on Important Bird Areas.) CDM cites a rough estimate from EAFB staff of use by 700 to 800 birdwatchers per year. In 1989, EAFB estimated that approximately 30 bird study groups, varying in size from 15 to 35 people, visited the Piute Ponds area each year.

The extent to which birdwatchers wade in the ponds and wetlands and risk accidental body contact with water is unknown.

The Piute Ponds and wetlands are important for environmental education and scientific research. Through 1988, there were over 40 class visits to Piute Ponds from the Lancaster school district. The site has also been used by Antelope Valley College; University of California, Los Angeles; University of Southern California extension classes; and the Palmdale schools. CDM (2003) states that there have been about a dozen scientific research projects at the ponds, including studies by the Los Angeles County Natural History Museum and the Los Angeles Zoo. Comments on the CEQA Notice of Preparation for LACSD No. 14's draft facilities plan Environmental Impact Report (Appendix B to ESA, 2004) give some idea of the extent of current student use of the Piute Ponds area. A letter from Carolyn Oppenheimer, President of the San Fernando Valley Audubon Society, states:

> *"Our chapter has been hosting educational field trips for Los Angeles Unified School District children for many years. We bring in about 2000 children per year who would not otherwise get a chance to experience even a replication of a natural setting."*

Kristie Grubb, an educator with the Muroc Joint Unified School District, located within EAFB, also submitted scoping comments indicating that more than 500 students have used the wetlands over a five year period and summarized educational activities at Piute Ponds as follows:

> *"Through the use of Piute Wetlands students have learned to conduct bird counts, monitor bird populations, record weather data, compare desert and wetland ecosystems, and conduct plant surveys. ... More than 50 trees have been planted at Piute by students and several interpretive projects are underway. Additionally, an interdisciplinary program to build, install and monitor wood duck nesting boxes is in the planning stage."*

It is not clear whether any of these student visits have involved wading, water contact for collection of aquatic organisms, or other water contact activities.

The USEPA's (2002) draft *Implementation Guidance for Ambient Water Quality Criteria for Bacteria* states, "Secondary contact recreation activities generally do not involve immersion in the water, unless it is incidental (e.g., slipping and falling into the water or being inadvertently splashed in the face)." Using this interpretation, ingestion of water at Piute Ponds by hunters, birdwatchers, students, and researchers can probably be interpreted as incidental, leading to the conclusion that REC-1 is not an existing use.

Applicable standards and criteria. The water quality criteria most commonly associated with water contact recreation are those for pathogenic bacteria. The

Lahontan Basin Plan includes a regionwide water quality objective for coliform bacteria. The objective provides that waters shall not contain concentrations of coliform organisms attributable to anthropogenic sources, including human and livestock wastes, and that fecal coliform concentrations during any 30-day period shall not exceed a log mean of 20/100 ml [20 colonies per hundred milliliters]. This objective applies to all surface waters of the region, whether or not they are designated for the REC-1 use.

The California Department of Health Services has established criteria for pathogenic bacteria in recycled water (CCR Title 22, Division 4, Chapter 3 - Reclamation Criteria, Sections 60301 through 60475, referred to as "Title 22" in the following discussion). LACSD No. 14 considers Piute Ponds to be a "restricted recreational impoundment" requiring "disinfected secondary 2.2 recycled water." Restricted recreational impoundment refers to an impoundment of recycled water in which recreation is limited to fishing, boating, and non-body contact water recreational activities.

Disinfected secondary-2.2 recycled water is recycled water that has been oxidized and disinfected so that the median concentration of total coliform bacteria in the disinfected effluent does not exceed a Most Probable Number (MPN) of 2.2 colonies per hundred milliliters based on bacteriological results for the last seven days for which analyses have been completed, and the number of total coliform bacteria does not exceed an MPN of 23 colonies per 100 milliliters in more than one sample within any 30 day period. LACSD No. 14 routinely disinfects the effluent discharged to lower Amargosa Creek and Piute Ponds to meet Title 22 secondary-2.2 requirements and increases the level of disinfection during the duck-hunting season (ESA, 2004). The Water Board considers this level of disinfection to be in compliance with WDRs and the water quality objective. Disinfection to the 2.2 level is expected to continue with tertiary treatment.

Although the effluent is disinfected, historic fecal coliform levels at all of LACSD's ambient monitoring stations are high (Table 10). The single sample from Station RS1 represents a stormwater event. High fecal bacteria levels in stormwater can come from a variety of sources including agricultural runoff, urban pet wastes, wildlife, and leaks and spills from wastewater collection and treatment facilities. The high levels of fecal coliform bacteria at Stations RS2 through RS5 probably represent stormwater sources and wildlife, particularly birds, using the ponds and wetlands. To the extent that birds use them, ephemeral waters ponded elsewhere in Rosamond Dry Lake probably also have at least seasonally high numbers of fecal bacteria.

Other constituents. As discussed for the MUN use above, violations of drinking water MCLs for a variety of chemical constituents occur at all of LACSD No. 14's ambient water monitoring stations. It is important to recognize that the drinking water standards are based on assumptions of lifetime ingestion, rather than short term ingestion in connection with recreational activities. Nevertheless, the MCL violations add to the evidence that the waters of lower Amargosa Creek, Piute Ponds and wetlands, and Rosamond Dry Lake are not suitable for water contact recreation involving ingestion.

The federal Agency for Toxic Substances and Disease Registry (2003) has conducted a public health study of EAFB. The issues investigated included the potential for exposure of recreational users of Piute Ponds to harmful levels of contaminants in surface water or sediment. The study concluded that EAFB was not a potential source for any contamination of the ponds. (The developed area of EAFB is centered near Rogers Dry Lake, and there are 471 toxic cleanup sites on the base as a whole. However, the Piute Ponds and wetlands are distant from these sites and in a relatively undeveloped, undisturbed area.) The public health study investigated one former chemical warfare material site, presumed to have a 1-mile radius, located in the southeast corner of Rosamond Dry Lake, northeast of Piute Ponds. This site was used from 1966 to 1968 to test the dissemination and dispersion of non-pathogenic "simulant" bacteria and to verify cloud detection devices. The study found no evidence that any materials were left onsite, and simulants were assumed to have degraded due to the harsh desert environment.

The federal public health study also reviewed earlier testing of amphibians and birds for toxic chemicals in connection with potential exposure from consumption of waterfowl. This information is discussed in connection with the WARM and WILD beneficial uses below. The study concluded that there was no significant risk to hunters.

Although no site-specific data are available, the Piute Ponds and wetlands, as eutrophic systems, may support toxin-producing blue-green algae (cyanobacteria). Adverse health effects of recreational body contact with cyanotoxins can include hay fever, asthma, eye irritation, dermatitis, and gastrointestinal illness from accidental ingestion of water. Poisoning of animals has occurred from short-term ingestion. There are efforts under way internationally to develop cell number criteria for recreational exposure to cyanotoxins and guidance for posting public advisories (Backer, 2002).

The applicability to the REC-1 use to saline lakes has been questioned due to their unsuitability as drinking water, the corrosivity of high pH to the skin, and the formation of a white crust on objects that come into contact with saturated brine solutions. However, saline waters may be attractive for contact because of the novelty of their unique chemical and physical properties. The bouyancy of some salt lakes (e.g., Great Salt Lake, Utah) has led to their use for swimming. Windsurfing has been reported to occur on the alkali lakes of Long Valley in the Owens River watershed (California Regional Water Quality Control Board, Lahontan Region, 2000). Compared to other California playa lakes, Rosamond Dry Lake is moderately saline. Given the scarcity of surface water in Antelope

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Valley, Rosamond Dry Lake might be attractive for water contact recreation during wet years if it were located on public lands with unrestricted access.

Guidance for removal of a REC-1 use. The USEPA *Water Quality Standards Handbook* (1994) states that physical factors such as low flows may not be used as the basis for not designating recreational uses consistent with the "swimmable" goal of the Clean Water Act. "The basis for this policy is that the States and EPA have an obligation to do as much as possible to protect the health of the public. In certain instances, people will use whatever water bodies are available for recreation, regardless of the physical conditions." Using this guidance, the REC-1 use should not be removed from upper Amargosa Creek and Rosamond Dry Lake simply because they are ephemeral.

The USEPA's (2002) draft *Implementation Guidance for Ambient Water Quality Criteria for Bacteria* recognizes that states may find that primary contact recreation uses are not attainable when ambient water quality criteria are routinely exceeded due to natural sources of pollution.

"Changes to the designated use may be the most appropriate way to address these situations. Examples of natural (and potentially uncontrollable) sources are resident wildlife populations, migrating waterfowl, wildlife refuges, or lakes frequented by waterfowl. For waterbodies affected by natural sources such as these, where a significant portion of fecal contamination is shown to be from natural sources and a state or authorized tribe demonstrates the water quality criterion for bacteria and the primary contact recreation designated use is not attainable through the control of other sources, an intermittent, wildlife impacted or secondary contact recreational use may be the most important designated use."

Table 10. Fecal Coliform Bacteria Data for LACSD No. 14 Ambient Water Quality Monitoring Stations. Source: CDM, 2003. All concentrations expressed as Most Probable Number of colonies (MPN)/100 ml.

	Effluent	**RS1**[1]	**RS2**	**RS3**	**RS4**	**RS5**
Range	range <2 to <20	>1600	1 to 16,000	50 to 4,300	1 to 800	4 to 500
Mean	<4		1, 830	1,035	129	171

[1] Data available for only one sampling date.

Public Access. The Basin Plan (page 2-5) explains that the beneficial uses of surface waters of the Lahontan Region generally include the REC-1 use in order to implement the "swimmable" goals of the federal Clean Water Act. However, exceptions have been made in a few cases, such as agricultural reservoirs,

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wastewater reservoirs, drinking water aqueducts, and in some special wildlife areas where access for REC-1 use is restricted or prohibited by the entities that control those waters. The USEPA's (2002) *Implementation Guidance* also states that the considerations in determining whether water contact use is an existing beneficial use may include whether access to a water body is prevented by fencing.

The LACSD treatment plant and EAFB are fenced and unauthorized personnel are not allowed to visit the treatment facilities, the Piute Ponds and wetlands, the adjacent impoundment areas, or Rosamond Dry Lake. EAFB facilities are patrolled by military police, and the base issues permits to recreational users. Title 22 requires that all areas where recycled water is used that are accessible to the public shall be posted with signs that including the following words: RECYCLED WATER- DO NOT DRINK" (ESA, 2004; CDM; 2003).

Conclusion. The proposed removal of the REC-1 use from lower Amargosa Creek, Piute Ponds and wetlands and Rosamond Dry Lake is appropriate because of the probability that water contact recreation is not a historic or existing use, the presence of high levels of fecal bacteria from uncontrollable wildlife sources, and the fact that public access to these waters is limited.

No water quality data are available on the intermittent reaches of upper Amargosa Creek, or (during wet years) in the hydromodified reaches of the creek in urban areas to show whether water quality in these reaches is suitable for ingestion. Staff proposes to designate the REC-1 use, now categorically designated for the upper reach of Amargosa Creek, as a site-specific use for this reach unless and until data are available to justify its removal.

Non-Contact Water Recreation (REC-2)

Definition: "Beneficial uses of waters used for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to: picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, and aesthetic enjoyment in connection with the above activities."

Current Application: The REC-2 use applies categorically to Amargosa Creek, Piute Ponds and the associated wetlands, Rosamond Dry Lake, and minor surface waters and wetlands of the Lancaster HA.

Proposed Application: REC-2 would continue to be a designated use for all surface waters within the Lancaster HA, and would be included among the site-specific uses of both reaches of Amargosa Creek, Piute Ponds and the associated wetlands, and Rosamond Dry Lake.

Consequences: There would be no changes in the applicability of Basin Plan provisions related to REC-2 in the Water Board's permitting and enforcement activities for the affected water bodies.

Discussion: The discussion of the REC-1 use, above, summarizes the available information about current and historic recreational use of Amargosa Creek, Piute Ponds and the associated wetlands, and Rosamond Dry Lake, and that discussion provides the evidence that REC-2, rather than REC-1, is an existing use of these waters. The headwaters of Amargosa Creek are within Angeles National Forest, in an area presumably available for dispersed recreational use such as hiking, and there are opportunities for public viewing of or access to the creek in other parts of the watershed. The proposed designations of site-specific REC-2 uses are appropriate.

Commercial and Sportfishing (COMM)

Definition: "Beneficial use of waters used for commercial or recreational collection of fish or other organisms, including but not limited to, uses involving organisms intended for human consumption."

Current Application: The COMM use is currently a categorically designated use for all minor surface waters of the Antelope HU, but not for minor wetlands.

Proposed Application: The COMM use would be removed from lower Amargosa Creek, Piute Ponds, and the surface waters of Rosamond Dry Lake.

Consequences: Water quality criteria related to fish consumption would not be a consideration in the Water Board's permitting and enforcement activities for discharges to waters without the COMM use. The absence of the use designation would not prohibit or prevent collection of fish and other aquatic organisms for scientific and educational purposes.

Discussion: The definition of the COMM use overlaps to some extent with the definitions of the REC-1 use (including fishing) and the REC-2 use (involving outdoor education activities such as tidepool study). The Basin Plan (page 2-5) notes that the COMM use was previously "solely designated to protect large populations of fish for commercial collection. The revised definition emphasizes the protection of human health from consumption of fish or other aquatic species collected for commercial or recreation purposes."

No fish were historically native to the Amargosa Creek watershed. The extent to which Native Americans and early European settlers in the area used amphibians and other aquatic organisms for food is unknown. The fish species (and some of the amphibian species) currently known from Piute Ponds are not native to California and may have been deliberately stocked by humans or accidentally transported by birds (e.g., as eggs in mud on the feet of waterfowl).

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Two of the fish species in Piute Ponds (brown bullhead and carp) and one of the amphibians (bullfrog) are generally considered edible and were introduced to California to provide food sources (Moyle, 1976; Behler and King, 1979). Warmwater fish stocked and caught in artificial ponds elsewhere on EAFB (Miller and Payne, 2000) may be eaten, but there is no evidence of a sport fishery at Piute Ponds. Collection of aquatic organisms for scientific research (and probably for educational purposes) has occurred at Piute Ponds and Rosamond Dry Lake, as noted in the discussions of other beneficial uses in this staff report. As shown in Table 11, the ambient concentrations of some constituents in Piute Ponds exceed water quality criteria related to human consumption of fish. No fish tissue data from Piute Ponds are available for comparison with tissue criteria. There has been some study of amphibian deformities (discussed in the context of the WARM beneficial use below), but the cause of these deformities is unknown. Aside from concerns about toxic substances, aesthetic considerations would probably discourage human consumption of fish from effluent dominated waters.

Tertiary effluent from LACSD No. 14 is currently used to support a recreational fishery at the Apollo Park lakes. ESA (2004) states, "Swimming at Apollo Park is prohibited. The park provides trout and catfish fishing and holds fishing derbies for youths and adults several times a year."

Piute Ponds could conceivably support a recreational "catch and release" fishery for warmwater fish species, without the potential for human consumption, especially when tertiary rather than secondary effluent is used to maintain the ponds. However, to Water Board staff's knowledge, EAFB has not expressed interest in such a fishery, and there are other opportunities for fishing available to residents of the base. Given the lack of evidence of historic sportfishing, the limited public access to EAFB, and the probable unsuitability of aquatic organisms in Piute Ponds for human consumption, the proposed removal of the COMM beneficial use appears to be appropriate. The absence of a designated COMM use would not prohibit the establishment of a fishery in the future.

Warm Freshwater Habitat (WARM)

Definition: "Beneficial uses of waters that support warm water ecosystems including, but not limited to, preservation and enhancement of aquatic habitats, vegetation, fish, and wildlife, including invertebrates."

Current Application: WARM is currently a designated use for minor surface waters and minor wetlands in the Antelope HU and the Lancaster HA, including the waters affected by the proposed Basin Plan amendments

Proposed Application: WARM would be included among the site specific uses of both reaches of Amargosa Creek, Piute Ponds and the associated wetlands, and Rosamond Dry Lake.

Table 11. LACSD No. 14 Monitoring Data Compared to Human Fish Consumption Criteria. Except as noted, criteria are "One-in-a-Million Incremental Cancer Risk Estimates". Ambient data are from CDM (2003) and criteria from the summaries of National Ambient Water Quality Criteria in California Regional Water Quality Control Board, Central Valley (2003). All units are micrograms per liter (μg/L).

Constituent	**Criterion for Water & Fish Consumption**	**Criterion for Fish Consumption Only**	**Effluent**	**RS1**	**RS2**	**RS3**	**RS4**	**RS5**
Arsenic	0.018	0.14	3.3	6.9	7.3	8.5	16.8	128.4
Chloroform	5.7	470	7[1]	ND	10.7	2.0	<0.5	<0.5
Manganese		100[2]	20.0	<20.0	192.5	207.5	182.0	110.0
Thallium	0.24	0.47			18[3]			

[1] Chloroform concentration from ESA (2004)
[2] Criterion for public health effects other than cancer risk.
[3] Ambient thallium concentration is from Agency for Toxic Substances and Disease Registry (2003) report; location of sample in Piute Ponds was not given.

<u>Consequences</u>: Continuation of the WARM beneficial use designation (and removal of the Cold Freshwater Habitat or COLD designation as discussed below) defines the water quality objectives for dissolved oxygen and temperature that will be used in future Water Board permitting and enforcement activities. If SSOs are not adopted, less stringent limits for ammonia would apply to waters designated for the WARM but not the COLD use under the current regionwide water quality objectives. The differences between the two sets of objectives occur at relatively high water temperatures; see Basin Plan Tables 3-1 through 3-4.

<u>Discussion:</u> The following is a summary of important physical and chemical habitat characteristics, and of the available biological data for the waters of the Antelope HU.

Physical and chemical characteristics. The limited available data indicate that all of the waters proposed for site-specific beneficial uses qualify as "fresh" (with TDS concentrations below 3000 mg/L) at least at some times of the year. The proposed Basin Plan amendments would apply the WARM use to Rosamond Dry Lake <u>in addition to</u> the proposed new designation of an Inland Saline Water Habitat (SAL) use. Both uses are appropriate because the surface waters of the lake may occasionally be dilute enough to be considered fresh water.

Temperature. The Lahontan Basin Plan does not set a temperature threshold between warm freshwater and cold freshwater habitats. The State Water Resources Control Board's *Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California* (Thermal Plan), included in the appendices to the Basin Plan, defines cold interstate waters as "Streams and lakes having a range of temperatures generally suitable for trout and salmon" and warm interstate waters as "Interstate streams and lakes having a range of temperature generally suitable for warm water fishes such as bass and catfish." (This plan has no comparable definitions for intrastate waters.) The Thermal Plan defines "Natural Receiving Water Temperature" as, "The temperature of the receiving water at locations, depths, and times which represent conditions unaffected by any elevated temperature waste discharge or irrigation return waters."

Citing an ichthyology textbook, a report by the California Regional Water Quality Control Board, Central Valley Region (2000) states that warm water streams have temperatures that exceed 24 to 26° C (75 to 79° F) for extended periods of time and are characterized by smallmouth bass, green sunfish, catfish, and a diversity of small fishes, especially cyprinids and darters, while cold-water streams rarely exceed 24 to 26° C (75 to 79° F) and are characterized by trout and sculpins. Amargosa Creek and Rosamond Dry Lake do not support fish. There are at least three species of fish in Piute Ponds (all non-natives to California), including carp (a cyprinid) and brown bullhead (a catfish).

The Lahontan Basin Plan's water quality objective for temperature applicable to surface waters of the Antelope HU is as follows:

> *"The natural receiving water temperature of all waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Board that such an alteration in temperature does not adversely affect the water for beneficial uses.*
>
> *For waters designated WARM, water temperature shall not be altered by more than five degrees Fahrenheit (5°F) above or below the natural temperature. For waters designated COLD, the temperature shall not be altered."*

Because of the ephemeral nature of most surface waters of the Antelope HU, and the variability of climate and precipitation, natural background temperatures cannot be easily defined. As artificial water bodies, the Piute Ponds and wetlands do not have "natural" background temperatures, and there are no comparable waters in the HU that could serve to define "reference" conditions. Temperature data have not been collected frequently enough to define diurnal, seasonal, and annual variations, or variations within one water body due to factors such as water depth, flow or wind mixing, and shading by vegetation. Long term monitoring of temperatures at relatively undisturbed sites would be needed to define the natural range of water temperature conditions.

The available data for Piute Ponds show cooler temperatures than might be expected for a desert water body, mostly below the threshold levels from the literature cited above. CDM (2003) states that the summer average temperature in Piute Ponds is 70° F [21°C] and that mean temperatures at three stations in Piute Ponds range from 12.8 to 14.1° C [55 to 57° F]. Extreme temperatures at these stations range from 4.0 to 24.0° C [39 to 75° F]. Temperatures cited by AMEC (2003) for Station RS2 ranged from a minimum of 43° F [6° C] in December to 72° F [22° C] in August, with a mean of 56° F [13° C]. The mean temperature at Station RS4 was 58° F [14° C] during this period. Recorded temperatures at Station RS5 (on Rosamond Dry Lake) have a mean of 19.7° C [67° F] and a range of 17.5 to 20.0° C [64 to 68° F](CDM, 2003).

The three fish species found in Piute Ponds are generally considered "warmwater" fish, but they can survive fairly wide ranges of temperature conditions. The following information on temperature tolerances is summarized from Moyle (1976). Carp (*Cyprinus carpio*) are active at water temperatures of 4 to 34°C [39 to 93° F] although the optimum temperature for growth seems to be around 24° C [75° F]; they can withstand sudden temperature changes. Carp spawn in early spring or summer when water temperatures start to exceed 15° C [59° F]. The brown bullhead (*Ictalurus nebulosus*) can live in water temperatures from nearly 0 to 37° C [32 to 99° F]. However, their optimum temperatures for growth are about 20 to 35° C [68 to 95° F]. Mosquitofish (*Gambusia affinis*) can survive temperatures up to 37.3° C [99° F], as well as extreme daily temperature

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fluctuations. They generally cannot survive prolonged exposure to cold water (less than 4° C or 39°F), although they can acclimate to conditions as severe as those found in northern Illinois.

Further indications of temperature optima for warmwater organisms are provided in guidance for laboratory bioassays. Recommended bioassay temperatures for organisms found in Piute Ponds, or related species, are as follows: channel catfish (*Ictalurus punctatus*) 20 to 28° C [68 to 82° F]; African clawed frog (*Xenopus laevis*), 24° C [75° F]; *Hyalella azteca* (sediment toxicity test), 23 ° ± 1° C [about 73° F] (California Office of Environmental Health Hazard Assessment, 2004).

Although the limited temperature data for surface waters of the Antelope HU are generally cooler than the optima for warm water organisms cited above, other environmental factors such as low dissolved oxygen would probably preclude the survival of cold water fish in Piute Ponds.

Dissolved oxygen. The minimum dissolved oxygen concentration allowed in waters designated WARM under the water quality objectives in Basin Plan Table 3-6 is a 1-day minimum, applicable as an instantaneous value, of 3.0 mg/L. The 7-day mean minimum concentration of dissolved oxygen for WARM waters is 4.0 mg/L, and the 30-day mean concentration is 5.5 mg/L. The water quality objectives for dissolved oxygen are based primarily on protection of fish, and are more stringent for cold water habitat due to the requirements of salmonids. Warmwater fish are less sensitive to low dissolved oxygen than salmonids. Carp can withstand oxygen concentrations as low as 0.5 mg/L. Mosquitofish can survive low oxygen levels by using the few millimeters of water close to the surface into which oxygen diffuses from the air. (Moyle, 1976).

As shown in Table 4, the historic average dissolved oxygen concentrations at LACSD No. 14's ambient monitoring stations range from 6.2 to 8.8 mg/L. The historic minimum concentration has been as low as 2.7 mg/L, slightly lower than the minimum applicable water quality objective (3.0 mg/L). The frequency of available dissolved oxygen measurements is insufficient to define diurnal, seasonal and annual variation, or variation with depth in Piute Ponds. Changes in oxygen concentration over the course of a day, from photosynthesis, biological respiration, and wind mixing, are likely to occur in Piute Ponds and may be significant habitat factors.

Dissolved oxygen conditions in Piute Ponds may change in the future when the ponds are maintained with a lower volume of tertiary effluent. Lower water depth will affect temperature, the rates of biological processes and the extent of aeration through wind mixing. Tertiary effluent is projected to have a lower biochemical oxygen demand than secondary effluent (see Table 1) and this will affect the potential for dissolved oxygen depletion. Changes in the dissolved

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Table 12. Dissolved oxygen and pH at LACSD No. 14 Monitoring Stations. Sources: CDM (2003) and Lahontan Basin Plan.

Constituent	**Applicable Water Quality Objective Value**	**Effluent Concentration**	**RS1[1]**	**RS2**	**RS3**	**RS4**	**RS5**
Dissolved Oxygen (mg/L)	5.5 mg/L[2]	range: 3 to 9 mean 7.3	11	range: 4.6 to 8.8 mean: 7.1	range: 2.7 to 10.1 mean: 6.2	range: 4 to 11.5 mean 8.8	range: 7.5 to 11.6 mean 9.4
pH (standard units)	6.5 to 8.5 units	range 7.3 to 9.4 mean 8.1	9.2	range 7.2 to 9.4 mean 7.9	range 7.2 to 9.4 mean 7.9	range 8.2 to 9.9 mean 7.9	range 9.6 to 9.8 mean 9.7

[1] Allowable instantaneous minimum dissolved oxygen concentration.

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oxygen environment of the ponds under future management scenarios cannot be precisely predicted at this time.

Nutrients. Although no data are available on indicators of biological productivity such as chlorophyll a, the total nitrogen and phosphorus levels in the secondary effluent currently discharged to lower Amargosa Creek and the Piute Ponds and wetlands are at levels typical of hypereutrophic systems (see Tables 1 and 7). For example, the concentration of "total phosphate" in the secondary effluent is 12.5 mg/L, and data from the USEPA's National Eutrophication Survey (summarized in USEPA, 1988) indicate that lakes with total phosphorus concentrations over 120 μg/L have a high probability of being hypereutrophic. A different "eutrophication scale" summarized in the USEPA's (1999) guidance for development of Total Maximum Daily Loads for nutrients indicates that total nitrogen concentrations in eutrophic lakes range from 390-6100 μg/L, with a mean value of 1900 μg/L. The historical average ammonia nitrogen concentrations in Piute Ponds greatly exceed this value (Tables 4, 5 and 6).

Nutrients are of concern because of the generally detrimental impacts of eutrophication on beneficial uses, and because of the potential for nitrate and ammonia toxicity. Some types of natural wetlands can be naturally eutrophic, and wetland functions include treatment and removal of nutrients (see the discussion of the Water Quality Enhancement beneficial use below). Eutrophication can be detrimental to aquatic life uses because it can lead to low dissolved oxygen concentrations, fish kills, reduced clarity, and blooms of toxin producing blue-green algae.

Ammonia toxicity is discussed in the context of the proposed SSOs, below. High concentrations of ammonia are also of concern because of the likelihood that they will be converted to nitrate. Recent research indicates that nitrate can be toxic to amphibians. A Canadian government fact sheet (Environment Canada, 2000) states that "Studies examining nitrate toxicity to selected native North American amphibian species indicate that nitrate concentrations required to kill 50% of the tadpoles are in the range of 13 to 40 parts per million", and "Chronic effects on amphibians (reduced feeding, reduced swimming, and developmental deformities) occur at concentrations as low as 2 to 5 ppm in some species." A literature review by Rouse et al. (1999) provides a more detailed summary of these data.

When LACSD No. 14 uses tertiary rather than secondary effluent to maintain Piute Ponds (with a smaller volume of effluent), nutrient loading to the ponds should decrease significantly. However, nutrient concentrations may remain high due to internal loading of phosphorus and ammonia from the sediment, and nitrogen fixation by blue green algae. The Water Board may need to consider developing site-specific water quality objectives for nutrients to protect habitat uses in the Piute Ponds and wetlands at a later date.

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Toxicity. Other toxic constituents in Piute Ponds may impact the Warm Freshwater Habitat beneficial use. Table 13 shows violations of a number of USEPA aquatic life criteria at LACSD No. 14's ambient monitoring stations. A public health study of EAFB by the federal Agency for Toxic Substances and Disease Registry (2003) cited earlier studies of toxic substance impacts at Piute Ponds:

> *"In 1996, a scientist from the California Science Center, Davis, trapped African clawed frogs from Piute Ponds. Of the 50 animals trapped, 5 showed abnormalities (i.e. blind eye, crooked spine, undeveloped reproductive system, abnormally shaped fat bodies, and an extra forelimb.) The cause of these abnormalities was not determined)...*
>
> *...To support a reproductive bird study, the U.S. Geological Survey (USGS) analyzed African clawed frogs collected from Piute Ponds and concluded that they were not contaminated with organochlorine pesticides or polychlorinated biphenyls (PCBs). Metals and trace elements were detected in frogs, but mean concentrations and upper ranges were not thought to be sufficient to adversely affect bird reproduction."*

A later publication on the USGS study (Hothem et al., 2006) included the results of studies on eggs of several top predator bird species presumed to be feeding on African clawed frogs at Piute Ponds. It concluded that observed egg failures could not be attributed to contaminants.

As more data become available, the Water Board may need to consider developing site-specific water quality objectives for toxics and other constituents in the Piute Ponds and wetlands to protect aquatic life and wildlife uses.

Aquatic biota. The following discussion focuses on the aquatic organisms and communities of Amargosa Creek and the Piute Ponds and wetlands. Similar information for Rosamond Dry Lake is discussed in the context of the Inland Saline Water Habitat (SAL) beneficial use below.

Relatively little information is available on the aquatic life of Amargosa Creek, either above or below the LACSD discharge. The Los Angeles County Planning Departments' (undated) summary report for the proposed San Andreas Rift Zone Significant Ecological Area (SEA) states that the wetlands and aquatic habitats within the SEA support diverse faunas of freshwater and alkaline pool arthropods, including native fairy shrimp, brine flies, and tiger beetles, and that "amphibian populations may be particularly abundant where desert riparian areas occur." The ephemeral nature of Amargosa Creek within the urbanized area of Antelope Valley limits the nature of aquatic life in surface waters. CDM (2003) theorized that the aquatic community near Station RS1 would be limited to organisms that can colonize the temporary pools that are briefly present following storm events. However, there has been no study of the extent to which

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Amargosa Creek supports (or historically supported) aquatic life in the "hyporheic zone" or shallow ground water beneath or adjacent to the streambed.

Research on desert streams in Arizona, summarized in California Regional Water Quality Control Board, Lahontan Region (2000) indicates that hyporheic processes are very important to these stream ecosystems. Their hypohreic zones support microorganisms and a distinct invertebrate fauna. Four different invertebrate communities have been identified in the hyporheic sediments, including a "dry channel hyporheic" community that appears briefly after surface water disappears. Habitat boundaries change over the year with upwelling and downwelling of water. The invertebrates can resist both flooding and drying, and some are able to recolonize a given area within two days of rehydration following several months of drying. If they exist, hyporheic biological communities and ecosystem processes are probably more important in the intermittent reaches of Amargosa Creek near its headwaters than in the ephemeral reaches crossing areas of ground water overdraft.

There have been at least two surveys of the aquatic life of the Piute Ponds and wetlands. Miller and Payne (2000) surveyed the aquatic macroinvertebrates of EAFB, including Piute Ponds, in 1995 and 1996. They identified at least 28 taxonomic groups of invertebrates (taxa). Of the water bodies studied, Piute Ponds typically supported the greatest macroinvertebrate density, with higher values found in the fall than spring or early summer (up to nearly 100,000 individuals per square meter). The four major macroinvertebrate groups in permanent water habitats were chironomids or true flies, predatory leeches (*Helobdella stagnalis*), amphipod crustaceans (*Hyalella azteca*), and oligochaete worms (Tubificidae).

Mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera), or "EPT organisms" are often considered indicators of good water quality. While the number of EPT organisms found in the ponds in the Miller and Payne study were low, the presence of Ephemeroptera in Piute Ponds indicates that water quality was good enough, at least at the time of sampling, to support these sensitive organisms. The AMEC (2003) survey in August and September of 2002 found *Hydropsyche* caddisflies in the ponds.

Miller and Payne stated that, of the abundant taxa in Piute Ponds, only chironomids disperse easily (adults can fly). "Oligochaetes, amphipods and leeches are entirely aquatic and not especially tolerant of dessication", and are thus dependent on permanent water.

CDM (2003) notes the presence of three fish species at Piute Ponds (brown bullhead, mosquitofish and carp) but states that other fish may be present. Amphibians listed by CDM as occurring near Piute Ponds include California toad, red-spotted toad and Pacific chorus frog. Miller and Payne (2000) state that the

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Table 13. LACSD No. 14 Monitoring Data Compared to Aquatic Life Criteria. Sources: Ambient data from CDM (2003); criteria information from California Regional Water Quality Control Board, Central Valley Region (2004)

Station	Constituent	Criterion	Criterion Value[1]	Ambient Value
RS1	Aluminum	USEPA, Freshwater Aquatic Life, 4-day average	87 μg/L	89 μg/L
	Copper (total)	USEPA, Freshwater Aquatic Life, 4-day average	11 μg/L	9.0 μg/L
	Lead (Total Recoverable)	USEPA, Freshwater Aquatic Life, 4-day average	4.0 μg/L	40.0 μg/L
	Nickel (dissolved or total)	USEPA, Freshwater Aquatic Life, 4-day average	61 μg/L	60.0 μg/L
	Zinc (dissolved or total)	USEPA, Freshwater Aquatic Life, 1 hour maximum and 4-day average	140 μg/L	320 μg/L
RS2	Aluminum	USEPA, Freshwater Aquatic Life, 4-day average	87 μg/L	633.3 μg/L
RS3	Aluminum	USEPA, Freshwater Aquatic Life, 4-day average	87 μg/L	433.3 μg/L
RS4	Aluminum	USEPA Freshwater Aquatic Life, 4-day average	87 μg/L	3,533.3 μg/L
RS4	Chloride	USEPA Freshwater Aquatic Life, 4-day average	230,000 μg/L	232,400 μg/L
RS4	Iron	USEPA Freshwater Aquatic Life, 4-day average	1000 μg/L	3783.3 μg/L
RS5	Aluminum	USEPA, Freshwater Aquatic Life, 4-day average[2]	87 μg/L	9,200 μg/L
RS5	Chloride	USEPA Freshwater Aquatic Life, 4-day average[2]	230,000 μg/L	711,000 μg/L
RS5	Iron	USEPA Freshwater Aquatic Life, 4-day average[2]	1000 μg/L	8700 μg/L

[1] Criteria values for copper, lead, nickel, and zinc were estimated using a hardness of 120 mg/L as calcium carbonate, close to the "typical" hardness of 122 mg/L reported for Station RS2 by LWA (2003). In February 2007, the USEPA approved revised freshwater copper criteria. The 2007 hardness-based acute toxicity criterion at pH = 8, hardness = 159 mg/L $CaCO_3$, and dissolved organic carbon = 16 mg/L would be 21.7 μg/L copper under the hardness based model, and 142 μg/L copper under the Biotic Ligand Model. The RS1 ambient concentrations are from a single storm runoff event and probably does not represent "average" conditions,

[2] Freshwater aquatic life criteria are appropriate for Rosamond Dry Lake only at time when the lake is diluted below the threshold for defining saline waters. The USEPA's salt water aquatic life criteria are based on toxicity tests with marine/estuarine organisms and are inappropriate for inland saline lakes.

African clawed frog (*Xenopus laevis*) and bullfrog (*Rana catesbiana*), present at the ponds, both have aquatic larvae and require permanent water. The African clawed frog is almost entirely aquatic as an adult, but can burrow in mud and estivate for up to a year when its habitat dries (AMEC, 2003). Aquatic reptiles identified in/near the ponds include southwestern pond turtle (Los Angeles County Department of Regional Planning, 2000) and snapping turtle (CDM, 2003); the latter is a prohibited species in California.

Habitat quality. Miller and Payne concluded that the aquatic invertebrate community of Piute Ponds is relatively simple and dominated by taxa tolerant of stressful conditions including moderately high water temperature and slightly brackish water, and also that it is "a very productive community." AMEC (2003) stated that:

> *As a permanent water feature in the Mojave Desert, Paiute Ponds is a unique and important area for biology. Some experts believe there to be a relictual assemblage of invertebrates from the area's more natural hydrologic past. The region was known for many artesian spring-fed areas, but as the water table dropped through the years many of these spring areas are no longer present. Although Paiute Ponds has been impounded, the area still contains a significant diversity of species relative to adjacent areas."*

Conclusion. From the evidence available, WARM appears to be a more appropriate site-specific beneficial use for lower Amargosa Creek and the Piute Ponds and wetlands than COLD. Retention of the currently designated WARM use for other surface waters of the Antelope HU is also appropriate unless and until additional temperature data are available to justify a change. More frequent monitoring to document diurnal, seasonal and annual variations in temperature and other water quality parameters would be desirable. The Water Board may also need to consider developing additional SSOs to protect the WARM beneficial use.

Cold Freshwater Habitat (COLD)

Definition: "Beneficial uses of waters that support cold water ecosystems including, but not limited to, preservation and enhancement of aquatic habitats, vegetation, fish, and wildlife, including invertebrates."

Current Application: This beneficial use is currently designated categorically for minor surface waters of the Antelope HU, but not for minor wetlands.

Proposed Application: COLD would not be included in the site-specific beneficial uses for the reach of Amargosa Creek below the LACSD discharge, Piute Ponds and the associated wetlands, and Rosamond Dry Lake. The COLD use would be retained for Amargosa Creek and its tributaries above the LACSD discharge point, and for minor surface waters within the Lancaster HA.

Consequences: In the absence of a COLD use designation, less stringent water quality objectives for ammonia toxicity (under the existing regionwide objective), temperature and dissolved oxygen would apply. Less stringent limits for ammonia toxicity would apply (at relatively high water temperatures) under the existing regionwide ammonia objectives (see Basin Plan Tables 3-1 through 3-4).

Discussion: Some of the surface waters of the Antelope HU are currently designated for both the WARM and the COLD beneficial uses. The Basin Plan (page 2-4) notes that

> *"...certain surface waters, including internal drainage lakes, may have varying water quality from changes in natural conditions (e.g., change in water volume). The designation of multiple beneficial uses in Table 2-1, which may appear conflicting for a particular surface water, indicates existing or probable future beneficial uses that may occur only temporarily."*

As indicated in the discussion of the WARM use above, the Basin Plan does not include a specific temperature threshold between warm and cold freshwater habitat. The scientific literature threshold between warm water and cold water habitat is 75 to 79° F [24 to 26° C]; cold water habitat is generally interpreted in terms of the temperature (and other) requirements of trout. Rainbow trout can survive temperatures between 0 and 28° C [32 and 82° F], but can withstand higher temperatures if they are gradually acclimated and the water is saturated with oxygen. The optimal temperature range for growth and completion of the life cycle seems to be 13-21° C [55-70° F]. Rainbow trout eggs hatch at 10-15° C [50-59° F]. The preferred temperature range of brook trout is 15-19° C [59- 66° F], but they can feed at temperatures as low as 1° C [34° F] and survive temperatures up to 26° C [79° F]. Their growth is poor to nonexistent at temperatures above 9°C [66° F] (Moyle, 1976).

The mean ambient temperature data for Piute Ponds and Rosamond Dry Lake, summarized in the discussion of the WARM use and in Tables 4, 5, and 6, above, tend to be on the "cold" side of the literature threshold. However, the frequency of temperature sampling has been too low to define diurnal and seasonal temperature extremes, and extremes are probably more relevant to aquatic life than mean temperatures. Since the Piute Ponds and associated wetlands will be maintained at the same wetted area with a lower volume of effluent in the future, water temperature may increase. Also, the historic minimum dissolved oxygen concentrations in Piute Ponds (less than 3 mg/L; see Table 11) are below the minimum concentrations (5.0 mg/L) required in water quality objectives for waters designated COLD (Basin Plan Table 3-6).

The Lahontan Basin Plan's water quality objective for temperature allows no change in the natural temperature regimes of waters designated for the COLD use. As indicated for the WARM use, the available data are not sufficient to establish the natural background temperature regimes for surface waters of the Antelope HU. The Piute Ponds and wetlands are not natural water bodies, and there are no comparable water bodies in the HU that could be used as reference sites.

The removal of the categorical COLD use is recommended for lower Amargosa Creek and Piute Ponds based on the limited temperature and biological data available. Similar data are not available for the remainder of Amargosa Creek, especially for the upper reach in the San Andreas Rift Zone, which might be expected to support at least seasonal cold water habitat. Water Board staff recommend retaining the COLD use as a site-specific use for the upper reach of Amargosa until more information becomes available. The mean temperature reported for Station RS5 on Rosamond Dry Lake (see Table 4) is below the literature threshold between warm water and cold water habitat, and temperature data are lacking for other parts of the lake. However, because of the temperature extremes discussed in connection with the SAL use below, removal of the COLD use from Rosamond Dry Lake appears to be appropriate.

Inland Saline Water Habitat (SAL)

Definition: "Beneficial uses of waters that support inland saline water ecosystems including, but not limited to, preservation and enhancement of aquatic saline habitats, vegetation, fish and wildlife, including invertebrates."

Current Application: The SAL use is not currently a designated use for any waters within the Antelope HU.

Proposed Application: The SAL use would be designated for the ephemeral surface waters of Rosamond Dry Lake. It would apply in addition to the WARM use. A footnote would be added to Basin Plan Table 2-1 to specify that the SAL use for Rosamond Dry Lake does not apply to its tributaries.

Consequences: No additional water quality objectives or criteria would be applied to Rosamond Dry Lake as a result of the designation of the SAL use.

Discussion: The original description of the SAL use (California Regional Water Quality Control Board, Lahontan Region, 1975b) recognized that "Saline water habitats are relatively limited in number and offer a unique biological setting." It also mentioned the tolerance of the plants and animals associated with these habitats to extremes of temperature and salinity, and the value of these habitats as food sources and resting areas for migratory waterfowl. Starkweather (1999) states that "ephemeral ponds and playa lakes in warm deserts must be considered to be among the most extreme environments on earth" and cites resting stage embryos of several kinds of crustaceans in the central Mojave Desert that persist in dried sediment where surface temperatures frequently exceed 65° C (149 ° F) in summer and undergo weeks of daily freeze-thaw cycles in winter. Most of the following information about general characteristics of inland saline lakes and the organisms inhabiting them is taken from an earlier Water Board staff literature review (California Regional Water Quality Control Board, Lahontan Region, 2000).

The salinity of inland waters is generally expressed as "total dissolved solids" (TDS) or "electrical conductivity" or "specific conductivity." The definitions of these terms depend on the methods used for measurement. "Salinity" is the sum of all dissolved ions, but TDS is the mass of dissolved material estimated by evaporation to dryness at a specific temperature. TDS may not include bicarbonate and other ions driven off during the evaporation process. "Dissolved solids" consist of inorganic salts, small amounts of organic matter, and "dissolved materials." The main inorganic ions are carbonates, chlorides, sulfate, nitrate, sodium, potassium, calcium and magnesium. TDS also includes phosphates, bicarbonates, and traces of manganese, iron, etc. The 3000 mg/L TDS threshold in the State Water Board's "Sources of Drinking Water Policy" is also a widely accepted literature threshold between fresh and salt water.

The salinity of inland salt lakes changes seasonally, including dilution by runoff in spring, concentration by evaporation in summer, and freezing out in winter. During the latter process the ice formed is fresh water, and the remaining saline solution is more concentrated. Salts can be removed from dry lakes by wind transport, or they may be covered periodically by sediment from flash flooding or wind deposition.

As salinity increases, dissolved oxygen saturation occurs at lower concentrations at a given temperature. Oxygen levels below 1 mg/L are not uncommon in ephemeral saline ponds, especially at night under summer temperatures. Aquatic invertebrates of saline lakes adapt to low dissolved oxygen either physiologically (some have hemoglobin) or behaviorially, by staying near the surface. *Branchinecta mackini*, one of the fairy shrimp species present in Rosamond Dry Lake, tolerates oxygen at about 10 to 20 percent saturation (Thorp and Covich, 1991). For comparison, the Lahontan Basin Plan's regionwide narrative water quality objective for dissolved oxygen states that the minimum concentration shall not be less than 80 percent saturation.

Wind induced water movement may shift the water of desert playa lakes considerable distances or drive it to one end of the lake. Brostoff *et al.* (2001) cite an earlier study of the rate of water movement on Rogers and Rosamond Dry Lakes in relation to wind velocity. Water movement rates of up to 6 feet per minute occurred in response to a wind of 42 miles per hour. On Rogers Dry Lake, wind induced changes in water depth of more than a foot were reported. Wind mixing would probably increase dissolved oxygen concentrations.

The pH in inland saline lakes tends to be alkaline, up to 11 units. Kubly and Cole (1979) measured pH values greater than 8.5 (the upper limit of the Lahontan

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Basin Plan's regionwide water quality objective) in 31 of 38 California playa lakes sampled.

Organisms of inland saline waters must be adapted to extreme conditions and often to wide, unpredictable temporal variations in those conditions. Adaptations include combinations of life cycle stages resistant to drying, life cycles responsive to key environmental stimuli, high tolerance for changes in osmotic concentrations, physiological regulation of internal fluids, and the ability to "escape" in space and time by migrating or entering "resting" life stages.

Aquatic organisms in inland saline lakes can tolerate very high levels of salinity. Halobacteria can grow in near saturated concentrations of salt. Other salt tolerance levels (expressed as mg/L TDS, from the Water Board staff literature review) include diatoms from Lower Panamint Lake, 130,000 mg/L; *Dunaliella* (a green alga), 200,000 mg/L; fairy shrimp (*Branchinecta),* 40,000 mg/L; and *Trichocorixa* (an insect), 80,000 mg/L.

Saline lakes can support large numbers of individuals of a relatively few aquatic invertebrate species. Kubly and Cole (1979) collected limnologic data from ephemeral lakes and/or associated marsh pools at 24 playas in California and cultured playa sediments in the laboratory. They found a "total of 84 aquatic or semiaquatic invertebrate taxa, including four major groups: rotifers, crustaceans, insects and snails." (The snails were felt to be transient and carried by floodwaters from streams.) Sediments from 10 playa lakes supported 43 diatom taxa in 20 genera, and three genera of blue-green algae. Kubly and Cole noted that insect species using playa lakes during wet periods take refuge in nearby marsh pools during dry periods.

"Cryptobiotic crusts," including algae and other microorganisms, form on playa surfaces following drying, and are very important to aquatic organisms. Kubly and Cole (1979) concluded that even the driest appearing playa crusts contain some water. Crusts from dry type playas with greater than 50 percent clay-sized particles held up to 5 percent water, and wet crusts as much as 32 percent. Therefore, the resting stages of aquatic invertebrates and microorganisms may not face total dryness. Desert shrimp eggs remain viable just below the surface, usually in the top 5 to 10 millimeters of surface crusts, for at least several decades, but hatch and complete their life cycles quickly after inundation (Brostoff et. al, 2001). *Branchinecta mackini* can complete a generation within a week.

The available water quality data for Rosamond Dry Lake are from samples collected at Station RS5 by LACSD No.14 (Tables 4 and 7 through 13, above) and samples collected elsewhere in the lake by the Branchiopod Research Group (CDM, 2003), summarized in Table 14. The differences between the Table 14 data for "salinity" and "TDS" at the same stations on Rosamond Dry Lake probably reflect the volatilization of certain constituents during analysis, as noted above. The salinity units "ppt" or "parts per thousand" equal "grams per liter"; and the reported salinity values in Table 14 can be converted to a range of 0 to 14,000 mg/L. This is relatively low compared to the salinity of some other playa lakes in the Lahontan Region (e.g., Deep Springs Lake, a moist playa east of the Owens Valley, has recorded salinities of 82,400 to 200,000 mg/L TDS). Table 14 shows spatial and temporal variability in salinity and other environmental factors such as dissolved oxygen.

The Branchiopod Research Group study of Rosamond Dry Lake and other ephemeral waters on EAFB (summarized in CDM, 2003) found four species of eubranchiopod crustaceans, the tadpole shrimp *Lepidurus lemmoni*, and the fairy shrimp *Branchinecta mackini*, *B. gigas*, and *B. lindahli* in pools on the lake. Some of the shrimp were observed at pH levels exceeding 10.0 and temperatures exceeding 30° C (86 ° F). *B. gigas* was observed at an alkalinity of 2120 mg/L, much higher than that previously recorded in the literature.

LACSD No. 14's ambient water quality monitoring data for Station RS5 (summarized in Tables 4 and 7 through 14) are the only basis for assessment of the impacts of historical wastewater discharges on the natural aquatic habitat of Rosamond Dry Lake. There are no specific Lahontan Basin Plan water quality objectives or numeric federal or state criteria for protection of inland saline water habitat. Federal saltwater aquatic life criteria are based on studies of marine and estuarine organisms and may not be appropriate for inland saline water organisms. Antidegradation considerations, aimed at protecting the natural range of water quality conditions and all beneficial uses, would apply in Water Board permitting and enforcement activities for discharges to Rosamond Dry Lake.

In general, there are higher concentrations of TDS and constituents such as aluminum, arsenic, chloride, and sulfate at RS5 than at Stations RS2 through RS4 in Piute Ponds; this probably reflects concentration through evaporation. Alkalinity and pH are also higher at RS5. Levels of nitrogen compounds, including ammonia are lower at RS5 than in Piute Ponds, possibly reflecting the treatment processes discussed in connection with the Water Quality Enhancement (WQE) beneficial use below. While desert playa lakes naturally accumulate high concentrations of salts and nutrients such as phosphorus, Rosamond Dry Lake has probably received much higher loading of salts, nutrients, and other constituents such as aluminum from wastewater than it would naturally have received from Amargosa Creek. There are no aquatic biology data for Station RS5, but aquatic organisms are abundant enough to provide food for migratory shorebirds (see the discussion of mudflat habitat in connection with the Wildlife Habitat (WILD) beneficial use, below).

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Table 14. Water Quality Data from Rosamond Dry Lake. Source: CDM, 2003, summarizing data collected by the Branchiopod Research Group. Sites RL, RL2N, and RL3B were dry in May and June 1993. Site RL3B was also dry in March 1993.

Sampling Site	Date	pH (standard units)	Salinity (ppt)[1]	Alkalinity (mg/L)	Total Dissolved Solids (ppm)[2]	Dissolved Oxygen mg/L	Na (mmol/L)[3]	K (mmol/L)	Mg (mmol/L)
RL (East)	3/20/93	8.7	10	1580	59		15.05	2.87	1.7
RL2N (North)	1/25/93	8.7	0	776					
RL2N (North)	3/90/93	8.8	14	1560	73	3.2	18.04	1.32	1.03
RL2N (North)	1/25/93	8.8	5	1340		13	9.29	1.5	0.39
RL2S (South)	3/30/93	8.8	14	1680	57	2.4	14.74	2.83	1.66
RL2S(South)	5/12/93	9.2					41	2.76	1.5
RL2S (South)	6/19/93	9.4	1	2100	163		39.9	0.54	0.07
RL3B (West)	1/25/93	8.6	0	528		11.6	9.16	1.41	1.08

[1] ppt= parts per thousand
[2] ppm = parts per million (equivalent to milligrams per liter)
[3] mmol = millimoles per liter

Conclusion: SAL is an existing use of Rosamond Dry Lake and should be designated in addition to the WARM use, since the salinity of California desert playa lakes varies over time depending on dilution by runoff and concentration by evaporation. Under the "tributary rule" (see Basin Plan page 2-3), unless otherwise specified, the designated beneficial uses automatically apply upstream to tributaries of a given water body. The SAL use is proposed to be excluded from tributaries of Rosamond Dry Lake because of the scarcity of water quality data and the likelihood that surface stream flows, when they occur, will be less than saline.

The SAL use would probably be appropriate for some of the other surface waters within the Antelope HU (e.g., Buckhorn and Rogers Dry Lakes and the small "clay pans" surrounding the larger dry lakes). However, there is insufficient site-specific water quality information to support wider designation of the SAL use at this time.

Wildlife Habitat (WILD)

Definition: "Beneficial uses of waters that support wildlife habitats including, but not limited to, the preservation and enhancement of vegetation and prey species used by wildlife, such as waterfowl."

Current Application: WILD is currently a categorically designated beneficial use for all surface waters of the Antelope HU.

Proposed Application: The WILD use will be designated as a site-specific beneficial use of Amargosa Creek, the Piute Ponds system, and Rosamond Dry Lake, and will remain applicable to all other surface waters within the Antelope HU.

Consequences: There will be no changes in the applicability of water quality objectives as a result of the site-specific use designation.

Discussion: WILD is an existing beneficial use of Amargosa Creek, Piute Ponds and Rosamond Dry Lake, and one of the most important uses of these waters. "Wildlife" should be understood broadly to include both vertebrates, such as birds, and invertebrates such as terrestrial insects.

Amargosa Creek, Piute Ponds, Rosamond Dry Lake, and the associated wetlands and riparian areas, provide feeding, resting, and breeding habitat for hundreds of animal species. Even though Rosamond Dry Lake supports no vegetation, the ephemeral ponds on its surface provide feeding habitat for shorebirds, and the Snowy Plover, a sensitive bird species, nests on playa lakebeds.

ESA (2004) states that the Piute Ponds are not particularly diverse from a vegetative standpoint, but that a combination of their strategic location along the Pacific Flyway, their large size, and the large amount of vegetative forage and cover provide an important resource bank for native and migratory wildlife species. The Pacific Flyway is one of the four major north-to-south migration corridors in North America that migratory birds follow during spring and fall migrations. Piute Ponds is one of eleven sites in California in the U.S. Geological Survey's Western Shorebird Survey (WSS). The WSS shares data with the International Shorebird Survey, and its goals are "to monitor numbers of shorebirds at major stop-over sites, with specific survey areas being chosen to include the most heavily used areas at each state and any areas that are of special interest to local managers" (U.S. Geological Survey, no date).

The Piute Ponds area provides habitat for over 200 species of birds; aquatic birds are represented by grebes, geese, ducks, plovers, sandpipers, gulls and terns. Dryland habitats near the ponds support flycatchers, hummingbirds, thrushes, wood warblers, and sparrows, among others (ESA, 2004). Of the 250 species listed in the EAFB bird checklist, 109 species, or 44 percent, can be considered commonly associated with aquatic habitats (CDM, 2003). ESA (2004) lists a variety of reptiles, birds and mammals associated with upland habitats near Piute Ponds, and CDM (2003) states that large numbers of rodents are present near the ponds, with predators including coyotes, foxes, and badgers in the general area.

Miller and Payne (2000) cited an earlier study of terrestrial invertebrates at EAFB, and noted the especially high richness of terrestrial invertebrate species at sites adjacent to Piute Pond (293 species at one sampling site). Of these species, 35 percent were identified only at Piute Ponds. Miller and Payne stated that:

> *"...permanent ponds, a rare habitat, were associated with high terrestrial species richness and occurrence of possibly endemic species. Factors including availability of water, saltbush shrubs, insect prey of larger predaceous insects, and droppings of vertebrates that drink or feed from ponds probably supported the high terrestrial invertebrate richness."*

There are no specific water quality objectives associated with the WILD beneficial use. Constituents that exceed criteria for human or livestock drinking water may be of concern for wildlife (see the discussions of the MUN and AGR beneficial uses above).

The federal public health report on EAFB (Agency for Toxic Substances and Disease Registry, 2003) mentions a study of 226 bird nests at Piute Ponds in 1999 that found metals and trace elements in avian eggs at concentrations that were not likely to cause impaired reproduction. Organochlorine pesticides and

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PCBs were not found in ducks and avocets sampled in this study. The public health report also mentions water and sediment grab sampling by EAFB at Piute Ponds and Rosamond Dry Lake. Water samples were analyzed for VOCs, SVOCs, pesticides, PCBs, chlorinated herbicides, metals, surfactants, TSS, TDS, fecal coliform, E. coli, and total fecal coliform. All sediment samples were analyzed for VOCs, SVOCs, pesticides and PCBs, chlorinated herbicides and metals. Water samples were within their respective water quality standards or LACSD No. 14 effluent limitations for all contaminants except thallium, whose maximum concentration was 18 ppb. Sediment samples were within health-based guidelines for all parameters. (This study was carried out before the USEPA's promulgation of additional standards for toxic priority pollutants in the California Toxics Rule.) The Agency for Toxic Substances and Disease Registry assessed the risk of human thallium exposure through consumption of waterfowl from Piute Ponds and concluded that eating waterfowl hunted from the ponds would not result in adverse health effects.

Some habitat characteristics of the Piute Ponds and wetlands, and of portions of Rosamond Dry Lake, are likely to change as a result of implementation of LACSD No 14's facilities plan. Although LACSD No. 14 intends to maintain the current wetted acreage of ponds and wetlands under the facilities plan, the volume of effluent discharged to Piute Ponds will decrease. As a result, the depth of the ponds may decrease, and the amount of emergent vegetation may increase. This may be beneficial to waterfowl; ESA (2004) states that they are primarily dabblers needing suitable forage plants at a water depth of 12 inches or less. Wading birds also need shallow water depths, and habitat for these species could increase around the ponds and wetlands.

Water quality in the ponds and wetlands should improve with the use of tertiary effluent. Reduced nutrient loading could affect biological productivity, but given the large amount of nutrients stored in the system from more than 40 years of wastewater disposal, this will probably be a long-term effect.

The most significant habitat impact of LACSD's facilities plan will be on the ephemeral "mudflats" on the Rosamond Dry Lake bed, created by overflows of effluent. Piute Ponds has overflowed from approximately November through June each year since the early 1990s. Estimates of the size of the mudflats range from 100 to 2,000 acres (ESA, 2004) to up to one-quarter of the lake surface (CDM, 2003). Shorebird use of the mudflats for foraging appears to be correlated with the amount of overflow. LACSD adopted the EIR for its facilities plan with findings of overriding consideration regarding the loss of mudflat habitat as a result of the elimination of overflows related to effluent disposal.

When overflows of effluent are ended, ponding on the lakebed will still occur as a result of stormwater flows. ESA (2004) notes the existence of "transitional marshy areas" apparently fed by seepage beneath the C-Dike that will probably

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remain wetted even after the elimination of overflows. In March 2003, the entire lakebed was

> "*...covered with storm water runoff a few feet deep resulting from a storm the previous week. Thousands of ducks and gulls were observed floating on the lake, with a few hundred shorebirds foraging on the lakebed edges. From these observations, it appears that the storm flows that periodically inundate the lakebed create a different type of habitat from the consistent, low volume, nutrient-rich, effluent-induced overflows. The storm water runoff observed on the lakebed in March 2003 was too deep to create the mudflat habitat used for foraging by wading shorebirds* (ESA, 2004)."

Rare, Threatened, or Endangered Species (RARE)

Definition: "Beneficial uses of waters that support habitat necessary for the survival and successful maintenance of plant or animal species established under state and/or federal law as rare, threatened or endangered."

Current Application: The RARE use is not currently a formally designated use of any of the waters of the Antelope HU.

Proposed Application: The Piute Ponds and wetlands are proposed to be designated for the RARE use.

Consequences: The water quality criteria for protection of the RARE use do not differ from those for protection of aquatic life and wildlife uses.

Discussion: The RARE use is an existing use of the Piute Ponds and wetlands, and formal designation of the use is appropriate. Table 15 lists sensitive plant and animal species present in the Piute Ponds area. Six of these species are formally listed as threatened or endangered under state or federal law, and the other species are either protected by different laws and regulations (e.g., state "fully protected" species), or are recognized as needing protection. Two of the 13 bird taxa in California that are on the IUCN (International Union for the Conservation of Nature) "Red List" of sensitive species are found at Piute Ponds. These are the Ferruginous Hawk and the Mountain Plover (Cooper, 2004).

There are other sensitive species in upland habitats in the Lancaster area, including 12 special status plants, and reptiles (Mojave fringe-toed lizard and silver legless lizard) that may occur in sand fields, dune, or other "blowsand" habitats between Rosamond Dry Lake and the LACSD No. 14 treatment plant (ESA, 2004). The desert tortoise (federally listed as threatened) may be present at Piute Ponds but the area is not part of its designated critical habitat. Mammal surveys by EAFB indicate that Mojave ground squirrel (state listed as threatened) is not expected to be present in the area around Piute Ponds.

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Designation of the RARE use would not result in more stringent permit conditions for LACSD No. 14. State and federal regulations for protection of sensitive species will continue to apply whether or not the use is formally designated. When adopting the current Basin Plan, the Water Board made a commitment to the Department of Fish and Game to adopt site-specific objectives for toxic pollutants if necessary to protect rare and endangered species. The currently available information and data on water quality and impacts on toxics on wildlife are insufficient to support a determination that SSOs are needed. The commitment to develop SSOs was made before the promulgation of the California Toxics Rule, and the toxics criteria in that rule probably provide adequate protection based on current scientific knowledge.

Preservation of Biological Habitats of Special Significance (BIOL)

Definition: "Beneficial uses of waters that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, and Areas of Special Biological Significance (ASBS) where the preservation and enhancement of natural resources requires special protection."

Current Application: The BIOL use is not currently a designated beneficial use for any of the surface waters of the Antelope HA.

Proposed Application: The BIOL use would be designated for the Piute Ponds and wetlands.

Consequences: The water quality objectives and criteria for protection of the BIOL use do not differ from those for protection of aquatic life and wildlife uses.

Discussion: The presence of multiple sensitive species in the Antelope HU is discussed in connection with the RARE use above. Portions of the Amargosa Creek watershed and Rosamond Dry Lake have been designated, or are proposed for designation, as special areas in recognition of their ecological importance. Examples of these designations include:

- The Department of Fish and Game (DFG) has designated Piute Ponds as a regionally significant wildlife habitat, and in 1981 it entered into a Memorandum of Agreement with LACSD No. 14 and EAFB that specified conditions for discharge of effluent and other conditions related to maintenance of the ponds.

- Rosamond Dry Lake is part of an existing Los Angeles County "Significant Ecological Area" (SEA). The County has proposed to include Rosamond Dry Lake and Piute Ponds in a larger Antelope Valley SEA. The purpose and consequences of SEA designation are discussed below.

Table 15. Sensitive Species in the Piute Ponds Area. Sources: CDM (2003), ESA (2004), Cooper (2004).

Species	Listing Status[1]	IBA[2]	Comments
Plants			
Lancaster milkvetch, *Astragalus perusi* var.. *laxifolius*	1B		Possibly associated with ponds; prefers areas of high water table in saltbush scrub.
Reptiles			
California horned lizard, *Phrynosoma coronatum frontale*	CSC, SP		
Southwestern pond turtle, *Clemmys marmorata pallida*	CSC, SP		Noted at Piute Ponds by Los Angeles County Department of Regional Planning (2002); federal Category 2 species
Birds			
American White Pelican, *Pelecanus erythrorhynchos*	CSC		
Double-crested Cormorant *Phalacrocorax auritus*	CSC		
Cooper's Hawk, *Accipiter cooperi*	CSC		
Sharp-shinned Hawk, *Accipiter striatus*	CSC		
Golden Eagle, *Aquila chrysaetos*	CSC, SFP		
Ferruginous Hawk, *Buteo regalis*	CSC	Yes	Considered "threatened" or "near threatened" by IUCN
Swainson's Hawk, *Buteo swainsoni*	ST		
Northern Harrier, *Circus cyaneus*	CSC	Yes	
Bald Eagle, *Haliaeetus leucocephalus*	FT, CSC, SE, SFP		(proposed for federal delisting)
Osprey, *Pandion haliaetus*	CSC		
Merlin, *Falco columbarius*	CSC		
Prairie Falcon, *Falco mexicanus*	CSC	Yes	
American Peregrine Falcon, *Falco peregrinus anatum*	SE, SFP		Formerly a federal endangered species
White-tailed Kite, *Elanus leucurus*	SFP		Occurs seasonally at Piute Ponds
Western Snowy Plover, *Charadrius alexandrinus nivosus*	CSC	Yes	Nests at Piute Ponds and on Rosamond Dry Lake.

Species	Listing Status	IBA	Comments
Mountain Plover, *Charadrius montanus*	Proposed FT, CSC		Considered "threatened" or "near threatened" by IUCN
Bank Swallow, *Riparia riparia*	ST		
Black Tern, *Childonias niger*	FSC, CSC		
California Gull, *Larus californicus*	CSC		
Short-eared Owl, *Asio flammeus*	CSC	Yes	
Long-eared Owl, *Asio otus*	CSC	Yes	
Burrowing Owl, *Athene cunicularia hypugea*	FSC, CSC	Yes	Possibly associated with Piute Ponds (CDM 2003).
Vaux's Swift, *Chaetura vauxi*	CSC		
White-faced Ibis, *Plegadis chihi*	ST	Yes	Breeding colonies at Piute Ponds
Willow Flycatcher, *Empidonax traillii*	SE		
California Horned Lark, *Eremophila alpestris actia*	CSC		
Le Conte's Thrasher, *Toxostoma lecontei*	CSC	Yes	
Loggerhead Shrike, *Lanius ludovicianus*	FSC, CSC	Yes	
Tri-colored Blackbird, *Agelaius tricolor*	FSC, CSC	Yes	Breeding colonies at Piute Ponds.
Yellow-headed Blackbird, *Xanthocephalus xanthocephalus*		Yes	Breeds at Piute Ponds
Redhead, *Athya americana*		Yes	Breeds at Piute Ponds
Yellow warbler, *Dendroica petechia brewsteri*	CSC		
Mammals			
American badger, Taxidea taxus	CSC		

[1] Listing Status Codes:
1B- California Native Plant Society listed as rare, threatened or endangered throughout its range
FE- Federally listed as endangered
FT- Federally listed as threatened
FSC- Federal Species of concern
SE- State listed as endangered
ST- State listed as threatened
SP- State protected
SFP- State fully protected
CSC-California Special Concern Species

[2] Species is part of the rationale for Audubon California's identification of Edwards Air Force Base as an Important Bird Area (IBA).

- Audubon California has named Edwards Air Force Base, including Piute Ponds and Rosamond Dry Lake, as an "Important Bird Area" (IBA). The background of the IBA designation is discussed below

Significant Ecological Areas. In comments on the CEQA Notice of Preparation for LACSD No. 14's facilities plan EIR, the Los Angeles County Department of Regional Planning stated:

> *"SEAs are ecologically important or fragile land and water areas that are valuable as plant or animal communities and often important to the preservation of threatened or endangered species. Each SEA includes areas which possess examples of plants and animals that cumulatively represent biological diversity. Preservation of this biological diversity is the main objective of the SEA designation, and connecting important natural habitats plays an important role in maintaining biotic communities. SEAs are neither preserves nor conservation areas, as they do not take away a property owner's right to appropriate land use. They are areas in which the county requires development to be designed around the existing biological resources and their ability to continue to function even after a project is complete."*

The biological resources assessment for the proposed Antelope Valley SEA (Los Angeles County Department of Regional Planning, 2000) includes the following information related to the Piute Ponds and wetlands in its discussions of ecological values and criteria for SEA designation:

- *"Piute Ponds, on the southwestern margin of Rosamond Dry Lake, support freshwater marsh and alkali grassland habitat, providing essential wintering areas and resident habitat for waterfowl, wading birds, marshland birds, and a variety of other vertebrate species."*
- *"...[T]he ponds and other riparian and wetland systems in the northern portion of the SEA support numerous water birds and raptors not resident elsewhere in the County."*
- *"The alkali meadow/marsh, desert freshwater marsh, playa lake and seasonal pool habitats are located within, or are unique to, or best represented within the SEA."*

Important Bird Areas. EAFB, including Piute Ponds and Rosamond Dry Lake, has been identified by Audubon California as an "Important Bird Area" (IBA). IBAs are part of an international program to recognize and work toward protection of "hot spots of bird diversity." The following is a summary of Audubon California's criteria for designating IBAs, with relevant information for Piute Ponds (Cooper, 2004).

- The presence of more than 10 percent of the California population or more than one percent of the global population (either a breeding or wintering population) of one or more sensitive bird taxa.

- The presence of more than nine sensitive species. (Cooper identifies 13 sensitive species within the IBA.)
- The possibility of seeing more than 10,000 birds in a one-day count (12,000 Western Sandpipers were identified in one day.)

- The possibility of seeing more than 5000 waterfowl in a one-day count (7265 Northern Shovelers were identified in one day).

Although the Edwards Air Force Base IBA does not meet the first criterion, the Piute Ponds area supports "some of the only large breeding colonies of White-faced Ibis and Tricolored Blackbird in the Mojave Desert." The area also supports "sizable portions" of the Southern California breeding populations of marsh birds such as Redhead, Gadwall, and Yellowheaded blackbird.

Cooper rates the threat to this IBA as "critical"; his summary of conservation issues for this IBA includes statements that the wetlands receive no formal protection and are seen as a liability in connection with bird strikes with aircraft, and that "changes in water treatment practices could have devastating effects on the waterbird community associated with the wetlands and Rosamond Dry Lake." The latter issue is apparently related to the elimination of overflows of effluent from Piute Ponds, and the consequent loss of mudflat habitat on Rosamond Dry Lake.

Mechanisms for protection of Biological Habitats of Special Significance. The Los Angeles County Department of Regional Planning's (2002) biological resources report for the proposed Antelope Valley SEA states:

> *"While Edwards AFB utilizes portions of the dry lake playas for training and facility siting, the base recognizes the need for responsible stewardship of the sensitive natural resources; Edwards AFB has a proactive resource monitoring and management plan. Development on the Base is largely confined to use corridors, clustered facilities, roadways, and training exercise areas. Few of the roads in the northern portion of the SEA are paved, and development is light and very widely dispersed."*

EAFB's Bird Checklist cites the Air Force Natural Resources Program and states:

> *"... the Air Force has developed a network of dedicated professionals who work in coordination with local, regional and national authorities. Their challenge is to find a balance in requirements for military mission, security and environmental habitat protection. ... This effort requires the cooperation and support of the Air Force and its neighbors. The primary goal is to guarantee the quality of public lands under Air Force stewardship.*
>
> *The Air force supports partnerships with many resource groups: Neotropical Migratory/Bird Conservation, Ducks Unlimited, North American Waterfowl*

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Management Plan, Wetlands Protection and Enhancement and the National Watchable Wildlife program."

Los Angeles County's (2002) proposed management measures for the Antelope Valley SEA include several policies that could directly affect the Piute Ponds and wetlands or indirectly help to improve the quality of stormwater reaching the ponds:

- Review of proposals for ground water extraction to prevent overdrafting of the shallow aquifer supporting the dry lakes and riparian habitat areas
- Requirements for implementation of agricultural best management practices and conformity with legal standards for legal standards for pesticide, herbicide and fertilizer applications
- Review of proposed development in relation to potential impacts on listed species or wetland areas
- Retaining rare communities with adequate buffers to allow for the long-term viability and integrity of plant communities as a whole. (Rare communities include freshwater marsh, alkali marsh, and desert alluvial wash.

In addition, as discussed elsewhere in this staff report, LACSD No. 14 is committed to maintaining the Piute Ponds and wetlands at their current wetted area with tertiary effluent under its facilities plan.

Conclusion: The Piute Ponds and wetlands are important not only as habitat for individual wildlife species, but also as biological communities with statewide and international value because of their position on the Pacific Flyway. Several agencies and organizations have recognized the Piute Ponds and wetlands as ecologically significant and deserving of protection, and protection is being provided by EAFB and LACSD No. 14. Because of these factors the BIOL beneficial use can be considered an existing use, and formal designation is appropriate.

Water Quality Enhancement (WQE)

Definition: "Beneficial uses of waters that support natural enhancement or improvement of water quality in or downstream of a water body, including, but not limited to, erosion control, filtration and purification of naturally occurring water pollutants, streambank stabilization, maintenance of channel integrity, and siltation control."

Current Application: This use currently applies to minor wetlands of the Antelope HU and all of the HAs within this HU.

Proposed Application: The proposed amendments will recognize the wetlands associated with Piute Ponds with a new row in Table 2-1 and a site-specific WQE

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beneficial use designation. The WQE use will continue to apply to other wetlands throughout the Antelope HU and its HAs.

Consequences: There would be no change in the applicability of existing water quality objectives for wetlands as result of the site-specific designation of this use.

Discussion: The WQE use was added to the 1995 Lahontan Basin Plan as a beneficial use for essentially all wetlands of the region. The Basin Plan (page 4.9-11 and Table 4.9-2) suggests methods for determining the functions and values of specific wetlands.

Curry (1993) calls Water Quality Enhancement the primary beneficial use for wetlands worldwide and in the Lahontan Region. His study includes a bibliography with over 1,000 citations that specifically focus on the value of wetlands in maintaining and improving water quality. Curry discusses wetland water quality enhancement functions such as:

- *Sediment capture and deposition.* This function includes removal of sediment-bound contaminants such as phosphorus and metals, and some organic constituents such as pesticides.

- *Nutrient cycling and retention.* This function involves complex mechanisms linked to soils, hydrology and vegetation. It includes capture and sequestration of nutrients through sedimentation, plant uptake, decomposition of litter, retention in the soil, and microbial processes such as denitrification.

- *Metal sequestering.* Organic and clay particles in wetlands surround and attach to metal ions; large metal ions such as lead are trapped and held away from interaction with other water-soluble ions. The roots and other parts of perennial wetland plants also provide long-term storage of metal ions.

- *Salinity reduction.* Playa lakes and shoreline areas of residual water bodies, alkali flats and lowland wetland areas provide a vital water quality function through evaporative surface concentration of salts. Evapotranspiration in desert wetlands removes salts from underlying ground water, and winds then remove salts from dry surface soils. This function helps to maintain lower salinity in both the ground water and the wetlands.

The nutrient removal function of wetlands has become an important consideration in recent years for treatment of municipal and agricultural wastewater, and stormwater. The efficiency of nutrient removal varies with wetland type, wastewater type, local climate and other factors. However, high removal rates have been documented. For example, a pilot-scale wetland system for treatment of dairy wastewater initially achieved 50.5 percent removal of ammonia nitrogen, and the efficiency improved to 93.3 percent following the use of aeration to increase denitrification (Jamieson *et al.*, 2003).

Boundaries cannot easily be drawn between the Piute Ponds and wetlands; they can be expected to vary seasonally with runoff, evaporation, and input of effluent. The wetlands include the ephemeral Ducks Unlimited ponds and the shallow areas in the perennial Piute Ponds with emergent vegetation surrounding deeper open water. When LACSD reduces the volume of effluent discharged to Piute Ponds while maintaining the same wetted acreage, the overall depth of the ponds will likely decrease, and the extent of emergent vegetation may increase. These changes may in turn affect the types and rates of specific wetland water quality enhancement functions.

The available data do not permit quantitative assessment of current and future wetland processes. However, they provide evidence that WQE is an existing use of the Piute Ponds wetlands.

The wetlands associated with the main Piute Ponds are not "constructed wetlands" in the sense that they were specifically designed to provide treatment. However, the differences in ammonia concentrations between Stations RS2 and RS4 and between these stations and Station R5 on the Rosamond Dry Lake bed show that nutrient removal is occurring.

The metals sequestration function may also be important, particularly given the high concentration of aluminum in the ponds. Recent Canadian research (Gallon et al., 2004) on several wetland plants shows that cattail (*Typha latifolia*, a dominant species at Piute Ponds) accumulates aluminum in its roots; the authors concluded that their study results showed that aquatic plants have a potential for phytoremediation of aluminum.

Flood Peak Attenuation/Flood Water Storage (FLD)

Definition: "Beneficial uses of riparian wetlands in flood plain areas and other wetlands that receive natural surface drainage and buffer its passage to receiving waters."

Current Application: This use is currently designated for the "minor wetlands" categories of the Antelope HU and all HAs within the HU.

Proposed Application: This use is proposed to be retained for the "minor wetlands" categories and designated as a site-specific beneficial use for the Piute Ponds wetlands.

Consequences: There will be no changes in applicable water quality objectives as a result of the proposed site-specific use designation.

Discussion: The FLD use should be considered an existing beneficial use of the Piute Ponds wetlands whether or not it is formally designated.

Like the WQE use, the FLD beneficial use was added to the 1995 Basin Plan as a result of Curry's (1993) study of the beneficial uses of wetlands in the Lahontan Region. In addition to providing treatment for constituents of surface runoff, wetlands can physically slow and store runoff, mitigating the effects of flooding. Curry notes that wetlands' slowing of runoff and temporary storage of direct precipitation and runoff serve to reduce the heights of flood peaks in adjacent receiving waters and lengthen the periods of runoff supplied to them. Wetland herbaceous roots play an important role in providing strength to non-cohesive soils associated with sites subject to flooding and sediment capture.

Meyer and Bowers (2002) studied and mapped flood-prone areas on EAFB. Rosamond Dry Lake, the Piute Ponds and wetlands, and the segment of Amargosa Creek within EAFB are mapped as flood-prone area areas. ESA (2004) states that Piute Ponds are within a 100 to 500 year flood zone. Floods generally coincide with winter storms between November and April, with the highest frequency and intensity in December through March. Infrequent thunderstorms in summer and fall also produce flash floods.

Meyer and Bowers (2002) identified three types of flooding at EAFB: flooding associated with channels, shallow flooding, and inundation caused by ponding. They state that arid environments, if undisturbed by human activity, preserve erosional and depositional features for many years. However, a "100 year" storm of 3.38 inches in 1982 did not produce any erosional or depositional evidence of flows greater than 10 cubic feet per second (cfs) in any observed natural channel at EAFB. The most significant surface runoff observed in their study came from disturbed areas on the north side of the base. Flow in recently active channels (active within the last 25 years) was almost exclusively the result of human disturbance of natural flow patterns. Most "sheetflow" or "overland flow" on the base also originates in disturbed areas or comes from alluvial fans originating in the San Gabriel Mountains.

The Basin Plan does not include specific water quality criteria for the FLD use. By reducing the volume of effluent discharged to the Piute Ponds system when its tertiary treatment facilities are complete, LACSD No. 14 will increase the capacity of Piute Ponds to store floodwaters from storm events.

C. Site-Specific Objectives for Ammonia Toxicity

Ammonia is a colorless, gaseous, alkaline compound of hydrogen and nitrogen, and highly soluble in water. It is biologically active, and occurs in most waters as a normal degradation product of nitrogenous organic matter. In natural waters, ammonia is present in two forms, the ammonium ion (NH_4^+), and un-ionized ammonia (NH_3). "Total ammonia" refers to the sum of concentrations of the two forms. In solution, the two forms of ammonia are in chemical equilibrium with each other. At a temperature of 25° C and a pH of 9.24, the concentrations of the two forms will be equal. At a higher pH and/or temperature, more ammonia will be present in the un-ionized form. At lower pH and/or temperature levels, the ammonium ion will be the predominant form of ammonia present (Nevada Division of Environmental Protection, 2002).

Ammonia toxicity. Un-ionized ammonia is the more toxic of the two forms. Because it is a neutral molecule, it can diffuse across biological membranes more readily than the charged ammonia ion. Ammonia is unique among regulated pollutants because it is an endogenously produced toxicant that aquatic organisms have developed various strategies to excrete. Excretion occurs largely through passive diffusion of un-ionized ammonia from the gills. High external un-ionized ammonia concentrations reduce or reverse diffusive gradients and cause the buildup of ammonia in gill tissue and blood. Although it is less toxic, the ammonium ion can still be an important factor because it is generally present in much higher concentrations than un-ionized ammonia (USEPA, 1999).

Acute ammonia toxicity to fish may lead to loss of equilibrium, hyperexcitability, increased breathing, cardiac output and oxygen uptake,and in extreme cases, convulsions, coma and death. At lower concentrations, ammonia may cause reduction in hatching success, reduction in growth rate and morphological development, hormonal dysfunction, and pathological changes in gill, liver, brain and kidney tissues (USEPA, 1986, 1999). The USEPA ammonia criteria have been developed with data from toxicology studies that used survival, growth and reproduction as endpoints.

The data on ammonia toxicity to freshwater phytoplankton and vascular plants are limited, but they indicate that plants are more tolerant to un-ionized ammonia than are invertebrates and fish. Criteria developed for aquatic animals are assumed to be protective of plants (USEPA, 1986).

Factors that have been shown to affect ammonia toxicity include dissolved oxygen concentration, temperature, pH, previous acclimation to ammonia, fluctuating or intermittent exposures, carbon dioxide concentration, salinity, and the presence of other toxicants. The USEPA ammonia criteria emphasize the influence of pH and temperature on toxicity (USEPA, 1986, 1999).

Existing Water Quality Objectives. The Lahontan Basin Plan's current regionwide water quality objectives for ammonia toxicity are found on pages 3-3 and 3-4, and in Tables 3-1 through 3-5. The narrative language includes formulas for computing allowable acute (1 hour) and chronic (4 day) concentrations of both total and un-ionized ammonia, based on ambient water temperature and pH conditions. The tables summarize allowable ammonia concentrations under representative temperature and pH conditions. As indicated in footnotes to the tables, the objectives and tables are based on the USEPA's 1984/85 ammonia criteria as summarized in USEPA, 1986, and on revised tables in a July 30, 1992 memorandum from the USEPA Office of Water.

The narrative objective language includes a typographical error that would be corrected as part of the proposed Basin Plan amendments. In the first equation on Basin Plan page 3-4, the coefficient "0.052" should be replaced with "0.52."

EPA Freshwater Ammonia Criteria. The USEPA's recommended national freshwater aquatic life criteria for ammonia and other constituents are based upon available toxicity data for species with reproducing wild populations in North America. The national aquatic life criteria developed from tests in laboratory water are intended to be protective of aquatic organisms in all surface waters, because they are based on data for many species and because tests are generally conducted in high quality waters.

Most national aquatic life criteria consist of an acute (short-term) toxicity value and a chronic (long-term) toxicity value. Both the acute and chronic toxicity limits have three parts, an average concentration magnitude, an averaging duration, and a return period. The magnitude is expressed as a chemical concentration and is calculated from the toxicity dataset for each chemical. The duration and return periods are default periods established by the USEPA. Duration is the period over which the concentration is averaged. For most toxic chemicals, the duration is usually one hour for the acute criterion and four days for the chronic criterion. The current "return period" for all USEPA aquatic life criteria is one allowable exceedance every three years on the average (California State Water Resources Control Board, 2003).

The three-year exceedance frequency is based on the USEPA's best scientific judgment of the average amount of time it will take an unstressed system to recover from a pollution event in which exposure to ammonia exceeds the criterion. A stressed system, for example one in which several wastewater outfalls occur in a limited area, would be expected to require more time for recovery (USEPA, 1986).

The USEPA revised its freshwater ammonia criteria in 1999. Acute and chronic ammonia criteria were formulated through statistical modeling of data from multiple toxicity tests using assumptions about levels of acceptable risk. For the acute criteria, a five percent maximum acceptable risk level is used; the chronic criteria assume a maximum acceptable 20 percent reduction in survival, growth and/or reproduction. The criteria document notes that the chronic criterion is sufficiently low relative to the acute criterion that it will generally be the determining factor for permit limits. Detailed information on the toxicology data used and the modeling process is provided in the USEPA's 147-page criteria document.

The 1999 criteria development process resulted in four different equations for calculation of ammonia toxicity limits based on pH and/or temperature. There are two equations for acute toxicity, one for circumstances where salmonid fish are present, and one for circumstances where salmonids are absent. ("Salmonid" refers to the fish family including salmon, trout, whitefish and graylings.) The criteria also include two different equations for calculating chronic toxicity limits, one for situations with fish early life stages present, and one for situations with early life stages absent.

The criteria equations applicable to Lower Amargosa Creek and Paiute Ponds are those for situations with "salmonids absent" and "fish early life stages present." As noted in the discussion of the WARM beneficial use above, there are at least three resident fish species in the ponds. These fish are assumed to be reproducing and early life stages are expected to be present during at least part of the year, especially during spring and early summer (CDM, 2003). Salmonids have not been found in the ponds, although trout are maintained in the Apollo Lakes in Lancaster.

The equation for the acute toxicity limit (1-hour limit) for total ammonia (as mg/L N) when salmonids are absent is:

$$\text{Acute Limit} = \frac{0.411}{1+10^{7.204-pH}} + \frac{58.4}{1+10^{pH-7.204}}$$

In this equation, pH is expressed in standard units.

The formula for the chronic toxicity limit (30-day limit) for total ammonia in mg/L N, when fish early life stages are present, is:

$$\text{Chronic Limit} = \left(\frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}}\right) * MIN(2.85,$$

$$1.45 * 10^{0.028*(25-T)})$$

In the equation above, temperature is expressed in degrees Celsius, and "MIN" means that the calculation should use either 2.85 or the number resulting from the second expression, whichever is lower.

The 1999 USEPA ammonia criteria differ from older criteria and the regionwide Basin Plan water quality objectives in several respects:

- The 1999 criteria focus on total ammonia, expressed "as N", rather than on un-ionized ammonia.
- The 1999 acute (one-hour) criteria depend on pH only, rather than on temperature and pH.
- The averaging period for the 1999 chronic criteria is 30 days rather than 4 days. The 1999 criteria include a recommendation that the highest four-day average within the 30-day period should not exceed 2.5 times the chronic criterion.

The USEPA's 1999 criteria are less stringent under some conditions than the older USEPA criteria used in the Lahontan Basin Plan's water quality objectives (California State Water Resources Control Board, 2001). Because of antidegradation concerns related to high quality salmonid habitat in the eastern Sierra Nevada, the 1999 criteria are not being proposed for adoption as regionwide objectives. Additional resources would be required for analysis of the potential impacts of these criteria in other parts of the Lahontan Region

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Proposed Site-Specific Water Quality Objectives (SSOs). The proposed ammonia SSOs for lower Amargosa Creek and the Paiute Ponds and wetlands will be added to Chapter 3 of the Basin Plan. A narrative statement including the acute (1-hour limit) and chronic (30-day limit) equations above will be added under the "Antelope Hydrologic Unit" heading that is now on page 3-11 of the Basin Plan. The SSOs will specify the highest four-day average ammonia concentration within the 30-day period should not exceed 2.5 times the chronic limit. The SSOs will have a "return period" allowance of no more than one exceedance in a three-year period, in conformance with the USEPA's general direction for nationwide aquatic life criteria. The narrative language will include direction from the USEPA criteria document regarding determination of average temperature and pH.

The SSOs will also include new tables of allowable acute and chronic concentrations of total ammonia under a range of temperature and pH conditions. The equations and tables are taken from the USEPA criteria document's tables for situations with salmonid fish (salmon and trout) absent, and fish early life stages present. A map showing the locations of the affected waters will accompany the tables. The new tables and map will be located following the existing Table 3-19 and Figure 3-12 for other waters of the Antelope HU.

The maximum total ammonia concentrations allowed under the proposed SSOs would be higher than those allowed for similar temperature and pH conditions under the current water quality objectives (see Table 16, below). The estimated average ammonia concentration in disinfected tertiary effluent, including ammonia added during the disinfection process is 1 mg/L (Sanitation Districts of Los Angeles County, 2006).

LACSD No. 14's ambient monitoring Station RS2, located 150 feet downstream from the point of discharge into Piute Ponds, is the current compliance point for effluent limitations in the District's waste discharge requirements, and it represents "worst case" conditions for the ponds. Ammonia toxicity is expected to be lower downstream from Station RS2 because of reduced ammonia concentrations due natural processes such as volatilization of ammonia gas, uptake by plants, conversion of ammonia to nitrate by microorganisms, etc., and because the constituents that affect toxicity (hardness, sodium, potassium and calcium) may have higher concentrations due to evaporation. LACSD's 2005 monitoring data (Tables 5 and 6, above) show decreases in ammonia concentrations between stations RS2 and RS4. In the future, the ponds will receive reduced ammonia loading due to tertiary treatment and smaller discharge volumes, and natural processes should continue to reduce ammonia concentrations between Stations RS2 and RS4.

Table 16, below, compares the existing and proposed water quality acute and chronic limits for ammonia in lower Amargosa Creek and the Paiute Ponds and wetlands, under pH and temperature conditions close to the average conditions monitored at Station RS2. The SSOs would be less stringent than the current objectives, but are expected to be protective of the aquatic life in the affected waters. For example, the USEPA's "Genus Mean Acute Values" (at pH = 8) for ammonia for two kinds of fish found in

Paiute Ponds are 51.06 mg N/L for *Gambusia* (mosquitofish) and 32.44 mg N/L for *Ictalurus* (catfish).

Table 16. Ammonia Limits Under Existing and Proposed Water Quality Objectives. Concentrations are total ammonia in milligrams per liter (mg/L) as N; pH is assumed to be 8.0 units and the temperature 15°C.

	Existing Regionwide Objectives[1]	Proposed SSOs
Acute (1-hour) limit	5.7 mg/L	8.40 mg/L
Chronic[2] limit	1.29 mg/L	2.36 mg/L

[1] From Basin Plan Tables 3.1 through 3.4, with conversion of ammonia "as NH3" concentrations to "as N" concentrations. Allowable total ammonia concentrations for the WARM and COLD beneficial uses are the same under the temperature and pH conditions cited above.
[2] The current regionwide objectives specify allowable chronic concentrations as 4-day averages; the 1999 USEPA criteria and the proposed amendments specify 30-day averages, and provide that the highest four-day average in the 30 day period shall not exceed 2.5 times the chronic limit.

6. Implementation

The California Water Code requires Basin Plans to include water quality control measures for the implementation of water quality standards. If approved, the revised beneficial use designations and SSOs for ammonia toxicity will be implemented through the Water Board's existing permitting and enforcement authority. Appropriate revisions will be made in the Board's waste discharge requirements and discharger self-monitoring program for LACSD No 14. The revised standards will also be used, as appropriate, in permits and monitoring programs for other discharges to surface waters of the Antelope HU.

7. Conclusion

This staff report provides evidence that beneficial uses proposed for retention or addition as site specific uses of lower Amargosa Creek, the Piute Ponds and wetlands, and Rosamond Dry Lake are existing uses that must be protected whether or not they are formally designated. This report also provides evidence that uses proposed for removal are not existing uses, and that they are unlikely to be attained in the future due to factors such as restricted public access, poor water quality, and limited water quantity. The proposed site-specific water quality objectives for ammonia toxicity are based on peer reviewed federal criteria. They are scientifically defensible and attainable with LACSD No. 14's planned tertiary treatment technology. Staff's recommendation is for adoption of the proposed amendments.

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