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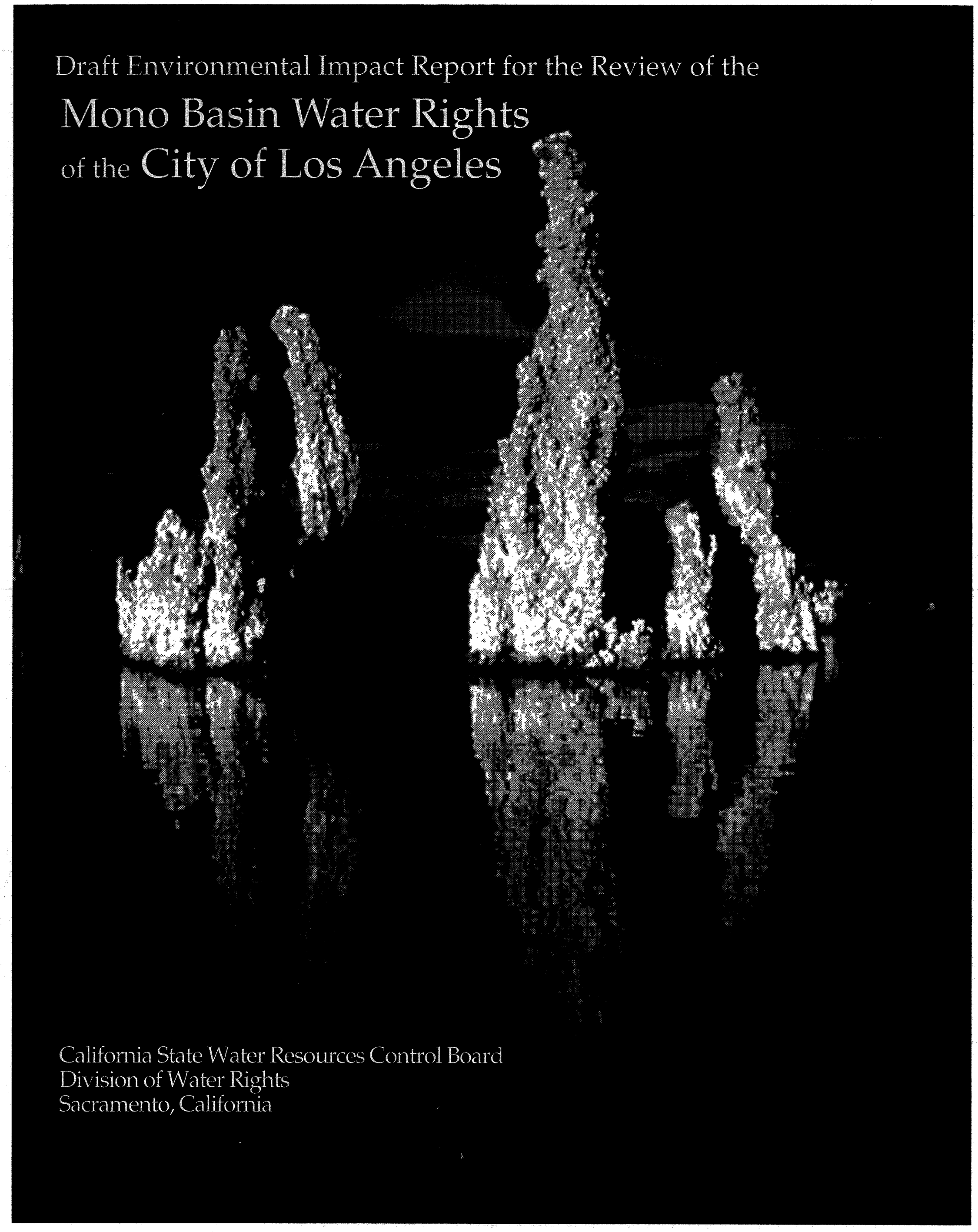


Draft Environmental Impact Report for the Review of the

Mono Basin Water Rights of the City of Los Angeles

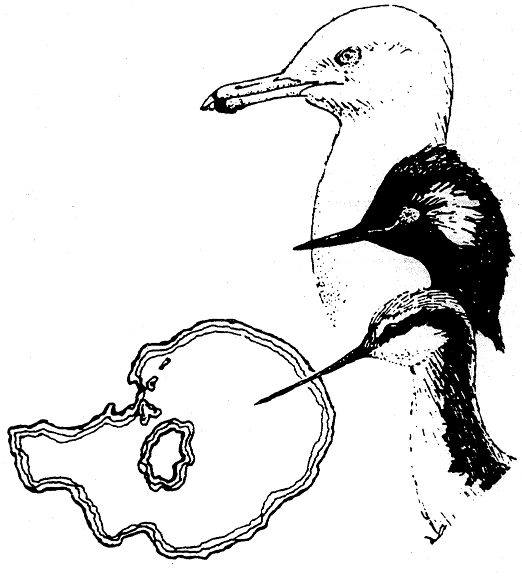
California State Water Resources Control Board
Division of Water Rights
Sacramento, California

Volume 2

MONO BASIN EIR

Prepared by Jones & Stokes Associates
Sacramento, California

Chapter 3F. Environmental Setting, Impacts, and Mitigation Measures - Wildlife



Chapter 3F. Environmental Setting, Impacts, and Mitigation Measures - Wildlife

INTRODUCTION

This chapter describes wildlife resources in Mono Basin and Upper Owens River Basin and the potential effects on these resources that could result from changes in LADWP's water rights to the diverted tributaries of Mono Lake. Although water rights changes could affect streamflows throughout the Owens River system, the potential changes downstream of Lake Crowley reservoir would be insufficient to induce significant changes in wildlife populations.

For the environmental setting, information is presented about the status of wildlife habitats and populations before streamflow diversions, at the 1989 point of reference, and through 1992 when data were available. Although prediversion status is presented first, a more thorough description of these resources is found in the "Environmental Setting" section.

Common and scientific names of all wildlife species mentioned in the text are listed in Appendix B. Technical discussions of long-term population trends and factors affecting the survival and reproductive success of California gulls at Mono Lake are contained in Appendix C. A report on 1991 wildlife use of Mono Basin and Upper Owens River habitats is contained in Appendix D. Appendix E comprises an assessment of special-status wildlife species in Mono Basin and along the Upper Owens River. All of these appendices should be considered as key elements of this assessment.

PREDIVERSION CONDITIONS

This section describes wildlife resources in Mono Basin and along the Upper Owens River in the years preceding the start of stream diversions in 1941.

Sources of Information

Most pre-1900 accounts of the wildlife inhabiting Mono Basin were anecdotal and qualitative, and some accounts were based on secondhand information (Jehl et al. 1988). SWRCB consultants did not conduct detailed reviews of pre-1900 information sources on wildlife of Mono Basin, but instead consulted the summary references, such as Gaines (1981, 1988), Jehl (1988a), Jehl et al. (1984, 1988), and Winkler and Shuford (1988).

In the early 1900s, expert naturalists such as Dixon (1915 and 1916) and Dawson (1923) made detailed wildlife observations in the Mono Lake region. SWRCB consultants reviewed these references and selected field notes from Joseph Grinnell, Tracy Storer, Walter Taylor, and their associates. In addition to reviewing these sources, they reviewed other relevant literature published since 1900 and solicited information about historical wildlife populations from several individuals who resided or worked in the Mono Lake area before 1940, including Don Banta, Kent DeChambeau, Wallis McPherson, and Eldon Vestal (retired from DFG). SWRCB consultants also reviewed the transcripts of court testimony from the Mono Lake hearings (Superior Court of the State of California for the County of El Dorado 1990) and reviewed interviews with long-term Mono Basin residents (Jerry Andrews, Don Banta, Katherine Clover, Jessie Durant, August Hess, Wallis McPherson, and Jack Preston pers. comms.). Unfortunately, few quantitative data are available in these sources that describe the wildlife inhabiting prediversion freshwater wetlands and riparian forests of Mono Basin.

SWRCB consultants also reviewed all prediversion records of special-status wildlife species, plant species, and natural communities contained in the California Department of Fish and Game's (DFG's) Natural Diversity Data Base (NDDB). They also reviewed maps and photographs of Mono Lake and its tributary streams that were made in prediversion times.

General Conditions

Mono Lake is more than 700,000 years old, making it one of the most ancient lakes in North America (Lajoie 1968). It lies in a closed basin and has no natural outlets; through the millennia, its waters fluctuated widely in response to changes in climate and became increasingly saline and alkaline (Lajoie 1968, Stine 1990). This hypersaline lake reached its highest historical elevation of 6,428 feet in 1919. However, when diversions of its primary tributary streams began in 1940, its level had already naturally declined by 11 feet to a surface elevation of 6,417 feet (Vorster 1985, Stine 1990).

At prediversion and early diversion lake elevations (i.e., greater than about 6,402 feet), Mono Lake supported a diversity of ponds, lagoons, and other freshwater and brackish water habitats that were fed by creeks and springs (Chapter 3C, "Vegetation") (Stine pers. comm.). Similarly, dense, continuous stands of riparian forest dominated by cottonwoods and willows grew along the major tributary streams to the lakeshore (Chapter 3C, "Vegetation").

Wildlife on Mono Lake's Islands and Islets

General

Mono Lake has two major islands, Negit and Paoha (Figure 3F-1); both islands have volcanic origins and are quite young geologically (Stine 1987a, 1990). Negit Island, in the northwestern part of the lake, is composed of a series of volcanic flows that formed between about 1,700 and 300 years ago. By 1940, it consisted of about 162 acres of mostly unvegetated, rough volcanic rock. An older platform of explosion debris lying near the center of the island and blanketed by volcanic ash was colonized by a relatively dense shrub cover dominated by greasewood. The island was separated from the mainland by 2.5 miles of deep, open water (Figure 3F-1). Nine small volcanic islets, totaling about 0.7 acre, flanked Negit Island to the north and northeast (Stine 1990a).

Paoha Island, near the center of the lake, is a large mass of lakebed sediment that was uplifted in a single volcanic event about 300 years ago (Stine 1987b). In 1940, the island was 1,236 acres in size lying about two-thirds of a mile southeast of Negit Island and not flanked by any islets.

Both Negit and Paoha Islands offered nesting habitat for California gulls because their isolation provided protection from mainland predators (see "California Gull" below). Other bird species recorded at Negit Island included the peregrine falcon, common poorwill, Say's phoebe, rock wren, violet-green swallow, white-crowned sparrow, Brewer's sparrow, sage sparrow, and house finch (Dixon 1916, Nichols 1938). However, Negit Island's isolation, lack of fresh water, and extremely rocky terrain made it inaccessible and inhospitable to terrestrial species such as small mammals, reptiles, and amphibians.

Compared to Negit Island, Paoha Island offered a greater diversity of wildlife habitats, including a freshwater marsh, greasewood and sage scrub communities, and alkali meadows (Dixon 1916, DeDecker 1975). Heart and Dollar Lakes were located on Paoha Island, and their salty waters provided abundant brine shrimp and a protected feeding area for gulls and other water birds (McPherson pers. comm.). An operating goat farm was located on Paoha Island in the 1920s and 1930s (Dawson 1923, Moore 1991, McPherson pers. comm.), which undoubtedly affected the island's natural vegetation.

During field surveys of Paoha Island, Dixon (1916) observed a variety of bird species, including the California gull, Say's phoebe, violet-green swallow, sage thrasher, orange-crowned warbler, Wilson's warbler, song sparrow, white-crowned sparrow, Brewer's sparrow, and western meadowlark. The freshwater marsh attracted a variety of ducks, shorebirds, and wading birds (McPherson pers. comm.). Because the island was isolated, however, reptiles and amphibians were absent, and bats were the only native mammals to visit it (Harris pers. comm.).

California Gull

California gull populations since 1900 are described in detail in Appendix C, "California Gulls at Mono Lake since 1900: Population Trends, Survivorship, and Reproductive Success". In the discussion of this species to follow here and in the "Environmental Setting" section, the detailed information in the appendix is summarized.

Nineteenth-Century Populations. Jehl et al. (1984, 1988) and Winkler and Shuford (1988) summarized the available historical sources describing Mono Lake's nesting California gulls, including published literature, unpublished field notes, newspaper articles, books on regional human history, and egg collection records in major western museums.

Several 19th-century visitors described "clouds" and "immense swarms" of California gulls nesting at Mono Lake (Winkler and Shuford 1988), but most of these accounts were qualitative and sometimes based on secondhand information (Jehl et al. 1988). Despite the lack of reliable information about the size and distribution of Mono Lake's California gull colony during the 19th century, historical records suggest that the colony was large enough to provide a reliable food source for resident Paiutes in Mono Basin (Winkler and Shuford 1988).

Commercial egg collectors began to exploit the Mono Lake gull colony in the 1860s (Winkler and Shuford 1988), and by the 1880s local newspapers reported a scarcity of gull eggs and suggested that the gulls may have moved their nesting grounds because of disturbance by egg collectors (Shuford and Winkler 1991). The exact effects of egg collecting on the Mono Lake's breeding gulls will never be known; however, it is clear that local settlers relied on this colony as a source of food and thought that it was declining or shifting its nesting grounds in response to egg collecting.

Populations from 1900 to 1940. Jehl et al. (1984, 1988) and Winkler and Shuford (1988) also summarized the available information on Mono Lake's nesting California gulls since 1900 (Appendix C, Table C-1). These authors reviewed most of the same references contained in the incomplete historical record. They disagreed, however, on the reliability and interpretation of historical population estimates, especially the possible inferences regarding changes in the size and distribution of the gull colony in this century (see "Environmental Setting" below).

Despite the few direct counts of the prediversion gull colony, the available observations provide evidence that at least a few thousand nesting gulls were present on Negit Island or Paoha Island before 1940 (Appendix C). Although it is much larger than Negit Island, Paoha Island was used less frequently by nesting gulls during this century because of the intermittent presence of humans, domestic goats, and coyotes (Jehl et al. 1984, McPherson pers. comm.).

Caspian Tern

Nesting Caspian terns at Mono Lake were not mentioned by Dawson (1923) or Grinnell and Storer (1924). The first observations of this species at Mono Lake apparently occurred after LADWP water diversions began (see "Environmental Setting" below).

Birds on Mono Lake's Open Waters

General

In the prediversion period, the open waters of Mono Lake served as an important stopover point for migratory water birds in the western Great Basin. The most abundant species were eared grebes, red-necked phalaropes, Wilson's phalaropes, and many species of ducks, which frequented Mono Lake in summer or fall to feed on its productive aquatic life before continuing their migrations.

Eared Grebe

Historical sources describing the status of eared grebes at Mono Lake were reviewed by Jehl (1988a, 1988b) and are summarized from this and other sources below.

Fisher (1902) reported that he collected both western and horned grebes and believed that the thousands of grebes he observed at Mono Lake belonged to these two species. The horned grebes probably were actually eared grebes (Jehl 1988a), which currently outnumber all other water birds at Mono Lake (Winkler et al. 1977; Jehl 1987a, 1988a, 1988b).

Dawson (1923) reported that eared grebes "breed abundantly at Mono Lake, and commonly east and north of the Sierra at various locations". Grinnell and Storer (1924) also noted that eared grebes were common at Mono Lake in summer and fall but concluded that most birds were probably migrants and transients attracted by the abundant supplies of brine shrimp and alkali flies. They observed no evidence of nesting at Mono Lake and suggested that its shoreline did not provide attractive breeding habitat. Nichols (1938) reported hundreds of eared grebes around Paoha Island but none around Negit Island.

Apparently no quantitative counts were made of eared grebes at Mono Lake in prediversion times. Qualitative estimates from pre-1940 observers, however, leave little doubt that thousands of eared grebes visited the lake in fall (Jehl 1988b). One prediversion resident (McPherson pers. comm.) recalled that "eared grebes were abundant in fall migration, but they were outnumbered by waterfowl".

Red-Necked Phalarope

Fisher (1902) observed "countless hundreds" of southward migrating red-necked phalaropes at Mono Lake in September 1901. Because they were relatively tame, these phalaropes "fall easy prey to pot hunters. The species is locally called 'Mono Lake pigeon'." Grinnell and Storer (1924) stated that this species was numerous during migration, but apparently these observers did not visit Mono Lake in fall.

Wilson's Phalarope

Data on the prediversion status of Wilson's phalaropes at Mono Lake were summarized by Jehl (1988b). Dixon (1916) collected a Wilson's phalarope in breeding condition and observed territorial males in wet meadows near Farrington's Ranch (near Cain Ranch). Grinnell and Storer (1924) described this species as a summer visitor and probable nester in marshy meadows and pond margins of the eastern Sierra Nevada; Grinnell and Storer apparently did not visit Mono Lake in fall to observe the migrant population. Prior to 1940, McPherson (pers. comm.) saw "clouds of phalaropes in late summer and fall", but he apparently did not attempt to distinguish the species.

Wildlife on Lands and Wetlands Surrounding Mono Lake

General

Areas surrounding Mono Lake have always provided a variety of wildlife habitats. Great Basin scrub and alkali dry meadow habitats in upland areas gave way to willow scrub and mixed scrub, alkali wet meadow, and short and tall emergent marsh habitats on approach to the lakeshore. Open, alkali flats were generally absent in 1940. In the prediversion period, more than 260 acres of open water habitat existed around Mono Lake's shoreline, including freshwater ponds at DeChambeau marsh, near Bridgeport-Cottonwood Beach, Black Point, Wilson-Mill Creek delta, Rush Creek delta, and brackish lagoons along the northeastern shoreline near Sulphur Springs. Of particular importance was the use of these habitats by shorebirds and waterfowl.

Shorebirds

Fisher (1902) observed avocets, killdeers, and least sandpipers feeding on the abundance of brine flies at Mono Lake in mid-September 1901; he described the flies as forming a "black zone or band two or three feet wide next to the water all around the lake". In some years, observers recalled seeing thousands of avocets at the lagoons along the northern shoreline (McPherson pers. comm.).

Snowy Plover

Dawson (1923) noted that snowy plovers occur in the interior of California, especially near larger inland bodies of water. However, he and other early visitors such as Dixon (1916) and Grinnell and Storer (1924) did not report nesting snowy plovers at Mono Lake. These observers did not conduct thorough surveys for snowy plovers at the lake and because this species nests on barren, remote areas around the lakeshore, it could easily pass undetected.

Ducks

Observations of Early Ornithologists and Other Visitors. Pre-1900 accounts of water birds at Mono Lake suggested that ducks were numerous. Gaines (1981) reviewed historical newspapers, including an 1852 article that spoke of "wild ducks and gulls, in abundance". Gaines (1981) also referenced an 1865 article by J. Ross Browne who described a hunting expedition as, "nothing short of wholesale slaughter . . . 20 or 30 teal duck at a shot is nothing unusual . . . sportsmen find it a laborious job to carry home their game."

In mid-September 1901, Fisher (1902) observed thousands of ducks at Mono Lake. The dominant species were northern shovelers, mallards, green-winged teals, and redheads. He noted that "when the north winds drive them [the ducks] in large numbers near shore, Indians and some few whites hide behind blinds made of sage brush and mow down the unsuspecting birds in great numbers."

Other early ornithologists such as Dixon (1916), Dawson (1923), and Grinnell and Storer (1924) apparently did not visit Mono Lake in fall and did not report large waterfowl populations. However, long-time residents of Mono Basin recalled that large concentrations of fall-migrating ducks typically visited Mono Lake every year.

Observations of Long-Term Residents. A prediversion resident along Rush Creek remembered duck blinds and many hunters near the mouth of Rush Creek prior to 1940. She stated that "the sky used to go black with huge flocks of ducks. There were so many! They fed in the lake near the mouth of Rush Creek and would rinse off their feathers in the fresh creek water. The ducks would settle in big flocks on the sandbar at the creek mouth." (Clover pers. comm.)

A native Paiute born in 1913 who grew up on land near the mouth of Rush Creek, also reported many ducks using ponds on the delta. Sometimes her grandfather would return home with a gunnysack full of ducks, mostly mallards and teals. Their family made soup from the meat and blankets and pillows from the duck down (Durant pers. comm.).

A resident in Mono Basin since 1901 recalled that there used to be many more ducks at the lake, especially at the creek mouths and in "swamps" around the lakeshore. He remembered hunting for northern shovelers "spoonbills" on windy days when "there were so many ducks along the shore sometimes--that when they'd move out all together like the shore itself was moving out" (Preston pers. comm.).

A resident of the DeChambeau Ranch near Wilson Creek from 1928 until 1939 recalled that many migratory ducks visited Mono Lake every fall, noting that prediversion duck concentrations at the lake were comparable to those he has seen when hunting at Tule Lake NWR, when more than 1 million ducks were counted during aerial censuses by USFWS. He noted that ducks at Mono Lake needed to visit fresh water frequently and that major concentration areas were at the creek deltas and at the many fresh and brackish water ponds around the lakeshore. The crop contents of birds he had shot suggested that northern shovelers foraged primarily on brine shrimp, while other common ducks such as mallards, green-winged teal, American wigeon, and gadwalls consumed mostly alkali flies. (DeChambeau pers. comm.)

A Lee Vining resident since 1933 who hunted ducks at Mono Lake since childhood described large concentrations of ducks at the lake during the 1930s and 1940s that began to arrive in early September and remained until the alkali fly populations declined in late fall. Northern shovelers were the first to arrive (in early September) and were the most abundant species, but a variety of other ducks, including mallards, northern pintails, green-winged teals, and American wigeons, also were numerous at Mono Lake in this period. Ducks typically foraged along the lakeshore, but the most productive hunting areas were at sources of fresh water such as the deltas of Lee Vining and Rush Creeks and at fresh marshes and ponds at Simon's Spring, Warm Springs, and the DeChambeau marsh. In prediversion years, ducks were so numerous at Mono Lake that hunters could easily kill their limit with a single shot. (Banta pers. comm.)

A resident of Paoha Island from 1917 until 1921, who hunted waterfowl and resided in Mono Basin for most of his life, recalled that large numbers of ducks visited Mono Lake prior to 1940. He noted that on windy days lagoons along the northern shoreline near Sulphur Springs attracted flocks of migratory waterfowl seeking protected resting areas away from the high waves of the lake. Ducks often concentrated at the creek deltas and near-shore areas where he watched them forage. Large numbers of ducks also gathered in the lower Rush Creek marshes and ponds where watercress and other aquatic plants were plentiful. In prediversion times, ducks were abundant enough in fall to appear as a dark, moving, 10-foot-wide ring around the lakeshore, stretching from the mouth of Lee Vining Creek to beyond the mouth of Rush Creek. When viewed from a boat, flocks of northern shovelers and other ducks often looked like "large sandbars". This observer described prediversion waterfowling as "more like duck killing than hunting . . . you could get 25 ducks with five shots". He estimated that at least a million waterfowl gathered around the creek deltas, marshes, ponds, and lagoons of Mono Lake at one time during the peak of fall migration. (McPherson pers. comm.).

Reliability of Accounts by Nonscientists. Jehl (pers. comm.) suggested that prediversion estimates of duck numbers at Mono Lake could be inaccurate because they were not conducted by trained observers using systematic census methods. Further, he questioned whether hunters around the lakeshore could correctly identify ducks far out on the lake and he believed that many birds identified as ducks were probably eared grebes instead.

SWRCB consultants contacted three of the early witnesses cited above (Banta, DeChambeau, McPherson) to question them about their observations. All have spent many years observing ducks, grebes, and other water birds at the lake, and all emphasized that ducks are not similar to eared grebes, either physically or behaviorally. These observers, who spent years boating and observing birds at the lake through binoculars, confirmed earlier estimates that at least 1 million ducks, not grebes, regularly stopped at Mono Lake during peak migration prior to 1940.

Conclusion. Bird counts by untrained observers are usually inaccurate, but in the absence of specific census data, qualitative counts have been used to analyze long-term population trends of California gulls (Jehl et al. 1984, 1988; Shuford and Winkler 1991; Winkler and Shuford 1988) and Wilson's phalaropes and eared grebes at Mono Lake (Jehl 1988b). Similarly, prediversion duck counts do not provide precise estimates of their total abundance, but the combined recollections of several experienced observers permit evaluation of their long-term population changes. These observers all agreed that ducks, especially northern shovelers, were extremely abundant in the prediversion period. They also agreed that the lake and its associated freshwater and brackish water wetlands attracted large concentrations of ducks because they provided abundant food, fresh water, and resting habitat. It is concluded, therefore, that Mono Lake was a major stopover point for ducks migrating through the Great Basin prior to 1940.

Geese and Swans

Quantitative data also are lacking for prediversion populations of geese and swans at Mono Lake, but observers in this period reported that these species were far less abundant than ducks (Banta, DeChambeau, and McPherson pers. comms.). Most geese and swans are herbivores (Martin et al. 1951), so they would not be attracted by the abundant invertebrate prey at Mono Lake.

A Paiute descendent recalled that her grandfather frequently hunted for geese along lower Rush Creek during the early 1900s, and her family made pillows and blankets using their down. It requires the down of many birds to make a blanket, suggesting that goose hunting was relatively productive in the Rush Creek bottomlands during this period. (Durant pers. comm.).

Other long-term residents stated that perhaps a few thousand geese visited Mono Basin in fall. Canada geese were the most common species and usually about 200-300 remained for winter. Canada geese would often fly up Rush Creek and graze on the wet meadow vegetation. Occasionally, small flocks also would visit wet pastures on the Cain Ranch, west of U.S. 395. White-fronted geese were regular visitors, but they were never common in Mono Basin. Usually about 15-30 snow geese would appear in early winter and stay for short periods; when present, they were usually found near the county park along the north shore. Often 200-300 tundra swans remained at Mono Lake during the winter months. Similar to most of the ducks, geese and swans visited sources of fresh water while at Mono Lake. (Banta, DeChambeau, and McPherson pers. comms.)

Other Wildlife

No information about other prediversion wildlife in these wetland habitats was found by SWRCB consultants.

Wildlife along Streams Tributary to Mono Lake

General

Perennial streams feeding Mono Lake originate high on the eastern slope of the Sierra Nevada, and the riparian vegetation that developed along these streams provided almost continuous corridors of woodland habitat that stretched from montane conifer forests to within one-quarter mile of the lakeshore (Chapter 3C, "Vegetation"). Riparian conifer forests dominating the streamsides in the higher elevations gave way to conifer-broadleaf forests and cottonwood-willow woodlands at successively lower elevations, the latter having been especially widespread in prediversion times. These riparian forests provided wildlife with a protected corridor to move between upland and lakeshore areas, as well as important resting, foraging, and nesting habitat (Appendix D).

By 1940, this vegetation had been altered from its natural state, reflecting an 80-year history of canal building, flow manipulation, flood irrigation, and grazing, and the consequent alteration of groundwater flow patterns, as described in Chapter 3E, "Vegetation". Springflow giving rise to marsh conditions, such as in the Rush Creek bottomlands, had probably been considerably enhanced locally by irrigation of adjacent lands (Stine 1991).

Accounts of wildlife populations from this period are anecdotal, and apparently no systematic surveys were made of the wildlife inhabiting the riparian corridors of Mono Lake's major tributary streams.

Streams Diverted by LADWP

Rush Creek. In his travels through Mono Basin, Fisher (1902) made incidental observations of wildlife in meadows and willow thickets near the current Cain Ranch. He noted that the willow-lined streams flowing down Bloody Canyon and neighboring areas formed "natural highways" for secretive wildlife moving between montane areas and the lowlands of the eastern slope. They were also, he noted, inviting stopover points for migrating birds through the arid Great Basin. In his surveys of riparian corridors, he observed house wrens, yellow-rumped warblers, MacGillivray's warblers, western tanagers, and white-crowned sparrows (Fisher 1902).

Dixon (1916) and Grinnell (1915) surveyed willow and cottonwood thickets and boggy meadows along lower Rush Creek and observed a diversity of nesting and migratory bird species in this vicinity, including great horned owls, long-eared owls, house wrens, black-headed grosbeaks, Wilson's warblers, MacGillivray's warblers, yellow warblers, common yellowthroats, American robins, warbling vireos, song sparrows, red-winged blackbirds, and willow flycatchers. These are the same species that continue to visit Mono Basin today although long-eared owls, yellow warblers, and willow flycatchers have declined substantially in recent decades (see "Special-Status Species in Mono Basin and Upper Owens River" in the "Environmental Setting" section).

One long-term resident described the land near the mouth of Rush Creek as a "paradise where the vegetation was lush and green and the wildlife was abundant". According to her, it was dominated by aspens, cottonwoods, and Jeffrey pines. Her grandfather hunted for wild game, principally rabbits, deer, ducks, and geese. Mallards and teals were especially abundant in the ponds and marshes of Rush Creek bottomlands. (Durant pers. comm.)

Another resident recalled the presence of large riparian trees, mostly cottonwoods, large flocks of ducks at the mouth of the creek, and abundant waterfowl and other wildlife farther upstream. (Clover pers. comm.)

Other historical observers recalled that dense riparian vegetation in the bottomlands supported abundant wildlife, including ducks, geese, deer, mountain lions, bobcats, and coyotes (Andrews, Hess, and Preston pers. comms.). Many more deer browsing and resting in the sage scrub upland used the creek as a source of water (Andrews pers. comm.).

Lee Vining Creek. Grinnell (1915) and Taylor (1915) surveyed the aspen and conifer forests of upper Lee Vining Creek canyon in September 1915. There they observed northern flickers, American robins, mountain bluebirds, Townsend's solitaires, ruby-crowned kinglets, mountain chickadees, white-breasted nuthatches, red-breasted nuthatches, Steller's jays, Clark's nutcrackers, brown creepers, yellow-rumped warblers, MacGillivray's warblers, pine siskins, lazuli buntings, fox sparrows, song sparrows, white-crowned sparrows, and dark-eyed juncos.

They noted broad stands of lush riparian vegetation along the length of the creek, describing it as a continuous corridor for wildlife species moving between the montane forests and the shores of Mono Lake (Grinnell 1915, Taylor 1915).

Parker and Walker Creeks. A group of 30-50 sage grouse historically used the Parker Creek meadow as a lekking site (Banta pers. comm.).

Site-specific wildlife information on prediversion wildlife of Parker and Walker Creeks is scarce. It is likely, however, that these creeks served as important habitat for resident and migratory wildlife as important components of the Rush Creek corridor. By at least 1940, however, the extent of willow habitats along portions of these creeks had been reduced by sheep grazing. Despite intensive grazing pressure, however, wildlife was abundant along these riparian corridors in prediversion times. (Hess and Andrews pers. comms.)

Other Streams

The status of pre-1940 wildlife resources along streams not diverted by LADWP (i.e., Wilson, Mill, and Post Office Creeks) is undocumented. Inferences about probable wildlife communities can be drawn from vegetation types making up the creek environments; see Chapter 3C, "Vegetation". It is probable that wildlife along these creeks was similar to that along Lee Vining, Parker, and Walker Creeks discussed above.

Wildlife along the Upper Owens River

Apparently, no systematic observations of wildlife along the Upper Owens River were made in prediversion times. Populations of most game species, such as mule deer, ducks, geese, and sage grouse, appear to some to have been more abundant in the prediversion period than they are today (Arcularius pers. comm.).

Livestock grazing was a predominant influence on wildlife habitat conditions in the prediversion period. Then, as today, irrigated meadow was the primary habitat type, accompanied by some areas of riparian willow scrub in the reaches just below East Portal (Chapter 3C, "Vegetation"). The wildlife species dominating these riparian habitats and meadows were undoubtedly those tolerant of the ongoing habitat disturbances that result from livestock grazing.

Special-Status Species in Mono Basin and Upper Owens River Valley

Special-status species are animals that are legally protected under state and federal Endangered Species Acts or other regulations, and species that are considered sufficiently rare by the scientific community to qualify for such listing. These wildlife types fall into the following categories:

- animals listed or proposed for listing as threatened or endangered under the federal Endangered Species Act (50 CFR 17.11 [listed animals] and various notices in the Federal Register [proposed species]);

- animals that are Category 1 or 2 candidates for possible future listing as threatened or endangered under the federal Endangered Species Act (54 Federal Register 554, January 6, 1989);
- animals listed or proposed for listing by the State of California as threatened or endangered under the California Endangered Species Act (14 CCR 670.5);
- animal species of special concern to the California Department of Fish and Game (Remsen 1978, California Department of Fish and Game 1991 [birds] and Williams 1986 [mammals]);
- animals listed as sensitive by the local U.S. Forest Service region (Forest Service Manual 2670) or U.S. Bureau of Land Management resource area.

Thirty-nine special-status species occur or potentially occur in Mono Basin or along Upper Owens River to Lake Crowley reservoir in Long Valley. Thirteen species may have been affected by LADWP diversions, although historical information for most of these species is unavailable. They are:

- Mono brine shrimp (*Artemia monica*),
- American white pelican (*Pelecanus erythrorhynchos*),
- osprey (*Pandion haliaetus*),
- bald eagle (*Haliaeetus leucocephalus*),
- northern harrier (*Circus cyaneus*),
- yellow rail (*Coturnicops noveboracensis*),
- western snowy plover (*Charadrius alexandrius nivosus*)
- California gull (*Larus californicus*),
- long-eared owl (*Asio otus*),
- short-eared owl (*Asio flammeus*),
- willow flycatcher (*Empidonax traillii*),
- California yellow warbler (*Dendroica petechia brewsteri*), and
- Sierra Nevada mountain beaver (*Aplodontia rufa californica*).

Detailed analyses of the prediversion and point-of-reference status of all 39 special-status species are provided in Appendix E, except for three special-status species described elsewhere in this report. The Mono Lake brine shrimp is discussed in Chapter 3E, "Aquatic Productivity". The California gull and snowy plover were described earlier in this chapter.

ENVIRONMENTAL SETTING

This section describes changes in wildlife resources in Mono Basin and along Upper Owens River from 1941 to the present, and identifies the status of those resources at the 1989 point of reference.

Sources of Information

SWRCB consultants reviewed the available literature on wildlife of Mono Basin that has been published since 1900 and contacted many Mono Basin researchers, including Joseph Jehl, Jr., David Shuford, David Winkler, and Margaret Rubega (birds); Robert Crabtree and John Shivik (coyote and gull predator-prey interactions); Gary Page (snowy plovers); Michael Morrison (wildlife of Paoha Island); David Herbst (alkali flies); John Harris (mammals); Scott Stine (geology and vegetation); and Peter Vorster (hydrology). Agency personnel with knowledge of wildlife in Mono Basin were also contacted, including Tina Hargis and Nancy Upham (Inyo National Forest), Ron Thomas (DFG), Terry Russi (BLM), and Brian Tillemans and Randall Orton (LADWP).

Gaines (1988) reviewed the recent status of ducks in Mono Basin, but published accounts of waterfowl at the lake are not available for the early diversion period. Thus, data from 1940 until 1970 were derived from a variety of sources, including unpublished summaries of waterfowl censuses (Dombrowski 1948), transcripts of interviews and conversations with long-term residents of Mono Basin (Andrews, Banta, DeChambeau, Hess, McPherson, Murphy, Vestal, and Taylor pers. comms.), discussions with active field ornithologists in Mono Basin (Jehl, Rubega, Shuford, Strauss, and Winkler pers. comms.), and personnel from LADWP (Tillemans pers. comm.) and DFG (Yparraguirre pers. comm.).

In 1991, SWRCB consultants conducted surveys of island, lakeshore, and streamside habitats in Mono Basin and floodplain habitats on Upper Owens River to determine the current distribution and habitat associations of bird, mammal, reptile, and amphibian species. Survey methods are fully described in Appendix D.

Study design was developed by wildlife biologists of Jones & Stokes Associates of Sacramento. Wildlife surveys of Mono Lake tributary streams, lakeshore areas, and Upper Owens River were conducted by Jones & Stokes Associates and Dr. John Harris of Mills College. Dr. Michael Morrison of the University of California, Berkeley conducted wildlife surveys on Paoha Island and upland sites near Black Point.

SWRCB consultants also reviewed historical and recent maps and aerial photographs of Mono Basin and Upper Owens River and conducted a search of the NDDB to document occurrences of special-status wildlife and sensitive communities in the project area.

General Conditions

Since the diversion of its primary tributary streams began in 1941, Mono Lake's surface elevation has fallen nearly 45 feet (NAS 1987, CORI 1988) and its surface area has been reduced by about 29% (from 55,000 acres to 39,000 acres) (Chapter 3A, "Hydrology"). These changes in the lake's size had important effects on the extent and distribution of islands, wetlands, shallowly submerged hard substrate, riparian communities, and other wildlife habitats (NAS 1987, CORI 1988). During this period, Mono Lake's salinity has almost doubled. Such changes in the lake's salinity affect the abundance and distribution of alkali fly and brine shrimp populations, Mono Lake's dominant invertebrates and the food sources for the lake's bird populations (Chapter 3E, "Aquatic Productivity"). Increased lake salinity probably also affects the character of freshwater and brackish water wetlands around the lake.

Losses of riparian vegetation along the major tributary streams because of stream dewatering and channel incision have been substantial, causing habitat discontinuities and undoubtedly affecting terrestrial wildlife populations (Chapter 3C, "Vegetation").

Approximately 100 species of water birds have been observed at Mono Lake (Gaines 1988). Mono Lake continues to provide important nesting habitat for California gulls and, since diversions began, now provides new or increased nesting habitat for snowy plovers and Caspian terns. Eared grebes, Wilson's phalaropes, and red-necked phalaropes continue to be abundant at the lake during migration, and their numbers may have increased from the prediversion period. Some bird species visit Mono Lake only briefly because they are unable to forage effectively or adapt to the physiological stresses imposed by the lake's highly saline conditions (Jehl 1987a). In contrast, a few species, such as eared grebes, prefer saline habitats and occur abundantly at the lake for extended periods (Jehl 1987a). Increased salinity and loss of freshwater habitats may be factors in the relatively substantial decrease in use of the lake by ducks since the prediversion period.

Wildlife on Mono Lake's Islands and Islets

General

Stream diversion and lowering of Mono Lake's surface resulted in the enlargement of the two major islands in the lake and the exposure and enlargement of many small islets in their vicinity (Figure 3F-1; Table 3F-1). It also resulted in episodes of land-bridging between the mainland and Negit Island and three neighboring islets (Java, Pancake, and Twain). Declines in lake elevations have generally enlarged the availability of terrestrial island habitats, while land-bridging has both enlarged habitat for mainland species, such as coyotes, and diminished the secure nesting habitat of California gulls. Most of the recently exposed island habitats are sparsely vegetated, eroding lakebed sediments and barren, rocky areas (Chapter 3C, "Vegetation"), which, except for gull and tern nesting, have relatively low wildlife habitat value (Appendix D). In addition to gulls, however, the Negit Islets support an expanding black-crowned night-heron colony, which contained 24 active nests on three islets (Twain, Little Tahiti, and Steamboat) in May 1992 (Shuford pers. comm.). Several pairs of Canada geese also nest on the Negit Islets each year (Jehl pers. comm.).

Paoha and Negit Islands generally support fewer wildlife species than the mainland, and no species are unique to the islands within Mono Basin (Morrison 1991). Paoha Island is dominated by a scrub vegetation community and supports emergent, freshwater marsh.

Perhaps because it is near the only source of fresh water on the island, however, this marsh supports more species of birds than can be found at similar, mainland marshes (Appendix D). As many as 46 species of wildlife were observed on the island in 1991, including black-tailed hares, deer mice, montane voles, and coyotes. Fewer species occur on Negit Island because of the predominance of bedrock habitats; deer mice, Nuttall's cottontails, black-tailed hares, and, periodically, coyotes inhabit the island. Amphibian and reptile species have not been located on either island (Morrison 1991, Appendix D).

Changes to Negit Island and the Negit Islets. By the 1989 point of reference (6,376.3 feet) the lake surface had fallen from the 1940 prediversion elevation of 6,417 feet to a 1982 lowstand of 6,372 feet, and then risen to an elevation of 6,381 feet in 1984 because of a period of high precipitation and a lack of diversions. Land-bridging of Negit Island occurred when the lake dropped below 6,376 feet in 1977, and land-bridging of Java, Twain, and Pancake Islets occurred at the lowstand of 6,372 feet in 1982. Since 1986, the lake surface has lowered again, and in 1990 the land bridge to Negit Island was reexposed.

At the 1989 point of reference, Negit Island had enlarged from 162 acres in the prediversion period to approximately 255 acres. To the north-northeast of the island, the number of islets has grown from the nine of prediversion times to a total of 17. The combined acreage of these islets had increased from 0.7 acre to approximately 39 acres. Two islets, Little Tahiti and Twain, each exceeded 10 acres in area. Like Negit Island, these islets are made up of lava (often coated with tufa) with local sand deposits (Stine 1992).

As discussed under "California Gull" below, Negit Island has frequently provided nesting habitat for many California gulls. The emerging islets, especially the larger ones, have also been used by many gulls for nesting. Episodes of mainland-bridging to Negit Island and Twain, Pancake, and Java Islets, however, have resulted in failures in their nesting populations.

Changes to Paoha Island and Emergence of the Paoha Islets. At the 1989 point of reference, Paoha Island had enlarged from 1,236 acres in the prediversion period to approximately 2,030 acres. Much of the enlargement consists of an extensive flat of salt-encrusted lake sediments on the south and west sides of the island. A group of islets began to emerge west of the island during the early 1960s, and by 1989, about 20 islets had emerged. The islets are composed of fine, unconsolidated sediments that slid from the flank of Paoha Island when it was formed 300 years ago. (Stine 1992.)

Unlike the hard rocks that compose Negit Island and the Negit Islets, the soft sediments of the Paoha Islets are easily eroded by waves and longshore currents (Stine 1992). Erosion of the Paoha Islets creates a wave-cut platform, a low-gradient surface that terminates islandward at a cliff and lakeward at the shoreline. A lake surface that is either receding or holding stable against the islet flanks is capable of eroding only a narrow platform (Stine 1992). Low platforms (e.g., less than about 1 foot high) that are exposed to wave action are not suitable gull nesting habitat on the Paoha Islets (Jehl pers. comm.).

During periods of rising lake elevations (transgressions), waves are elevated above existing platforms where they wear back the cliffs and transform the islet flanks into new platforms (Stine 1992). For example, after a lake transgression from 6,372 feet in 1982 to 6,381 feet in 1986, the number of Paoha Islets diminished to half the number exposed at a similar lake elevation in 1974; the total islet area was reduced to about 10.6 acres, representing only about 74% of the 1974 value (Stine 1992).

As discussed in the following section, Paoha Island and its islets also have been used by California gulls for nesting. Paoha Island supported 2,000 nesting gulls as late as 1919. The higher portions of the emerging islets above the zones of active wave erosion have supported many nesting gulls, which favor areas where the substrate is irregular (Jehl pers. comm.).

California Gull

California gulls breed from western and central Canada south through the western United States, including northeastern California. Their wintering range extends from British Columbia along the Pacific Coast south to southern Baja California and the coast of Mexico (American Ornithologists' Union 1983, Jehl pers. comm.). Nesting has been recorded at lakes in northeastern California (Grinnell and Miller 1944) and in south San Francisco Bay (Jones 1986), but the state's largest breeding colony is at Mono Lake (Jehl 1984a, Winkler et al. 1977). In winter, California gulls are abundant and widespread at landfills, reservoirs, agricultural fields, and especially in coastal areas and in the Central Valley (Cogswell 1977).

Status during the Diversion Period. Jehl et al. (1984, 1988) and Winkler and Shuford (1988) summarized the history of the California gull colony at Mono Lake, and most of the information used in this report for the period 1950-1975 is derived from these sources. Most gull population estimates during this period were qualitative and incomplete, and the first attempts to count Mono Lake's entire population were not made until 1976 (Winkler et al. 1977). Gull census data provide historical trends, and data gathered prior to 1976 should not be interpreted as exact counts (Winkler and Shuford 1988). Gull population trends and dynamics during the diversion period are discussed in detail in Appendix C.

Jehl et al. (1984) characterized the gull population at Mono Lake as remaining at a relatively low level of 3,000-5,000 nesting birds from the first surveys in 1916 until the early 1950s. They described a rapid population increase to more than 50,000 nesting birds in 1976 and attributed this rapid growth to the exposure of new islets with declining lake levels, which provided new nesting substrate, together with immigration of birds from other colonies. Winkler and Shuford (1988) questioned the habitat limitation hypothesis and argued that the incomplete data gathered before 1977 were insufficient to draw conclusions regarding the rates or timing of the gull population increase at Mono Lake.

Shuford and Winkler (1991) noted that island acreage was increasing throughout (and after) the period that Negit Island supported its largest nesting colony. In 1976, for example, more than 25,000 gulls (about 75% of the 33,000 nesting adults) on Negit Island nested in habitats (primarily greasewood scrub) that stood above the lake's historical high stand (6,428 feet). Consequently, this nesting acreage was available to nesting gulls before and after lakewide habitat availability increased with falling lake elevations. Similarly, the rapid increases of gulls nesting in greasewood habitats (a more than eight fold change from about 3,000 to 25,000) appeared to be independent of any increases of lakewide nesting habitat availability (Shuford and Winkler 1991).

In 1976, the Negit Islets (total 33 acres) supported about 18,000 nesting gulls at an approximate density of 273 nests per acre (Winkler et al. 1977). In 1986, when the lake's elevation was more than 2 feet higher than that recorded in 1976, the Negit Islets supported 41,000 gulls at an approximate density of 620 nests per acre. These large increases in total population and nesting densities occurred, even though less habitat acreage was available for nesting and the lakewide gull population was relatively stable (Winkler and Shuford 1988).

Although the Paoha Islets first emerged from the lake in the early 1960s (Stine 1992), they were not occupied by nesting gulls until 1979 when the Negit Island population was disrupted by coyotes and other mainland predators crossing the newly formed land bridge (Winkler and Shuford 1988). Thus, evidence from Negit Island, the Negit Islets, and the Paoha Islets suggests that the overall population size of the Mono Lake colony was not limited by habitat availability prior to 1976, when the largest population increases occurred.

Increases in Mono Lake's nesting gull population during 1990 and 1992 (see below) also suggest that nesting habitat was not limiting to the colony at the lake elevations observed during these years. An increase in total population and nesting density occurred with a minimal change in lakewide acreage of suitable nesting habitat in both years (Stine pers. comm.). Gull densities were higher on virtually all the key nesting islets in 1990 and in 1992, suggesting that habitat had not been previously saturated at a local level (Shuford and Winkler 1991, Shuford pers. comm.).

Throughout their range, California gull populations have more than doubled during the last 50 years and have apparently benefited from increased food supplies (e.g., landfills) and habitat (e.g., reservoirs and sewage lagoons) that enhance their winter survival (Conover 1983; Jehl 1991, Court Testimony, Vol. XII, pp. 44-52). Perhaps the increase in Mono Lake's nesting gull population is part of a phenomenon occurring throughout the species' range.

Status at Point of Reference. As described in Appendix C, the total of 44,000 breeding gulls at Mono Lake in 1989 was similar to estimated totals for the previous 6 years, which varied between about 44,000 and 49,000 adult birds. Two of the ensuing 3 years provided the highest counts ever recorded, when about 61,500 and 65,000 were observed in 1990 and 1992, respectively. Similarly, gull reproductive success was the highest ever recorded in these 2 years.

The present status of gull nesting at Mono Lake is a complex interplay between several factors. Winkler (1987) described six factors that could potentially have major effects on the breeding productivity of gulls at Mono Lake, including predation, weather, parasites, food supply, nesting density, and habitat quality. The relationship of these factors to gull breeding productivity at Mono Lake in recent years is discussed in detail in Appendix C.

Despite more than a decade of research, the exact causes of year-to-year variations in gull nesting success at Mono Lake are not well understood (Shuford, Winkler, and Jehl pers. comms.). The relatively clear historical events occurred in a few years at low lake levels when coyotes crossed the newly created land bridge and caused abandonment of the colonies on Negit Island in 1979, on Twain and Java Islets in 1982, and on Pancake Islet in 1990. Nest disruption by coyotes also was observed on Java Islet in 1992. The interacting effects of predation, heat stress, food shortages, and parasites may have also reduced gull reproductive success in other years, such as 1981 and 1984 (Appendix C).

At the point-of-reference lake level (6,376.3 feet), the expanse and depth of water covering the land bridge to Negit Island may not be sufficient to prevent crossings by coyotes. Thus, the point-of-reference lake level may be considered a threshold at which, and certainly below which, coyote predation renders most of Negit Island unsuitable for successful gull reproduction.

The maintenance of Negit as an island does not appear to be crucial to the successful nesting of the Mono Lake gull population, which has adapted to this condition by shifting colonies to the islets near both Negit and Paoha Islands. Negit Island, however, may have long-term benefits to nesting gulls because it offers the largest acreage of potential nesting habitat if the colony expands in the future (Shuford and Winkler pers. comms.) Paoha Island has not supported successful nesting by gulls since the late 1920s or early 1930s, possibly due to resident coyote populations. Future nesting on Paoha Island appears to be unlikely unless the coyotes are removed. However, even when the island was free of land predators, it never supported more than about 2,000 nesting gulls (Appendix C).

In years when the lake level has been high enough to prevent predator intrusions through shallow waters or over land bridges to Twain and Java Islets, these islets have provided about one-third of the total gull nesting habitat and one-half of the lakewide gull nesting population (Dierks and Shuford 1992). Land-bridging of these islets during the 1982 nesting season, however, caused major disruption of gull nesting.

If Twain and Java Islets were again land-bridged (at approximately 6,373 feet) prior to establishment of nesting colonies, it is possible that as many as 32,000 adults nesting there might shift to other Negit and Paoha Islets because their nesting habitat would be reduced and the already densely populated islets may not be large enough to accommodate thousands of new gulls. Alternatively, the overall population at the lake could begin to diminish. Assessment of these possibilities would require an evaluation of apparent suitable islet nesting habitat at appropriate lake levels, which should account for wave erosion effects on the softer substrates of the Paoha Islets. If Negit Island and Twain and Java Islets were land-bridged for long periods, it is possible that Mono Lake's California gull population would be reduced by 30 to 50% (Jehl 1991; Court Testimony, Vol. XII, pp. 128-131; Shuford 1991a; Court Testimony, Vol. XIV, p. 20).

Importance of Mono Lake. If Mono Lake or certain key nesting areas became unsuitable for gull nesting because of loss of food supplies, safe nesting areas, or any other cause, displaced birds may be unable to relocate; none of the freshwater lakes nearby (i.e., within several hundred miles) appear to have suitable nesting islands or sufficiently abundant invertebrate food to support tens of thousands of new gulls (Dennis M. Power and Associates 1980).

Jehl (pers. comm.) noted that, aside from Great Salt Lake, Lahontan Reservoir and Pyramid Lake (and Honey Lake Wildlife Area and Stillwater National Wildlife Refuge during wet years) have islands and could potentially support many nesting gulls. However, Mono Lake is the only site for many hundreds of miles that consistently provides superior habitat for tens of thousands of nesting gulls in the form of isolated islands and an abundant invertebrate food supply. The loss or degradation of gull nesting habitat at Mono Lake could cause a long-term decline of this species' breeding population in California.

Caspian Tern

Caspian terns breed at scattered locations throughout North America, including the Pacific and Atlantic coasts and interior regions as far north as northcentral Canada (American Ornithologists' Union 1983). This species also breeds in northern Europe, southern Asia, eastern China, the Persian Gulf, Australia, New Zealand, and along both coasts of Africa (American Ornithologists' Union 1983). Since the beginning of this century, the western North American population has shifted from nesting at numerous freshwater marshes in the interior to nesting primarily in large colonies on human-created habitats along the coast; their populations have increased along the Pacific Coast since 1960 (Gill and Mewaldt 1983). In the interior of California, this species breeds at isolated lakes of the northeastern plateau (Winkler 1982). Caspian terns are fairly common on bays, beaches near river mouths, and salt ponds from April to early October and uncommon or rare the rest of the year (Grinnell and Miller 1944, Cogswell 1977).

Status during the Diversion Period. Caspian terns probably began nesting at Mono Lake in the mid-1960s when falling lake levels exposed suitable nesting habitat at the Negit Islets; this species prefers flat, sandy substrates with good visibility for its nesting substrate (Jehl 1986a). Jurek (1972) observed Caspian terns in his surveys of Mono Lake but provided no details of their nesting status. About 38 adult Caspian terns fledged 6-12 young within the California gull colony on Twain and Pancake Islets in 1976 (Winkler et al. 1977). The terns must have traveled at least 15 miles to Grant Lake reservoir to forage for fish; Mono Lake's lack of fish probably reduces its attractiveness for nesting by other species of fish-eating birds, such as common loons, white pelicans, western grebes, and double-crested cormorants (Winkler et al. 1977). Avoidance of Mono Lake as a breeding area by piscivorous birds cannot be entirely attributed to a lack of fish, however, because large breeding colonies of pelicans and cormorants occupy islands in the Great Salt Lake, where they must commute at least 30 miles to find sources of fish (Winkler et al. 1977, Jehl pers. comm.).

A small Caspian tern colony persisted on Twain Islet until 1981 (Jehl 1986a). In 1982, when coyote predation of nesting gulls on Twain Islet occurred, the Caspian terns moved to the Paoha Islets and nested within the California gull colony on the western end of Gull Islet A; an estimated 14 pairs of adults fledged about three or four young that year (Jehl 1983). In 1983, a similar sized colony was in the same location as the previous year, but the colony fledged only two young. The major cause of nesting failure was predation of eggs and chicks by gulls (Jehl 1983).

In 1984, erosion of the Paoha Islets resulting from rising lake levels caused the nesting colony of Caspian terns to relocate to Browne Islet, the closest remaining Paoha islet (Jehl 1984b). The Caspian tern population declined in 1985 when only two pairs nested unsuccessfully, and no young were produced in 1986 (Jehl 1986a). Three Caspian terns nested on the islets in 1987, but no fledglings survived (Jehl and Stewart 1988). In 1988, an estimated five pairs fledged two young (Jehl 1989).

Status at Point of Reference. The Caspian tern colony consisted of seven nests on Browne Islet in 1991; only one tern fledged that year (Jehl 1991). In 1992, however, 20 adults had 10 nests and fledged two or three young (Jehl pers. comm.). Thus, the numbers of nesting Caspian terns at Mono Lake are highly variable and are probably sustained by immigration rather than local reproduction (Jehl pers. comm.).

Although gull predation appears to be detrimental to the small population of nesting Caspian terns at Mono Lake, this species frequently nests successfully on islands with gull colonies. In most years, aside from extreme droughts, Caspian terns nest on islands with both California and ring-billed gulls at Hartson Reservoir, within the Dakin Unit of the Honey Lake Wildlife Management Area (Shuford pers. comm.). Caspian terns also nest at Bridgeport reservoir (Gaines 1988) and possibly at Lake Crowley reservoir, suggesting that some pairs may have relocated from Mono Lake (Shuford pers. comm.).

Importance of Mono Lake. Nesting Caspian terns are of interest to ornithologists and recreationists at Mono Lake and they add avian diversity to the island gull colonies. Their high nesting densities elsewhere in California and the world, however, indicate that Mono Lake is probably a marginal breeding area for this species. If the Caspian tern colony at Mono Lake increases from its current low densities, however, it could become an important component in their expanding population in the western Great Basin.

Birds on Mono Lake's Open Waters

General

Mono Lake represents a major stopover point for migratory water birds in the Great Basin (Wiens 1988) because of the lake's large size and strategic location and because it promotes abundant food in the form of brine shrimp and alkali flies (Winkler et al. 1977). Winkler et al. (1977) stated that increasing concentrations of dissolved ions in the lake's water as a result of stream diversions may put migratory birds under osmotic stress and prevent them for utilizing their primary food sources. However, Jehl (1987a) reported that gulls, grebes, phalaropes, and other water birds avoid osmotic stress by not ingesting saltwater while foraging and by consuming prey with dilute body fluids. These findings suggest that the abundance and availability of prey, rather than salinity, are the critical factors influencing the use of Mono Lake by most of these species over the range of lake levels observed to date (Jehl 1987a) (see Chapter 3E, "Mono Lake Aquatic Productivity").

Eared grebes are by far the most abundant migratory water birds at Mono Lake, followed by the two phalarope species (Winkler et al. 1977, Dennis Power and Associates 1980, Jehl 1988a, Wiens 1988).

Eared Grebe

Eared grebes are widespread in North America, Eurasia, and Africa (American Ornithologists' Union 1983). In California, they are abundant migrants and breed locally in marshy habitats of the Central Valley, northeastern plateau, and the Great Basin including Lake Crowley reservoir but not Mono Lake (Tillemans pers. comm.). Most eared grebes migrating through the state winter at the Salton Sea and in the Gulf of California (Small 1974, Cogswell 1977).

Status during the Diversion Period. Many thousands of migrant eared grebes visited Mono Lake in the early 1950s and their numbers are thought to have increased noticeably during the early and mid-1960s (Banta, DeChambeau, and McPherson pers. comms.); nesting at Mono Lake has never been recorded (Winkler et al. 1977). During aerial surveys in late August 1973, Jurek (1973) estimated their population density at about 7,100 adults per square mile, or approximately 437,500 birds on the entire lake. Qualitative observations during the mid-1970s suggested that many thousands of eared grebes frequented Mono Lake during fall migration (Small 1974, Cogswell 1977).

Winkler et al. (1977) made the first quantitative surveys of the lake's eared grebe population and estimated their numbers at approximately 707,000 in mid-September 1976. Intensive studies during the next decade indicated that migrant eared grebes at Mono Lake average about 750,000 individuals annually (Winkler and Cooper 1986, Jehl 1988a). This total represents the largest fall staging area in North American population (Jehl pers. comm.). Other Great Basin lakes such as the Great Salt Lake and Lake Abert also support many thousands of migrant eared grebes, but their combined total in 1985 and 1986 was only about one-third of Mono Lake's population (Jehl et al. 1987).

Nonbreeding eared grebes begin to arrive at Mono Lake in mid-June, and the summer flock may contain 25,000 or more birds, mainly subadults or first year nonbreeders (Jehl 1988a). Postbreeding migrant adults typically arrive before the juveniles, and large numbers are present by mid-August (Winkler and Cooper 1986, Jehl 1988a). Juveniles and adults continue to accumulate at Mono Lake at rates of up to 10,000 individuals per day through the early fall, and their numbers peak in September and October (Winkler and Cooper 1986; Jehl 1987a, 1988a).

The lack of quantitative counts before the 1970s precludes any direct comparison of recent eared grebe numbers with historical population estimates. Although recent annual counts vary between about 600,000 and 900,000, peak numbers of eared grebe averaged about 750,000 through the mid-1980s (Jehl 1988a, 1988b).

Status at Point of Reference. Eared grebe populations at Mono Lake at the point of reference (1989) and during 1990 and 1991 were similar to those counted throughout the late 1980s. In fall 1992, peak populations were conservatively estimated at 966,800. (Jehl pers. comm.)

Ecological Requirements at Mono Lake. Postbreeding eared grebes use Mono Lake as a place to molt their plumage and to restore food reserves during migration (Winkler et al. 1977; Jehl 1988a, 1988b). Shortly after arriving at the lake, the adults begin to gain weight and molt their flight feathers (Storer and Jehl 1985). They continue to molt flight feathers and body plumage and are flightless for more than 1 month; during this period, their breast muscles may atrophy to about 50% of their arrival size (Gaunt et al. 1990). Eared grebes accumulate vast quantities of fat from the abundant invertebrate food and more than double their body weights while at Mono Lake (Storer and Jehl 1985; Jehl 1987a, 1988a).

During summer and early fall, eared grebes apparently prefer to forage on alkali flies and tend to congregate at nearshore areas dominated by hard substrate habitats (Winkler et al. 1977, Jehl 1988a). Later in fall, eared grebes forage in open waters far from shore probably because the food supply along the shoreline will not sustain them (Jehl 1988b). Brine shrimp populations increase through late summer and fall and at that time represent more than 90% of the eared grebe's diet; the remainder of its diet is composed of alkali flies and small numbers of terrestrial arthropods (Winkler and Cooper 1986). At the peak of fall migration, eared grebes at Mono Lake may consume more than 60 tons of brine shrimp daily (Jehl 1988a).

While at the lake, eared grebes require no free water and avoid salt intake by consuming prey with dilute body fluids and by minimizing their intake of saltwater while feeding (Mahoney and Jehl 1985). The eared grebe's daily and seasonal distribution at the lake varies with food availability, and shoaled pumice blocks and tufa towers are a favored feeding location because they provide an abundance of alkali fly larvae and pupae (Jehl 1987a, 1988a).

Eared grebes remain at Mono Lake continuously until late fall or early winter when brine shrimp populations collapse (Storer and Jehl 1985, Jehl 1988a); departure of grebes from the lake is probably precipitated by a lack of food (Winkler et al. 1977, Cooper et al. 1984, Winkler and Cooper 1986, Jehl 1988a). Before migrating, they regain flying condition by metabolizing fat reserves and rebuilding their breast muscles (Storer and Jehl 1985, Jehl 1988a).

Based on the findings of Cooper et al. (1984), the NAS (1987) concluded that densities of at least 20,000-25,000 brine shrimp per square meter are required for eared grebes to acquire sufficient food to gain weight. Jehl (1988b, pers. comm.) found that staging grebes in fall can maintain their weight at lakewide densities of about 3,000 shrimp per square meter. More precise calculations are complicated by the effects of patchiness in shrimp populations. In any case, alkali fly and brine shrimp populations were sufficient to meet grebe requirements at the historical low stand in 1982, the point-of-reference, and through 1992 (Jehl pers. comm.).

Factors Affecting Survival at Mono Lake. Numerous beached bird censuses revealed mortalities of no more than 0.5% of the migrant eared grebe population; beached juveniles were observed most frequently, especially in late fall just before migration (Jehl 1981a, 1982a, 1988a, 1988b). In spring 1982, an estimated 1,000 eared grebes were found dead at Mono Lake; the cause of death was not determined (Jehl 1982a, 1988c).

Slightly lower numbers of fall migrant eared grebes were recorded at Mono Lake in 1988 than were in previous years (Jehl and Yochem 1989). More than 1,000 dead eared grebes were found around the lakeshore in summer 1991; external examination of their carcasses did not reveal the cause of this mortality (Jehl, Rubega, and Strauss pers. comms.).

Mortality in other parts of the eared grebes' range (e.g., the unexplained die off of an estimated 150,000 birds at the Salton Sea in spring 1992) could affect the numbers of birds detected at Mono Lake in the next staging period. Knowledge of these major events is necessary for correctly interpreting population trends at Mono Lake (Jehl pers. comm.).

Importance of Mono Lake. Mono Lake is the largest known fall staging area for eared grebes in North America and is important as a large, saline lake with abundant and predictable food resources. With the exception of Great Salt Lake, no other sites in the Great Basin appear able to accommodate hundreds of thousands of grebes through their molting and staging period (Jehl pers. comm., Winkler 1982). The nearest alternative sites that currently support thousands of migrating grebes include Abert Lake, Oregon (more than 300 miles north) and salt ponds at the south end of San Francisco Bay (more than 100 miles west) (Jehl 1988c).

The Salton Sea (more than 300 miles south) is a major wintering and spring staging area for this species and hundreds of thousands of grebes, representing most of the North

American population, occur there from January through March (Jehl pers. comm.). This area has a rich invertebrate fauna, and grebes appear to thrive there in most years (Jehl pers. comm.). However, the Salton Sea annually receives large volumes of agricultural and urban wastewater that undoubtedly expose migratory and nesting water birds to far higher levels of contamination (e.g., organochloride and organophosphate residues and inorganic elements) than they experience at Mono Lake (Audet and Skorupa pers. comms.).

No lakes within hundreds of miles of Mono Lake offer similar values to eared grebes in terms of size, stability, or abundance of invertebrate prey. For this reason, Mono Lake must be considered a critical staging area for hundreds of thousands of migratory eared grebes in western North America.

Red-Necked Phalarope

The breeding range of the red-necked phalarope includes arctic regions worldwide; in North America, their range extends from the high arctic to southeastern Alaska (American Ornithologists' Union 1983). This species migrates annually to wintering grounds on the open seas off the coast of Peru. In California, red-necked phalaropes are common to abundant in spring migration and very abundant in fall migration. This species is especially numerous along coastal areas and, in fall, at saline, interior lakes such as Mono Lake (Small 1974, Cogswell 1977).

Status during the Diversion Period. A lack of census counts before the mid-1970s precludes any direct comparison of recent red-necked phalarope numbers with the prediversion populations.

Studies of this species during 1981 to 1984 suggested that small numbers of red-necked phalaropes visit Mono Lake in spring, and fall migrants begin to return by mid-July (Jehl 1986b). Because they breed at higher latitudes than Wilson's phalaropes, migrating red-necked phalaropes arrive later at Mono Lake. Female red-necked phalaropes usually arrive first, and a rapid population increase in late July results from the arrival of post-breeding males. Juveniles begin to arrive in late July and their numbers peak in early September. Total red-necked phalarope numbers peak at Mono Lake in mid-August when adults are still present and juveniles are still arriving; numbers remain high until mid-September (Jehl 1986b).

Jurek (1973) conducted the first aerial censuses of water birds at Mono Lake in late August 1973 and estimated that 8,680 phalaropes (both species) were present at Mono Lake. Of those, most were sighted near land on the west half of the lake from Hot Springs (DeChambeau ponds) to an area northeast of Panum Crater. Tufa tower habitat east of Black Point and submerged pumice blocks near the Negit Islets were the primary concentration areas where 62% of all phalaropes were counted. Shallowly submerged tufa, pumice, and other hard substrates, especially those within 1 meter of the lake surface, provide optimal habitat for alkali fly larvae and pupae (Herbst 1992), the primary prey of phalaropes at Mono Lake (Rubega 1992).

The first systematic phalarope censuses were made by Winkler et al. (1977), who counted 21,600 red-necked phalaropes at Mono Lake on August 30, 1976, and suggested that their numbers peak in this period. They found the highest phalarope concentrations in open waters of the lake near shallowly submerged tufa and in shallow water near the creek deltas.

It has been estimated that individual red-necked phalaropes may not stay at the lake for more than 1 or 2 weeks (Winkler et al. 1977, Jehl 1986b). Rubega (1992), however, suspects that the birds may remain at the lake longer than was previously supposed, and that the absence of weight gain may result from a less than optimal diet rather than a short stay at the lake. Due to uncertainties about the duration of their stay at the lake, total population estimates are difficult to make (Rubega 1992). Within the limits of sampling error, however, total population estimates ranged between 52,000 and 65,000 from 1981 to 1984, which represents roughly 2-3% of the Western Hemisphere's population (Jehl 1987a). However, only about 30,000 red-necked phalaropes were observed in 1983, an El Nino year characterized by reduced food supplies on the birds' winter range (Jehl 1986b, 1987a).

The spatial distribution of phalaropes at Mono Lake observed by Jurek (1973) continued through the diversion period at least until the lake surface elevation dropped below 6,376 feet in 1977. Above this elevation, phalaropes foraged in large numbers near tufa groves and submerged pumice blocks along the western and northern shoreline of the lake (Jurek 1973, Ford pers. comm.). Thousands of red-necked phalaropes were also observed in the western embayment of the lake during 1983 to 1987, when the lake surface temporarily rose as high as 6,381 feet (Obst pers. comm.).

For the period 1978-1980 when the lake surface elevation first dropped below 6,376 feet, no information about phalarope distribution is apparently available.

During the period of temporary lowstand of the lake near 6,372 feet elevation in 1981 and 1982, a substantial number of birds remained in the western embayment, but a large number were also counted in the eastern half of the lake in all but one census (Jehl 1986b). A comparison of observed bird distributions in 1981 and 1982 (Jehl 1986b) revealed that they were often found along the northern shoreline, but birds were found in many parts of the lake in both years. However, Jehl (pers. comm.) indicated that his observations in these years and several years thereafter showed that distributions were similar throughout the period of lowstand and the temporary highstand. He associated the distributions with patterns of shallowly submerged tufa, although the accessibility of tufa and other hard substrates to alkali fly pupae changes with the lake elevation. The relationship of hard substrate availability to lake level is evaluated in the "Impacts" section of this report.

Other important concentrations of fall-migrating red-necked phalaropes include 242,000 individuals at the Great Salt Lake (Paul 1983), tens of thousands at Lake Abert, Oregon (Jehl 1986b); an apparently undetermined number of migrants also visit the Salton Sea (Garrett and Dunn 1981).

Status at Point of Reference. Because of uncertainty about the turnover rates of red-necked phalaropes at Mono Lake, total annual population estimates are difficult to make.

For this reason, daily census data for peak periods in different years probably provide the best assessment of population changes (Rubega 1992).

Teams of observers conducted intensive, full-lake counts of phalaropes (both species) and eared grebes simultaneously from a boat and from land between August 7 and September 16, 1990 and between July 10 and August 11, 1991. The peak red-necked phalarope count in 1990 was 17,536 on September 16; in 1991 the peak count was 18,000 on August 11. (Rubega 1992.) (Jehl (pers. comm.) reported 45,000 red-necked phalaropes at the lake on September 2, 1992, and as late as September 26, 12,000 individuals remained. These high counts are unprecedented and difficult to interpret in light of census results from any previous years (Jehl pers. comm.).

Jehl's (1986b) data for the years 1981 to 1984 are the most complete and detailed information available for comparison with these recent data. His maximum counts from these years were 10,078 (August 10, 1981), 10,910 (September 2-3, 1982), 8,000 (August 10, 1983), and 12,000 (August 13, 1984). Because Jehl (1986b) and Rubega (1992) used somewhat different census techniques, some variability in their daily census results would be expected.

In recent years as the lake surface elevation has again declined below 6,376 feet, the distribution of red-necked phalaropes and Wilson's phalaropes appears to have changed substantially from distributions observed during the mid- and late-1980s. Rubega (1992) and Jehl (pers. comm.) consistently find that almost the entire migrant populations of both species currently forage and spend most of their time in the northeastern sector of the lake.

A large area of shallowly submerged pumice blocks in the northeast sector of the lake provides favorable habitat for alkali fly reproduction. Recent, intensive surveys of the distribution of alkali fly larvae and pupae at Mono Lake suggest that they typically occur in aggregated patches that often correspond to foam lines and other zones of water circulation convergence in the lake (Herbst 1992). These surveys revealed that the highest alkali fly densities (larvae, pupae, and emerging adults) were at foam lines in the northeastern sector of the lake. Foam lines at the lake are ephemeral, and when present they attract hundreds of foraging phalaropes. The largest numbers of phalaropes, however, forage most consistently in the immediate vicinity of shallowly submerged tufa formations and pumice blocks, as well as in longshore pools (formed by the longshore drift of sand) along the northeastern shoreline (Rubega 1992).

Although the lake currents and submerged hard substrates in the northeastern sector of the lake may provide sufficient prey to sustain current red-necked phalarope populations at Mono Lake, their restricted distribution suggests that they do not currently find the western embayment of the lake to be a suitable foraging habitat.

Ecological Requirements at Mono Lake. Unlike Wilson's phalaropes and eared grebes, red-necked phalaropes do not accumulate great fat stores at this point in their migration, and it follows that they do not use Mono Lake as a staging area prior to undertaking a long, nonstop migration to their wintering grounds (Jehl 1986b). While at the lake, they may visit fresh water to bathe and drink, especially at DeChambeau ponds, springs, and creek deltas (Winkler et al. 1977, Rubega pers. comm.). Thus, while the physiological requirements of this species at Mono Lake have not been determined, laboratory and field studies strongly suggest that fresh water is important to migratory red-necked phalaropes (Rubega pers. comm.).

Factors Affecting Survival at Mono Lake. NAS (1987) noted that existing data were inadequate to characterize the effects on red-necked phalaropes at Mono Lake of changes in prey densities that result from changing lake salinities, but suggested that red-necked phalaropes would eat brine shrimp if alkali fly populations were significantly reduced at Mono Lake.

Recent laboratory studies by Rubega (1992), however, revealed that red-necked phalaropes reject brine shrimp as a food source unless the birds are near their starvation weight. Moreover, phalaropes that were on a diet of only brine shrimp lost weight even though they consumed three times their body weight in brine shrimp over a 12-hour period, while birds that were maintained on diets of alkali fly adults or larvae gained weight. Although the laboratory environment differs greatly from the Mono Lake environment (the captive birds were given unlimited food and expended less energy than free-living birds), the experiments indicated that red-necked phalaropes that are unable to meet their minimal metabolic requirements on alkali flies would most likely abandon Mono Lake as a migratory stopover point before switching to a diet almost entirely of brine shrimp (Rubega 1992).

Lake levels that maximize alkali fly production are of most benefit to red-necked phalaropes. Laboratory experiments demonstrated that this species is strongly affected by changes in prey densities; at current average alkali fly densities, birds feeding in the wild make approximately 1.5 attempts to catch a single prey item as birds in the laboratory (Rubega 1992). Moreover, females do not reach an upper limit of their feeding rate at prey densities many times higher than the current lakewide average (Rubega 1992). Even the maximum local prey densities observed by Herbst (1992) in the northeastern sector of the lake (e.g., 50-100 individuals per cubic meter) are 5-10 times lower than the optimal foraging density of red-necked phalaropes under laboratory conditions (Rubega 1992).

Ongoing analyses of data from field observational studies (Rubega 1992) appear to corroborate the results of the laboratory studies. Mean feeding efficiencies on alkali fly larvae in the laboratory are significantly higher than those in the field, indicating that laboratory-based feeding studies underestimate the negative effects of decreasing prey densities in a field situation (Rubega 1992).

Rubega (1992) also observed that red-necked phalaropes, while foraging at Mono Lake, frequently display territorial behavior near fully or partially submerged tufa blocks where alkali fly larvae and pupae are locally abundant. Because defensive behaviors are energetically expensive, they are sometimes viewed as a sign of a limited or unevenly distributed food resource. Despite what has been described as a superabundance of prey at Mono Lake (NAS 1987), these observations indicate that under current conditions, prey densities do not permit red-necked phalaropes to forage at optimal rates (Rubega 1992).

For this reason, it cannot be assumed that current alkali fly densities at Mono Lake are nonlimiting to red-necked phalaropes.

Importance of Mono Lake. Thousands of red-necked phalaropes migrate across the Great Basin in fall, and Mono Lake is a traditional migratory stopover point that provides abundant food important to the successful completion of their long-distance migratory flights (Winkler et al. 1977, 1982; Rubega 1992).

While at Mono Lake, red-necked phalaropes deposit sufficient fat to power flights of 1,000 miles or more (Winkler et al. 1977); after arriving at the ocean, they probably make a series of short flights rather than one long flight to their wintering grounds (Jehl 1986b). Red-necked phalaropes migrate extensively over the open sea and inland areas of both continents of the Northern Hemisphere (Hayman et al. 1986). Thus, while Mono Lake may be critical to regional populations, it is not essential to the overall survival of this species (Wiens 1988).

Fat reserves acquired at Mono Lake are especially important to regional red-necked phalarope populations because no comparable lakes (in terms of size or aquatic productivity) exist in its vicinity (Winkler 1982). Mono Lake and Great Salt Lake provide the only dependable food supplies and staging areas for red-necked phalaropes migrating through the Great Basin (Winkler 1982). The nearest alternative sites that might accommodate significant numbers of migrating phalaropes are Abert Lake in Oregon, Stillwater National Wildlife Refuge in Nevada, salt ponds at the south end of San Francisco Bay, and the Salton Sea. As discussed under "Eared Grebes", large volumes of agricultural and urban wastewater may expose waterbird populations at the Salton Sea to elevated levels of contamination (Skorupa pers. comm.).

Wilson's Phalarope

The breeding range of the Wilson's phalarope is restricted to North America and extends from British Columbia across the Canadian prairies to Manitoba and south to California (American Ornithologists' Union 1983). In California, this species rarely nests in the Central Valley but is an uncommon breeder in Great Basin marshlands, including Mono Basin (Small 1974, Cogswell 1977, Jehl pers. comm.). Wilson's phalaropes migrate annually to wintering grounds at high latitude saline lakes in southern Bolivia, northern Chile, and Argentina (Jehl 1988a). During migration, they are especially common at interior saline wetlands such as Mono Lake.

Status during the Diversion Period. A lack of counts before the mid-1970s precludes any direct comparison of recent Wilson's phalarope numbers with historical population estimates (Jehl 1988a).

During aerial censuses of Mono Lake in August 1973, Jurek (1973) estimated that 8,680 phalaropes (both species) were present, most of which were near land along the western lakeshore (see "Red-Necked Phalarope" above). Winkler et al. (1977) estimated the Wilson's phalarope population at Mono Lake to be about 93,000 on July 26, 1976 and suggested that their numbers peak in this period.

Adult females begin to arrive at Mono Lake in mid-June and are followed by smaller numbers of adult males in early July. Small numbers of juveniles (2% of the total population) arrive in late July and early August when peak numbers are present at the lake (Jehl 1988a). Most adults have migrated south by mid-August, and the juveniles have departed by early September (Jehl 1988a).

The total number of Wilson's phalaropes at Mono Lake varies annually, and correct estimates of their population there requires information on turnover rates. Jehl (1988a) considered evidence from arrival and departure weights, molt condition, and distributional data from other localities to estimate the Mono Lake flock at 77,950 in 1981 and 65,780 in 1982. Within the limits of censusing accuracy, Jehl (pers. comm.) detected no differences in Wilson's phalarope population size between 1980 and 1986, when the flock was estimated at 50,000-60,000 individuals. After 1986, however, the number of individuals of this species began to decline.

Surveys conducted in the western United States and Canada indicate that the Great Salt Lake supported the highest concentration of Wilson's phalaropes with an estimated 404,000 present in late July 1982 (Paul 1983). About 387,000 Wilson's phalaropes were present at the Great Salt Lake during late July 1986 (Paul and McKay 1989). Other important fall concentration areas for this species include salt lakes in Canada, Montana, Nevada, and South San Francisco Bay (Jehl 1988a, 1988c).

Status at Point of Reference. Rubega (1992) recently made systematic censuses of phalaropes at Mono Lake (see "Red-Necked Phalarope" section). Her data suggest a possible decline of this species from Jehl's (1988a) counts from 1980 to 1986. Rubega's (1992) peak counts included 9,037 on August 10, 1990, and 35,225 on July 18, 1991. During his study, Jehl (1988a) made a maximum peak estimate of 70,000 +/- 10,000, which is approximately twice Rubega's (1992) highest count. Jehl (pers. comm.) noted that Wilson's phalarope numbers in 1992 were very low, and the peak count was 3,400 individuals on August 10. He also reported low counts for this species at the Great Salt Lake, suggesting a possible response to the long-term drought on their prairie breeding grounds.

Jehl (pers. comm.) indicated that the major foraging and roosting areas of Wilson's phalaropes have tended to be on the eastern side of Mono Lake through the 1980s, regardless of lake level. He also noted that some years they are found in the western embayment and substantial variations between years obscure any general trends about phalarope distribution at the lake.

Others, however, observed large phalarope concentrations (e.g., thousands of individuals) in the western embayment of the lake in the mid-1980s when lake elevations were higher (Banta and Obst pers. comms.). Further, Rubega (pers. comm.) reported that both Wilson's and red-necked phalaropes have been consistently in the northeastern sector of the lake since 1989; the lake's elevation fell to about 6,376 feet in that year and exposed large acreages of tufa and pumice blocks (Stine 1992) that were formerly used as hard substrates for the attachment of alkali fly pupae (Herbst et al. 1984). Thus, evidence from the early 1990s suggests that important foraging areas along the western shoreline are currently unavailable to this species.

Ecological Requirements at Mono Lake. Winkler et al. (1977) observed territorial male Wilson's phalaropes at Mono County Park and at Sneaker Flat along the western shoreline during May and June 1976, but they did not confirm that this species nested at Mono Lake. They considered Wilson's phalaropes probable breeders because of the presence of large areas of wet meadow and low marsh nesting habitat and estimated that the species' total nesting population did not exceed 30 pairs. In 1984, Shuford (pers. comm.) observed a Wilson's phalarope nest at Mono Lake County Park, confirming nesting at the lake. Similarly, Jehl (pers. comm.) has confirmed that this species is nesting at Simon's Spring, and he feels that 30 pairs is probably the maximum reasonable estimate.

Migrant Wilson's phalaropes may not require fresh water for drinking; the dilute body fluids of their prey probably supply most of their water needs (Mahoney and Jehl 1985). While at Mono Lake, however, thousands of Wilson's phalaropes have been observed making early morning, evening, and nocturnal visits to County Park, South Tufa Grove, Simon's Spring, Rush Creek, DeChambeau ponds, Gull Bath (at the mouth of Wilson Creek), and other freshwater wetlands to bathe and possibly to drink (Jehl 1987a, 1988a; Rubega, Strauss, and Shuford pers. comms.).

Adult Wilson's phalaropes remain at Mono Lake continuously for 30-40 days to molt and accumulate their fat reserves (Jehl 1988a, 1988b). During this period, they molt their body plumage and most wing and tail feathers, and often double their body weight (Jehl 1988a, 1988b). The rate of molting and fattening is extremely rapid compared to other birds and is made possible by the invertebrate food available at Mono Lake (Jehl 1988a). Juveniles do not attain the great weight characteristic of premigratory adults, and they do not use Mono Lake as a migratory staging area (Jehl 1988a).

Adult females represent about 70% of the lake's population, and they tend to congregate in open water where they forage for brine shrimp and smaller amounts of alkali fly pupae (Jehl 1988a, 1988b). Males forage closer to shore and consume a higher proportion of alkali flies; flies also predominate in the juveniles' diet (Jehl 1988a). Herbst et al. (1984) found that all developmental stages of alkali flies were nutritionally superior to brine shrimp, both in total caloric value and lipid content. During the final 2 weeks of their stay at Mono Lake, however, both males and females forage primarily on brine shrimp because their increased weight makes it difficult to capture agile fly larvae (Jehl 1988b).

Factors Affecting Survival at Mono Lake. The relationship of alkali fly abundance to survival of red-necked phalaropes was discussed in the "Red-Necked Phalarope" section above. Much of this assessment also may apply to Wilson's phalaropes, especially juveniles, which depend substantially on alkali flies for their diet at Mono Lake (Jehl 1987a, Rubega 1992).

Importance of Mono Lake. Mono Lake is one of the world's most important migratory stopover points for Wilson's phalaropes (Winkler 1982, Jehl 1988a), serving as a critical staging area before this species' nonstop, 3,000-mile migratory flight to its wintering grounds (Winkler et al. 1977, Jehl 1988a).

No similar lakes (in terms of size or invertebrate productivity) exist in the vicinity of Mono Lake, which therefore provides one of the few dependable food supplies and staging area for Wilson's phalaropes migrating through the western Great Basin (Jehl 1981b, 1988a; Winkler 1982). The nearest alternative sites in California that might accommodate significant numbers of migrating phalaropes are the contaminated Salton Sea and salt ponds at the south end of San Francisco Bay. Abert Lake, Oregon, is also a dependable migratory stopover point, and it occasionally holds as many or more staging birds as Mono Lake (Jehl pers. comm.). Other alternative sites include Stillwater National Wildlife Refuge (often dry) and evaporation ponds in the Tulare Lake Basin where selenium levels in bird tissues are higher than those recorded at Kesterson National Wildlife Refuge (Skorupa pers. comm.).

Wildlife on Lands and Wetlands Surrounding Mono Lake

General

Substantial populations of migratory shorebirds continue to stop at Mono Lake. Snowy plovers, federal candidates for threatened or endangered status, that were not observed at Mono Lake in prediversion times breed there today. The large populations of migratory waterfowl in the prediversion period, however, are no longer present.

By 1989, stream diversions and the resultant lowering of Mono Lake had exposed approximately 14,560 acres of formerly submerged lakebed (the "relicted" lands). Almost 6,000 acres of this area (Table 3F-2) are covered with an alkaline salt crust (alkali flats) that supports no vegetation and provides extremely low wildlife habitat value except for snowy plovers (Appendix D).

Wetlands proximate to the lake also changed. The lower lake level and tributary stream incision resulted in the drainage of ponds on the deltas; lakeshore marshes, ponds, and the extensive lagoons in the northeastern shoreline area desiccated due to a drop in the water table. Overall, almost 260 acres of open-water habitat around the lakeshore lost during the diversion period were replaced with large expanses of saline wetlands having little open water area (Table 3F-2).

Current lakeshore areas are dominated by alkali flats (about 50% of the current shoreline acreage), dry and alkali meadows, and tall and short emergent marshes (Table 3F-2), which support relatively few wildlife species (Appendix D).

Wetland Habitats

Alkali and Dry Meadows. Alkali and dry meadows currently occupy almost 4,000 acres around the Mono Lake shoreline, representing a 95% increase since the prediversion period (Table 3F-2). Wildlife species in these habitats are relatively few because vertical structure, vegetative diversity, and moisture are lacking. The large acreage of alkali and dry meadow habitats around Mono Lake provides some cover and limited foraging opportunities, but no water. Species that use this habitat include horned larks, violet-green swallows, savannah sparrows, red-winged blackbirds, Brewer's blackbirds, black-tailed hares, Panamint kangaroo rats, deer mice, and coyotes (Appendix D).

Wet meadows (including brackish and freshwater conditions) currently occupy about 50 acres around the lake's shoreline (Table 3F-2). Despite their typically high plant diversity, wet meadows receive limited wildlife use due to their limited extent and lack of open water. Species using wet meadows include killdeer, Wilson's phalaropes, horned larks, violet-green swallows, cliff swallows, song sparrows, red-winged blackbirds, western meadowlarks, Brewer's blackbirds, montane voles, and Great Basin spadefoot toads (Appendix D).

Emergent Marsh. Currently, almost 1,000 acres of short and tall emergent marshes exist around Mono Lake, representing more than 90% increase in these habitats since the prediversion period (Table 3F-2). Most existing emergent marsh habitats at the lake are very dense and typically lack open-water areas that are attractive to waterfowl and other common marsh inhabitants. Short emergent marsh vegetation supports killdeer, American avocets, Wilson's phalaropes, violet-green swallows, savannah sparrows, red-winged blackbirds, yellow-headed blackbirds, and Brewer's blackbirds (Appendix D). Tall emergent marsh vegetation provides important nesting habitat and hiding cover for Virginia rails, yellow-headed blackbirds, and other marsh-nesting birds requiring tall cattails and bulrushes. The relative lack of fresh or brackish open water near the lakeshore, however, limits the accessibility of this habitat to waterfowl, herons, egrets, and other birds that typically frequent tall marsh vegetation in the Great Basin.

Snowy Plover

This species' breeding range extends across much of North America, Eurasia, and portions of South American (American Ornithologists' Union 1983). In North America, it breeds along the Gulf coast and Pacific coast from Washington south to California; in California, it nests commonly along the coast where there are suitable sandy beaches free from human disturbance. Recent statewide surveys revealed that breeding adults, however, were more common at interior locations, such as Mono Lake, Owens Lake, the Salton Sea, and Alkali Lakes in Surprise Valley, rather than along the coast (Page and Stenzel 1981, Page and Bruce 1989). Recent surveys of Western North America suggest about 7,800 breeding adults at interior locations and about 1,900 adults along the coast (Page et al. 1991).

Status during the Diversion Period. Winkler et al. (1977) first recorded nesting snowy plovers at Mono Lake and estimated at least 10 nesting pairs and more than 100 total birds during fall migration. However, this species probably had nested at Mono Lake in previous years and remained undiscovered because it nests in barren and remote portions of the lakeshore (Winkler 1987).

In 1978, statewide censuses for this species revealed 384 individuals at Mono Lake (Page et al. 1979), representing 11% of California's breeding population and the state's second largest concentration of nesting birds (Page and Stenzel 1981). Regional surveys in the late 1980s indicated that the Mono Lake breeding population had declined by 42 individuals since the 1978 surveys (Page and Bruce 1989). This apparent population decline may have resulted from variable census coverage and intensity in different years rather than an actual decline in Mono Lake's snowy plover population (Page and Bruce 1989, Page pers. comm.).

Page et al. (1983) and Winkler (1987) analyzed the adult survival rate and reproductive success of snowy plovers at Mono Lake and determined that large-scale population increases or decreases were not evident during the mid-1980s when the lake's levels fluctuated dramatically. This suggests that potential snowy plover nesting habitat may be superabundant at Mono Lake, because its population did not increase significantly during the late 1980s when the falling lake level exposed large acreages of potential alkali-flat breeding habitat (Page pers. comm.). Conversely, the nesting population did not decrease significantly during 1983 and 1984 when the lake elevation rose by 9 feet and inundated thousands of acres of alkali flats.

The snowy plover population at the historic lakebed of Owens Lake was the state's largest in 1978 (Page and Stenzel 1981, Swarth 1983). However, this population declined by more than 60% during the next decade for unknown reasons (Page and Bruce 1989, Page pers. comm.).

Status at Point of Reference. Mono Lake's snowy plover population has not been censused systematically since 1988 (Page pers. comm.), so its status at the 1989 point of reference cannot be assessed. Page and Bruce (1989), however, found little change in this population in the last decade despite major changes in the amount of potential alkali flat breeding habitat. For this reason, one can assume that the population in 1989 was similar to that reported the previous year by Page and Bruce (1989).

At the point of reference (6,376.3 feet), snowy plovers had almost 10,000 acres of potential nesting habitat on alkali flats (about 6,000 acres) and pumice berms and other barren habitats (Chapter 3C, "Vegetation") around Mono Lake's shoreline. Assuming nesting densities of one pair per 6 hectares (about 14.8 acres; see discussion in the "Factors Affecting Survival at Mono Lake" section below), about 2,516 acres of breeding habitat would be required to support the current nesting population of 340 adults (about 170 pairs). Thus, approximately 6,500 acres or 72% of the potentially suitable habitat at Mono Lake were unoccupied by nesting snowy plovers at the point of reference.

Ecological Requirements at Mono Lake. Snowy plovers nest in alkali flats and sand dune habitats around the eastern half of the lake and a small population also exists along the northwestern shoreline near the county park (Winkler 1987). In most years, snowy plovers nest on pumice berms far from the current lakeshore early in the breeding season (i.e., mid-April to late May) and are more typical on the low, alkali flats in the late season (i.e., early June to mid-July) (Page et al. 1983, Page pers. comm.).

Snowy plovers lay three eggs in pebble-lined scrapes; their nesting season at Mono Lake extends from mid-April to mid-July (Page et al. 1983, Winkler 1987). Clutches located near objects are typically less successful than those laid in the open or beneath objects; those on sand-gravel substrates tend to fail more often than those on open alkali flats (Page et al. 1985). The young leave the nests almost immediately and begin foraging with their parents (Winkler 1987).

Snowy plovers probably forage over large, open areas of alkali flat and dune habitats, but adults and juveniles concentrate most of their feeding in moist areas because such areas typically attract abundant insect prey (Winkler 1987). Swarth (1983) examined densities of the snowy plover's prey, mostly flies and beetles, in five major microhabitats around Mono Lake and determined that the region within 25 meters of the lakeshore and freshwater seeps had the highest abundance of ground-dwelling arthropods. More snowy plovers tended to forage along the shoreline than at seeps, which can be more than 1 mile from their nesting sites (Swarth 1983, Page pers. comm.). Their diet consists primarily of alkali fly adults and larvae and two species of beetles (Swarth 1983).

Access to a water source (either fresh water or saltwater) may be a breeding requirement for snowy plovers, but they may nest hundreds of meters away from water when unobstructed corridors are available for the chicks to walk to the source (Page and Stenzel 1981). Thus, snowy plovers can breed successfully in relatively flat shoreline areas at Mono Lake where the water line may retreat during the nesting season (Page and Stenzel 1981).

Factors Affecting Survival at Mono Lake. During 1978 and 1981, Page et al. (1983) observed the failure of 122 clutches at Mono Lake. The cause of 71 failures could not be determined. The other clutches were lost because of predators (41), humans (one), wind (one), and desertion (eight). The primary predators of snowy plover clutches were California gulls (28), coyotes or domestic dogs (seven), and common ravens (six). Continuing field observations at Mono Lake suggest that gulls prey on snowy plover nests incidentally while scavenging along the shoreline. Coyotes and dogs also are considered incidental predators of snowy plover nests (Page pers. comm.). Ravens, however, are predators that systematically search the alkali flats for nests.

Page et al. (1983) conducted a series of experiments with artificial nests to determine the effects of nest spacing as a defense against predation. Using artificial nests with quail eggs marked to resemble snowy plover eggs, they demonstrated that predators could have an adverse effect on snowy plover reproductive success if nests are placed close together. With high nest densities, gulls and other predators can find nests more easily and reduce their searching time. Based on this work, Page et al. (1983) hypothesized that low nesting densities (approximately one nest per 6 hectares [14.8 acres]) over large areas are an effective defense against gull predation.

The declining water levels of Mono Lake during the past 50 years have exposed large acreages of alkali flats. As a result of increased breeding habitat, snowy plover populations at the lake have probably expanded. Presumably, shallow creeks, seeps, and saline groundwater in lakebed sediments would sustain moist conditions and continue to attract sufficient arthropod prey to sustain nesting snowy plovers.

Importance of Mono Lake. Western snowy plovers are federal candidates (Category 2) for listing as threatened or endangered (56 FR 58804-58836). USFWS has also proposed the coastal population of this subspecies as threatened, under the federal Endangered Species Act of 1973 (57 FR 1443-1449, January 14, 1992). Interior snowy plover populations, such as those breeding at Mono Lake, were not included in this listing proposal because the intermixing of coastal and interior populations has been documented only on a few occasions. Because of the overall declines of this federal candidate species, however, the large population at Mono Lake has regional significance as one of the state's most important breeding concentrations.

Other Shorebirds

Status during the Diversion Period. Repeated shorebird surveys were conducted at the Mono Marina and at the South Boat Ramp between 1971 and 1973 (Jurek 1974). These surveys revealed large numbers of killdeer, western sandpipers, American avocets, Wilson's phalaropes, and red-necked phalaropes, suggesting that Mono Lake is one of the state's most important inland stopover points for migratory shorebirds (Jurek 1974).

Jurek (1973) estimated 4,030 American avocets during aerial surveys of Mono Lake in August; these birds were concentrated along the northwest, south, and east shorelines and exposed lakebed sediments. Winkler et al. (1977) did not document nesting of American avocets at Mono Lake but suggested that this species may have nested on Paoha Island in the mid-1960s, and on the land bridge to Negit Island in the early 1980s (Gaines 1988).

An additional 25 shorebird species were identified at Mono Lake during the 1976 surveys, and nesting was confirmed for snowy plover, killdeer, common snipe, and spotted sandpiper (Winkler et al. 1977). American avocets, Wilson's phalaropes, and probably black-necked stilts also have nested at Mono Lake (Gaines 1988). Large, freshwater mudflats, springs, and seeps along the southeastern shoreline of Mono Lake (i.e., Simon's Spring and its vicinity) were reported to contain the highest quality shorebird habitats, where 19 shorebird species reached peak abundance. A survey of lakes in northeastern California concluded that Mono Lake was of outstanding importance to several species of migratory shorebirds (Winkler 1982).

Status at Point of Reference. The Point Reyes Bird Observatory (PRBO) has sponsored spring and fall shorebird counts at coastal and inland areas of California since

1989 (Shuford pers. comm.). PRBO shorebird counts conducted at Mono Lake in late August of 1989, 1990, and 1991 revealed the presence of 27 shorebird species. Aside from the phalaropes, high counts for the most abundant species included American avocet (8,467), western sandpiper (4,043), least sandpiper (1,408), and killdeer (202). High spring counts of the most abundant species in this 3-year period included semipalmated plover (286), American avocet (1,564), western sandpiper (19,107), and least sandpiper (4,810) (Shuford pers. comm.). Wilson's and red-necked phalaropes were counted during the PRBO surveys, but land-based counts of these species in late August were not considered estimates of their peak populations at Mono Lake (Shuford pers. comm.).

Because of its importance as a migratory stopover point for Wilson's phalaropes and other shorebirds, Mono Lake was designated as part of the Western Hemisphere Shorebird Network in September 1991. As one of only 17 sites in the Western Hemisphere to receive this designation, Mono Lake is considered a shorebird habitat of international importance.

Ducks

Status during the Diversion Period

Populations from 1940 to 1945. According to long-term residents of Mono Basin, early diversions appeared to have had little effect on migratory duck populations at Mono Lake. Major concentrations continued to be present through the 1940s, and ducks were especially abundant at lakeshore ponds, lagoons, and marshes, as well as at the creek deltas where freshwater streamflows floated over the more saline waters of the lake for variable distances (Banta, DeChambeau, and McPherson pers. comms.). In the early 1940s, about 260 acres of open water habitat existed around the lakeshore. The largest areas of open water were a discontinuous chain of brackish lagoons along the northeastern shoreline near Sulphur Springs; the DeChambeau lagoon near Black Point; and ponds near the deltas of Lee Vining, Rush, and Wilson Creeks (Stine 1993).

Creek deltas and ponds offered sources of fresh water for drinking and bathing, and the lagoons provided relatively sheltered areas for foraging and resting away from the frequently turbulent waters of Mono Lake (Banta, DeChambeau, McPherson pers. comms.). During peak fall migration, concentrations of northern shovelers and other ducks in these areas reportedly were so dense that, at a distance, they made the shallow water "look like land" (DeChambeau and McPherson pers. comms.).

A cattail-lined pond on the west side of Lee Vining Creek was an especially good place to hunt during windy conditions when the ducks would leave the lake in search of calmer waters. The pond existed before the diversion of Lee Vining Creek, and it remained until the early 1950s (Banta pers. comm.). Mallards, American wigeons, green-winged teals, and northern pintails were common species at freshwater bodies away from the lakeshore in the early diversion period. Diving ducks such as canvasbacks and redheads frequented deeper ponds near the lake, such as the DeChambeau lagoon (Banta, DeChambeau, and McPherson pers. comms.).

Populations from 1945 to 1949. In the mid-1940s, about 50 acres of artificial ponds were created for a duck club near the mouth of Rush Creek (Stine 1993). These ponds were watered by diversions from Rush Creek, so they probably contained water only intermittently after 1947 when full-scale diversions of the tributary streams began (Stine pers. comm.). As long as water was available, however, these ponds offered excellent duck hunting (Banta, DeChambeau, and McPherson pers. comms.).

The first systematic waterfowl surveys at Mono Lake were performed by DFG biologist Walter Dombrowski[1], who also managed the Rush Creek duck club and acted as a duck hunting guide in Mono Basin. His surveys were part of the Bureau of Sport Fisheries and Wildlife's (now USFWS) Pacific Flyway Waterfowl Investigations (Dombrowski 1948). Apparently, these nationwide counts were done only in 1948 (and not in subsequent years) to assess the need for creating federal wildlife refuges to decrease waterfowl depredation of agricultural crops (Yparraguirre pers. comm.).

The most abundant species reported in Dombrowski's surveys were northern shovelers, and on November 1, 1948, Dombrowski estimated the total number of waterfowl in Mono Basin at 1 million birds, which were mainly concentrated in the Rush Creek delta (45%), Lee Vining Creek delta (10%), DeChambeau lagoon (15%), Warm Springs (5%), Simon's Spring (15%), and South Tufa (5%). Other observers said that Dombrowski's estimate of 1 million ducks was consistent with their recollections of peak fall duck concentrations in the late 1940s (Banta, DeChambeau, McPherson, and Vestal pers. comms.).

Populations from 1950 to 1969. From 1947 through 1951, diversions of Rush, Lee Vining, Parker, and Walker Creeks were increased to the point that these streams had little or no flow below the diversion points. Thereafter, freshwater inflows to the lake at the deltas of Rush and Lee Vining Creeks were reduced to a low level, except during flood periods when runoff surpassed aqueduct capacity. (Stine pers. comm.)

Despite the reduction of freshwater flows in the creeks and the loss of the Rush Creek duck ponds in the late 1940s, large concentrations of ducks continued to be reported at Mono Lake through the 1950s. The largest flocks of ducks and the best hunting were usually at lagoons along the northern and eastern shorelines, the DeChambeau lagoon, and at marshlands of the Rush Creek delta, Warm Springs, and Simon's Spring (Banta, DeChambeau, McPherson, and Vestal pers. comms.). In the mid-1950s, a 1-mile-long, spring-fed pond formed behind a lakeshore berm at Simon's Spring (Stine pers. comm.). This ponded area supported dense beds of watercress and other aquatic plants and attracted large flocks of mallards, American wigeons, green-winged teals, and other ducks (Banta and McPherson pers. comms.).

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[1] Banta, DeChambeau, McPherson, and Vestal (pers. comms.) knew Dombrowski well and reported that he censused ducks at his ponds and at Mono Lake using binoculars and a 20X scope to view distant flocks. These observers emphasized that Dombrowski was an avid waterfowl observer and careful census taker who was able to correctly identify ducks in flight and on the water from great distances. During his six systematic censuses in 1948, he drove around the entire lakeshore and estimated the number of ducks present at major concentration areas. He also estimated duck population numbers from his motor boat while cruising around the lakeshore. Whether using land- or water-based surveys, Dombrowski employed a grid pattern, marked by natural landmarks such as partially submerged tufa towers, to avoid counting the same flocks twice (Vestal pers. comm.).

As the lake's surface elevation dropped during the diversion period, the acreage of marshlands around the lake actually increased, but most of the marshlands that formed were saline or brackish and lacked significant open water areas attractive to waterfowl (Banta, DeChambeau, and McPherson pers. comms.). Existing freshwater ponds were lost by incision of their drainage channels to the lake or, in the case of the delta ponds, by incision of the tributary streams, drop in water table, and lack of flow in recharge ditches (Stine 1993).

The large lagoons along the northeastern shoreline gradually diminished in size with declining lake elevations and disappeared when the lake fell below 6,405 feet in 1957; open water areas at DeChambeau lagoon and at the creek deltas were lost when the lake fell below about 6,400 feet in the early 1960s (Stine 1993). Similarly, in 1967 Rush Creek incised its delta, forcing a drop in the water table and converting former ponds and marshes to arid scrublands (Stine 1993).

Systematic duck census data at Mono Lake are not available from the 1950s or 1960s. DFG-sponsored waterfowl counts in Mono County during these decades were not specific to Mono Lake and were conducted in late January, long after most ducks had departed from Mono Basin (Yparraguirre pers. comm.). Despite the lack of census data, the combined recollections of long-term residents suggested that the loss of open water habitats and sources of fresh water around the lakeshore coincided with the abrupt declines of migratory duck populations at Mono Lake. By the early 1960s, peak duck concentrations were about half their former numbers (i.e., about 500,000); by the end of the decade, so few ducks remained that hunting was sporadic and often unproductive (Banta, DeChambeau, McPherson, and Murphy pers. comms.).

In contrast to the declines of most ducks during the 1960s, ruddy ducks may have become more common during that decade. Long-term residents recalled that, unlike most ducks, ruddy ducks tended to be scattered across the entire lake and did not concentrate at fresh water (Banta, DeChambeau, and McPherson pers. comms.).

Populations from 1970 to 1988. During the 1970s and 1980s, Mono Lake's elevation varied between a high of about 6,386 feet in the early 1970s to its historical lowstand of about 6,372 feet in 1982. Even at the highest lake elevation reached in these decades, however, few areas of protected open-water habitat or sources of fresh water were available for migratory ducks (Stine 1993).

Populations of most migratory ducks declined across North America during the 1970s and 1980s (Caithamer et al. 1992), and populations at Mono Lake reflected this rangewide trend. Censuses conducted at the lake during these decades suggested that no more than a few thousand ducks were present at Mono Lake at one time. For example, during an all-lake census on September 14, 1976, Winkler et al. (1977) observed a total of about 3,700 ducks at the lake, including more than 2,200 northern shovelers, almost 1,000 "unidentifiable teal", and almost 300 northern pintails.

Gaines (1988) reviewed bird distributional records from Mono Basin, and the highest recent duck counts he reported were 3,000 mallards at Simon's Spring on November 17, 1982, and 2,230 northern shovelers at Mono Lake on September 14, 1976. He noted that green-winged teals often outnumber all other ducks at the lake and cited a high count of 580 on January 1, 1984.

A professional wildlife biologist, who hunted ducks at Mono Lake for more than 25 years, confirmed that duck populations declined noticeably during the 1980s. He saw the fewest ducks in the late 1980s, during a period of persistent drought. (Taylor pers. comm.) Aside from frequent ruddy ducks and occasional flocks of northern shovelers on the open water, the most reliable places to find ducks around the lake are at remaining sources of fresh water such as the deltas, Simon's Spring, Warm Springs, and DeChambeau marsh. (Taylor pers. comm.)

Taylor (pers. comm.) has seen nearshore flocks with as many as 1,000 northern shovelers on a few occasions and scattered flocks totaling up to 1,000 ruddy ducks often visible from the shoreline. On most hunting trips during the late 1980s, however, he was unlikely to see more than a hundred ducks other than ruddy ducks on the entire lake.

Status at Point of Reference

Populations at Mono Lake. Based on observations made during hundreds of hunting trips in the 1980s and early 1990s, Taylor (pers. comm.) estimates the current annual lakewide populations of migratory ducks at about 11,000, including 5,000 ruddy ducks, 2,000 northern shovelers, 2,000 green-winged teals, 1,000 mallards, 500 northern pintails, 250 American wigeons, 100 gadwalls, and possibly as many as 150 assorted individuals of other species such as diving ducks (Taylor pers. comm.).

Jehl (pers. comm.) estimates the current number of migratory ducks at about 15,000, including about 5,000 ruddy ducks, 500 mallards, 5,000 northern shovelers, 2,500 green-winged teals, 750 American wigeons, 400 gadwalls, 400 cinnamon teals, and 300 miscellaneous diving ducks. His peak count in 1992 was nearly 5,000 ducks, which included about 2,000 ruddy ducks.

Thus, estimates of Mono Lake's migratory duck population at the point of reference, and in subsequent years, vary between about 11,000 to about 15,000 individuals per year. Clearly, current duck populations at Mono Lake represent a small fraction of the numbers present before diversions and through the early 1950s. Long-time residents of the region agreed the declining duck populations were the most pronounced of the changes occurring in Mono Lake's avifauna since the prediversion period (Banta, DeChambeau, McPherson, and Vestal pers. comms.).

Regional Duck Populations. It is possible that duck populations that formerly stopped at Mono Lake no longer exist or have shifted their fall migrations to other Great Basin lakes or the Central Valley (Reid pers. comm.). Duck populations have declined throughout North America in recent decades (Caithamer et al. 1992), principally due to losses of breeding and wintering habitat. For example, total waterfowl populations (i.e., including ducks, geese, and swans) in the Central Valley have declined from 10-12 million birds in the mid-1960s to a current population of 4-5 million, representing an approximate decline of about 40-60% in these years (Reid pers. comm.).

Systematic duck census data are not available from Mono Lake from peak migration periods during the 1960s (Yparraguirre pers. comm.), but local residents reported that major declines in the lake's duck populations began at about that time (Banta, McPherson, and Murphy pers. comms.). Assuming that their numbers declined by about half between the late 1940s and early 1960s (i.e., to about 500,000), and assuming about 15,000 ducks visited Mono Lake at the point of reference, the lake's duck populations have declined by about 97% since the mid-1960s. Compared to the magnitude of the decline in waterfowl in the Central Valley, the greatly reduced numbers of ducks in Mono Basin since the 1960s suggest that fundamental changes in the quality of the duck habitat at the lake have occurred during the diversion period (Reid pers. comm.).

Ecological Requirements at Mono Lake. Prediversion accounts indicated that most ducks at Mono Lake concentrated near sources of fresh water, such as deltas and springs, to bathe and drink (Banta, McPherson, Preston, and Vestal pers. comms.). Similarly, the few remaining migratory ducks at the lake frequently visit extant sources of fresh water, such as the DeChambeau ponds and the creek deltas (Banta, Rubega, Shuford, Strauss, and Taylor pers. comms.). Ruddy ducks, currently one of the most common ducks at Mono Lake, have a higher salinity tolerance than other ducks and visit sources of fresh water less often (Jehl pers. comm.). The effects of salinity on waterfowl are discussed in the survival factors section below.

Systematic studies of waterfowl foraging behavior at Mono Lake have not been performed. DeChambeau and Taylor have examined the crop contents of mallards, northern pintails, green-winged teals, and many other ducks shot at the lake and the dominant prey were larvae and pupae of alkali flies. DeChambeau recalled ducks foraging in windrows of alkali flies along the lakeshore. Banta, DeChambeau, and McPherson have observed northern shovelers foraging at close range; the shovelers appeared to be consuming mostly brine shrimp and algae while at Mono Lake (DeChambeau, Taylor, Banta, and McPherson pers. comms.).

Factors Affecting Survival at Mono Lake. Swanson et al. (1984) examined the factors influencing waterfowl use of saline lakes in North Dakota and concluded that ducklings were closely associated with freshwater inflows from spring seepages or adjacent wetlands with low salt concentrations. In general, ducks tended to use lakes with sheltered bays and chemically stratified water that provided a thin layer of fresh water on the surface (Swanson pers. comm.).

Under laboratory conditions, ducklings 1-3 days old experienced some mortality at 16 g/l and would not tolerate concentrations greater than 20 g/l unless a source of fresh water was available nearby (Swanson et al. 1984). Salt concentrations greater than 17 g/l significantly reduced duckling growth, and high levels of magnesium and sulfates caused the birds greater physiological stress than equivalent concentrations of sodium chloride. Mitcham and Wobeser (1988) also reported numerous sublethal effects on growth and feather development among mallard ducklings that were fed brackish or moderately saline water; some mortality resulted when ducklings raised on fresh water were abruptly fed saline water.

The chemistry of Mono Lake is very different from prairie lakes, but a similar phenomenon of salt avoidance behavior apparently occurs. Mono Lake's waters are high in sulfates but magnesium is present only in trace amounts (NAS 1987). Under prediversion conditions, the lake's salinity was approximately 50 g/l and far exceeded the apparent limits of successful waterfowl reproduction. Significant amounts of fresh water also floated on the surface, especially near the deltas, which probably enhanced the attractiveness of these areas to ducks. As described earlier, prediversion observations suggested that migratory ducks probably spent most of their time at deltas, freshwater and brackish water marshes, ponds, and lagoons around the lakeshore.

At the point of reference, Mono Lake's salinity was about 90 g/l, more than twice its prediversion levels (NAS 1987). The highly saline waters may now be unattractive to ducks; the salt glands of ducks (aside from ruddy ducks) at Mono Lake are probably not as well developed as those of grebes, gulls, and phalaropes (Swanson pers. comm.).

Flightless gadwall ducklings captured at the lake have holes in the webbing of their feet and lesions on their legs (Jehl pers. comm.). The cause of this condition has not been determined, but it could be related to a foot pox (bacteriological or viral) and it could be specific to gadwalls (Jehl pers. comm.). Studies from the upper midwest, however, suggest that ducklings have a lower tolerance of highly saline lakes than adults. Further research is needed on the effects of Mono Lake's highly saline waters on young ducklings, possibly in combination with disease factors (Swanson pers. comm.).

It is unlikely that short-term migrant ducks experience any adverse physical effects caused by prolonged contact with Mono Lake's waters (Jehl pers. comm.). However, studies in the southern San Joaquin Valley suggest that, with the exception of ruddy ducks, most species of migrant and wintering ducks select freshwater wetlands in preference to highly saline evaporation ponds (Coe 1990). Because they offer large areas of fresh water, many ducks in the vicinity of Mono Lake may prefer alternative migratory stopover points such as Bridgeport Reservoir (currently nearly dry) and Lake Crowley reservoir (Gaines and Shuford pers. comms.).

The acreage of tall and short emergent vegetation around the lakeshore has increased by more than 900 acres since prediversion times (Chapter 3C, "Vegetation"), but most of these wetlands are highly saline and lack any substantial freshwater or brackish water sources that most ducks require. The combined effects of increased salinity of the lake; the reduction of freshwater inflows from Rush and Lee Vining Creeks; and the loss of springs, ponds, lagoons, and other wetlands around the lakeshore have likely caused an overall degradation of the waterfowl habitat of Mono Lake.

Importance of Mono Lake. As described earlier, in the prediversion and early diversion periods, Mono Lake was a major stopover point for at least 1 million migratory ducks. The loss of freshwater and brackish water wetlands around the lakeshore and the increasing salinity of the lake made it less attractive to migratory ducks. Estimates of current duck populations at Mono Lake range between about 11,000 and 15,000 individuals per year; even the high estimate, however, represents only about 3% of the duck populations reported at one time during the prediversion years and through the 1950s. As noted earlier, this rate of decline appears to be substantially higher than overall population declines in California.

Lake Crowley reservoir currently supports 10,000 or more ruddy ducks in fall migration (Tillemans pers. comm.) and Bridgeport Reservoir (currently nearly dry) also provides habitat for thousands of migratory ducks when it has adequate water (Gaines 1988, Shuford pers. comm.). Grant Lake reservoir also provides some potential duck habitat, but its denuded shoreline, lack of emergent vegetation, and heavy recreational boating use make it relatively unattractive waterfowl habitat (Taylor and Shuford pers. comms.). Based on numerous accounts, however, it appears that these reservoirs provide only a fraction of the duck habitat value that was once available at Mono Lake. Therefore, it is concluded that the degradation or loss of suitable habitat at Mono Lake has resulted in greatly reduced numbers of ducks stopping there during fall migration.

Geese and Swans

Seven species of swans and geese have been observed in Mono Basin and Upper Owens River, but only the Canada goose, tundra swan, greater white-fronted goose, and snow goose are likely to frequent the eastern Sierra each year; of these species, the Canada goose is by far the most common and is the only one that regularly nests in the eastern Sierra (Gaines 1988).

Status during the Diversion Period. Banta and McPherson (pers. comms.) reported that Canada geese were fairly common during the 1940s and 1950s, and they were the only geese that were likely to occur in Mono Basin at any time of year. Tundra swans and snow geese also were regular visitors to the lake in November and December. Due to their vegetarian habits, geese in Mono Basin could usually be found in wet pastures around the lakeshore or in wet meadows of the Rush Creek bottomlands. Flights of geese were frequent enough to attract local hunters, but geese represented only a small fraction of the waterfowl present in Mono Basin in this period (Banta and McPherson pers. comms.).

Status at Point of Reference. Small numbers of Canada geese nest each year on the Negit Islets, and about 30-50 individuals are present in Mono Basin year-round (Jehl pers. comm.). In addition to Canada geese, tundra swans and a few snow geese still visit Mono Basin in fall and winter (Banta, Jehl, and Taylor pers. comms.). In general, the number of geese and swans has declined from the prediversion period but not to the same extent as the ducks (Banta and McPherson pers. comms.).

Currently, Canada geese are common in Long Valley and Bridgeport Valley where they often graze in wet pastures with cattle and loaf on larger reservoirs where they are safe from mainland predators (Gaines 1988, Shuford pers. comm.). A resident population of 35-45 individuals lives near Lake Crowley reservoir, and as many as 1,000 birds may be present in this area during the peak of fall migration (Tillemans pers. comm.).

Importance of Mono Lake. Mono Lake was apparently a frequently used area by geese and swans in the prediversion period and reduced numbers currently visit the area. At present, however, other nearby areas such as the Bridgeport and Long Valleys may provide more attractive habitat for these species (Shuford pers. comm.).

Wildlife along Streams Tributary to Mono Lake

Assessment Methods

The status of wildlife along the streams tributary to Mono Lake at the point of reference was assessed by establishing the distribution of habitat types and surveying their wildlife use. The distribution of habitat types prior to diversions was also established, allowing assessment of changes in wildlife habitat and wildlife value over the diversion period (Table 3F-3).

SWRCB consultants mapped approximately 2,080 acres of riparian and upland vegetation types in the LADWP-diverted stream channel corridors as they existed in 1989 (Chapter 3C, "Vegetation"). They then grouped these vegetation types into wildlife habitat types (Table 3F-3) and conducted wildlife surveys on 45 plots. The surveys involved recording reptile, bird, and mammal species trapped or observed during systematic surveys. Species observed outside systematic survey periods were also recorded. This study, comprising Appendix D, provides the basis for the information presented in this section.

Major Habitat Changes

As described in Chapter 3C, "Vegetation", by 1989 major losses of mature riparian vegetation had occurred along Rush and Lee Vining Creeks due to dewatering followed by torrential spills, stream incision, lowering of groundwater tables, and reduction in groundwater recharge. About 180 acres of cottonwood-willow woodland habitat and 19 acres of conifer-broadleaf forest were lost during the diversion period (Table 3F-3). These habitat losses have caused significant reductions in wildlife habitat value (Appendix D). These riparian forest and woodland habitats are relatively rich in numbers of species when compared to other habitats in Mono Basin (Appendix D). Although still extensive, more than 90 acres of montane habitat in the stream floodplains were also lost (Table 3F-3), but this habitat type has moderate species richness, especially when compared to mature riparian forests (Appendix D).

These vegetation losses have also created discontinuities in the formerly continuous riparian woodland corridors. These openings prevent or impede the movements of wildlife species that are intolerant of open habitats, some using the corridor to travel from upland forest to the delta habitats. As the lake receded, the dominance of unvegetated habitats also imposed a considerable separation between riparian woodland and the lakeshore, increasing from 300-400 feet in 1940 to 1,800 feet in 1989 along lower Lee Vining Creek and increasing from 1,000-1,200 feet to 2,500 feet along lower Rush Creek.

Reduction of Cottonwood-Willow Woodlands. Cottonwood-willow woodlands declined by a greater acreage than any other habitat along Mono Lake's diverted tributary streams (Table 3F-3) and most existing stands are in early successional stages. In the prediversion years, cottonwood-willow woodlands formed broad, extensive riparian corridors of mature forest covering about 50 and 160 acres along Lee Vining and Rush Creeks, respectively. Currently, only about 4 acres of narrow, regenerating cottonwood-willow woodlands are present in patches along each creek. The extent of mature cottonwood-willow forests has been reduced by almost 93% on Lee Vining Creek and by more than 97% on Rush Creek (Chapter 3C, "Vegetation", Appendix D).

Current cottonwood-willow woodlands along Lee Vining and Rush Creeks lack mature, multistoried vegetation (e.g., groundcover, shrub layer, saplings, and mature trees) that characterized prediversion riparian corridors (Chapter 3C, "Vegetation"). Narrow, discontinuous stands of small trees and shrubs offer nesting, foraging, and resting opportunities for fewer wildlife species than mature riparian corridors (Verner and Boss 1980). Studies in Mono Basin revealed significant relationships between bird species diversity and the number of vegetative layers, percent cover of tall trees, the presence of shrubs and low trees, and relatively moist soils (Appendix D). Because of their small acreages, lack of tall trees, and general absence of understory or midstory vegetation, these stands probably provide greatly reduced wildlife habitat values compared to conditions that existed under prediversion flow regimes (Appendix D). Similarly, bird distributional summaries (e.g., Gaines 1988, Hart and Gaines 1983) suggest that prediversion cottonwood-willow woodlands probably supported more species than any other terrestrial habitat in Mono Basin.

Other Habitat Reductions. The remaining conifer-broadleaf forest habitat provides the greatest diversity of plant species and vegetative structure of the habitat types now present along the tributary streams and throughout Mono Basin (Chapter 3C, "Vegetation"). The vertical structure of the habitat type is complex, and conifers and deciduous trees provide abundant cavities for nesting and support a variety of insect food for wildlife. Accordingly, this type has the highest wildlife species richness of any habitat type currently existing along the diverted tributary streams and probably throughout Mono Basin (Appendix D).

New Habitats. The lost woody riparian habitats have been replaced principally with unvegetated floodplain habitats (increased more than 180 acres) and Great Basin scrub habitats (increased more than 140 acres) (Table 3F-3), which generally support relatively low or moderate species richness (Appendix D). The increased Great Basin scrub habitat represents a conversion to a widespread, nonriparian habitat, replacing a high-value habitat with low- to moderate-value habitat (Appendix D).

Moderate increases in mixed riparian and riparian willow scrub habitats have also occurred (Table 3F-3). Minimum streamflows, judicially mandated by the point of reference, are causing these habitats to recover in formerly unvegetated floodplain habitat present in the early 1980s; this recovery is ongoing (Chapter 3C, "Vegetation"). These habitats, when mature, support relatively high species richness (Appendix D).

Riparian willow scrub and Great Basin scrub are the dominant habitats establishing on the lowermost 114 acres of the Rush and Lee Vining Creeks corridors where they flow over relicted lands exposed by lowering lake levels. These particular riparian willow scrub habitats currently provide lower wildlife values than similar but mature habitats above the relicted lands, because newly established shrubs lack the size, number of vegetation layers, and cover provided by the more mature habitats. Through time, however, they will probably develop higher species richness typical of this habitat type.

Important Wildlife Species

Typical, or representative, species observed in the tributary stream habitats in 1991 plot surveys are described in Appendix D.

Streams Diverted by LADWP

Rush Creek

Habitats. During the diversion period, the acreage of riparian habitats along Rush Creek increased by about 75 acres over relicted lands as the lake receded. Nonetheless, cottonwood-willow woodland (all successional stages), conifer-broadleaf forest, and montane meadow habitats had diminished by 85%, 70%, and 70%, respectively; habitat losses totaled 240 acres. These habitats were principally converted to unvegetated floodplain habitat, which had increased threefold or 125 acres, and to nonriparian Great Basin scrub habitat, which had increased 103 acres. Smaller but significant gains in riparian willow scrub habitats and mixed riparian scrub habitats also occurred (Table 3F-3).

Wildlife Use. A total of 48 species of birds, mammals, and reptiles were observed using the Rush Creek habitats during systematic surveys conducted in 1991 (Appendix D). All species recorded by prediversion observers (see "Prediversion Conditions") are present in Mono Basin and were observed during the 1991 surveys. Breeding populations of long-eared owls, willow flycatchers, and yellow warblers have declined statewide during the diversion period (Remsen 1978); their declines in Mono Basin are discussed below under "Special-Status Species".

Lee Vining Creek

Habitats. As the lake receded during the diversion period, the acreage of riparian habitats along Lee Vining Creek increased by about 42 acres. This increase notwithstanding, cottonwood-willow woodland (all types), conifer-broadleaf forest, and montane meadow habitats diminished by 75%, 19%, and 26%, respectively; this resulted in a combined change in these habitats of 66 acres. These habitats were principally converted to unvegetated floodplain habitat, which more than doubled (increasing by 40 acres), and to nonriparian Great Basin scrub habitat, which increased 56 acres. Smaller gains in riparian willow scrub habitats and mixed riparian scrub habitats also occurred (Table 3F-3).

Many of the large cottonwoods, aspens, and Jeffrey pines along Lee Vining Creek died after the creek was dewatered in the late 1940s, and most of the remainder, desiccated by the dewatering, were destroyed by a large fire in the early 1950s (Stine 1991).

Wildlife Use. Forty-three species of birds, mammals, and reptiles were observed on systematic wildlife plot surveys conducted along Lee Vining Creek in 1991 (Appendix D). Of the species reported by early observers along Lee Vining Creek prior to the diversion period (see "Prediversion Conditions"), only pine siskins were not observed during the 1991 surveys. The absence of pine siskin observations does not indicate low populations because this species sometimes occurs irregularly on the east slope of the Sierra Nevada (Gaines 1988).

Parker and Walker Creeks

Habitats. Unlike Rush and Lee Vining Creeks, Parker and Walker Creeks support very little riparian forest or woodland habitat; they primarily support montane meadow and willow woodland habitats (Table 3F-3). Reaches of these creeks were dewatered during the diversion period, but habitat losses were much less than along the larger streams. Some reaches were used for irrigation water conveyance, and irrigation of the stream's alluvial fans was extensive, apparently preventing larger losses of willow woodlands. Reductions in willow woodlands were 18% along Parker Creek and 38% along Walker Creek.

Loss of riparian willow scrub habitat is probably attributable to a low replacement of mature willows by juveniles. Resulting increases in the acreage of montane meadow were the intended result of livestock management practices on the Cain Ranch to promote the establishment of a desirable forage crop. Along Walker Creek, however, increases in unvegetated floodplain habitats were twice as large as increases in montane meadow habitat (Table 3F-3).

Wildlife Use. Thirty-two and 29 species of birds, mammals, and reptiles were observed during surveys conducted on Parker and Walker Creeks, respectively (Appendix D). The current status of a sage grouse lekking site used by 30-50 grouse on the Parker Creek meadow prior to the diversion period (see "Prediversion Conditions") is unknown. A sage grouse was observed near Parker Creek in 1991, suggesting that this species persists in Mono Basin, although numbers have probably declined (Gaines 1988) (see also Appendix E).

Other Streams

Riparian habitat gains occurred along other perennial streams tributary to Mono Lake during the diversion period. Post Office Creek lengthened by over 1,000 feet due to lake recession, and it did not incise. Riparian scrub habitat developed along the new channel, and no upstream losses occurred. The habitat gain has been about 24 acres but, because the new habitat does not yet extend to the lakeshore, another 6 acres of habitat may yet develop. (Stine 1991.)

Wilson and Mill Creeks lengthened about 2,100 and 2,200 feet, respectively, during the diversion period, but both channels incised and now support only about 2 acres of riparian vegetation. The incision, however, did not cause losses of riparian habitat above the relicted lands (Stine 1991).

Systematic wildlife surveys were not conducted on Post Office, Wilson, or Mill Creeks in 1991, but informal surveys there suggested that wildlife present in the newly developed riparian scrub habitats was similar to that in the riparian scrub and cottonwood-willow habitats along the diverted tributary streams (Appendix D). Accordingly, significant wildlife value has been created along Post Office Creek over the diversion period.

Wildlife along the Upper Owens River

Habitat Changes

The distribution of habitats along Upper Owens River has not changed significantly with augmentation of flows from Mono Basin (Chapter 3C, "Vegetation"). Some riparian willow scrub continues to border the upper reaches of the stream below East Portal, while most of the river valley is irrigated meadow habitat. Densities of willow have decreased downstream from East Portal by about 12.4 acres during the diversion period, representing a 77% decline in the extent of this habitat (Chapter 3C, "Vegetation"). Increased soil saturation resulting from augmented streamflows to the adverse effects of livestock browsing may have caused this decline (Stromberg and Patten 1991). Some bank collapse and possibly channel-widening is ongoing along the river, gradually reducing irrigated meadow habitat.

The use of Upper Owens River valley for livestock grazing continues, but the human presence has increased considerably during the diversion period through the growth of summer cabins and commercial recreational fishing.

Wildlife Use

Forty-two species of birds and mammals were observed along the Upper Owens River during the 1991 surveys (Appendix D). Populations of game species, such as waterfowl, sage grouse, and mule deer, have generally declined since 1940 (Arcularius pers. comm.). Population declines, however, are probably not associated with augmentation of flows, because these species have also declined regionally during the same period. The loss of riparian willow-scrub habitat may be important to migratory birds and other wildlife because scrub vegetation is otherwise absent from the river's banks upstream from Lake Crowley reservoir (Chapter 3C, "Vegetation").

Immediately downstream from East Portal, a small ponded marsh was created during construction of East Portal outflow. This habitat is atypical on the Upper Owens River and is used by species, such as cinnamon teal, American wigeon, American coots, and yellow-headed blackbirds, thereby enhancing overall species richness of the Upper Owens River.

Special-Status Species in Mono Basin and Upper Owens River Valley

As noted previously, 39 special-status species occur or potentially occur in the areas of concern in Mono Basin and along the Upper Owens River. Three of these species are described elsewhere: the Mono Lake brine shrimp is discussed in Chapter 3E, "Aquatic Productivity", and the California gull and western snowy plover in prior sections of this chapter. Appendix E describes the prediversion status, the current status, and the possible effects of LADWP diversion on the remaining 36 special-status species.

Several conclusions arise from the assessment in Appendix E:

- Ospreys and bald eagles would probably benefit from restoration of fisheries on Lee Vining and Rush Creeks.
- Reductions of spring flows and grazing in Mono Basin and construction of Lake Crowley reservoir probably reduced the availability of habitat for yellow rails, which prefer to nest in shallow, freshwater marshes with low, sparse emergent vegetation.
- Long-eared owls, yellow warblers, yellow-breasted chats, and willow flycatchers probably declined in the project area during the diversion period due to a loss of riparian broadleaf and willow scrub vegetation along diverted tributary streams.

IMPACT ASSESSMENT METHODOLOGY

Impact Prediction Methodology

This section describes the methods used to predict the benefits and adverse impacts of each alternative on wildlife habitat and populations in Mono Basin and the Upper Owens River. Assumptions, analytical methods, and significance criteria are identified for each environmental variable used to assess impacts. The purpose of this section is to provide the necessary background information and rationale for predicting impacts and making findings of significance under each alternative.

California Gull Nesting Colony at Mono Lake

As described in the "Environmental Setting" section and in Appendix C, the only clear trend in the gull colony that can be attributed directly to changes in the surface elevation of Mono Lake is abandonment of nesting islands and islets in response to land-bridging, and subsequent predation. Thus, the objectives of this analysis were to:

- estimate the acreage of suitable gull nesting habitat available for the Mono Lake colony under each alternative and
- determine whether the availability of suitable island nesting habitat could potentially limit the size of the colony under each alternative.

As discussed in the following sections, estimating the potential nesting capacity of individual islands and islets involved categorizing exposed substrates according to their size, habitat characteristics, and long-term occupancy by nesting gulls.

Preparation of Base Maps. Stine (1992) prepared base maps of each major nesting island and islet at Mono Lake using 1991 aerial photographs taken at a lake elevation of 6,375 feet (Figures 3F-2, 3F-3a, 3F-3b, and 3F-4). For Negit Island and the Negit Islets, the contours of alternative target lake elevations (i.e., 6,372 feet, 6,377 feet, 6,383.5 feet, 6,390 feet, and 6,410 feet) were superimposed on the maps using USGS 7.5-inch topographic maps, Pacific Western Aerial survey maps, the revised topographic map prepared by SWRCB consultants (Appendix G), and a chrono-cartographic map sequence derived from aerial photographs taken in 1930, 1940, 1956, 1964, 1973, 1975, 1979, and 1982 (Stine 1992).

In contrast to the hard rocks of Negit Island and the Negit Islets, the soft sediments composing the Paoha Islets are eroded by waves and longshore currents during periods of rising lake elevations (Stine 1992). For this reason, Stine (1992) depicted the size and configurations of these islets as they would likely appear following a rise to the normal maximum lake elevation predicted under each alternative (Figure 3F-4).

For the 6,372-Ft Alternative, the average shorelines of the Paoha Islets are shown at 6,375 feet (the average surface elevation predicted under the 6,372-Ft Alternative) and the uplands are depicted as all areas above the 6,380.9-foot contour (i.e., the highest elevation of the last lake transgression in 1986). Similarly, uplands under the 6,377-Ft Alternative are shown as the areas above the 6,382.9-foot contour, the highest lake elevation predicted under this alternative.

A lake transgression to 6,389.5 feet is the normal maximum under the 6,383.5-Ft Alternative. At this and all higher elevations, all existing uplands on the Paoha Islets would be reduced to low, wave-cut platforms; these remnant islets would have limited value to nesting gulls and therefore were not mapped on Figure 3F-4 (Stine pers. comm.).

Characterization of Nesting Habitat Potential. Gull researchers on Negit Island (Winkler pers. comm.) and the Negit Islets (Shuford pers. comm.) categorized the gull habitat suitability of each major nesting substrate as high, moderate, low, or unsuitable. These categories represented the researchers' best estimates of the future nesting capacity of various substrates and exposures integrated over a period of years; the categories were not intended to predict the specific density or nest dispersion observed in a particular year (Shuford and Winkler pers. comms.).

Winkler based his habitat categorization on the map of the Negit Island gull colony he prepared in 1976 and later observations of PRBO researchers (Dierks 1990, 1991; Dierks and Shuford 1992). He mapped low-gradient scrublands that were used by high densities of nesting gulls during 1976-1978 as high suitability habitat. Similar, but historically unoccupied scrublands and rocky shoreline areas used by nesting gulls between 1985 and 1991 were mapped as moderate suitability. All remaining lava flows, cinder cones, and other steep, rocky areas on Negit Island were considered unsuitable gull nesting habitat (Winkler pers. comm.).

Stine (1992) and Shuford (pers. comm.) made onsite inspections of the Negit Islets to identify areas with similar habitat characteristics, including substrate type, slope, surface elevation, and exposure. They also considered the distribution and density of nests during the past decade when assigning specific areas to habitat suitability categories. They mapped tufa-encrusted areas with gentle slopes and historically high nesting densities as high suitability. Sandy beach areas lacking surface debris and steeper rocky slopes were mapped as moderate suitability. Low suitability areas included steep, rocky slopes and water proximate, windward wave-cut platforms that supported few nesting gulls during the last decade. Unsuitable habitats included vertical, rocky cliffs and the lowest wave-exposed platforms that have never supported nesting gulls.

Jehl (pers. comm.) refined Stine's (1992) base map of potential nesting habitat on the Paoha Islets during the 1992 breeding season. He made onsite inspections to confirm the size and configuration of individual islets and sketched the areas with rugose substrates (e.g., tufa-encrusted areas, small boulders, logs, and other debris) currently preferred by nesting gulls. The first, and often most densely, settled portions of these islets tend to be on protected, rugose substrates near the shoreline; open, sandy areas, especially those at interior locations, are usually settled later but sometimes attain nesting densities approaching those on rugose substrates. Wave-cut platforms less than about 1 foot above the water's surface on windward sides of islands and steep wave-cut cliffs were mapped as unsuitable habitat because they do not support nesting gulls.

Nesting Density Assumptions for Negit Island and the Negit Islets. Shuford (pers. comm.) provided detailed maps of gull nesting densities observed on the most important Negit Islets in 1992. These data were used in combination with fixed-plot nest counts from the Negit Islets (Dierks 1990, 1991; Dierks and Shuford 1992) to provide a quantitative basis for defining habitat suitability categories.

Based on the maximum nest counts observed at specific mapped habitats on the Negit Islets and consultation with gull researchers (Shuford and Winkler pers. comms.), SWRCB consultants defined the potential nesting capacities of each suitability category as: high = 1,300 nests per acre, moderate = 600 nests per acre, and low = 200 nests per acre. Areas mapped as unsuitable by the gull researchers were not included in acreage calculations.

Nesting Density Assumptions for the Paoha Islets. Jehl (pers. comm.) indicated that he could not apply the habitat suitability values derived from the Negit Islets to the Paoha Islets. He noted that similar maximum nesting densities have been observed on rugose and nonrugose substrates of these islets and suggested that the both habitats are potentially capable of supporting increasing numbers of nesting gulls if the Mono Lake colony expands in the future. Based on his observations at Mono Lake and other large nesting colonies (e.g., Bamforth Lake, Wyoming Lake, and Great Salt Lake), he indicated that 1,000 nests per acre would be a realistic maximum nesting capacity for all suitable breeding habitats on the Paoha Islets.

Island and Islet Area Measurements. The habitat suitability maps prepared by Stine (1992) and the gull researchers were used to calculate the approximate acreages of potential nesting habitats available under each alternative. Using a planimeter, acreages were estimated for each habitat suitability category (i.e., high, moderate, low, or unsuitable on Negit Island and the Negit Islets and rugose and nonrugose on the Paoha Islets) and were summed for each island and islet.

Predation and Land Bridging. As described in the "Environmental Setting" section, Negit Island and Pancake Islet become accessible to mainland predators at lake elevations of about 6,376.5 feet, and Java and Twain Islets are accessible to predators at about 6,373.5 feet. Thus, at lower alternatives (e.g., the 6,372-Ft and No-Restriction Alternatives) these areas were not included in the calculations of potential habitat available for nesting gulls.

Predicting Population Effects. For Negit Island and the Negit Islets, potential gull nesting capacity values for each habitat suitability category (i.e., high = 1,300 nests per acre, moderate = 600 nests per acre, low = 200 nests per acre) were multiplied by their estimated acreages on each island and islet.

For comparative purposes, potential nesting capacity of the Paoha Islets was calculated using two sets of density assumptions:

- rugose substrates were regarded as high suitability (i.e., 1,300 nests per acre) and other nonrugose, upland substrates were regarded as moderate suitabilities (i.e., 600 nests per acre), as derived from maximum counts at similar habitats on the Negit Islets and
- all upland substrates (rugose and nonrugose) were assumed to have high suitability (i.e., 1,000 nests per acre), as observed at other large nesting colonies.

The calculated habitat acreage and nesting capacity estimates were summed for Negit Island and for the Negit and Paoha islets under each alternative. These values were compared to point-of-reference and current maximum nesting populations to determine if the availability of suitable nesting habitat under each alternative could potentially limit the size or reproductive success of the California gull colony.

Effects of Invertebrate Productivity on Migratory and Nesting Water Birds at Mono Lake

This analysis focused on the most abundant migratory water birds at Mono Lake: eared grebes, Wilson's phalaropes, and red-necked phalaropes (whose status and ecological requirements are described in the "Environmental Setting" section).

Invertebrate Productivity. Trends in alkali fly and brine shrimp productivity at Mono Lake, which are described in Chapter 3E, "Aquatic Productivity", formed the basis for assessing the relative amounts of food available for water birds under each alternative.

Food Limitations on Bird Populations. Aside from Rubega's (1992) field and laboratory studies of red-necked phalaropes, the prey density requirements of most water birds at Mono Lake have not been examined in detail. Rubega's (1992) data were used to compare the potential responses of red-necked phalaropes to changes in prey densities and for comparative purposes, the responses of Wilson's phalaropes were assumed to be similar to those of red-necked phalaropes. The observed distributions of foraging phalaropes at different lake levels were also utilized as an indication of foraging efficiency.

Potential responses of eared grebes to changing prey densities were compared using the observations of various researchers of this species at different lake elevations.

Predicting Bird Population Effects. Levels of invertebrate productivity were evaluated for each alternative to determine whether lakewide prey densities could potentially limit the population size or foraging efficiency of migrant grebes or phalaropes at Mono Lake.

Abundance of Migratory Ducks at Mono Lake

Population Effects. Past and current population trends and the habitat requirements of migratory ducks at Mono Lake are described in the "Environmental Setting" section. Based on that discussion, it is assumed that the freshwater habitats are currently limiting duck use of Mono Lake. Thus, the acreage of open water around the lakeshore and the volume of fresh water at the creek deltas are assumed to represent the habitat available and usable for migratory ducks under any of the alternatives compared to point-of-reference conditions. The predictions of invertebrate food potentially available to migratory ducks were based on analysis in Chapter 3E, "Aquatic Productivity".

Habitat Availability. Methods for calculating the acreages of suitable habitats (e.g., creek deltas, ponds, and lagoons) under each alternative are described in Chapter 3C, "Vegetation". In particular, Stine's (1993) estimates of the surface elevations required for reemergence of ponds and lagoons were used to estimate availability of these habitats under each alternative.

Freshwater inflows at the creek deltas were estimated for the months of September, October, November, and December from the cumulative frequency tables presented in Chapter 3A, "Hydrology". The 20th, 50th, and 80th percentiles were used to represent dry, average, and wet year conditions, respectively.

Snowy Plover Nesting Habitat at Mono Lake

Nesting Habitat Availability. Characteristics of suitable snowy plover nesting habitats (i.e., pumice berms, alkali flats, wetlands, and other barren habitats within 1 mile of the lakeshore or other water source) are described in the "Environmental Setting" section. Methods for calculating the acreages of these habitats under each alternative are described in Chapter 3C, "Vegetation".

Population Effects. Acreages of suitable snowy plover nesting habitat potentially available under each alternative were compared to the estimated nest area requirement of this species. These carrying capacities were compared to the point-of-reference capacity to determine whether available habitat could potentially limit the size of Mono Lake's snowy plover population under any of the alternatives.

Page et al. (1983) calculated the nesting densities of snowy plovers at Mono Lake to be about one nest per 6 hectares (about 15 acres). The 170 nesting pairs present under point-of-reference conditions therefore occupied about 2,500 acres of nesting habitat around the lakeshore. The responses of nesting snowy plovers to changing lake elevations, however, have not been adequately examined (Page pers. comm.), and continued monitoring of their population at Mono Lake should be an element of the SWRCB's mitigation monitoring plan.

Wildlife Habitat Values of the Mono Lake Shoreline

Habitat Availability. Methods for calculating the acreages of lakeshore habitats are described in Chapter 3C, "Vegetation".

Wildlife Value. A specific wildlife habitat index (WHI) was derived for each major lakeshore habitat by estimating its species richness relative to other wildlife habitats in Mono Basin and the Upper Owens River (Appendix D). Total wildlife habitat value or "units" (WHUs) for the prediversion and point-of-reference conditions and the alternatives were calculated by multiplying the habitat-specific WHI values by the acreages predicted to occur.

Special-Status Species. The overall wildlife value of each habitat reflects its potential to support special-status species, including snowy plovers, ospreys, and yellow rails (Appendix E). WHUs for lakeshore ponds and lagoons were not calculated because prediversion and point-of-reference species counts were not available for these habitats.

Wildlife Habitat Values along Streams Tributary to Mono Lake

Wildlife Habitat Value. The same process used for shoreline habitats (described above) was used to compare wildlife habitat values for various alternatives and conditions.

Special-Status Species. The overall wildlife value of each habitat reflects its potential to support special-status species, including bald eagles, ospreys, long-eared owls, willow flycatchers, yellow warblers, yellow-breasted chats, and mountain beavers (Appendix E).

Wildlife Habitat Values along the Upper Owens River

Wildlife Habitat Value. The same process used to compare wildlife habitat values for various alternatives and conditions as described above for shoreline habitats was used for riparian willow scrub and irrigated meadow habitats, estimating their species richness relative to other wildlife habitats in Mono Basin and the Upper Owens River (Appendix D).

Special-Status Species. The overall wildlife value of each habitat reflects its potential to support special-status species, including willow flycatchers, yellow warblers, and yellow-breasted chats (Appendix E).

Criteria for Determining Impact Significance

For each response variable, all beneficial and adverse impacts are measured as changes from point-of-reference conditions. Where possible, quantitative criteria are employed to assess the degree of change that would likely occur under each alternative. The thresholds used to determine whether predicted adverse changes would be significant are described below.

California Gull Nesting Colony at Mono Lake

The potential habitat acreage and estimated lakewide nesting capacity secure from terrestrial predators were evaluated for each alternative to determine whether they could potentially accommodate the maximum breeding colony observed at Mono Lake. During the past 16 years of record (i.e., 1976-1992), the gull colony averaged about 24,000 nests, with maximums of about 31,000 nests and 32,500 nests in 1990 and 1992, respectively. Thus, significant adverse impacts were identified for alternatives if the predicted lakewide nesting capacity would be less than 32,500 nests (assumed to represent the point-of-reference condition). Beneficial effects were identified for alternatives that would increase the lakewide nesting capacity by more than a minor amount (10%) from point-of-reference conditions.

Effects of Invertebrate Food Productivity on Migratory and Nesting Water Birds at Mono Lake

At the point of reference, thousands of red-necked and Wilson's phalaropes continued to visit Mono Lake; however, they were restricted to the lake's northeastern sector where they foraged at less than optimal efficiency (Rubega 1992). Thus, lakewide productivity of alkali flies at the point of reference may be approaching a threshold for successful phalarope foraging. For these reasons, significant impacts on phalaropes are defined as more than minor (10%) declines in the lakewide alkali fly productivity from point-of-reference conditions. Beneficial impacts were defined similarly.

Brine shrimp populations were sufficient to meet eared grebe foraging requirements at the historical lowstand in 1982 (elevation 6,372 feet), the point of reference, and through 1992. Thus, significant adverse impacts on this species are defined as more than minor (10%) declines of brine shrimp productivity from the historical lowstand. Beneficial impacts were defined similarly.

Abundance of Migratory Ducks at Mono Lake

As stated in the "Environmental Setting" section of this chapter, migratory duck populations at Mono Lake at the point of reference were greatly reduced from prediversion conditions. Thus, significant adverse impacts are defined as any more-than-minor (10%) reduction of freshwater inflows, open water habitat acreage, or invertebrate food supplies compared to point-of-reference conditions. Beneficial impacts are defined similarly.

Snowy Plover Nesting Habitat at Mono Lake

Significant adverse impacts on snowy plovers are identified for alternatives for which the lakewide acreage of suitable nesting habitat would fall below 2,500 acres. Any decrease in the size of occupied habitat at the point of reference for this candidate threatened species is considered significant.

Wildlife Habitat Values of the Mono Lake Shoreline, Tributary Streams, and the Upper Owens River

Under each alternative, declines of more than a minor amount (10%) in the total WHUs are considered significant adverse impacts for shoreline, tributary stream, and Upper Owens River areas. Any permanent losses of habitat occupied by special-status species at the point of reference were also considered significantly adverse. Beneficial impacts are similarly defined.

SUMMARY COMPARISON OF IMPACTS AND BENEFITS OF THE ALTERNATIVES

As described above in the "Impact Assessment Methodology" section, relative wildlife effects of the alternatives are addressed in this chapter through several key variables:

- acreage of secure nesting habitat for California gulls,
- productivity of invertebrate food for migratory water birds,
- feeding behavior and distribution of phalaropes,
- availability of freshwater habitats for migratory ducks,
- availability of nesting habitat for snowy plovers, and
- acreage and species richness of lakeshore and tributary stream habitats.

Table 3F-4 provides a summary comparison of the alternatives using these variables. Values of the variables for each alternative are compared to values for the prediversion and point-of-reference conditions. Those values representing significant adverse direct or cumulative impacts are indicted. A discussion of these variables for each alternative is provided in the following sections of this chapter.

As the summary table indicates, the 6,377-Ft Alternative and lower elevation alternatives would have significant impacts on gull nesting, migratory bird feeding, and phalarope behavior. High lake levels also have some significant impacts: decreasing wildlife value of shorelines and, for the No-Diversion Alternative, diminished habitat for snowy plovers.

Two significant cumulative effects, relatived to prediversion conditions, would occur under most alternatives. The loss of freshwater habitats for migrating ducks and other water birds could be substantially reduced only under the highest lake level alternatives or through mitigation. Due to stream incision, losses of terrestrial habitat value along the tributary streams could be fully reversed only through habitat restoration.

Table 3F-5 shows the potential acreage and nesting capacity for California gulls on the Mono Lake islands under the alternatives. As shown, the amount of habitat available under both the No-Restriction and 6,372-Ft Alternatives would be inadequate to support point-of-reference gull populations. Potential nesting capacity would at least double under all the other alternatives; however, periodic land bridging of Negit Island predicted under the 6,377-Ft Alternative would disrupt nesting gulls.

Table 3F-6 gives the acreages and wildlife habitat values of the Mono Lake shoreline and tributary streams for each of the alternatives. Compared to the point of reference, wildlife habitat values of the tributary streams would decline under the No-Restriction Alternative but would increase under all the other alternatives. Terrestrial wildlife habitat values of the shoreline habitats would increase slightly under the 6,372-Ft Alternative but would gradually decline under increasingly higher lake elevation alternatives. Most shoreline vegetation would be inundated under both the 6,410-Ft and No-Diversion Alternatives, but lakeshore ponds and lagoons would be restored to near their prediversion acreages, providing significant benefits to migrating ducks.

IMPACTS AND MITIGATION MEASURES FOR THE NO-RESTRICTION ALTERNATIVE

Changes in Resource Condition

California Gull Nesting Colony at Mono Lake

Under this alternative, Mono Lake's surface elevation would gradually decline from the point of reference (6,376.3 feet) to an average elevation of about 6,355 feet. In wet years, the lake could rise to a maximum elevation of about 6,365.5 feet, and under an extreme drought, it could decline to a minimum elevation of about 6,336.5 feet (see Chapter 2, "Project Description").

Near-Term Changes. At the point of reference, Negit Island would be effectively land bridged and accessible to coyotes and probably would support few nesting gulls. This condition would not change under the No-Restriction Alternative, but during at least the first few years gulls would find suitable nesting habitat on the Negit and Paoha Islets. However, Twain and Java Islets would become effectively land bridged at about 6,373.5 feet, which could disrupt up to half of the Mono Lake colony (see discussion for the 6,372-Ft Alternative).

Long-Term Changes. After a period of years under the No-Restriction Alternative, the lake's surface elevation would fall to an average of about 6,355 feet. At this elevation, most historically important nesting areas on the Negit Islets (e.g., Twain, Java, Little Tahiti, Little Norway, Krakatoa, Geographic, Comma, Saddle, and Winkler) would be land bridged and only about 8 acres of potential nesting habitat would remain (Stine pers. comm.). Similarly, most of the historically occupied Paoha Islets (e.g., Anderson, Browne, Coyote, Cluster, Conway, Gull, Russell, McPherson, and Smith) would be land bridged to Paoha Island under this alternative and only about 4 acres of potential gull nesting habitat would remain (Stine pers. comm.). Land bridging of most of the Negit and Paoha Islets would result in a loss of more than 80% of the potential habitat acreage and gull nesting capacity compared to the point of reference (Table 3F-5).

In addition to the loss of secure nesting habitat, the lakewide productivity of alkali flies and brine shrimp would decline to extremely low levels under the No-Restriction Alternative (see "Effects of Invertebrate Food Productivity on Migratory and Nesting Water Birds" below). Alkali flies and brine shrimp are the primary food sources of gulls nesting at Mono Lake, and severe declines of these invertebrate prey species would further jeopardize the remaining breeding colony.

Drought Effects. Under extreme drought conditions, virtually all potential gull nesting substrates would be land bridged (Stine pers. comm.) and the increasing saline and alkaline conditions would virtually eliminate alkali fly and brine shrimp populations at Mono Lake (see Chapter 3E, "Aquatic Productivity"). Drought conditions would further degrade gull nesting habitat at Mono Lake, but most adverse effects on this species would probably be apparent at all lake elevations predicted under the No-Restriction Alternative.

Effects of Invertebrate Productivity on Migratory Water Birds

Near-Term Changes. During the first few years under this alternative, the lake's invertebrate productivity would decline from the point of reference (see Chapter 3E, "Aquatic Productivity"). The effects of these declines, however, are difficult to determine because precise calculations of the minimum densities of alkali flies and brine shrimp required by migratory eared grebes, Wilson's phalaropes, and red-necked phalaropes are complicated by patchiness of invertebrate productivity at Mono Lake (Jehl and Rubega pers. comms.).

At the lake's lowest historical elevation (i.e., 6,372 feet in 1982) sufficient food was apparently available to support populations of eared grebes and phalaropes at levels similar to the point of reference. Laboratory and field studies of red-necked phalaropes, however, suggest that this species foraged at less than optimal efficiency at these prey densities (see discussion for the 6,372-Ft Alternative).

Long-Term Changes. At the average elevations predicted under this alternative (i.e., about 6,355 feet), Mono Lake's salinity would increase to about 150 g/l. This value is near the upper limit for successful reproduction of alkali flies and brine shrimp, and both species are predicted to decline to very low levels under this alternative (see Chapter 3E, "Aquatic Productivity"). For example, production of third instar alkali fly larvae (the life stage with the highest caloric value) would decline by more than 60% from point-of-reference conditions and brine shrimp populations would decline by more than 50%. Major declines in their preferred prey species would probably cause most eared grebes, phalaropes, and other water birds to abandon Mono Lake as a migratory staging area.

Drought Effects. During extreme droughts, Mono Lake's salinity would decline substantially from the average conditions predicted under this alternative. Alkali fly and brine shrimp productivity would probably cease (see Chapter 3E, "Aquatic Productivity") and few, if any, water birds would continue to visit Mono Lake.

Abundance of Migratory Ducks at Mono Lake

Near-Term Changes. Less than 1 acre of open water habitat existed around the lakeshore at the point of reference (Table 3F-6); this habitat would dry out during the first few years under this alternative (see Chapter 3C, "Vegetation"). Similarly, all flows into Mono Lake's tributary streams would cease, except in maximum runoff years when LADWP's diversion structures would not be able to accommodate all the runoff.

In the near term, the lake would become more saline and ducks requiring fresh water probably would abandon the lake as a migratory stopover point. Ruddy ducks and a few other diving ducks probably would continue to visit the lake, however, because they do not require frequent access to fresh water. In the near term, lakewide invertebrate productivity probably would be sufficient to maintain point-of-reference populations of these species.

Long-Term Changes. Long-term changes under this alternative would include elimination of all open water habitats and freshwater inflows in the tributary streams. Similar to other migratory water birds, ducks would also experience adverse impacts as the lakewide invertebrate productivity declined to very low levels. Under these conditions, migratory ducks (including ruddy ducks) probably would be absent from Mono Lake.

Drought Effects. During extreme droughts, the lake's salinity would decline significantly from the average conditions predicted under this alternative. Alkali fly and brine shrimp productivity probably would cease (see Chapter 3E, "Aquatic Productivity") and few, if any, migratory ducks would continue to visit Mono Lake.

Snowy Plover Nesting Habitat at Mono Lake

Near-Term Changes. During the first few years under the No-Restriction Alternative, the lake's elevation would decline and expose more alkali lakebed, which could then be used by nesting snowy plovers. At the point of reference, however, this species had almost 10,000 acres of potential nesting habitat on alkali flats (about 6,000 acres), pumice berms, barren sands, and other unvegetated habitats around the lakeshore (see Chapter 3C, "Vegetation").

Only about 2,500 acres of barren habitat are required to support the current snowy plover population (see "Environmental Setting"). Because about 75% of the potential lakeshore habitat is currently unoccupied by snowy plovers, the near-term addition of new alkali flat acreage under this alternative probably would have no effect on the population at Mono Lake.

Long-Term Changes. The bathymetry of Mono Lake indicates the presence of a shallow, submarine terrace to about 6,368 feet (the "nick point"), and all lake elevations predicted under this alternative would be below this nick point. Under such conditions, Stine (1987a) predicted that steep cliffs and deep erosional features would form near the lakeshore. If such topography were to form in current snowy plover breeding areas, it could potentially impede and endanger access to the lakeshore and its feeding areas, especially for plover chicks (Winkler 1987, Page pers. comm.). Deeply incised hollows would also put snowy plovers at a disadvantage in the long-range detection of predators, which could elevate the predation risks to adults and chicks of this species.

Under this alternative, about 9,500 acres of alkali lakeshore would still exist above the nick point, providing breeding habitat for snowy plovers (Table 3F-6). However, the altered shoreline topography and difficult access to other water sources (i.e., than within 1 mile of the nesting site) probably would reduce the attractiveness of these areas to nesting snowy plovers. Further, productivity of alkali flies would be greatly reduced or eliminated under this alternative (see Chapter 3E, "Aquatic Productivity"). The combined effects of altered habitat and reduced food supply probably would cause most snowy plovers to abandon Mono Lake as a breeding area.

Drought Effects. If the lake's elevation declined to 6,336 feet during an extreme drought, the amount of suitable snowy plover habitat around the shoreline would be further reduced from the point of reference. Under such conditions, potential habitat and food supplies would be so reduced that snowy plovers could be eliminated as a breeding species at Mono Lake.

Wildlife Habitat Values of the Mono Lake Shoreline

Near-Term Changes. During the first few years under this alternative, the acreage and overall wildlife values of lakeshore marsh, meadow, and wetlands scrub habitats would be similar to the point of reference (see Chapter 3C, "Vegetation").

Long-Term Changes. At the average elevations predicted under this alternative, the acreage of lakeshore habitats would increase slightly from the point of reference, but the WHUs (methods for calculating WHUs are provided in Appendix D) would decrease by more than 40% (Table 3F-6). The overall wildlife value of the lakeshore would be low under this alternative because most of the newly exposed habitat would be alkali flats which provide habitat only for snowy plovers and few other species (Appendix D). Marsh, alkali and wet meadow, and wetland scrub habitats would decline by more than 80% compared to the point of reference (Table 3F-6), and sources of fresh water would not exist around the lakeshore (see Chapter 3C, "Vegetation").

Drought Effects. Extreme droughts would result in steep, incised shoreline topography that would not support marsh, meadow, or wetland scrub habitats (see Chapter 3C, "Vegetation"). Under these conditions, the shoreline of Mono Lake probably would support only incidental use by most wildlife species.

Wildlife Habitat Values along Streams Tributary to Mono Lake

Under this alternative, no water would be released into any of the tributary streams in most years, except for infrequent spilling flows in extremely wet years (see Chapter 2, "Project Description").

Near-Term Changes. Most of the mature and establishing riparian trees and shrubs present along Lee Vining and Rush Creeks at the point of reference would die because streamflows and groundwater would be inadequate to sustain them. For example, more than half of the mature cottonwood-willow woodland along Lee Vining and Rush Creeks that was present at the point of reference would be lost (Table 3F-6). Meadow and wetland vegetation along these two creeks also would be reduced by about 45%, and most of these areas would revert to Great Basin scrub, dry meadow, or unvegetated habitats (see Chapter 3C, "Vegetation").

A smaller proportion of the riparian vegetation, meadow, and wetland vegetation along Parker and Walker Creeks would die because these habitats had already been modified at the point of reference by the previous 50 years of water diversions and grazing (see Chapter 3C, "Vegetation").

In the near term, many wildlife species that were present at the point of reference would continue to use riparian and meadow habitats along the four diverted tributary streams. As the acreage of riparian, meadow, and wetland habitat declined through time, however, their value to wildlife would be reduced proportionally. Overall, the acreage and WHUs of tributary riparian streams could decline by more than 50% compared to the point of reference (Table 3F-6).

Reduced acreage and increased fragmentation of existing riparian habitats in Mono Basin would degrade habitat value for resident and migratory wildlife. Similarly, special-status species such as long-eared owls, willow flycatchers, yellow warblers, yellow-breasted chats, and mountain beavers would experience significant reductions in potential habitat. Bald eagles, ospreys, and other fish-eating birds also could experience adverse effects from the loss of fisheries in the tributary streams (Appendix E).

Long-Term Changes. Infrequent spilling flows in the creeks would cause further channel incision when the lake's elevation dropped below the historical lowstand of 6,372 feet (see Chapter 3C, "Vegetation"). Increased channel incision and decreased groundwater would cause most trees and wetland-dependent shrubs along the lower reaches of Lee Vining and Rush Creeks to die, resulting in a potential loss of up to 160 acres of mature riparian habitat (see Chapter 3C, "Vegetation"). Extensive areas of dead riparian trees and shrubs could promote fires, such as those that occurred along lower Lee Vining Creek during the early 1950s.

Long-term loss and degradation of woody vegetation along the diverted tributary streams would cause most riparian-dependent species to abandon these habitats, and the resulting wildlife habitat values would be similar to those in surrounding Great Basin scrub areas. Impacts on special-status species would be identical to those described for near-term changes above.

Drought Effects. Drought effects would not differ from the near- and long-term effects of this alternative because the streams would be dry in all but the wettest years (see Chapter 3C, "Vegetation").

Wildlife Habitat Values along the Upper Owens River

Under this alternative, the increased frequency of high flows (i.e., greater than 200 cfs) could increase channel instability and result in moderate losses of willow scrub habitat. However, the acreage and WHUs of willow scrub and wet meadow habitats along the Upper Owens River probably would not change significantly (i.e., more than 10%) in response to altered flows compared to the point of reference (see Chapter 3C, "Vegetation") and no significant impacts on wildlife are expected.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures
(No-Restriction Alternative)

- Significantly reduces or eliminates the California gull colony due to reduced food supply and permanent land bridging of Negit Island and most of the historically occupied Negit and Paoha Islets.

  Mitigation Measures. None are available.

- Significantly reduces populations of migratory eared grebes and Wilson's and red-necked phalaropes due to major declines in alkali flies (60%) and brine shrimp abundance (50%); under extreme droughts, invertebrate productivity would probably cease and most water birds would abandon the lake as a migratory staging area.

  Mitigation Measures. None are available.

- Significantly reduces migratory duck populations due to elimination of existing ponds and freshwater inflows at creek deltas and large reductions in invertebrate food supplies; under extreme droughts, invertebrate productivity would probably cease and most ducks would abandon the lake as a migratory staging area.

  Mitigation Measures. None are available.

- Significantly reduces snowy plover populations due to altered lakeshore topography, reduced access to water, and major declines of lakewide alkali fly productivity.

  Mitigation Measures. None are available.

- Causes loss of more than 80% in the acreage and wildlife habitat value of marshes, meadows, and wetland scrub habitats; a large increase in alkali lakebed acreage would offer few benefits to wildlife.

  Mitigation Measures. None are available.

- Causes loss of more than 50% in the acreage and WHUs of tributary riparian streams; under extreme droughts most wetland-dependent vegetation and riparian wildlife would be lost, resulting in probable declines of special-status species such as long-eared owls, willow flycatchers, yellow warblers, yellow-breasted chats, and mountain beavers; bald eagles and ospreys could also decline in Mono Basin due to loss of fisheries.

  Mitigation Measures. None are available.

IMPACTS AND MITIGATION MEASURES FOR THE 6,372-FT ALTERNATIVE

Changes in Resource Condition

California Gull Nesting Habitat at Mono Lake

Under this alternative, Mono Lake's surface elevation would fluctuate near an average elevation of 6,375 feet, slightly less than the point-of-reference elevation (6,376.3 feet). In wet years the lake could rise to a maximum elevation of nearly 6,379 feet, and under an extreme drought it could decline to a minimum elevation of about 6,370 feet (see Chapter 2, "Project Description").

Near-Term Changes. At the point-of-reference lake elevation, Negit Island would be effectively land bridged to the mainland and would not provide secure gull nesting habitat; this condition would not change under the 6,372-Ft Alternative. At lake elevations above 6,377 feet, Negit Island provides about 155 acres of potential gull nesting habitat (Table 3F-5) and offers the only large area available for future expansion of the Mono Lake colony (see the discussion for 6,377-Ft Alternative).

Long-Term Changes. Long-term management of the lake under this alternative would cause the surface elevation to drop below about 6,374 feet with a predicted frequency of about 20%. At these lake elevations, Twain and Java Islets would effectively be land bridged and would provide coyotes and other land predators access to about 50% of the breeding adults in the Mono Lake colony (Appendix C). Overall, potential gull habitat acreage would decline by almost 20% under this alternative compared to point-of-reference conditions (Table 3F-5).

Lacking a "natural experiment" in which the lake's elevation would be managed at 6,374 feet or lower for at least several years, the long-term effects of land bridging Twain and Java Islets on the overall reproductive success of the Mono Lake colony are unknown. If land bridging events occurred during the breeding season, however, the nesting efforts of up to half the colony likely would be disrupted.

If land bridging of Twain and Java Islets occurred during the nonbreeding season, at least some breeding adults probably would relocate to other Negit or Paoha islets (Jehl, Shuford, and Winkler pers. comms.). If Twain and Java Islets were unavailable for gull nesting, the remaining 22.3 acres of the Negit Islets would have a predicted capacity of about 12,500 gull nests under this alternative (Table 3F-5). The sum of the maximum densities observed on the remaining islets (i.e., all islets but Twain and Java) in any previous year was about 12,400 nests (Dierks and Shuford 1992), suggesting that habitat suitability categories used in this analysis accurately predicted the maximum nesting capacity of the Negit Islets.

The maximum nesting capacity of the Paoha Islets predicted under this alternative range between about 16,000 and 19,000 nests (Table 3F-5), depending on which density factors are used (i.e, high, moderate, and low suitable habitat having 1,300, 600, and 200 nests per acre or all suitable nesting habitats having 1,000 nests per acre). Although, theoretically, the Paoha Islets could support up to 19,000 nests, such densities would represent more than twice the highest nest count ever recorded on these islets (i.e., about 9,300 nests in 1992). The 1992 high count represented an increase of more than 200% from the 10-year average of about 4,590 nests on the Paoha Islets (with a standard deviation of 2,280).

Under current conditions, gulls on the Paoha Islets tend to nest in dense clusters separated by large unoccupied or low-density nesting areas (Appendix C). Densities as high as 1,000 nests per acre are rarely achieved over large areas (e.g., 1 acre or more) for long periods at most gull colonies because extremely high nesting concentrations often deplete local food supplies, attract predators, or promote the spread of disease (Jehl and Winkler pers. comms.). Thus, it is likely that the actual nesting capacity of the Paoha Islets is lower than either calculated value but probably somewhat higher than the maximum of 9,300 nests observed there in 1992 (Jehl pers. comm.).

During 1992, the Mono Lake colony supported about 32,500 nests (about 65,000 breeding adults) and about 17,000 of those were on Twain and Java Islets (Appendix C). The combined total for the other Negit Islets that year was about 6,300 nests, indicating a potential unused capacity of about 6,200 nests (i.e., 12,500 minus 6,300). Similarly, estimates of the unused capacity on the Paoha Islets in 1992 ranged between 6,700 nests and 9,700 nests (i.e., 16,000 or 19,000 minus 9,300). Assuming these nesting capacity values for the Negit and Paoha Islets, a minimum of about 1,300 nests and a maximum of 4,300 nests would be displaced if both Twain and Java Islets were land bridged under 1992 conditions (i.e,. 11,000 minus 9,700 or 6,700).

Alternatively, assuming the highest densities ever observed on the Paoha Islets (i.e., 9,300 nests) and Negit Islets (i.e., 12,500 nests) approaches the maximum nesting capacities of these areas, the land bridging of Twain and Java Islets could cause long-term displacement of about 11,000 nests (i.e., 17,000 displaced nests minus about 6,200 nests that could be relocated to other Negit Islets).

Observations at Mono Lake and at other California gull colonies suggest that adults displaced from their nests during the breeding season may prey on the eggs and chicks of other adults (Appendix C). The potential effects of predation by displaced gulls are unknown but may be short-term reductions in the overall reproductive success of the Mono Lake colony. Thus, the exact number of displaced gulls or their effects on other breeding adults cannot be accurately predicted. Depending on the initial assumptions, however, the number of displaced gull nests at Mono Lake is predicted to range from a low of about 1,300 (2,600 adults) to a high of about 11,000 (22,000 adults) under this alternative.

Drought Effects. Because the lake has not fallen to 6,370 feet in the historical period, the effects of drought under this alternative cannot be accurately predicted. Under extreme drought conditions, however, Twain and Java Islets would be continually land bridged and other nearby nesting islets such as Little Tahiti would become more accessible to coyotes and other land predators. Increased predation probably would cause further reductions in the size and reproductive success of the Mono Lake colony compared to the average lake elevations predicted under this alternative.

Effects of Invertebrate Availability on Migratory Water Birds

At the average elevation predicted under this alternative (i.e., 6,375 feet) levels of alkali fly and brine shrimp productivity would be similar to those observed at the point of reference (see Chapter 3E, "Aquatic Productivity"). Within the range of elevations that could occur during extreme droughts or very wet periods (i.e., 6,370-6,379 feet), however, the amount of hard substrate available for the attachment of alkali fly pupae changes substantially. For example, the number of alkali fly larvae (pupating third instars) at the point of reference would be about 40% higher than those at 6,370 feet but only about 65% of those at 6,379 feet (see Chapter 3E, "Aquatic Productivity").

At lower lake elevations (i.e., less than 6,376 feet), red-necked phalaropes would be generally restricted to the lake's northeastern sector where they would forage at less than optimal efficiency (Rubega 1992). Phalaropes are attracted to this area probably because it is the only suitable foraging habitat for these species remaining at lower elevations of Mono Lake. The prevailing southwesterly winds of Mono Basin cause lake currents to move in opposite directions along the northern and eastern shorelines until they collide in the lake's northeastern sector (Stine 1993b). This merging of currents from a large area tends to concentrate free-floating alkali fly larvae in densities higher than in any other portion of the lake (Herbst 1992). At elevations below the point of reference, this area would continue to provide ample prey to support migratory phalaropes while the remainder of Mono Lake probably would be unsuitable foraging habitat. At higher elevations (i.e., above 6,376 feet), however, lakewide prey densities would increase significantly (see Chapter 3E, "Aquatic Productivity") and phalaropes probably would be widespread at Mono Lake.

Brine shrimp populations would decline as lake elevation was reduced from the point of reference; however, even at the historical lowstand (i.e., 6,372 feet) this prey species was sufficiently abundant to support hundreds of thousands of eared grebes. Brine shrimp are unlikely to experience significant declines (i.e., more than 10%) from the point of reference if the lake falls as low as 6,372 feet. During an extreme drought, however, the lake could fall to 6,370 feet under this alternative, but the effect of the elevation change on eared grebes cannot be assessed because the lake never reached 6,370 feet elevation in the historical period.

Abundance of Migratory Ducks at Mono Lake

At the average and maximum surface elevations predicted under this alternative, Mono Lake probably would support point-of-reference populations of migratory ducks (i.e., 11,000-15,000 individuals per year). About 0.5 acre of open water habitat would exist near the mouth of Wilson Creek and a few small ponds (i.e., less than 0.1 acre) at Simon's Spring and Warm Springs would also be present. Compared to point-of-reference conditions, average freshwater inflows at the Rush and Lee Vining Creek deltas would increase by about 40% and 75%, respectively. Additional freshwater at the creek deltas would make them more attractive to migratory ducks.

In about half the years under this alternative, alkali fly productivity would be reduced from point-of-reference conditions and during extreme droughts lakewide densities of alkali files could decline by 40% (see Chapter 3E, "Aquatic Productivity"). The diets of most ducks at Mono Lake have not been examined in detail, but declining alkali fly productivity would probably reduce the food available to most species at the lake. Thus, the benefits of increased delta outflows could be offset by declines in lakewide alkali fly productivity and duck populations under this alternative probably would not change significantly from point-of-reference conditions.

Snowy Plover Nesting Habitat at Mono Lake

Mono Lake would remain above the nick point (i.e., 6,368 feet) at all surface elevations predicted under this alternative, including extreme droughts when it could fall as low as about 6,370 feet. At the point of reference, only about 25% of the potential habitat around the lakeshore was occupied by nesting snowy plovers and this condition would not change under the 6,372-Ft Alternative. During extremely wet periods, the lake's elevation could rise to about 6,379 feet, which would inundate more than 3,000 acres of alkali lakeshore. However, a similar 9-foot change in the lake's elevation from 1982 to 1986 had no measurable effect on the breeding snowy plover population (Page pers. comm.). Thus, the range of lake elevations predicted under this alternative would be unlikely to affect this species compared to the point of reference.

Wildlife Habitat Values of the Mono Lake Shoreline

Near-Term Changes. During the first few years under this alternative, the acreage and overall wildlife values of lakeshore marshes, meadows, and wetlands scrub habitats would be similar to the point of reference (see Chapter 3C, "Vegetation").

Long-Term Changes. At the average elevations predicted under this alternative, the acreage of lakeshore habitats would decrease by more than 10%, but the WHUs would be similar to the point of reference (Table 3F-6). Significant impacts on wildlife would not be expected.

Drought Effects. Extreme droughts would not result in steep, incised shoreline topography because the lake's surface elevation would not fall below the nick point (see Chapter 3C, "Vegetation"). Thus, lakeshore habitats and wildlife populations would not be expected to change significantly from the point of reference.

Wildlife Habitat Values along Streams Tributary to Mono Lake

Under this alternative, minimum flows would be required in the four diverted tributary streams to maintain fisheries and riparian vegetation; the range of flows would be similar in dry, normal, and wet years and would represent a significant increase from the point of reference (see Chapter 2, "Project Description").

Near-Term Changes. Mature riparian trees and shrubs existing along these streams would continue to grow and the acreage of establishing vegetation would increase in response to rewatering the channels. Compared to the point of reference, these riparian habitats would have improved plant vigor, canopy density, and vegetative layering (see Chapter 3C, "Vegetation"). These changes would have significant beneficial effects on wildlife.

Meadow and wetland vegetation on Lee Vining and Rush Creeks could increase slightly in extent and vigor in the near term due to increased groundwater and a moratorium on grazing (see Chapter 3C, "Vegetation"). These changes would have minor beneficial effects on wildlife.

Long-Term Changes. Most areas with mature riparian vegetation would continue to live and grow, and most areas with establishing vegetation would eventually support mature riparian habitat (see Chapter 3C, "Vegetation"). Similarly, meadow and wetland vegetation may expand slightly, especially if grazing continues to be excluded.

The acreage of mature cottonwood-willow woodland would increase by more than 110 acres under this alternative compared to the point of reference (Table 3F-6). This increased acreage would have major benefits for resident and migratory wildlife and for riparian-dependent special-status species such as long-eared owls, yellow warblers, yellow-breasted chats, and mountain beavers (Appendix E). Partial restoration of the riparian corridor would facilitate wildlife movement between the eastern flank of the Sierra and the shores of Mono Lake. Under this alternative, however, the relatively low lake elevation and deeply incised creek channels would disrupt the continuity of riparian corridors on the lower reaches of Lee Vining and Rush Creeks.

The acreage of riparian habitats along Parker and Walker Creeks under this alternative would be identical to the point of reference (see Chapter 3C, "Vegetation"); similarly, the wildlife habitat values would not change.

Wildlife Habitat Values along the Upper Owens River

Under this alternative, the increased frequency of high flows (i.e., greater than 200 cfs) could increase channel instability and result in moderate losses of willow scrub habitat; continued cattle browsing would also decrease the extent of this habitat (see Chapter 3C, "Vegetation"). Minor flow-induced changes in willow scrub acreage, however, would not cause significant impacts on wildlife compared to the point of reference.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures
(6,372-Ft Alternative)

- Allows nesting gulls to be disturbed by coyotes that could invade Negit Island 80% of the time and Twain and Java Islets 20% of time; half the gull colony could be affected if these islets were land bridged during the breeding season, and between 2,600 and 22,000 nesting adults could experience long-term displacement if these islets were permanently unavailable for gull nesting.

Mitigation Measures. Two methods of restricting coyote access to Negit Island have been attempted: predator-proof fences and channel blasting. Neither of these methods was effective, and substantial barriers of open water are probably required to prevent coyote predation of island nesting colonies (Appendix C). No mitigation measures are available.

- Significantly reduces alkali fly productivity in about half the years, which could be detrimental to phalaropes, ducks, and other migratory water birds; during wet periods, the lake's alkali fly productivity could increase by about 35%, which would benefit most migratory water birds.

Mitigation Measures. None are available; only managing diversions for high lake levels could avoid this impact.

- Increases cottonwood-willow woodlands by more than 110 acres, providing major benefits to resident and migratory wildlife and restoring the riparian corridor along tributary streams; new habitat also would provide significant benefits to special-status species such as long-eared owls, yellow warblers, yellow-breasted chats, and mountain beavers; bald eagles and ospreys could also benefit from enhanced fisheries.

IMPACTS AND MITIGATION MEASURES FOR THE 6,377-FT ALTERNATIVE

Changes in Resource Condition

California Gull Nesting Habitat at Mono Lake

Under this alternative, Mono Lake's surface elevation would gradually increase from the point of reference (6,376.3 feet) to an average elevation of about 6,379 feet. In wet years the lake could rise to a maximum elevation of about 6,383 feet, and under an extreme drought it could decline to a minimum elevation of about 6,373 feet (see Chapter 2, "Project Description").

Near-Term Changes. Compared to the point of reference, the target minimum lake elevation predicted under this alternative would protect about 155 acres of potential gull nesting habitat on Negit Island. The potential gull nesting capacity of Mono Lake would be maximized under this alternative; more than 180 acres of suitable nesting habitat would be available, representing an increase of about 360% from point-of-reference conditions (Table 3F-5).

Long-Term Changes. At lake elevations above 6,377 feet, Negit Island provides about 155 acres of potential gull nesting habitat (Table 3F-5) and offers the only large area available for future expansion of the Mono Lake colony. Overall, this would be considered a beneficial effect compared to point-of-reference conditions.

Drought Effects. Normal minimum runoff conditions under this alternative would cause the lake's elevation to fall below 6,376.5 feet in 2-4% of the years. This elevation could permit coyotes to cross the land bridge to Negit Island and could disrupt the nesting efforts of any gulls that recolonized this area. Episodes of gull colonization of Negit Island under this alternative would therefore be punctuated by periodic land bridging and subsequent coyote invasions that would have an overall disruptive effect on the Mono Lake colony. Similarly, Twain and Java Islets could be land bridged about 1% of the years during extreme droughts and would cause identical impacts to those described for the 6,372-Ft Alternative.

Effects of Invertebrate Productivity on Migratory Water Birds

At the average lake elevations predicted under this alternative the lakewide productivity of alkali flies would increase by about 40% from point-of-reference conditions, which would benefit phalaropes and other migratory water birds. Under extreme droughts, however, the lake's elevation could fall to about 6,373 feet and impacts on migratory water birds would be similar to those described for the 6,372-Ft Alternative.

Abundance of Migratory Ducks at Mono Lake

At the average lake elevations predicted under this alternative, the acreage of open water habitat around the lakeshore would not change from point-of-reference conditions (see Chapter 3C, "Vegetation"). Average freshwater outflows at the creek deltas (September-December) would be identical to those described for the 6,372-Ft Alternative, but normal maximum flows would be about 65% higher.

Migratory ducks would benefit from the 40% increase in lakewide alkali fly productivity compared to point-of-reference conditions (see Chapter 3E, "Aquatic Productivity"). Similarly, brine shrimp populations would increase by about 15%, which could provide benefits to northern shovelers and possibly other duck species.

Snowy Plover Nesting Habitat at Mono Lake

Mono Lake would remain above the nick point (i.e., 6,368 feet) at all surface elevations predicted under this alternative, including extreme droughts. Most alkali lakeshore habitat currently occupied by nesting snowy plovers would be inundated at the highest lake elevations (i.e., about 6,383 feet) but almost 5,000 acres of suitable habitat would remain on barren sands, pumice plains, and other unvegetated areas around the lakeshore (see Chapter 3C, "Vegetation"). Because this acreage represents more than twice the habitat area occupied by snowy plovers at the point of reference, the range of lake elevations predicted under this alternative would be unlikely to affect this species.

Wildlife Habitat Values of the Mono Lake Shoreline

Near-Term Changes. During the first few years under this alternative, the acreage and overall wildlife values of lakeshore marshes, meadows, and wetlands scrub habitats would be similar to the point of reference (see Chapter 3C, "Vegetation").

Long-Term Changes. At the average elevations predicted under this alternative, the acreage of lakeshore habitats would decrease by almost 40%, but the WHUs would be similar to the point of reference (Table 3F-6) and significant impacts on wildlife are not expected.

Drought Effects. Extreme droughts would result in increased acreage of alkali lakeshore habitats, which would have low value to wildlife. Thus, lakeshore habitats and wildlife populations are not expected to change significantly from the point of reference.

Wildlife Habitat Values Along Streams Tributary to Mono Lake

Under this alternative, minimum flows would be required in the four diverted tributary streams to maintain fisheries and riparian vegetation. Compared to the 6,372-Ft Alternative and the point of reference, however, ecosystem maintenance flows would be more frequent in summer (see Chapter 2, "Project Description").

Near-Term Changes. Similar to the 6,372-Ft Alternative, mature riparian trees and shrubs existing along the tributary streams would continue to grow and the acreage of establishing vegetation would increase. Implementation of the 6,377-Ft Alternative would increase the acreage of cottonwood-willow woodlands by about 120 acres, which would provide major benefits to resident and migratory wildlife. Compared to the point of reference, these riparian habitats would have improved plant vigor, canopy density, and vegetative layering (see Chapter 3C, "Vegetation") and would benefit more wildlife species than any other habitat in Mono Basin (Appendix D).

Meadow and wetland vegetation on Lee Vining and Rush Creeks could increase slightly in extent and vigor in the near term due to increased areas of shallow groundwater and a moratorium on grazing (see Chapter 3C, "Vegetation"). These changes would have beneficial but less-than-significant benefits on wildlife.

Long-Term Changes. Most areas with mature riparian vegetation would continue to live and grow and most areas with establishing vegetation would eventually support mature riparian habitat. Similarly, increased areas of shallow groundwater would permit a slight increase in the extent of meadow and wetland vegetation under this alternative, especially if the grazing moratorium is continued (see Chapter 3C, "Vegetation").

The acreage of mature cottonwood-willow woodland would increase by more than 120 acres under this alternative compared to the point of reference (Table 3F-6). The riparian corridor would become more continuous than under the 6,372-Ft Alternative, because vegetation beyond the low-flow channels would support establishing riparian trees and shrubs. Increased acreage and continuity would have major benefits for resident and migratory wildlife and for riparian-dependent special-status species such as long-eared owls, yellow warblers, yellow-breasted chats, and mountain beavers.

The acreage of riparian habitats along Parker and Walker Creeks under this alternative would be similar to the point of reference (see Chapter 3C, "Vegetation"); similarly, the wildlife habitat values would not change.

Wildlife Habitat Values along the Upper Owens River

Under this alternative, the frequency of high flows (i.e., greater than 200 cfs) would decrease slightly from the point of reference and the minor beneficial impacts would be similar to those described for the 6,372-ft Alternative.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,377-Ft Alternative)

- Maximizes potential gull nesting habitat in most years because Negit Island would be protected and additional habitat would be available on the Negit and Paoha Islets. In 2-4% of the years, however, Negit Island would be land bridged and gull nesting efforts would be disrupted; during extreme droughts, Twain and Java Islets would be land bridged and the impacts would be similar to those described previously for the 6,372-Ft Alternative.

  Mitigation Measures. No mitigation measures are available.

- Increases productivity of alkali flies (35%) and brine shrimp (15%) at the higher elevations predicted under this alternative, potentially providing significant benefits to most species of migratory water birds at Mono Lake. During extreme droughts, however, lakewide alkali fly productivity could be reduced by 40% and the adverse impacts on phalaropes and other water birds would be identical to those described for the 6,372-Ft Alternative.

  Mitigation Measures. None are available.

- Extreme droughts could reduce lakewide alkali fly productivity by 40%; the adverse impacts on migratory ducks would be similar to those described for the 6,372-Ft Alternative; benefits migrating ducks by increased productivity of alkali flies (35%) and brine shrimp (15%) at the higher elevations predicted under this alternative.

Mitigation Measures. None are available.

- Partially restores the wildlife movement corridor along the tributary streams because of increase of more than 120 acres in cottonwood-willow habitat. Increases value of the riparian zone to resident and migratory wildlife and special-status species due to increased vigor, density, and continuity, compared to the 6,372-Ft Alternative.

IMPACTS AND MITIGATION MEASURES FOR THE 6,383.5-FT ALTERNATIVE

Changes in Resource Condition

California Gull Nesting Habitat at Mono Lake

Under this alternative, Mono Lake's surface elevation would gradually increase from the point-of-reference (6,376.3 feet) to an average elevation of about 6,386 feet. In wet years the lake could rise to a maximum elevation of about 6,389 feet, and under an extreme drought it could decline to a minimum elevation of about 6,378 feet (see Chapter 2, "Project Description").

Near-Term Changes. Compared to the point of reference, the target minimum lake elevation predicted under this alternative would protect about 142 acres of gull nesting habitat on Negit Island, and the lakewide nesting capacity would increase by about 330% from the point of reference (Table 3F-5).

Long-Term Changes. At lake elevations above 6,389 feet, most of the Paoha Islets would be lost due to wave erosion (Stine 1993), a loss of almost 20 acres of potential gull nesting habitat. The presence of Negit Island, however, represents an increase of more than 330% in lakewide habitat acreage under this alternative compared to point-of-reference conditions (Table 3F-5). Thus, the loss of the Paoha Islets would not be considered a significant adverse impact because abundant potential habitat would be available for the Mono Lake colony.

Drought Effects. Even under conditions of extreme drought, Negit Island would be protected under this alternative and no significant impacts on the gull colony are expected.

Effects of Invertebrate Productivity on Migratory Water Birds

Lakewide productivity of alkali flies would be maximized at the range of surface elevations predicted under this alternative (see Chapter 3E, "Aquatic Productivity"). For example, at the average elevation (i.e., about 6,386 feet) the predicted production of third instar larvae would be about 40% higher than populations observed at the point of reference. Overall, this increase in food supply would be a substantial benefit to phalaropes and other water birds and it would enhance the value of Mono Lake as a migratory staging area for these species.

Brine shrimp populations would increase by about 20% under this alternative compared to the point of reference, which would be a substantial beneficial impact on eared grebes and other migratory water birds at the lake.

Abundance of Migratory Ducks at Mono Lake

Approximately 6 acres of ponds would be present around the lakeshore under this alternative (see Chapter 3C, "Vegetation"), providing migratory ducks with isolated sources of fresh water for drinking and bathing, which would offer substantial benefits compared to the point of reference. Normal minimum and average flows at the Rush and Lee Vining Creek deltas (September-December) would have identical benefits to those described for the 6,372-Ft Alternative.

Similar to phalaropes and other migratory water birds, ducks would benefit from increased alkali fly (40%) and brine shrimp (20%) productivity predicted under this alternative (see Chapter 3E, "Aquatic Productivity").

Snowy Plover Nesting Habitat at Mono Lake

During average lake elevations (i.e., about 6,386 feet) predicted under this alternative, only about 800 acres of alkali lakeshore habitat would exist for nesting snowy plovers. However, about 5,000 acres of suitable breeding habitat would still be available for this species on barren sands, pumice plains, and other unvegetated areas around the lakeshore (see Chapter 3C, "Vegetation"). Thus, effects on snowy plovers would be identical to those described for the 6,377-Ft Alternative.

Wildlife Habitat Values of the Mono Lake Shoreline

Near-Term Changes. During the first few years under this alternative, the acreage and overall wildlife values of lakeshore marshes, meadows, and wetland scrub habitats would be similar to the point of reference (see Chapter 3C, "Vegetation").

Long-Term Changes. At the average elevations predicted under this alternative, the acreage of lakeshore habitats would decrease by about 55% and the WHUs would decrease by more than 20% from the point of reference (Table 3F-6). Most of the inundated acreage, however, would be alkali lakeshore, which has extremely low wildlife habitat value (Appendix D).

After a period of years, approximately 6 acres of freshwater ponds would also form at the Rush Creek delta under this alternative, which would provide significant benefits to ducks, shorebirds, wading birds, and other migratory water birds. Thus, the adverse effects of inundating low-value lakeshore habitats would be more than offset by the re-creation of important new sources of water around the lakeshore; significant effects on wildlife are not expected.

Drought Effects. Extreme droughts would result in increased acreage of alkali lakeshore habitats, which would have low value to wildlife. Drought effects probably would be similar to the long-term changes described for this alternative.

Wildlife Habitat Values along Streams Tributary to Mono Lake

Under this alternative, minimum flows would be required in the four diverted tributary streams to maintain fisheries and riparian vegetation. Compared to the 6,377-Ft Alternative and the point of reference, however, ecosystem maintenance flows would be more frequent (see Chapter 2, "Project Description").

Near-Term Changes. Similar to the 6,377-Ft Alternative, mature riparian trees and shrubs existing along the tributary streams would continue to grow and the acreage of establishing vegetation would increase. The 6,383.5-Ft Alternative would increase the acreage of cottonwood-willow woodlands by about 125 acres, which would provide major benefits to resident and migratory wildlife. Compared to the point of reference, these riparian habitats would have improved plant vigor, canopy density, and vegetative layering (see Chapter 3C, "Vegetation") and would benefit more wildlife species than any other habitat in Mono Basin (Appendix D).

Meadow and wetland vegetation on Lee Vining and Rush Creeks could increase slightly in extent and vigor in the near-term due to increased groundwater and a moratorium on grazing (see Chapter 3C, "Vegetation"). These changes would have minor beneficial effects on wildlife.

Long-Term Changes. Most areas with mature riparian vegetation would continue to live and grow, and most areas with establishing vegetation would eventually support mature riparian habitat. Similarly, increased areas of shallow groundwater would permit a slight increase in the extent of meadow and wetland vegetation under this alternative, especially if the grazing moratorium is continued (see Chapter 3C, "Vegetation").

The riparian corridor would become more continuous than under the 6,377-Ft Alternative, because vegetation beyond the low flow channels would support establishing riparian trees and shrubs. Increased acreage and continuity would have major benefits for resident and migratory wildlife and for riparian-dependent special-status species such as long-eared owls, yellow warblers, yellow-breasted chats, and mountain beavers.

The acreage of riparian habitats along Parker and Walker Creeks under this alternative would be similar to the point of reference (see Chapter 3C, "Vegetation"); similarly, the wildlife habitat values would not change.

Wildlife Habitat Values along the Upper Owens River

Under this alternative, the frequency of high flows (i.e., greater than 200 cfs) would decrease from the point of reference and the minor beneficial impacts would be similar to those described for the 6,372-Ft Alternative.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures
(6,383.5-Ft Alternative)

- Provides long-term protection to Negit Island and Twain and Java Islets from coyote predation and increases the lakewide acreage of potential gull nesting habitat by more than 330%. Similar to phalaropes and ducks, gulls would benefit from maximum lakewide productivity of brine shrimp and alkali flies predicted under this alternative.
- Substantially benefits eared grebes, phalaropes, and other migratory water birds by increased productivity of alkali flies (40%) and brine shrimp (20%) at the average elevations predicted under this alternative.
- Substantially benefits migratory ducks through 6 acres of new ponds, increased flows at creek deltas, and increased productivity of alkali flies (40%) and brine shrimp (20%) predicted under this alternative.
- Partially restores the wildlife movement corridor along the tributary streams because of increase of more than 125 acres of cottonwood-willow habitat. Due to increased vigor, density, and continuity, increases the value of the riparian zone to resident and migratory wildlife and special-status species.

IMPACTS AND MITIGATION MEASURES FOR THE 6,390-FT ALTERNATIVE

Changes in Resource Condition

California Gull Nesting Habitat at Mono Lake

Under this alternative, Mono Lake would gradually increase from the point-of-reference surface elevation (6,376.3 feet) to an average elevation of about 6,392 feet. In wet years the lake could rise to a maximum elevation of about 6,395 feet, and under an extreme drought it could decline to a minimum elevation of about 6,383 feet (see Chapter 2, "Project Description"). Project impacts would be identical to those previously described for the 6,383.5-Ft Alternative, except that the potential habitat acreage for nesting gulls would not increase as much from the point-of-reference conditions (260%) because of inundation of habitat (Table 3F-5).

Effects of Invertebrate Productivity on Migratory Water Birds

Compared to point-of-reference populations, alkali flies and brine shrimp populations would both increase by about 30% under this alternative. Abundant invertebrate food would increase Mono Lake's attractiveness to grebes, phalaropes, and other migratory water birds, similar but somewhat less than the 6,383.5-Ft Alternative.

Abundance of Migratory Ducks at Mono Lake

After a period of years, approximately 16 acres of ponds would form at the Rush Creek delta and on Paoha Island under this alternative (see Chapter 3C, "Vegetation"), providing migratory ducks with new sources of fresh water for drinking and bathing. Normal minimum and average flows at the Rush and Lee Vining Creek deltas (September-December) would be identical to those described for the 6,372-Ft Alternative. Migratory ducks also would benefit from 30% increases in alkali fly and brine shrimp productivity. Increased sources of fresh water around the lakeshore would also provide substantial benefits to shorebirds, wading birds, and other migratory water birds.

Snowy Plover Nesting Habitat at Mono Lake

During average lake elevations predicted under this alternative (i.e., about 6,392 feet), all alkali lakeshore habitats would be inundated but about 4,870 acres of suitable habitat would still be available for nesting snowy plovers on barren sands, pumice plains, and other unvegetated areas around the lakeshore (see Chapter 3C, "Vegetation").

Thus, effects on snowy plovers would be identical to those described for the 6,377-Ft Alternative.

Wildlife Habitat Values of the Mono Lake Shoreline

Near-Term Changes. During the first few years under this alternative, the acreage and overall wildlife values of lakeshore marshes, meadows, and wetlands scrub habitats would be similar to the point of reference (see Chapter 3C, "Vegetation").

Long-Term Changes. At the average elevations predicted under this alternative, the acreage of lakeshore habitats would decrease by about 68%, and the WHUs would decrease by more than 40% from the point of reference and would displace resident wildlife (Table 3F-6). Most of the inundated acreage, however, would be alkali lakeshore and dry meadows, which have low wildlife habitat values (Appendix D).

As the lake's elevation gradually approached 6,390 feet under this alternative, nesting ospreys would probably be displaced from their current nesting site on a tufa tower just offshore from Navy Beach. With increasing lake elevations this site would be exposed to wave action and possibly inundation. Although ospreys often nest at the same site in multiple years, they will select a new nest site if the old one is destroyed (Airola and Shubert 1981); evidence suggests that this species will readily accept artificial platforms if they are provided (Garber et al. 1974). Under the higher lake level alternatives, numerous large, partially submerged tufa towers would be available to nesting ospreys near Navy Beach and South Tufa State Reserve if the current tufa tower became close to the lake surface or was submerged; some towers would presumably provide suitable habitat.

Drought Effects. Extreme droughts would result in increased acreage of alkali lakeshore and dry meadow habitats, which would have low value to wildlife. Thus, drought effects probably would be similar to the long-term changes described for this alternative.

Wildlife Habitat Values along Streams Tributary to Mono Lake

Beneficial impacts on wildlife of increased riparian habitat would be identical to those described for the 6,383.5-Ft Alternative.

Wildlife Habitat Values along the Upper Owens River

Under this alternative, the frequency of high flows (i.e., greater than 200 cfs) would decrease from the point of reference and the minor beneficial effects would be similar to those described for the 6,372-ft Alternative.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,390-Ft Alternative)

- Benefits to gulls would be similar to those described for the 6,383.5-Ft Alternative, except that the increase in lakewide acreage of potential nesting habitat from point-of-reference conditions (260%) would be somewhat less.
- Offers substantial but less than maximum benefits to eared grebes, phalaropes, and other migratory water birds because of increased productivity of alkali flies (30%) and brine shrimp (30%) compared to point-of-reference conditions.
- Offers substantial benefits to migratory ducks because of 16 acres of new ponds and increased productivity of alkali flies and brine shrimp compared to point-of-reference conditions.
- Benefits to wildlife of increased riparian habitat along diverted tributary streams would be identical to those described for the 6,383.5-Ft Alternative.
- Through inundation, loss of more than 1,000 acres of existing marshlands, wet meadows, and scrublands and displacement of resident wildlife.

  Mitigation Measure. None are available.

IMPACTS AND MITIGATION MEASURES FOR THE 6,410-FT ALTERNATIVE

Changes in Resource Condition

California Gull Nesting Habitat at Mono Lake

Under this alternative, Mono Lake would gradually increase from the point-of-reference surface elevation (6,376.3 feet) to an average of about 6,411 feet. In wet years the lake could rise to a maximum elevation of about 6,415 feet, and under an extreme drought it could decline to a minimum elevation of about 6,401 feet (see Chapter 2, "Project Description"). Project impacts would be identical to those previously described for the 6,383.5-Ft Alternative, except that the potential habitat acreage for nesting gulls would not increase as much from the point-of-reference conditions (195%) because of inundation of habitat (Table 3F-5).

Effects of Invertebrate Productivity for Migratory and Nesting Water Birds

Based on the occurrence of hard substrates, productivity of alkali flies is predicted to be 20% higher than under point-of-reference conditions (see Chapter 3E, "Aquatic Productivity). However, that analysis does not consider submerged lakeshore vegetation that could potentially serve as additional hard substrate for the attachment of alkali fly pupae (Herbst pers. comm.).

Due to uncertainties regarding the extent of submerged vegetation and algae around the lakeshore, the actual productivity of alkali flies cannot be accurately predicted at lake elevations above about 6,390 feet. Accounts by prediversion observers indicate that alkali flies may have been more abundant at the lake prior to 1940 than they were at the point of reference (Fisher 1902; Banta, DeChambeau, and McPherson pers. comms.).

Brine shrimp populations would increase by about 35% under this alternative compared to the point of reference. This increase would substantially benefit eared grebes. Thus, overall increase in invertebrate food supplies under this alternative is expected to increase Mono Lake's attractiveness to eared grebes, phalaropes, and other migratory water birds that consume brine shrimp.

Abundance of Migratory Ducks at Mono Lake

Approximately 260 acres of ponds and lagoons would reform at the north Mono shorelands (i.e., Black Point, Bridgeport embayment, Dune Lagoons), at South Tufa, and at the Wilson-Mill, Lee Vining, and Rush Creek deltas under this alternative (see Chapter 3C, "Vegetation") that would provide migratory ducks, shorebirds, and wading birds with new sources of fresh water for foraging, drinking, and bathing. Similarly, the average flows at the deltas of Rush and Lee Vining Creeks would increase by about 60% and 80%, respectively, from the point of reference. Thus, the increased acreage of open water, streamflows, and abundance of invertebrate food predicted under this alternative would provide habitat conditions for migratory ducks similar to those described in the prediversion period.

Restoration of prediversion habitats probably would permit substantial increases in the number of migratory ducks visiting Mono Lake compared to the point of reference. Populations of most species have declined throughout North America since 1940, however, and the number of ducks using restored habitats at the lake would likely be far less than maximum counts from the prediversion period. The actual number of ducks visiting Mono Lake each year probably would vary depending on the population size and reproductive success of these species in western North America.

Snowy Plover Nesting Habitat at Mono Lake

During average lake elevations predicted under this alternative, all alkali lakeshore habitats would be inundated but about 4,800 acres of suitable habitat would still be available for nesting snowy plovers on barren sands, pumice plains, and other unvegetated areas around the lakeshore (see Chapter 3C, "Vegetation"). Thus, impacts on snowy plovers would be identical to those described for the 6,377-Ft Alternative.

Wildlife Habitat Values of the Mono Lake Shoreline

Near-Term Changes. During the first few years under this alternative, the acreage and overall wildlife values of lakeshore marshes, meadows, and wetlands scrub habitats would be similar to the point of reference (see Chapter 3C, "Vegetation").

Long-Term Changes. At the average elevations predicted under this alternative, the acreage of lakeshore habitats would decrease by about 84%, and the WHUs would decrease by more than 75% from the point of reference (Table 3F-6). Much of the inundated acreage would be alkali lakeshore and dry meadows, but more than 2,000 acres of marshes, wet meadows, and wetland scrub habitats also would be inundated and would displace resident wildlife. Effects on nesting ospreys would be similar to those described for the 6,390-Ft Alternative, except that the tufa groves along the south shoreline of the lake would be inundated (Stine pers. comm.). By the time this impact materialized, however, alternate nesting sites for this species would develop in tall trees or live snags along Rush and Lee Vining Creeks.

Drought Effects. Extreme droughts would result in increased acreage of alkali lakeshore and dry meadow habitats, which would have low value to wildlife. Thus, drought effects probably would be similar to the long-term changes described for this alternative.

Wildlife Habitat Values along Streams Tributary to Mono Lake

Benefits to wildlife of increased riparian habitat would be identical to those described for the 6,383.5-Ft Alternative.

Wildlife Habitat Values along the Upper Owens River

Under this alternative, the frequency of high flows (i.e., greater than 200 cfs) would decrease from the point of reference and the minor benefits would be similar to those described for the 6,372-Ft Alternative.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,410-Ft Alternative)

- Benefits to gulls would be similar to those described for the 6,383.5-Ft Alternative, except that the lakewide increase in acreage of potential nesting habitat from point-of-reference conditions (195%) would be somewhat less.
- Benefits to eared grebes, phalaropes, and other water birds probably would be somewhat less or similar to those described for the 6,383.5-Ft Alternative.
- Provides significant potential for increases in migratory duck habitat through restoration of 260 acres of ponds and lagoons, increased flows at the creek deltas, and abundant invertebrate food.
- Results in major benefits for shorebirds, wading birds, and other migratory water birds because ponds and lagoons would be restored to their prediversion acreages.
- Through inundation loss of 2,000 acres of existing marshlands, wet meadows, and scrublands; resident wildlife would be displaced.
- Benefits to wildlife of increased riparian habitat along diverted tributary streams would be identical to those described for the 6,383.5-Ft Alternative.

Mitigation Measures. None are available.

IMPACTS AND MITIGATION MEASURES FOR THE NO-DIVERSION ALTERNATIVE

Changes in Resource Condition

California Gull Nesting Habitat at Mono Lake

Under this alternative, Mono Lake would gradually increase from the point-of-reference surface elevation (6,376.3 feet) to an average of about 6,427 feet. In wet years the lake could rise to a maximum elevation of about 6,436 feet, and under an extreme drought it could decline to a minimum elevation of about 6,416 feet (see Chapter 2, "Project Description"). Project impacts would be identical to those previously described for the 6,383.5-Ft Alternative, except that the potential habitat acreage for nesting gulls would not increase as much from point-of-reference conditions (184%) because of inundation of habitat (Table 3F-5).

Effects of Invertebrate Productivity on Migratory Water Birds

Based on the occurrence of hard substrates, productivity of alkali flies is predicted to be 12% higher than under point-of-reference conditions, and brine shrimp productivity would be 50% higher. Benefits to eared grebes probably would be similar to those described for the 6,383.5-Ft Alternative. Due to uncertainties regarding the extent of submerged vegetation and algae around the lakeshore, the productivity of alkali flies cannot be accurately predicted at the lake levels involved under this alternative, as described previously.

Abundance of Migratory Ducks at Mono Lake

Benefits to migratory ducks would be identical to those described for the 6,410-Ft Alternative.

Snowy Plover Nesting Habitat at Mono Lake

During average lake elevations predicted under this alternative (i.e., 6,425-6,430 feet), all alkali lakeshore habitats and many other barren areas would be inundated by the rising waters of Mono Lake. Under such conditions, the available habitat could fall below point-of-reference requirements for this species (i.e., a minimum of 2,500 acres) and significant adverse impacts on snowy plovers could result.

Wildlife Habitat Values of the Mono Lake Shoreline

Adverse impacts of inundating 95% of the lakeshore wetland habitat would be similar to those described for the 6,410-Ft Alternative. Effects on nesting ospreys would be similar to those described for the 6,410-Ft Alternative.

Wildlife Habitat Values along Streams Tributary to Mono Lake

Benefits to wildlife of increased riparian habitat would be similar to those described for the 6,383.5-Ft Alternative, except that the cottonwood-willow habitat would be slightly more extensive (Table 3F-6).

Wildlife Habitat Values along the Upper Owens River

Under this alternative, the frequency of high flows (i.e., greater than 200 cfs) would decrease from the point of reference and the minor benefits would be similar to those described for the 6,372-Ft Alternative.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (No-Diversion Alternative)

- Benefits to gulls would be similar to those described for the 6,383.5-Ft Alternative, except that the lakewide increase in acreage of potential nesting habitat from point-of-reference conditions (180%) would be somewhat less.

- Benefits to eared grebes would be similar to those described for the 6,383.5-Ft Alternative; benefits to phalaropes would be less or similar to those described for the 6,383.5-Ft Alternative.

- Benefits to migratory ducks would be identical to those described for the 6,410-Ft Alternative.

- Adverse impacts of inundating 95% of the lakeshore marshes, wet meadows, and wetland scrub habitats would be similar to those described for the 6,410-Ft Alternative.

  Mitigation Measure. None are available.

- Causes the acreage of potential snowy plover habitat to fall below the minimum requirements of the point-of-reference population.

  Mitigation Measures. None are available.

- Restores ponds and lagoons to their prediversion acreages; benefits to wildlife would be identical to those described under the 6,410-Ft Alternative.

- Benefits to wildlife of increased riparian habitat along diverted tributary streams would be similar to those described for the 6,383.5-Ft Alternative, except that cottonwood-willow woodlands would be slightly more extensive.

CUMULATIVE IMPACTS OF THE ALTERNATIVES

Related Impacts of Earlier Stream Diversions by LADWP

Changes in California Gull Nesting Habitat Availability at Mono Lake

The lakewide acreage of potential gull nesting habitat increased during the diversion period with the exposure of the Negit and Paoha Islets (Table 3F-5). As discussed above however, Negit Island provides more than twice the acreage of suitable habitat required to accommodate the largest gull colony ever recorded at Mono Lake (i.e., 65,000 adults in 1992). The newly exposed nesting habitat on the Negit and Paoha Islets was eventually occupied by nesting gulls, but it was not essential to the colony as long as Negit Island was isolated from the mainland and predator-free (i.e., at lake elevations above about 6,376.5 feet). Thus, the increased potential nesting acreage during the diversion period is considered a minor cumulative benefit to gulls.

After Negit Island became accessible to coyotes (i.e., below 6,376.5 feet), adequate habitat remained on the Negit and Paoha Islets to support the lake's largest recorded colony (Table 3F-5). The loss of Twain and Java Islets at lake elevations below about 6,373.5 feet, however, caused short-term displacement of about half of the lake's nesting adults.

Decline of Invertebrate Food Supply for Nesting and Migratory Birds

The productivity of alkali flies in the prediversion period could not be predicted with accuracy (see Chapter 3E, "Aquatic Productivity"), but qualitative descriptions and photographs suggest that flies gathered in dense windrows around the entire lakeshore and offered superabundant food for large flocks of water birds (Fisher 1902; Dawson 1923; Banta, DeChambeau, and McPherson pers. comms.). These windrows were a major source of food of native Paiutes in Mono Basin (Chapter 3K, "Cultural Resources").

Based on the occurrence of hard substrates around the lakeshore, maximum fly productivity may occur between about 6,380 and 6,390 feet and, depending on the amount of submerged vegetation and algae, at higher lake elevations. In contrast, brine shrimp would increase in direct proportion with declining salinities; they probably reached their greatest abundance in the prediversion years when the lake's salinity was about half that at the point of reference (see Chapter 3E, "Aquatic Productivity").

Similarly, the lack of prediversion census data for most water birds at the lake prohibits comparisons with counts made in recent decades. Qualitative accounts, however, suggest that eared grebes may have increased in the diversion years while phalaropes probably were always abundant and widespread around the lakeshore. Because they are nutritionally and calorically superior to brine shrimp, however, alkali flies offer the most important invertebrate food at the lake, and surface elevations that maximize their productivity would offer the greatest overall benefits to migratory water birds. As discussed previously, phalaropes foraged at less than optimal efficiencies at when lakewide productivity of alkali flies was similar to the point of reference.

Loss of Habitat for Migratory Ducks

As discussed in the "Environmental Setting" section, at least one million ducks were present at one time during fall migration in the prediversion years; the total number ducks visiting the lake during an entire year was never estimated (Banta, DeChambeau, and McPherson pers. comms.). Between 11,000 to 15,000 ducks currently visit the lake each year, over a 98% decline from the prediversion period. As also discussed previously, the decline in Mono Lake's duck population far exceeded declines observed in other parts of California during the same period. For example, duck populations in the Central Valley have declined by only 40% to 60% since the mid-1960s.

The declines of migratory ducks at Mono Lake were most abrupt during the 1960s when about 260 acres of lakeshore ponds and lagoons were lost (i.e., when the lake surface fell below about 6,400 feet) and freshwater inflows at the creek deltas ceased. The lack of freshwater sources for drinking and bathing apparently contributed significantly to the decline.

Creation of Snowy Plover Nesting Habitat

As discussed in the "Environmental Setting" section, snowy plovers were not recorded at Mono Lake before the prediversion period and their breeding populations were not discovered until 1976. Declining lake elevations expanded the area of potential breeding habitat to more than 10,000 acres, which was beneficial to this species. At the point of reference, however, approximately 75% of this habitat was not occupied and thousands of acres (including about 6,000 acres of alkali shoreline) could be inundated without causing cumulative, adverse impacts on snowy plovers at Mono Lake.

Increased Acreage of Vegetated Lakeshore Habitats

About 4,000 acres of alkali and dry meadows, tall and short emergent marsh, and wetland scrub habitats have colonized the lake's shoreline during the diversion period. By virtue of their large acreage alone, these habitats benefit wildlife. Overall, however, current shoreline habitats support a few bird species and almost no small mammals, reptiles, or amphibians (Appendix D). Similarly, the expansion of vegetation around the lakeshore coincided with the loss of freshwater springs, ponds, and lagoons, which provided essential habitat for migratory ducks and shorebirds. Compared to the prediversion years, current wildlife use of Mono Lake's shoreline habitats probably is greatly reduced and the creation of saline marsh, meadow, and scrub habitats did not compensate for the loss of ponds and lagoons.

Loss of Wildlife Habitat Values along Streams Tributary to Mono Lake

As discussed in the "Environmental Setting" section, the riparian habitats along the tributary streams were eliminated or greatly reduced by dewatering, channel incision, and grazing during the diversion years (see Chapter 3C, "Vegetation"). For example, more than 200 acres of mature cottonwood-willow riparian habitat were lost along Lee Vining and Rush Creeks, which destroyed an important wildlife movement corridor and removed a rare, diverse, and productive wildlife habitat of the eastern Sierra Nevada. This habitat loss also contributed to the decline of riparian-dependent special-status species in Mono Basin, including long-eared owls, willow flycatchers, yellow warblers, yellow-breasted chats, and mountain beavers.

In addition to desiccation of riparian corridors below the diversion points, significant areas of riparian habitats were lost along upper Rush Creek due to the construction and inundation of Grant Lake reservoir.

Almost 45 acres of riparian habitat were lost along lower Mill Creek during the diversion years. Similar to Rush Creek, Mill Creek experienced incision due to declines in the lake's elevation and uncontrolled spilling flows (see Chapter 3C, "Vegetation"). This loss of riparian habitat would contribute to the cumulative loss of riparian habitat values and disruption of movement corridors previously described for the diverted tributary streams.

Decreased Wildlife Habitat Values along the Upper Owens River

As described previously, minor losses of willow scrub riparian habitat may have occurred due to increased flows and channel instability below East Portal. About 11.8 acres of this habitat has been lost during the diversion years, but some was removed by cattle browsing (see Chapter 3C, "Vegetation").

Related Impacts of Other Past, Present, or Anticipated Projects or Events

Past Grazing Practices

As described in Chapter 3C, "Vegetation", grazing in the riparian corridors and surrounding uplands of Lee Vining, Rush, Walker, and Parker Creeks since the 1860s has apparently accelerated the loss of riparian and meadow habitats.

Other Projects

Other projects described in Chapter 3C, "Vegetation" (i.e., past highway construction, SCE construction, anticipated widening of U.S. 395, and interim stream restoration) could cause short-term disruption of wildlife and probably would contribute to long-term cumulative impacts if permanent losses of riparian habitat occurred.

Significant Adverse Cumulative Impacts

No-Restriction Alternative

- Eliminates California gull nesting habitat on most islands and islets; causes possible abandonment of Mono Lake as a breeding area.
- Eliminates invertebrate food supply for water birds; causes possible abandonment of Mono Lake as a migratory staging area for eared grebes, phalaropes, and ducks.
- Eliminates tributary riparian habitats and associated wildlife.

6,372-Ft Alternative

- Results in long-term loss of Negit Island and in loss of Twain and Java Islets as California gull nesting habitat 20% of the time.
- Results in decline of alkali fly and brine shrimp productivity, especially during droughts.
- Causes degraded habitat for migratory ducks due to loss of 260 acres of ponds and lagoons and reduced inflows at creek deltas.
- Causes reduced wildlife habitat values and corridor continuity due to loss of 61 acres of cottonwood-willow riparian habitat along the tributary streams.

6,377-Ft Alternative

- Potentially reduces alkali fly productivity and potential food for migratory water birds.
- Degrades habitat for migratory ducks due to loss of 260 acres of ponds and lagoons and reduced inflows at creek deltas.
- Reduces wildlife habitat values and corridor continuity due to loss of 52 acres of cottonwood-willow riparian habitat along the tributary streams.

6,383.5-Ft Alternative

- Degrades habitat for migratory ducks due to loss of 254 acres of ponds and lagoons and reduced inflows at stream deltas.

- Reduces wildlife habitat values and corridor continuity due to loss of 50 acres of cottonwood-willow riparian habitat along the tributary streams.

6,390-Ft Alternative

- Degrades habitat for migratory ducks due to loss of 245 acres of ponds and lagoons; potentially restores some lost values by increasing inflows at creek deltas.
- Reduces wildlife habitat values and corridor continuity due to loss of 48 acres of cottonwood-willow habitat along the tributary streams.

6,410-Ft Alternative

- Reduces wildlife habitat values and corridor continuity due to loss of 46 acres of cottonwood-willow habitat along the tributary streams.

No-Diversion Alternative

- Reduces wildlife habitat values and corridor continuity due to loss of 44 acres of cottonwood-willow habitat along the tributary streams.

Mitigation Measures for Significant Cumulative Impacts

Mono Lake

Cumulative impacts on nesting gulls and feeding of migratory water birds can be avoided only by selection of higher lake-level alternatives; no other mitigation measures are available. Predation of Twain and Java Islets could be avoided by maintaining the lake's elevation above about 6,374 feet; similarly, the land bridge to Negit Island would be covered at about 6,376.5 feet. The net loss of freshwater habitats providing migratory duck habitat can be mitigated.

Restore Lakeshore and Creek Delta Ponds to Provide Habitat for Migratory Ducks and Other Water Birds. Minor excavations and diversion of surface flows could be used to restore freshwater ponds at the deltas of Lee Vining and Rush Creeks (see Chapter 3A, "Hydrology"). Restoring freshwater ponds on the creeks and around the lakeshore (e.g., DeChambeau ponds) would offer major benefits for migratory ducks. Specific restoration plans should be prepared for each area that would specify soil types, construction techniques, water sources, vegetation establishment, and target wildlife habitat values. Overall, the goal should be to restore at least 260 acres of ponds and lagoons (i.e., the prediversion acreage) around the lakeshore. Due to declines in their populations throughout North America, ducks probably would not return to their former abundance in Mono Basin; however, restored lakeshore wetlands would enable ducks to expand their use of the lake.

Tributary Streams

Several measures are available.

Rewater Subsidiary Channels on Rush and Lee Vining Creeks. Techniques for rewatering of subsidiary channels on lower Rush and Lee Vining Creeks are described in Chapter 3C, "Vegetation". Restoring these habitats would have major benefits for wildlife, especially those species that avoid the swift-moving waters of the primary channels or are dependent on food and cover provided by cottonwood-willow corridors.

Manage Streamflows to Optimize Conditions for Natural Vegetation Recovery. Techniques for optimizing natural vegetation recovery described in Chapter 3C, "Vegetation" would offer major benefits to wildlife, including a variety of special-status species.

End Livestock Grazing in the Tributary Stream Riparian Corridors Permanently. As described in Chapter 3C, "Vegetation", a permanent ban on sheep grazing in the riparian corridors would enhance vegetation recovery and the wildlife habitat value of these areas. A single entry into a riparian corridor by a large flock of sheep can destroy a year's worth of restoration effort in a few hours.

Plant Woody Riparian Vegetation Onsite and Offsite. As described in Chapter 3C, "Vegetation", planting woody riparian vegetation onsite and offsite would enhance the recovery of riparian corridors. This would facilitate wildlife use of the restored areas.

Construct Freshwater Ponds at Cain Ranch, DeChambeau Ranch, and along Lower Lee Vining and Rush Creeks. Techniques for constructing freshwater ponds at Cain Ranch, and on lower Rush and Lee Vining Creeks are described in Chapter 3C, "Vegetation". Restoring these habitats would have major benefits for wildlife, especially migratory ducks.

CITATIONS

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Table 3F-1. Emergence of Negit and Paoha Islets

Islet	Approximate Lake Surface Elevation at Emergence (feet)	Date of Emergence
Negit		
Krakatoa	Above 6,420	Before 1930
Little Norway	Above 6,420	Before 1930
Little Tahiti	Above 6,420	Before 1930
Twain	Above 6,420	Before 1930
Steamboat	Above 6,420	Before 1930
Java	6,418	1931
Hat	6,392	1963
Tie	6,387	1970
La Paz	6,387	1970
Saddle	6,387	1970
Comma	6,387	1970
Muir	6,387	1970
Midget	6,380	1974
Siren	6,380	1974
Geographic	6,380	1974
Winkler	6,375	1978
Paoha		
Browne	6,395	1961
Coyote	6,395	1961
Duck[a]	6,392	1963
Anderson	6,386	1968
McPherson	6,384	1972
Brewer	6,384	1972
Gull	6,383	1973
Smith	6,383	1973
Dawson	6,383	1973
Conway	6,383	1973
Russell	6,383	1973
Whitney	6,375	1978
Hoffman	6,375	1978
Cluster	6,375	1978

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[a] "Duck Islet" is a peninsula of Paoha Island at lake elevations of 6,379.5 feet and below.

Source: Stine 1992.

Table 3F-2. Prediversion and Point-of-Reference Acreages of Habitats Surrounding Mono Lake

Habitat Type	Prediversion[a]	Point of Reference	Change
Lakeshore willow scrub	26.6	210.0	+183.4
Lakeshore mixed scrub	3.3	26.0	+22.7
Dry meadow	79.2	2,397.0	+2,317.8
Alkali meadow	52.8	1,521.0	+1,468.2
Wet meadow	6.4	51.0	+44.6
Short emergent marsh	117.6	933.0	+815.4
Tall emergent marsh	7.0	55.0	+48.0
Alkali flat	0.0	5,959.0	+5,959.0
Ponds and lagoons	260.0	2.0	-259.0
Total acres	552.9	11,154.0	+10,600.1

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[a] Prediversion acreages were estimated by multiplying the total vegetated lakeshore acreage at that time by the proportional acreage of each habitat type at the point of reference (see Appendix D).

Table 3F-3. Prediversion and Point-of-Reference Habitat Acreages for LADWP Diverted Streams

Habitat Type	Rush Creek			Lee Vining Creek			Parker Creek			Walker Creek			Total All Creeks		
	Prediversion	Point of Reference	Change	Prediversion	Point of Reference	Change	Prediversion	Point of Reference	Change	Prediversion	Point of Reference	Change	Prediversion	Point of Reference	Change
Riparian conifer forest	1.3	1.4	+0.1	17.9	16.4	-1.3	0.0	0.0	0.0	0.0	0.0	0.0	19.2	17.8	-1.4
Conifer-broadleaf forest	18.4	2.6	-12.8	34.5	27.8	-6.7	1.1	1.4	+0.3	0.5	0.6	+0.1	51.5	32.4	-19.1
Cottonwood-willow woodland	159.9	24.4	-135.5	60.9	15.0	-45.9	0.1	0.2	+0.1	0.0	0.2	+0.2	220.9	39.8	-181.1
Aspen woodland	4.4	4.2	-0.2	6.7	5.6	-1.1	0.2	0.2	0.0	1.3	1.3	0.0	12.6	11.3	-1.3
Riparian willow scrub	79.9	120.6	+40.7	10.3	15.7	+5.4	54.2	44.6	-9.7	42.4	26.2	-16.2	186.8	207.1	+20.3
Mixed riparian scrub	11.7	58.3	+46.6	0.2	6.3	+6.1	2.8	2.8	0.0	5.6	14.6	+9.0	20.3	82.0	+61.7
Unvegetated floodplain	61.0	186.0	+125.0	19.5	60.7	+41.2	6.1	6.1	0.0	5.1	18.0	+12.9	91.7	270.9	+179.1
Montane meadow	131.2	39.8	-91.4	43.5	32.3	-11.2	232.4	241.5	+9.1	181.2	188.0	+6.8	591.0	499.0	-92.0
Great Basin scrub	447.7	550.4	+102.7	123.4	179.3	+55.9	77.5	77.5	0.0	125.6	112.5	-13.1	776.0	918.6	+142.6
Total acres	915.5	987.7	+75.2	316.9	359.1	+42.4	374.4	374.3	-0.2	361.7	361.4	-0.3	1,970.0	2,078.9	+108.8

Table 3F-4. Summary Comparison of Effects of the Alternatives: Wildlife

Alternative or Condition	Potential Acreage of Gull Nesting Habitat	Invertebrate Food for Water Birds	Phalarope Distribution at Mono Lake	Potential Habitat for Migratory Ducks	Potential Snowy Plover Nesting Habitat	Wildlife Habitat Values of Mono Lake Shoreline Vegetation	Wildlife Habitat Values of Tributary Streams
Point of reference	51	Moderate	At threshold	Low	High	Moderate	Low
No restriction	10[a,c]	Low or nonexistent[a,c]	Restricted or absent[c]	Absent[a,c]	Low[a]	Low or none[a]	None[a,c]
6,372 Ft	41[a,c]	Low[a,c]	Restricted[c]	Low[c]	High	Moderate	Moderate[c]
6,377 Ft	183[b]	Moderate[b,d]	Sometimes restricted[b,d]	Low[c]	High	Moderate	Moderate[c]
6,383.5 Ft	169	High	Widespread	Moderate[c]	High	Moderate	Moderately high[c]
6,390 Ft	133	High	Widespread	Moderate[c]	High	Moderately low[a]	Moderately high[c]
6,410 Ft	99	Unknown	Unknown	High	Moderate	Low[a]	Moderately high[c]
No diversion	94	Unknown	Unknown	High	Low[a]	Low[a]	Moderately high[c]
Prediversion	94	Unknown	Unknown	High	Unknown	Low	High

Significant adverse effects:

[a] project impact.
[b] project drought impact.
[c] cumulative impact.
[d] potential cumulative impact.

Table 3F-5. Potential California Gull Nesting Capacity at Alternative Elevations of Mono Lake

	Negit Island			Negit Islets				Paoha Islets Change				Percent
Alternative	High	Moderate	Subtotal	High	Moderate	Low	Subtotal	Rugose	Non-Rugose	Subtotal	Total	from Point of Reference
Point of Reference												
Acreage	0	0	0	11.5	10.6	15.2	37.2	2.1	11.5	13.6	50.8	--
Nest capacity[a]				14,950	6,360	3,040	24,350	2,730	6,900	9,630	33,980	--
Nest capacity[b,c]										13,600	37,950	--
No Restriction[d]												
Acreage	0	0	0		1.9	5.9	7.8	2.0	2.0	4.0	9.9	-81
Nest capacity[a]					1,140	1,180	2,320	2,600	1,200	3,800	6,120	-82
Nest capacity[b,c]										4,000	6,320	-83
6,372 Ft[d]												
Acreage	0	0	0	4.2	8.5	9.6	22.3	6.9	12.1	19.0	41.3	-19
Nest capacity[a]				5,460	5,100	1,920	12,480	8,970	7,260	16,230	28,710	-16
Nest capacity[b,c]								6,900	12,100	19,000	31,480	-17
6,377 Ft												
Acreage	41.7	113.6	155.3	11.5	10.6	15.2	37.2	2.1	11.5	13.6	182.8	360
Nest capacity[a,c]	54,210	68,160	122,30	14,950	6,360	3,040	24,350	2,730	6,900	9,630	156,350	460
Nest capacity$_{b,c}$										13,600	160,320	422
6,383.5 Ft												
Acreage	41.7	100.3	142.0	8.7	7.7	10.7	27.2	0	0	0	169.2	333
Nest capacity	54,210	60,180	114,390	11,310	4,620	2,140	18,070				132,460	390
6,390 Ft												
Acreage	41.7	68.6	110.2	7.0	7.5	8.2	22.6	0	0	0	132.8	261
Nest capacity	54,210	41,160	95,370	9,100	4,500	1,640	15,240				110,610	326
6,410 Ft												
Acreage	41.7	50.9	92.6	2.2	1.5	2.9	6.6	0	0	0	99.2	195
Nest capacity	54,210	30,540	84,750	2,860	900	580	4,340				89,090	262
No Diversion												
Acreage	41.7	50.0	92.6	0	1	0	1	0	0	0	93.6	184
Nest capacity	54,210	30,540	84,750		600		600				85,350	251

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[a] Potential nest capacity categories for Negit Island and the Negit Islets include: high = 1,300 nests per acre, moderate = 600 nests per acre, and low = 200 nests per acre; areas considered as unsuitable gull nesting habitat were not included in this analysis.

[b] Potential nest capacity of the Paoha Islets were calculated using two sets of assumptions, including: 1) rugose = 1,300 nests per acre and nonrugose = 600 nests per acre; and 2) the entire acreage (both rugose and nonrugose substrates) = 1,000 nests per acre (see text).

[c] This analysis assumes that Java and Twain Islets are effectively land bridged at 6,373 feet, although actual land connection does not occur until 6,372 feet surface elevation.

[d] This analysis assumes that Duck Islet is a peninsula of Paoha Island at 6,379 feet surface elevation.

Table 3F-6. Predicted Long-Term Acreages and Wildlife Values of Mono Basin Habitats under Point-of-Reference and Alternative Conditions

Study Area/ Habitat Type	WHI Value	Prediversion		Point of Reference (POR)		No Restriction		6,372 Ft		6,377 Ft		6,383.5 Ft		6,390 Ft		6,410 Ft		No Diversion	
		Acres	WHUs	Acres	WHUs	Acres	WHUs	Acres	WHUs	Acres	WHUs	Acres	WHUs	Acres	WHUs	Acres	WHUs	Acres	WHUs
Tributary Streams																			
Conifer-broadleaf forest	.34	51.5	17.5	32.4	11.0	30.5	10.4	40.3	13.7	40.4	13.7	140.5	13.7	40.6	13.7	40.7	13.7	40.7	13.7
Mature cottonwood-willow	.38	200.9	83.9	18.3	6.9	9.3	3.5	131.1	49.8	141.3	53.7	144.5	54.9	147.7	56.2	149.3	56.7	146.5	55.7
Establishing cottonwood-willow	.18	0	0	5.7	1.0	1.1	0.2	8.3	1.5	7.7	1.4	6.8	1.2	4.9	1.4	5.2	0.9	10.3	1.9
Aspen woodland	.25	12.6	3.2	11.3	2.8	9.8	2.5	13.3	3.3	13.9	3.5	13.9	3.5	14.0	3.5	13.9	3.5	14.0	3.5
Mature willow scrub	.36	186.8	67.2	144.6	52.1	83.2	29.9	142.4	51.3	144.6	52.1	146.2	52.6	146.8	52.7	139.1	50.1	151.3	54.5
Establishing willow scrub	.17	0	0	37.9	6.4	8.0	1.4	43.1	7.3	37.7	6.4	29.2	5.0	22.5	3.8	18.9	3.2	21.2	3.6
Mixed riparian scrub	.21	20.3	4.3	81.4	17.1	20.4	4.3	16.9	3.5	11.7	2.5	17.8	3.7	17.9	3.8	18.0	3.8	18.3	3.9
Meadow and wetland[a]	.16	174.7	27.9	72.1	11.5	40.0	6.4	80.0	12.8	82.0	13.1	82.0	13.1	82.0	13.1	82.0	13.1	85.0	13.6
Total		666.8	204.0	403.7	108.8	202.3	58.6	475.0	143.2	479.0	146.4	480.0	147.7	476.4	148.2	467.1	145.0	487.0	150.4
Percent change from point of reference		165	188	–	–	-50	-54	118	132	119	135	119	136	118	136	116	133	121	138
Mono Lake Shoreline																			
Marsh, meadow, and wetland scrub (combined)[b]	.10	213.7	21.4			470.0	47.0											358.0	35.8
Marsh	.07			988.0	69.2			1,161.0	81.3	898.0	62.9	827.0	57.9	626.0	43.8	264.0	18.5		
Wet meadow	.13			51.0	6.6			52.0	6.7	42.0	5.5	61.0	7.9	22.0	2.9	110.0	14.3		
Alkali meadow	.12			1,521.0	182.5			1,417.0	170.0	1,495.0	179.0	1,233.0	148.0	920.0	110.4	272.0	32.6		
Wetland scrub	.08			236.0	18.9			228.0	18.2	190.0	15.2	204.0	16.3	157.0	12.6	108.0	8.6		
Dry meadow	.12	79.2	9.5	2,397.0	287.6	1,831.0	219.7	2,688.0	322.6	2,677.0	321.2	2,132.0	255.8	1,507.0	180.8	620.0	74.4		
Alkali lakebed	.01	0	0	5,959.0	59.6	9,512.0	95.1	4,082.0	40.8	1,492.0	14.9	521.0	5.2	377.0	3.8	151.0	1.5	0	0
Ponds and lagoons[c]		260.0	.	0.5	.	0.0	.	0.5	.	1.0	.	6.0	.	16.0	.	261.0	.	261.0	.
Total		552.9	30.9	11,153.0	624.0	11,813.0	362.0	9,628.5	639.6	6,795.0	598.7	4,984.0	491.1	3,625.0	354.3	1,786.0	149.9	619.0	35.8
Percent change from point of reference		-95	-95	–	–	106	-42	-13	102	-39	-4	-55	-21	-68	-43	-84	-76	-95	-94

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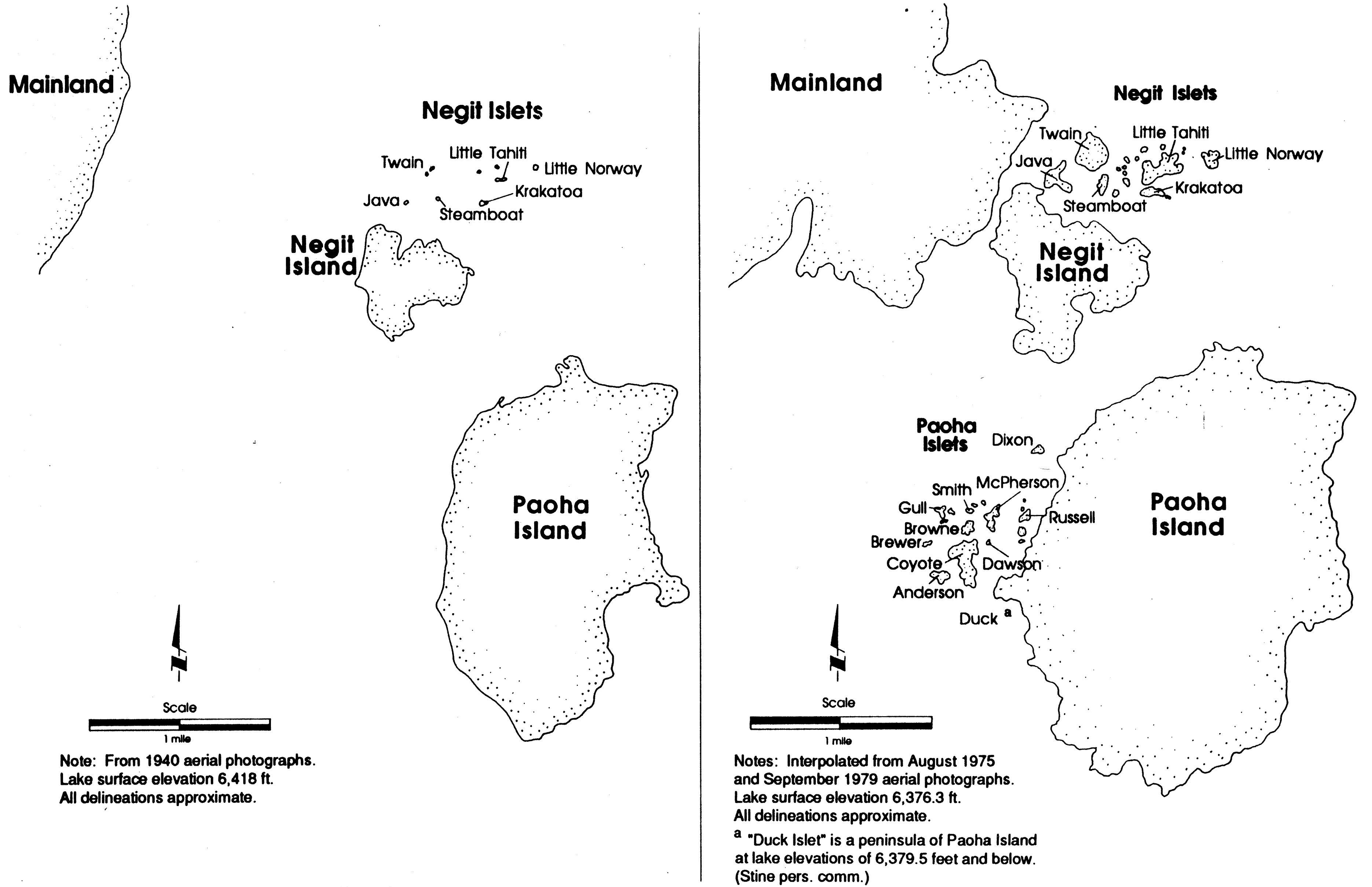
[a] Calculations do not include the acreages of irrigated pasture near Parker and Walker Creeks (see Chapter 3C, "Vegetation").

[b] Acreages of marsh, meadow, and wetland scrub were combined for prediversion, no-restriction, and no-diversion conditions because the extent of these habitats were not estimated for these extreme lake elevations (see Chapter 3C, "Vegetation").

[c] The wildlife habitat index (WHI) value of ponds and lagoons could not be estimated because only 0.5 acre of pond existed under point-of-reference conditions.



Note: From 1940 aerial photographs.
Lake surface elevation 6,418 ft.
All delineations approximate.

Prediversion

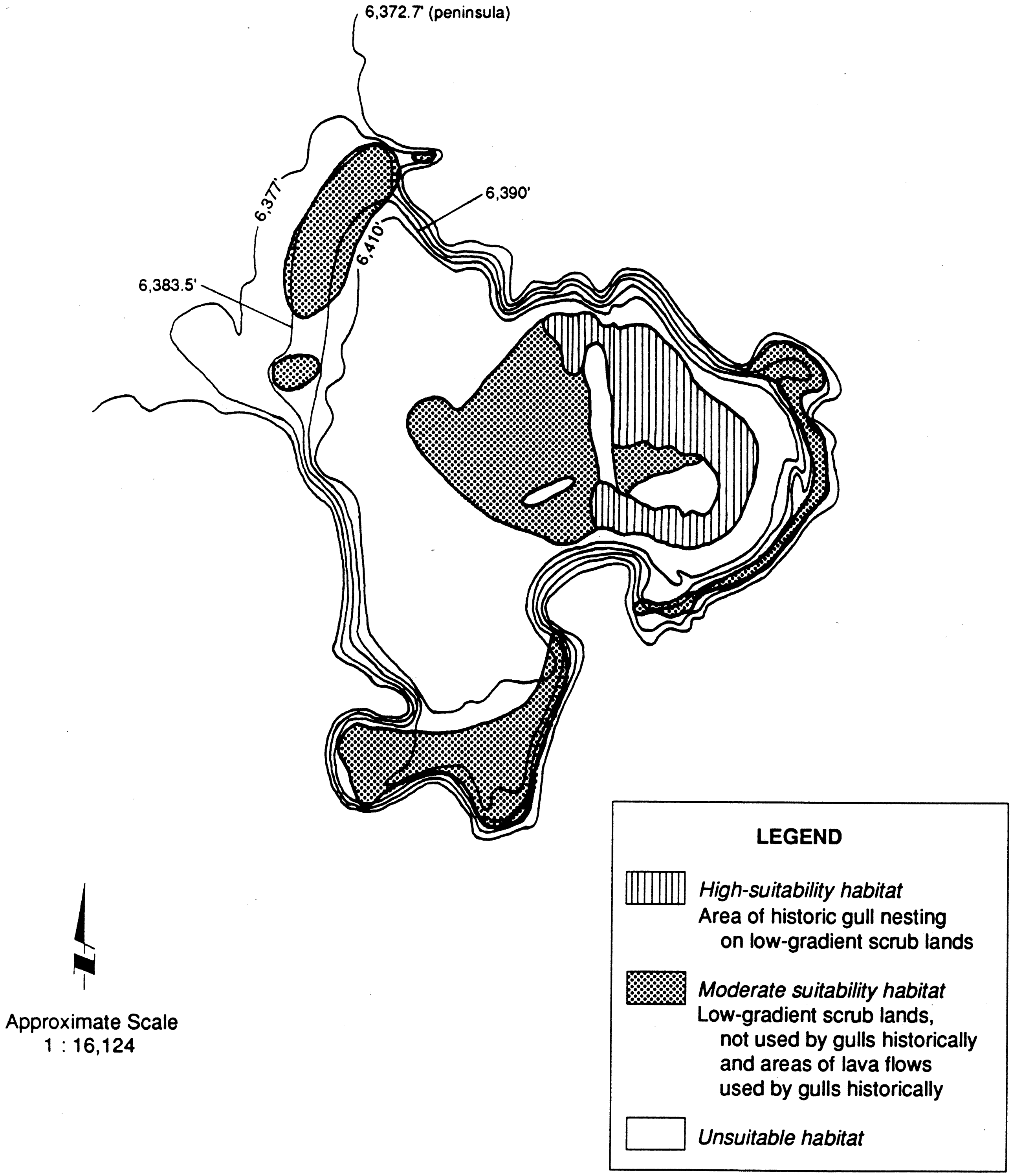
Notes: Interpolated from August 1975
and September 1979 aerial photographs.
Lake surface elevation 6,376.3 ft.
All delineations approximate.

[a] "Duck Islet" is a peninsula of Paoha Island
at lake elevations of 6,379.5 feet and below.
(Stine pers. comm.)

Point of Reference

Source: Stine 1992

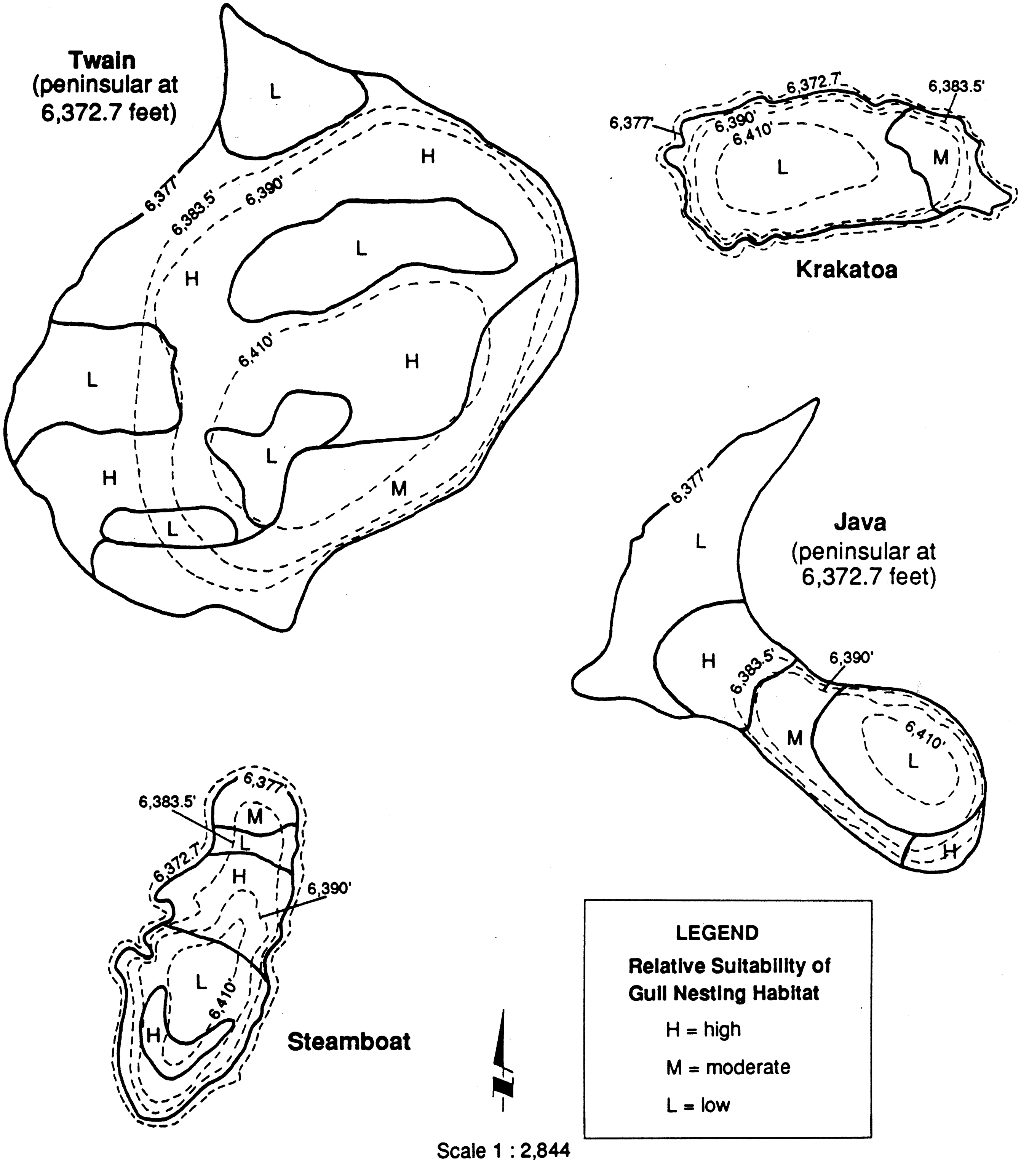
Figure 3F-1.
Mono Lake Islands



Note: Contours correspond to alternative management lake levels specified in SWRCB EIR.

Source: Stine 1993 after Winkler et al. 1977 and Winkler pers. comm.

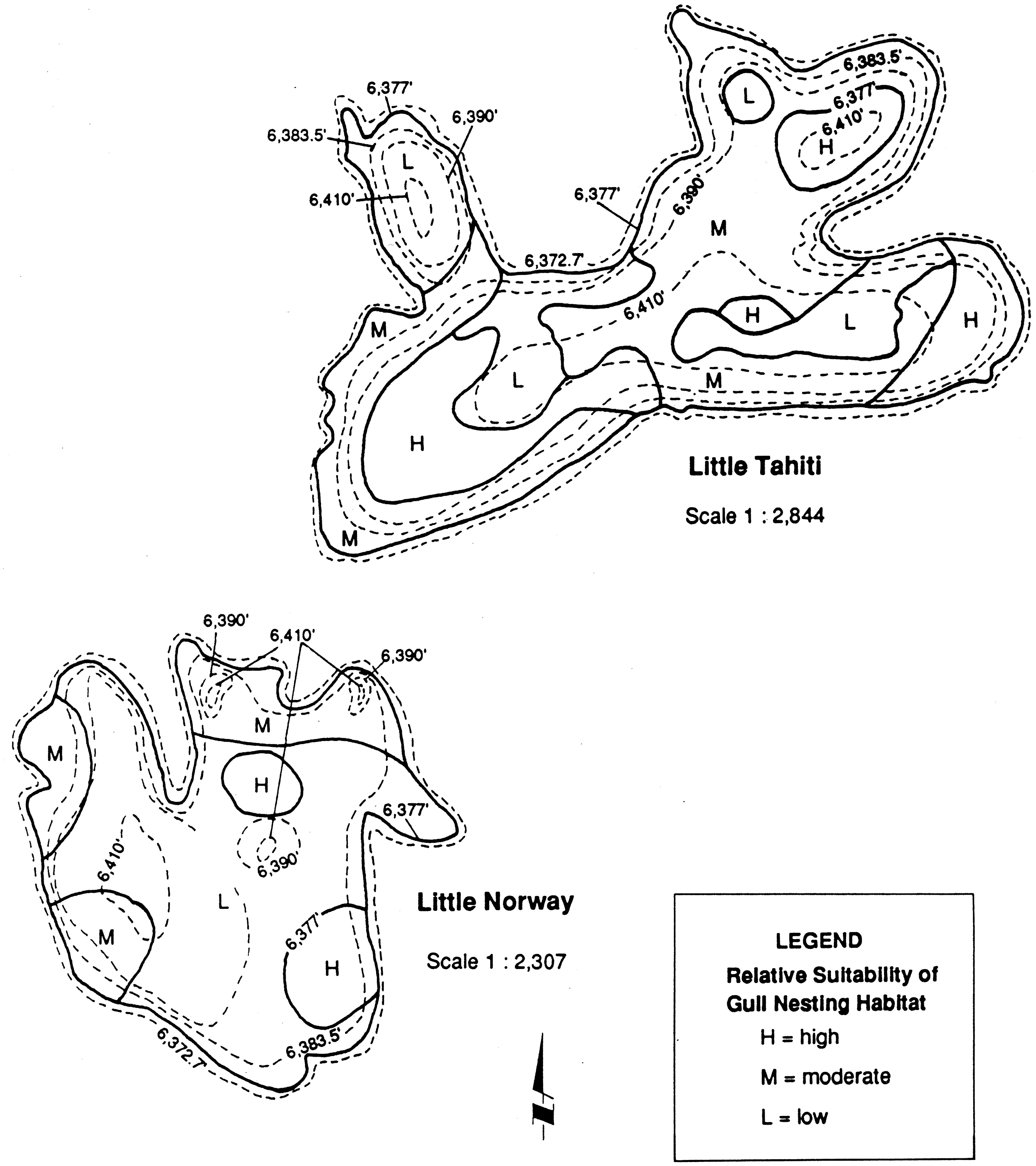
Figure 3F-2.
Negit Island



Notes: Islets are not shown in actual geographical relationship to one another; the relative positions of the islets are shown in Figure 3F-1.
Contours correspond to alternative management lake levels specified in SWRCB EIR.

Source: Stine 1993

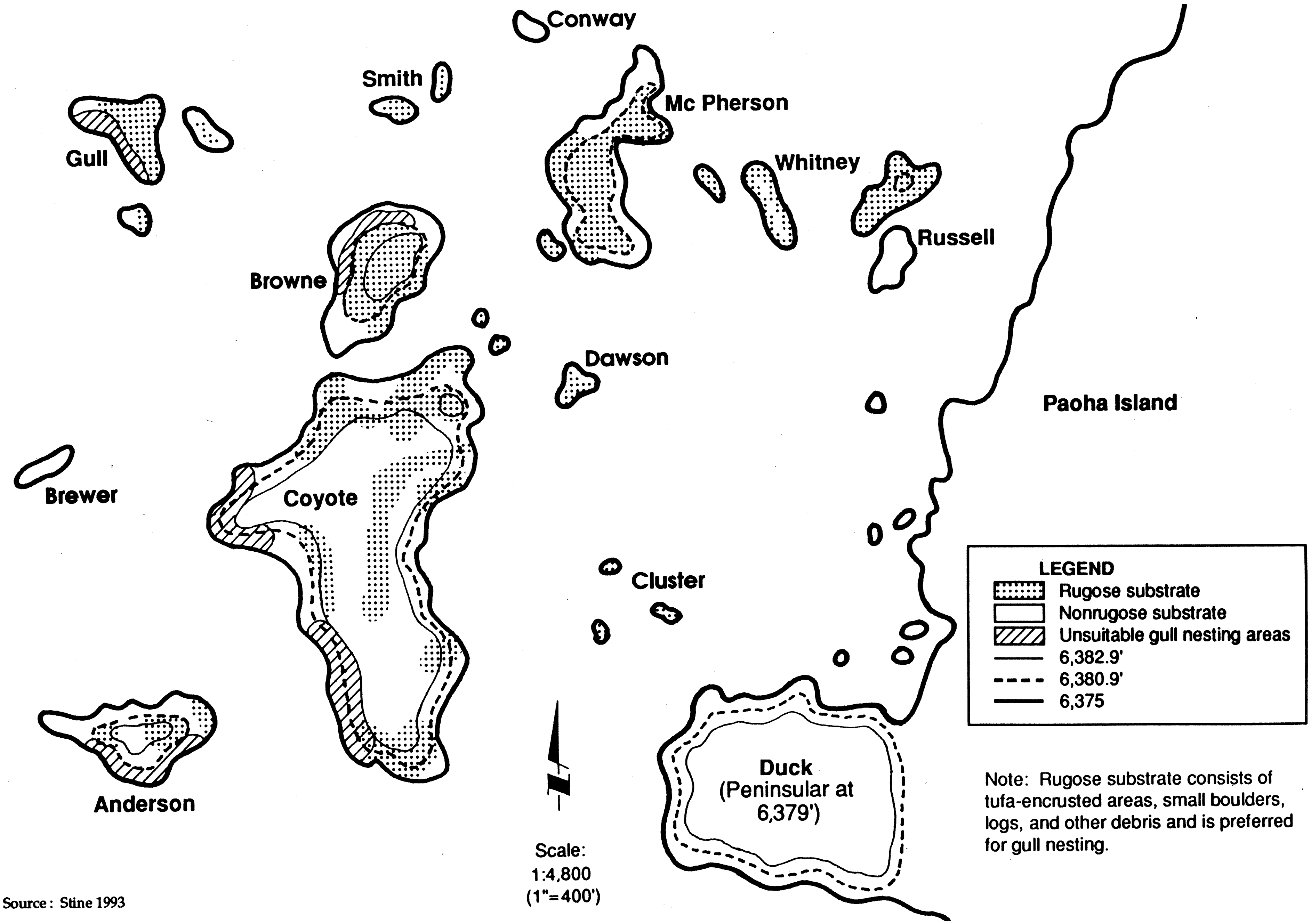
Figure 3F-3a.
Negit Islets



Notes: Islets are not shown in actual geographical relationship to one another; the relative positions of the islets are shown in Figure 3F-1.
Contours correspond to alternative management lake levels specified in SWRCB EIR.

Source: Stine 1993

Figure 3F-3b.
Negit Islets

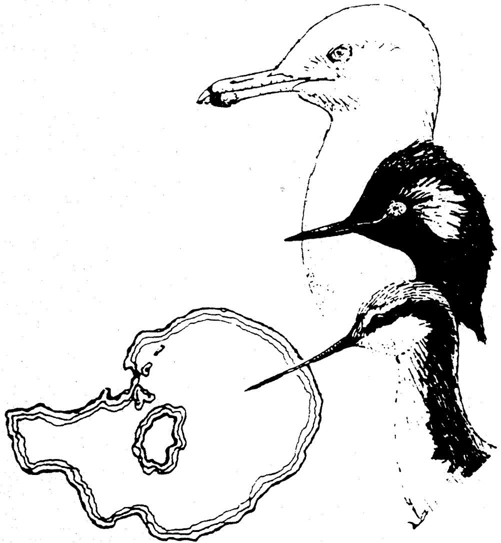


Note: Rugose substrate consists of tufa-encrusted areas, small boulders, logs, and other debris and is preferred for gull nesting.

Source: Stine 1993

Figure 3F-4.
Paoha Islets

Chapter 3G. Environmental Setting, Impacts, and Mitigation Measures - Land Use



MONO BASIN EIR

Prepared by Jones & Stokes Associates

Chapter 3G. Environmental Setting, Impacts, and Mitigation Measures - Land Use

The evaluation of land use impacts in this chapter focuses on two areas: lower-elevation portions of Mono Basin and the Upper Owens River basin or "Long Valley". The area of concern in Mono Basin includes land irrigated from the four diverted tributary streams, areas around Mono Lake that may be affected by changing lake levels, public land allotments that could be indirectly affected by project actions, and public and private properties that could be affected by use of the Mono Basin National Forest Scenic Area. This area includes land within the scenic area, additional LADWP land south and southwest of Mono Lake, and land along the June Lake Loop.

The area of concern in Long Valley includes private and LADWP land along the Upper Owens River that could be affected by changed flows in the river. This study area includes land from just upstream of the East Portal near Big Springs, south to Lake Crowley reservoir.

PREDIVERSION CONDITIONS

By the onset of LADWP's diversions, most areas of concern were dominated by agricultural activity, except for the town of Lee Vining, which was a small commercial and residential center. Homesteaders established homes in many areas to support their agricultural activities, and some vacation dwellings and resorts had been developed along the region's lakes and streams. In 1940, as today, Mono County was sparsely populated because of its geographic isolation, cold climate, and large portion of public open-space land.

Mono County's mineral resources had been a major attraction to early settlers to the eastern Sierra Nevada, although few of the mines were located within the areas of concern. Mining within the county as a whole had declined to a low level after the turn of the century. Quarrying of construction materials (gravel and pumice), however, has been a continuing activity in the area of concern.

Recreation and associated land uses in the prediversion period are described in Chapter 3J, "Recreation Resources". The following discussion focuses on the area's agriculture and on land ownership changes associated with development of the area's water resources for power generation and water export.

Sources of Information

Documents produced recently were consulted to obtain an overview of historical land uses and ownerships in the Mono-Inyo Region (USFS 1989a, Fletcher 1987, Kahrl 1982, Rawson 1990 [Court Testimony, Volume I, Streamflow]). This information was supplemented by discussions with local residents familiar with the history of the area (Alpers and J. Arcularius pers. comms.) and LADWP personnel (Anderson pers. comm.).

Land ownership information and some irrigation rights and practices were drawn from testimony and exhibits produced for the 1930 condemnation proceedings, commonly referred to as the Aitken case (Superior Court 1934). Promotional literature produced by LADWP during the prediversion period provided references to additional sources of information. Correspondence and legal documents contained in the Aitken case files, the National Archives, and elsewhere provided information about plans and policies relating to land acquisition (Van Bokkelen, Chappell, Gary, and Wilson pers. comms.; California Senate Committee on Local Governmental Agencies 1945; Verble 1989).

The mapped accounting of acquisition of land by LADWP herein may not be without error; acquisition data were extracted from documents describing the condemnation proceedings, but LADWP's parcel-by-parcel files have only been consulted to verify representative parcels (Wills pers. comm.).

Agriculture

Historical Overview of Agricultural Development in the Mono-Inyo Region

Native Americans. Agricultural development in the Mono-Inyo region predates discovery of the area by Euroamericans. Although the Northern Paiutes who inhabited the Mono Basin area never practiced any sort of agriculture in the basin in the prehistorical period, the Owens Valley Paiute to the south practiced irrigated agriculture to supplement their food supply (Fletcher 1987).

The Mono Basin Paiutes did turn to ranching and farming in the late 19th century and practiced agriculture up to prediversion times. They owned properties on Rush, Lee Vining, and Walker Creeks where they raised irrigated crops, horses, and sheep. Some Paiutes were employed on Euroamerican ranches.

Early Settlements of Euroamericans. Development of the Mono and Inyo County areas for agricultural uses by Euroamericans began during the mid-19th century. U.S. cavalry excursions into the Mono Basin area in the 1850s returned with reports of the area, including samples and reports of gold found in the basin. Based on these reports, a ranch and sawmill on Lee Vining Creek were soon established by Leroy Vining and companions (USFS 1989a). During the remaining years of the 19th century, ranching, logging, communication, and transportation systems were developed in response to the needs of the growing mining communities of Bodie, Monoville, and Aurora.

Supplying the Miners. The mining boom at Bodie in the 1870s stimulated agricultural development in and around Mono Basin. The demand for food and fiber at the mining towns and camps generated a market for locally produced hay, grains, vegetables, meat, and dairy products. Immigrants to the area were attracted to land suitable for agriculture that could be acquired free, in parcels not exceeding 160 acres, under the Homestead Act of 1882.

Agricultural settlement was most active in the period from 1878 to 1882, when the mines were at peak production. According to a report from 1880, more than 2,000 acres of land were under production near Mono Lake as sagebrush areas were converted to tillable farmland. Because a reliable water supply was needed to grow irrigated crops, farms were concentrated along Mill, Lee Vining, Walker, Parker, and Rush Creeks. Open ditches, controlled by sluices that were opened and closed according to need, diverted water from streams and springs. The total amount of irrigation in the basin during the 1880s and 1890s was probably about 4,000 acres, although irrigated acreage fluctuated. Most irrigation was on livestock pastures that were created by expanding natural meadows.

Conditions in the 1900s. Irrigated acreage probably changed little between 1880 and 1920. The agricultural census of 1919 reported 4,190 acres irrigated from tributaries of Mono Lake. In 1929, the census reported 11,500 irrigated acres in the basin. The increase from 1919 was mainly because of irrigation by the Cain Irrigation Company (Fletcher 1987).

Typical Operation. Mono Lake settlers practiced a mixed agricultural economy. Each homestead was usually a farm and ranch, where a variety of crops and animals were raised. Hay was by far the dominant crop, needed to supply winter feed for cattle and sheep. After hay, the most important crops were wheat, barley, alfalfa, and potatoes. Vegetable gardens, where peas, beans, carrots, onions, strawberries, and squash were grown, were also part of most homesteads. (Fletcher 1987.)

Livestock Grazing. Livestock grazing was introduced into Mono Basin in three distinct periods. The first period occurred in the 1860s when many cattle and sheep were herded through the basin from southern and western California enroute to grazing land in Nevada. The second period coincided with the mining boom of the 1880s. Many settlers who accompanied this boom were ranchers, bringing with them herds of cattle and sheep that remained within the basin year round. The third and most intense period occurred at the turn of the century when large bands of sheep began coming into the basin every summer from Kern County. The total influx every year approached 200,000 sheep, causing considerable competition for forage and range degradation. (USFS 1989a.)

Migratory domestic sheep bands were placed under stricter grazing controls in 1905 when much of the southern half of Mono Basin became part of the Sierra Forest Reserve (soon to become the Sierra National Forest), which regulated grazing within its boundaries. The northwest basin was protected in 1908 when the Mono National Forest was created.

Livestock grazing practices, however, remained relatively uncontrolled until the passage of the Taylor Grazing Act and the formation of the U.S. Bureau of Land Management (BLM) in 1934. (Fletcher 1987.)

Trends in the Prediversion Period. Selected characteristics of agricultural land use in Mono and Inyo Counties for 1910, 1930, and 1940 are shown in Table 3G-1. Agricultural land use trends in the two counties during this period were different. As shown, the number of farms in Mono County remained relatively stable at approximately 90 between 1910 and 1940; however, the number of farms in Inyo County decreased more than 200 over the same period, due in part to LADWP land acquisitions. As the number of farms decreased in Inyo County, the average size of farms increased from about 250 acres to about 800 acres. At the same time, the average size of farms in Mono County *decreased* an average of about 50%. Irrigated acreage in both counties decreased 40-60% between 1910 and 1940.

Mono Basin Agriculture

Irrigated Lands along Diverted Tributaries. When LADWP began acquiring land and water rights in Mono Basin in 1912, agricultural activities in the basin revolved around sheep and cattle production, as they do today, with sheep grazing being the primary activity. For the most part, sheep operators based in Kern County would bring bands of sheep into the basin during summer months to graze the high-country range.

Aerial photographs taken in 1929 show that water was being diverted from Gibbs, Lee Vining, Walker, Parker, and Rush Creeks to irrigate pastures. The photographs show two diversions off Lee Vining Creek, many diversions from Walker and Parker Creeks, and three diversions off Rush Creek. These diversions probably occurred after 1915, when the first dam was built at Grant Lake reservoir. Based on the 1929 aerial photographs, approximately 4,100 acres were irrigated from the four tributary streams, including 1,100 acres irrigated from Gibbs and Lee Vining Creeks, 2,000 acres irrigated from the Walker and Parker Creek drainages, and 1,000 acres irrigated from Rush Creek (Figure 3G-1). A portion of the acreage irrigated from Rush Creek was located east of what is now U.S. Highway 395 (U.S. 395). (Rawson 1990 [Court Testimony, Volume I, Streamflow].)

Property maps of the basin from 1934 show that irrigated acreage along the diverted tributaries remained relatively stable between 1929 and 1934, the years in which LADWP purchased most of its water rights and land in the basin. The Cain Irrigation Company, which owned most of the land along Walker, Parker, and Lee Vining Creeks, irrigated approximately 3,000 acres from these creeks in 1934, which is approximately the same amount of acreage irrigated from these creeks in 1929.

Irrigation practices in Mono Basin generally consisted of flood irrigation of native grass meadows, resulting in high per-acre water use relative to forage produced. During the 1920s, the Cain Irrigation Company, the primary user of water from the four tributary streams, annually applied as much as 6 acre-feet (af) of water per acre in its production of native hay (Kahrl 1982), or as much as 43 af per acre to eliminate sagebrush (Vorster 1985), presumably because of the preponderance of highly permeable alluvial fan and pumice soils in the area. LADWP estimated that historical water use on the Cain Ranch varied from 5 to 10 af per acre annually, with an average of approximately 7 af (Rawson 1990 [Court Testimony, Volume I, Streamflow]).

Based on this estimate and the irrigated acreage estimates from the 1929 photographs, approximately 7,700 af of irrigation water was annually diverted from Lee Vining Creek, 14,000 af from Walker and Parker Creeks, and 7,000 af from Rush Creek. Including stock water, an estimated 30,000 af of water was used annually from the four tributary streams before LADWP diversions began (Rawson 1990 [Court Testimony, Volume I, Streamflow]).

Other sources indicate that even more water may have been diverted for irrigation from the four creeks than the amounts suggested by irrigated acreage estimates. According to irrigation data available for various periods between 1923 and 1941, irrigation water application rates may have ranged from 4.2 af per acre from Walker Creek to 30.3 af per acre from Rush Creek (Vorster pers. comm.). These data indicate that irrigation diversions from the four creeks averaged approximately 49,000 af per year before LADWP diversions. The data show that an average of 4,050 acres were irrigated from the four streams, similar to the acreage indicated by the aerial photographs from 1929.

Information concerning prediversion livestock production on land irrigated from Lee Vining, Walker, Parker, and Rush Creeks is not available; however, forage production can be estimated based on the estimated average amount of acreage that was under irrigation and the current productivity of these irrigated pastures. Forage production is typically measured by Animal Unit Months (AUMs). An AUM is the amount of forage required by one cow and calf or five sheep for 1 month, or approximately 800-1,000 pounds of forage. LADWP currently estimates forage production of 4.5 AUMs per acre on good irrigated pasture in Mono Basin (Anderson pers. comm.).

Assuming the irrigation of 4,100 acres, an estimated 18,500 AUMs of forage was produced annually on pastures irrigated by the four tributary streams before LADWP diversions began. This amount of forage would support approximately 18,500 sheep for 5 months.

Mono Lake Margin. Little information is available concerning prediversion agricultural production near the margin of Mono Lake. Cattle and sheep were presumably grazed on naturally irrigated and dry rangeland surrounding the lake, especially near established ranches such as the DeChambeau Ranch on the northwestern edge of the lake and on the lower Cain Ranch located southwest of Mono Lake.

Grazing almost certainly occurred along the west side of the lake where tributary streams resulted in naturally irrigated pastures down to the lake margin. During the 1880s and 1890s, 15 farms were concentrated along Mill Creek and 10 homesteads were developed on lower Lee Vining, Walker, and Rush Creeks and along the Mono Lake shoreline between the deltas of Rush and Lee Vining Creeks (Fletcher 1987). Land along the eastern edge of the lake has always been relatively dry and has supported smaller livestock numbers. The eastern edge, however, was probably grazed by bands of migratory domestic sheep during summer months.

Upper Owens River Agriculture

The upper end of Long Valley was homesteaded in 1896 by the Alpers family (Alpers pers. comm.). Other families established homesteads in the area by the 1920s. Before 1940, all the land along the Upper Owens River north of Lake Crowley reservoir was in private, family ownership. Unlike Mono Basin, where sheep production became the primary agricultural activity, cattle production was the dominant activity in the Upper Owens River basin. One family, however, ran sheep in the area until the 1950s (J. Arcularius pers. comm.).

LADWP purchased private ranchland north of what is now Lake Crowley reservoir between approximately 1927 and 1932, leaving four ranches further upstream in private ownership.

Historically, cattle were grazed in Long Valley on pastures irrigated from the Upper Owens River and on adjacent private and public dry rangeland. Many ranches in Long Valley also included land in the Bishop area, where cattle would be pastured for the winter.

No information has been located documenting agricultural production in Long Valley before diversions from Mono Basin began. Pastures may have been irrigated more extensively before purchase by LADWP, but overall terrain constraints and the lower streamflows unaugmented by Mono Basin exports likely limited acreages irrigated from the Upper Owens River to amounts similar to 1989. The number of cattle pastured in Long Valley was probably greater prior to 1940 than today because grazing controls have been placed on users of LADWP land and adjacent federal land in leases and use permits. Additionally, cattle use of some private land is subordinated to fishery habitat enhancement where land is managed primarily as fishing vacation resorts.

Land Ownership and Water Resource Development

Although most land in Mono and Inyo Counties was initially put to agricultural and mining use, the area's abundant water resources derived from the high Sierra Nevada drew attention to the potential for hydroelectrical power generation and water supply for developing areas of Southern California. Land purchase by utilities for acquisition of water rights began in the early years of this century. Resulting changes in land ownership and use in the areas of concern by the beginning of LADWP's diversions are described in this section.

Federal Land and Water Policies

Settlers in the western United States could acquire free land under the Homestead Act of 1862, and much of the land in the areas of concern owned by private parties or LADWP was first acquired by homesteading of early settlers. To acquire land in this manner, settlers would make a claim on eligible federal land, submit an application to the government land office, demonstrate that they were actually using the land, obtain a survey meeting federal standards, and apply for a patent granting title to the land.

In the early 1900s, vacant public land in Mono County was gradually withdrawn from homesteading because federal management goals were developed that were inconsistent with further private land ownership. The southern half of Mono Basin was placed into the Sierra Forest Reserve in 1905, and the remainder was gradually withdrawn by Congress and the BLM between 1916 and 1931 to facilitate water and power development. In 1931, Congress withdrew the remaining public lands in Mono Basin from homesteading through Public Law 864 for the protection of the watershed supplying the City of Los Angeles and for other purposes (Porter pers. comm.).

The decline of mining and the diversion of human resources for World War I reduced occupancy of public land in Mono County, as much of the land entered under the Homestead Act was vacated before ownership was established.

Pursuant to the Reclamation Act of 1902, the federal government considered promoting and subsidizing agricultural growth in Mono County through a U.S. Bureau of Reclamation (Reclamation) water resource development program. The program was subsequently abandoned, apparently because it would have conflicted with LADWP's water development plans. The scale and form such a program would have taken in the area of concern is therefore unknown.

Early Water Resource Development for Power Production

By 1928, Southern Sierra Power Company (SSP) had acquired more than 11,000 acres of land in Mono County to facilitate the generation of power for export to Southern California. Five power plants were constructed on Rush, Mill, and Lee Vining Creeks between 1900 and 1928. One of the three Lee Vining Creek plants was at a site downstream of LADWP's eventual (current) diversion facility.

In conjunction with the Nevada-California Power Company, SSP had established a plan to accelerate agricultural settlement on lands proximate to its power transmission lines in the region to increase local electrical consumption primarily through pumping of groundwater for agricultural irrigation (Chappell pers. comm.).

LADWP Acquisition of Mono Basin Land and Water Rights, 1913-1945

In the early 1900s, LADWP began planning for diversion of water from Mono Basin in conjunction with plans for power development in the gorge below Long Valley (Kahrl 1982).

LADWP's diversions from Mono Lake tributaries were preceded by the acquisition of land and water rights in the basin beginning in 1912-1913. Waters of the tributary streams were being spread over substantial areas of rangeland for purposes of pasture irrigation; water rights were therefore distributed over large acreages. This situation required LADWP to acquire large tracts of land in specific areas. Other rights were needed to construct water export facilities and to affect the level of Mono Lake.

LADWP policies for land acquisition were developed during acquisition of land and water rights in Inyo County beginning in 1905. The policies were retained as LADWP expanded its operations north into Mono County. Acquisition policies at that time, which remain valid today, require that:

- the land has riparian or appropriative water rights or surface water of interest;
- the land, if developed, would affect existing city water gathering rights; and
- the price of the land is fair and reasonable (Wilson pers. comm.).

Planned Land Acquisitions. LADWP classified lands and appurtenant water rights needed for acquisition according to purpose in the Mono Basin water export project (Figure 3G-2) (Superior Court 1934). The first five divisions pertained to lands having riparian or appropriative water rights to the streams to be diverted. The sixth division encompassed lands surrounding Mono Lake. The seventh division was to accommodate conveyance facilities, and the last two divisions were to accommodate diversion dams and reservoir sites on Rush Creek. More specifically, the divisions included:

- Division 1 - land having water rights to Lee Vining Creek, including land with water rights obtained by the Mono County Irrigation Company in 1915;

- Division 2 - land having water rights to Rush Creek, including land with water rights obtained by Cain Irrigation Company and the California-Nevada Canal Water and Power Company in 1916;

- Division 3 - land having water rights to Walker Creek;

- Division 4 - land having water rights to Parker Creek;

- Division 5 - land having water rights to Gibbs Canyon Creek (as diverted to Horse Meadows);

- Division 6 - land having littoral, riparian, or other rights that could be affected by the level of Mono Lake, considered to be a band around the lake approximately 1-1.5 miles wide, as well as Paoha and Negit Islands;
- Division 7 - land for which ownership or an easement for installation of the Lee Vining conduit would be needed (this division overlaps other divisions above);
- Division 8 - land needed for a dam and reservoir at Grant Lake (much of this land was in federal ownership); and
- Division 9 - land needed for a dam and reservoir at Silver Lake on the June Lake Loop, including a tract of subdivided land.

Subsequently, public land was identified for which subsurface construction rights would be needed to accommodate the Mono Craters Tunnel.

Actual Land Acquisitions. Several means of acquiring necessary land and water rights in the above areas were pursued by LADWP:

- purchase of private land from willing sellers;
- acquisition of private land through condemnation proceedings, deriving from the City of Los Angeles' power of eminent domain;
- withdrawal of public lands from future homesteading by federal agencies, to preclude conflicts with additional private landowners in the future;
- acquisition of permits for rights-of-way on federal public land; and
- acquisition of public land ownership under 49 Stat. 1892 for lands serving "necessary purposes of said city", subject to such a finding by the Secretary of the Interior.

Figure 3G-3 depicts the prediversion pattern of land ownership in Mono Basin that resulted from LADWP's land acquisitions.

Private Land Purchase. Approximately 3,000 acres were acquired through purchase from willing buyers before subsequent condemnation proceedings were initiated in 1930. The perceived inevitability of transfers of land to LADWP, however, may have increased the amount of private land "willingly" sold.

Private Land Condemnation. In 1930, LADWP undertook condemnation proceedings to acquire remaining private land and water rights in Mono Basin that the city deemed necessary for its purposes. A total of 62 private property owners and 16 corporate owners were summoned to court, including banks holding foreclosed property and irrigation and power companies.

Much of the land sought through condemnation belonged to SSP and its associates. During the proceedings, LADWP agreed with SSP to purchase most of their property while not affecting SSP's rights to continued power generation. LADWP was thus able to purchase over 9,500 acres and obtain water rights to an additional 1,800 acres in Mono Basin. The SSP powerplant on Rush Creek and two of the plants on Lee Vining Creek could continue operation. The third plant on Lee Vining creek, located below the proposed LADWP diversion, was to be abandoned for power-generating purposes when the city began diversions.

SSP also offered to assign to LADWP land that had been optioned by private parties for purchase by SSP. An additional 3,100 acres were acquired in this manner. Seven ownerships ranging from 160 to 760 acres in size were involved. Throughout the proceedings, LADWP negotiated sales with several individual landowners, terminating portions of the litigation. Approximately 13,000 acres (Figure 3G-3) were so acquired.

In 1937, 7 years after the condemnation proceedings were initiated, the Aitkin case was closed and LADWP was awarded purchase rights to several additional properties at court-specified values. Subsequently, LADWP declined to purchase some of them. Much land originally sought remained in private hands, particularly along the perimeter of Mono Lake (Figure 3G-3).

Withdrawals of Public Land from Homesteading. Some public land near Mono Lake was withdrawn from entry by homesteaders by the BLM both to facilitate water and power development and, for some land, specifically at the request of LADWP. This land, shown of Figure 3G-3, remained in public ownership.

Acquisition of Public Land Rights. In 1937, LADWP acquired special-use permits from USFS and BLM for rights-of-way on federal land for the Mono Basin aqueduct and appurtenances.

In 1945, LADWP submitted two applications under 49 Stat. 1892 (noted previously) to the federal government requesting purchase of this land and nearly 24,000 acres of additional federal land for various purposes related to operation of the Los Angeles aqueduct system in both Mono Basin and the Owens River basin. This land entailed reservoir and dam sites, adjacent land that could affect water quality, water treatment sites, a disposal site for waste from the Mono Craters tunnel, land littoral to Mono Lake, and land riparian to Lee Vining and Rush Creeks. LADWP wanted ownership of this land because, although withdrawn, it could be opened to homesteading again in the future.

After a review lasting nearly 9 months, the Senate Committee on Local Governmental Agencies denied LADWP's request, stating that fee title (ownership) was not necessary and the city could successfully operate with easements, rights-of-way, and other commitments from the government (California Senate Commitee on Local Governmental Agencies 1945).

Acquisition of Appropriative Water Rights. In 1940, the City of Los Angeles was granted permits by the State of California allowing the appropriation of the flows from Rush, Lee Vining, Parker, and Walker Creeks into its newly constructed Mono Basin export system. Limited capacity of the Los Angeles aqueduct downstream prevented full appropriation of Mono Basin waters for many years. By 1970, however, the aqueduct system had been expanded, and full diversion during periods of average runoff became common.

In 1974, SWRCB issued licenses confirming the city's right to divert water from the Mono Lake tributaries. From 1974 until 1989, the city annually exported an average of 83,000 af of water from Mono Basin.

LADWP Acquisition of Lands and Water Rights along the Upper Owens River

In the prediversion period, private land along the Upper Owens River was used principally for cattle grazing, as previously discussed in the "Agriculture" section. Some private owners also established fishing ranches on their properties as described in Chapter 3J, "Recreation Resources".

By acquiring ownership of private land along the river, LADWP hoped to guarantee that conveyance of Mono Basin waters via the Upper Owens River would not be hampered. Several parcels, consisting of nearly 7,800 acres or nearly 65% of the private land in the area (Figure 3G-4), were purchased from private owners, including an individual who, knowing LADWP's interests, had been purchasing land several years before the above-described condemnation action was initiated.

During the condemnation action, LADWP had not yet determined the location of the Mono Craters Tunnel, so the other privately held parcels along the river were not sought through the condemnation process (Superior Court 1934). The testimony provided by LADWP in the Aitken Case indicated that additional properties in the Owens Valley would be identified for acquisition later, but additional acquisitions never occurred and additional condemnation proceedings were never undertaken.

Effects of Land Acquisition by LADWP

No substantial changes in use of acquired land appear to have resulted from LADWP's land acquisitions; however, the intensity of agricultural production in Mono Basin changed with variations in the amounts of water available for irrigation of LADWP properties. LADWP's policy allowed former owners to lease back properties for activities that would not disturb LADWP's water procurement (Verble 1989, Wilson pers. comm.). The amount of acreage allowed by LADWP to be irrigated by lessees varied each year due to runoff levels and LADWP's export needs. A total of about 3,000 acres was irrigated from streams supplying the aqueduct until the mid-1960s, when irrigation of lands east of U.S. 395 was eliminated by LADWP. Irrigated acreage has totaled approximately 2,000 acres in recent years. Irrigation water applications have also varied from 0 to 11 thousand acre-feet (TAF) on acquired lands, averaging an estimated 8 TAF over this period.

Commerce and other uses of other land in Mono Basin and Upper Owens River basin also were little affected by LADWP's land acquisitions. This situation resulted primarily because many privately owned parcels were not acquired by LADWP and, as noted, agriculture on LADWP-acquired land changed little. This situation was in contrast to events in Inyo County, where LADWP purchase of lands and water rights led to substantial reductions in irrigation, the departure of former occupants, and therefore an overall decline in local commercial activity.

The town of Lee Vining was little affected by the land acquisitions. At this time, Lee Vining encompassed approximately 16 acres. A substantial portion of the Lee Vining townsite was located on USFS land that was leased by residents and merchants on a renewable annual basis, and these leases were not affected by LADWP procurement of lands. (California Senate Committee on Local Governmental Agencies 1945.) The Lee Vining townsite has since passed to private ownership.

ENVIRONMENTAL SETTING

Sources of Information

Agricultural land use and production is derived from production information compiled by the Inyo-Mono Department of Agriculture and discussions with ranch owners, livestock managers, and BLM and LADWP staff responsible for rangeland management. Land use policies and practices of Mono County, LADWP, and USFS are reported as described by responsible personnel and relevant policy documents.

Agriculture

Agricultural Land Use and Production in Mono County

Most agricultural land uses in Mono County are dedicated to the production of livestock feed and forage crops, including alfalfa hay, irrigated pasture, and dryland grazing (Table 3G-2). These three crops accounted for an estimated 98% of Mono County's harvested acreage in 1989. The data presented in Table 3G-2 indicate that amounts of irrigated pasture in the county have increased substantially since 1974; however, much of this change is due to irrigated pastures on federal lands being included in this category beginning in 1979. Amounts of irrigated pasture in the county probably changed little between 1974 and 1989.

Irrigated pasture accounted for 36% of harvested agricultural land in the county at the point of reference in 1989; dry grazing land accounted for 58% of all agricultural land in the same year.

Livestock production, by far the largest agricultural activity in Mono County, increased nearly in proportion to the increase in acreage dedicated to feed and forage crops between 1974 and 1989. The number of cattle and calves produced in the county doubled from 1974 to 1989, increasing from almost 5,000 to nearly 10,000 head of cattle (Table 3G-3). While livestock production increases were substantial over this period, all the increases occurred in the first 5 years of the 15-year period (1974-1979); livestock production actually declined between 1979 and 1989.

Mono Basin Agriculture

Patterns of Use. About 79% of the land in Mono County is in public ownership (USFS 1989a). Within Mono Basin, the percentage of land in public ownership, including federal, state, and LADWP land, is even higher. Excluding the lake surface, 95% of the land within the Mono Basin National Forest Scenic Area is in public ownership (USFS 1989a). Because of the small amount of private land within the basin, most agriculture occurs on land leased from LADWP or used through permits issued USFS or BLM.

Livestock production is the dominant agricultural activity within Mono Basin. Sheep and cattle are grazed within the basin during summer months; very little livestock remain in the basin year round because of adverse weather conditions. Most livestock operations are based elsewhere, including Inyo and Kern Counties, California, and Nevada.

Typically, Mono Basin sheep operators truck animals from south to north, and from low elevations to high elevations following the growth of forage plants. This usually includes winter and early spring grazing in the lower San Joaquin Valley and Mojave Desert; late spring and summer grazing on LADWP, USFS, and BLM lands in Mono Basin; and fall grazing in the Owens Valley. This rotation incorporates forage produced by private properties in the San Joaquin Valley and forage produced by federal and LADWP properties in Mono Basin.

Levels of Use. The number of sheep and cattle brought into the basin each summer varies based on a number of factors, including relative forage availability in the basin, water availability, livestock prices, and operation-specific factors. Four sheep companies and one cattle company use most of the grazing lands within Mono Basin.

The agricultural productivity of Mono Basin can best be judged in terms of its forage production. Forage availability and livestock use associated with grazing land are measured and controlled by LADWP and federal agencies according to the number of animal unit months (AUMs) produced and allowed to be harvested by livestock per acre of land.

Estimated forage production within the area of concern during normal water availability years averages about 20,500 AUMs, including about 9,100 AUMs associated with federal grazing allotments and about 11,400 AUMs associated with LADWP properties (Tables 3G-4 and 3G-5). A small amount of forage is produced by private properties in Mono Basin. Approximately 86% of production on LADWP land is from pastures irrigated by the diverted tributary streams; the remainder is from dryland grazing. Irrigation occurs from April through October, with most of the irrigation occurring during the May-August period.

LADWP Land. Land along the diverted tributaries owned by LADWP was leased in 1989 to two sheep operations: the Mono Sheep Company and the Inyo Sheep Company. (The Mono Sheep Company was bought by the Inyo Sheep Company in 1991.) Leases cover a 1-year period, with the lease year spanning April 1 through March 30. Lease arrangements may be terminated at the end of any lease period but are normally offered to existing lessees for renewal. The two current lessees within Mono Basin have leased this land for many years. (Anderson pers. comm.)

Land leased by LADWP for grazing purposes is classified according to irrigability and forage productivity, with associated AUMs and lease rates per AUM. The productivity of LADWP's irrigable land in the basin ranges from 1.5 to 4.5 AUMs per acre. Adjacent dry grazing land produces from 0.05 to 0.125 AUMs per acre.

The application of water not to exceed 5 af per acre during the irrigation season is allowed on land classified as irrigable; however, according to the structure of its leases, LADWP may decrease or suspend the allowable water application rate at any time. Irrigable land is reclassified (called a "dry finding") if water is not available to serve the city's need during a given year because of dry conditions (c.f. LADWP model lease).

Mono Sheep Company. The Mono Sheep Company, based in Barstow, leases over 5,800 acres in Mono Basin from LADWP for the grazing of sheep. Leased land is located in three areas of the basin, including nearly 2,800 acres in the Horse Meadow/Lee Vining area, about 1,850 acres near the northwest corner of Mono Lake, and nearly 1,200 acres near the northeast corner of the lake.

As shown by Table 3G-4, allowable grazing use of LADWP land leased by the Mono Sheep Company is about 2,000 AUMs, with 76% derived from 440 acres of irrigated land and 24% contributed by the more than 5,000 acres of dry rangeland. The Mono Sheep Company's operation included approximately 3,000 sheep in 1989 (Iturriria pers. comm.).

During normal water availability years, and in 1989, the Mono Sheep Company irrigates 149 acres from creeks diverted by LADWP and creeks tributary to the diverted creeks in the basin. Based on the 5 af per acre maximum irrigation rate specified in the lease, irrigation during normal years would result in the annual use of 745 af of water from these creeks. The Mono Sheep Company irrigates 28 acres in Upper Horse Meadow and 31 acres in Lower Horse Meadow from Gibbs Creek (a tributary to Lee Vining Creek) through the Horse Meadow Diversion. Another 90 acres are irrigated along U.S. 395 south of Lee Vining through the Gibbs Siphon release and two sandtrap releases from water diverted from Lee Vining Creek.

Allowable grazing use of these irrigated pastures is 4.5 AUMs per acre. Pastures irrigated by the Mono Sheep Company from Lee Vining and Gibbs Creek produce a total of 670 AUMs during normal precipitation years. (Anderson pers. comm.)

Inyo Sheep Company. The Inyo Sheep Company, based in Oildale, Kern County, leases nearly 9,900 acres in Mono Basin from LADWP for sheep grazing. Almost all of this acreage is located on the Cain Ranch on both sides of U.S. 395 southwest of Mono Lake and south of Gibbs Canyon. As shown in Table 3G-4, LADWP classified over 1,800 acres for irrigation; remaining acreage is classified for dryland range. Based on the maximum irrigation rate of 5 af per acre specified in the lease, irrigation during normal water availability years results in the use of about 9.2 TAF of water from tributary creeks.

Property leased by LADWP to the Inyo Sheep Company produces nearly 9,400 AUMs during normal years, with the irrigated land accounting for 89% of this total (Table 3G-4). In 1989, a dry finding was made on 335 acres of irrigable land because of drought conditions, reducing total AUMs allowed by the lease to about 8,300. All of the land irrigated under the lease to the Inyo Sheep Company are located west of U.S. 395 and are irrigated from the Farrington Siphon located on the aqueduct between Lee Vining and Walker Creeks, and from diversions from Walker and Parker Creeks. (The Inyo Sheep Company also has access to one BLM range allotment and three USFS allotments within the basin, with total forage production of 3,987 AUMs.

The Inyo Sheep Company was established in 1938. The number of sheep included in the company's operation have declined from approximately 20,000 in 1940, to 14,000 in 1970 after the second barrel of the aqueduct became operational, and to 10,500 by 1989. Sheep are taken to the Cain Ranch area by late April and are rotated among pastures at the Cain Ranch and federal allotments in the Mono Basin area until late September or October. Ewes are then transported to Bakersfield to lamb, and the sheep are generally kept in the Bakersfield area until late April. When pasture and dry grazing forage are scarce, sheep are grazed on leased alfalfa fields in Mono, Inyo, and Kern Counties. Lambs are sold in spring to slaughterhouses in Dixon, California; Colorado; and Texas. (Iturriria pers. comm.)

Importance of LADWP Land. Land leased by LADWP to livestock operators in Mono Basin represent a substantial amount of the agricultural productivity of the basin. Together, land leased to the Mono and Inyo Sheep Companies produce approximately 11,400 of the 20,500 AUMs produced in Mono Basin from diversions of 11 TAF/yr. The 2,284 acres of irrigated pasture leased to the two companies accounted for about 4% of the irrigated pasture in Mono County in 1989.

Federal and Other Public Land. Most of the land along the margin of Mono Lake is federal public land managed by USFS. Small parcels of private land are distributed around the lake, with the greatest concentration of private land along the west shore. As mentioned previously, LADWP also owns land along the southwest and northwest margin of the lake. Sheep and cattle are grazed around the lake on much of this land.

Relicted Land. Some dryland grazing occurs on the relicted land, or land that has been exposed by the declining level of Mono Lake since LADWP diversions began. Relicted land lies between elevation 6,417 feet and the daily fluctuating lake level. Based on the point-reference (6,376.3 feet) lake elevation, approximately 14,100 acres of this land have been exposed since 1941. Approximately 43% of the relicted land is vegetated, primarily with bulrush and saltgrass. Relicted land is managed both by USFS and the DPR through a memorandum of understanding (MOU) (USFS 1989a).

Grazing on relicted land is prohibited by USFS as part of its management of the Mono Basin National Forest Scenic Area and by DPR. The relicted land, however, borders grazed public and private land, and unauthorized grazing on relicted land may occur. Relicted land is fenced off along the northeastern and eastern edge of the lake, but other relicted land is not separated from adjacent land by fencing.

Public Land Allotments. Range allotments managed by USFS and BLM ring Mono Lake and include substantial acreages. Among these allotments, six are located adjacent to Mono Lake and five are located west and south of the lake. Eight allotments are partially included within the Mono Basin National Forest Scenic Area and extend beyond onto adjacent land. Allotments often include both federal and nonfederal (private or LADWP) land that is managed together.

Allotments extending onto National Forest land are managed by USFS. The six allotments that extend onto BLM land are managed cooperatively under a 1985 MOU between USFS and BLM. Table 3G-5 lists the allotments within Mono Basin and the agency managing each allotment.

Forage production on federal land range from 0.125 to 0.020 AUMs per acre on shrub range; production on irrigated meadows range from 1.0 to 4.0 AUMs per acre (Primosch pers. comm.). Approximately 9,275 AUMs of forage are allowed to be grazed on the 10 allotments within the area (Table 3G-5). All but one of the allotments is grazed by sheep; the Mono Sand Flat allotment is grazed by cow-calf pairs.

Grazing permits run for 10 years and are usually renewed if the permittee wishes to continue using an allotment. An allotment is tied to its base property (private property owned by the permittee) or the livestock that use an allotment associated with leased land. If the base property is sold, the allotment permit is usually offered to the new owner. In the case of an allotment tied to leased land, the allotment would likely be offered to the buyer of the lessee's livestock.

An allotment is considered vacated if it is not used by the permittee over a 4-year period or if a new owner of base property or livestock does not choose to use an allotment. Vacated allotments may be offered to a new permittee, withdrawn from use by the managing agency, or reoffered with new use conditions. (Primosch pers. comm.)

The USFS management plan for the Mono Basin National Forest Scenic Area (USFS 1989b) calls for the closing of grazing allotments within the scenic area when permits are waived back to the government and when there is no qualified purchaser of either permitted livestock or base property belonging to the current permittee.

As shown in Table 3G-5, the Inyo Sheep Company is a permittee on four allotments within the area of concern. The Inyo Sheep Company controls the Horse Meadow, Mono Mills I, June Lake, and Alger Lake allotments. Together, the allotments produce nearly 4,000 AUMs of harvestable forage.

Aggregate Forage Utilization by the Inyo and Mono Sheep Companies. The Inyo and Mono Sheep Companies, utilizing both LADWP land and about 49% of the productivity of federal allotments, account for 77% of the livestock forage utilization in Mono Basin.

Upper Owens River Agriculture

Land ownership along the Upper Owens River is divided among private parties, LADWP, and the federal government. Within the study area, four private landowners operate cattle ranches in the northwest portion of the study area (Figure 1-4), and three ranchers lease land from LADWP north of Lake Crowley reservoir. At least three of the private landowners operate sportfishing facilities in addition to cattle ranches.

Few cattle stay in Long Valley year round because of adverse weather conditions. Cattle operators graze their cattle on land at lower elevations, usually in the Bishop area, during winter and early spring months. They truck them to Long Valley in May and graze them until October or November. All but one of the cattle operations along the Upper Owens River are cow-calf operations. Calves produced by these operations are usually sold to local buyers at weights ranging from 500 to 600 pounds. The animals are then typically shipped to Kern County for finishing.

Pastures in the area of concern are irrigated from both the Upper Owens River and Hot Creek, and dry rangeland also is used. Irrigation patterns are generally similar to those of Mono Basin, although the net evapotranspiration is higher; irrigation typically occurs from April through September, peaking in June and July. During a normal water availability year, a maximum of about 17 TAF is diverted and about 11 TAF is consumed for irrigation of this land.

Forage production from the combined use of private, LADWP, and federal grazing land along the Upper Owens River totals about 14,000 AUMs during normal water availability years (Tables 3G-6, 3G-7, and 3G-8).

Private Land. Four private properties, used for cattle and fishing operations, are located along the Upper Owens River in the northwest portion of Long Valley near the East Portal. All except the Owens River Ranch and a portion of the John Arcularius Ranch are downstream of the East Portal. These properties contain approximately 3,080 acres, n estimated 1,350 acres irrigated from the Upper Owens River. Three of the also control adjacent federal grazing allotments.

four landowners have riparian water rights that allow them to use a correlative atural streamflow for reasonable beneficial uses. An estimated maximum of 6.7 TAF of Upper Owens River streamflow is annually diverted, and 4.3 TAF is consumed, for irrigation of this land during periods of normal runoff, based on estimated evapotranspiration rates in this area (Table 3A-9). (The difference between these two amounts is irrigation runoff and percolation that return to the river.) Upper Owens River streamflow effects of these and LADWP's irrigations diversions are described in Chapter 3A, "Hydrology" (Table 3A-9).

Production on private land in the Long Valley study area is difficult to estimate because forage harvesting by cattle is not managed or regulated by public agencies. The amount of land being irrigated and the AUMs produced on the private land are not carefully documented by landowners. In addition, the number of cattle sold by ranches using private land does not provide a good measure of the productivity of this land because cattle are grazed on land outside of the area of concern for much of the year.

Average current production on private land along the Upper Owens River, expressed in AUMs of forage, was estimated assuming 3 AUMs of forage production per acre on irrigated land and 0.1 AUM per acre on dry grazing land. These production rates were based on rates used by BLM and LADWP for evaluating the carrying capacity of grazing properties.

As shown in Table 3G-6, an estimated 4,200 AUMs of forage are produced annually on this private land, or about 30% of the total production in the Upper Owens River basin. Land irrigated from the Upper Owens River accounts for more than 95% of the forage produced on the four private properties. Nearly 93% of the production is from the three ranches downstream of the East Portal.

LADWP Land. LADWP owns all the land along the Upper Owens River downstream of the four private ranches to Lake Crowley reservoir. These properties are leased to three cattle companies with cow-calf operations. As in Mono Basin, irrigation and livestock use of leased properties are regulated by LADWP.

LADWP land accounts for about 53% of the forage produced in the Upper Owens River basin. About 9,400 acres of land leased by LADWP produce over 7,400 AUMs of forage, with 86% of the forage produced on about 2,000 irrigated acres (Table 3G-7). About 470 acres are currently irrigated from the Upper Owens River, and 1,535 acres are irrigated from Hot Creek. During a normal year, an estimated maximum 2.4 TAF of Upper Owens River streamflow is annually diverted and 1.5 TAF is consumed from the Upper Owens River for irrigation (with the difference returning to the river), while 7.7 TAF and 4.9 TAF are diverted (maximum) and consumed, respectively, from Hot Creek.

The actual amount of irrigated acreage may change during years when flows in the Upper Owens River are reduced due to drought conditions or reduced exports from Mono Basin (Table 3A-9). LADWP leases stipulate an irrigation rate of 5 af per acre on land designated for irrigation; however, the rate was reduced to 4.5 af per acre for the 1991 lease year.

The J&L Livestock Company typically irrigates about 470 acres from the Upper Owens River. About 1,500 acres are irrigated by Cashbaugh Ranch and 4J Cattle Company using water diverted from Hot Creek. The 4J Cattle Company irrigated pasture from a meander of the Upper Owens River prior to 1989, but reduced flows in the river since then have reduced their ability to irrigate from the Upper Owens River (Johns pers. comm.).

All three cattle companies have grazing access to other nearby properties, including federal allotments and private properties. During normal water years, the three cattle companies run a total of approximately 2,350 cow-calf pairs and 500 replacement heifers, and annually sell approximately 1,550 500-pound calves. Calves are typically sold to a buyer based in Bakersfield, where the calves are shipped for finishing. (Iturriria, Cashbaugh, Johns pers. comms.)

Public Land Allotments. Most of the private landowners and LADWP lessees along the Upper Owens River control federal grazing allotments adjacent to their primary properties (Table 3G-7). These allotments are critical components of the grazing operations. Cattle are moved from irrigated pastures on private and leased land to dry grazing land on federal allotments throughout summer to maximize the use of available forage. Forage production on the six allotments totals nearly 2,500 AUMs, or about 17% of the total forage production in the Upper Owens River basin.

Land and Water Resource Ownership and Use

Land Use Changes during the Diversion Period

During the diversion period, land in Mono Basin and along the Upper Owens River continued to retain its rural character. With the steady growth in tourism along the east side of the Sierra Nevada, the town of Lee Vining and rural residency continued to grow slowly. The town's role as a gateway to Yosemite National Park became more prominent as visitation there increased, while a significant recreational-residential center developed along the June Lake Loop. The regional population increased and transportation facilities expanded and became more dependable, decreasing the area's isolation.

Land ownership changed little during much of the diversion period. LADWP did not actively pursue further land and water rights acquisitions during this period, although the southern half of Paoha Island was acquired.

The most significant land ownership change was the recent acquisition of private land within the boundaries of the Mono Basin National Forest Scenic Area by the USFS when private owners are willing. Land exchange for other USFS land, which may be facilitated by the intermediate purchase by a third party, is the most common acquisition procedure. Appropriated funds can also sometimes be obtained after a lengthy process. Since its creation, the scenic area has been expanded by over 2,000 acres through private land acquisitions. Management of the Mono Basin National Forest Scenic Area is described in a subsequent section.

Figures 3G-5 and 3G-4 present the ownership of land at the point of reference in Upper Owens River basin and Mono Basin, respectively.

Town of Lee Vining. The town of Lee Vining continued to expand as the only commercial center in the basin. Retail stores, lodging, restaurants, and gas stations serve the town residents, surrounding areas, and recreational visitors passing through. A USFS ranger station for the Mono Lake Ranger District was developed along Lee Vining Creek about 2 miles upstream of the town along the Tioga Pass Road in the 1960s, and the new Mono Basin National Forest Scenic Area Visitor Center opened at an overlook near the edge of town in 1992.

The town has now expanded to include essentially all the developable land owned by private parties. A lack of sufficient suitable housing in Lee Vining is considered directly linked to the reluctance of LADWP to develop or lease for development its land next to the town. (Mitchel pers. comm.)

Lakeshore. The perimeter of the prediversion lake continues to be a mixture of private, LADWP, and federal land supporting relatively low levels of activity consisting of dispersed housing, grazing (discussed previously), and dispersed recreation associated with the lake (see Chapter 3J, "Recreation Resources"). During the diversion period, LADWP increased its ownership of lakeshore land by purchasing the southern half of Paoha Island after an offer of sale was made. Otherwise, LADWP did not pursue further land acquisitions during the diversion period.

Over this period, a restaurant and a few lodging accommodations expanded or developed along U.S. 395 around the west side of the lake. In the early 1960s, a brine shrimp harvesting and processing facility was constructed in this area. This small facility processes Mono Lake brine shrimp for fish food and utilizes a minor portion of the annual shrimp production of the lake.

As the lake has drawndown by the diversions, approximately 14,000 acres of lakebed have emerged as noted previously. After adjudication, it was determined that "relicted" land downslope of federal land is federal public land and land downslope of private or LADWP land is state public land. This land is now managed by the Inyo National Forest and by DPR for the State Lands Commission. This land serves as habitat and is used only for nonintrusive public recreation activities.

Other Mono Basin Areas. Arid land east of the Sierra Nevada continues to serve principally as rangeland with gradually increasing dispersed recreation uses, as managed by BLM and USFS. Small pumice and gravel mining operations have continued to operate on federal and LADWP land in Pumice Valley to support local construction and road-building activities. One gravel pit, a Caltrans operation now terminated, was located along the dewatered bed of Parker Creek, east of U.S. 395. The other is located along Rush Creek near the confluence of Parker Creek. The pumice mine is next to the town of Lee Vining. Quarries are also present at Black Point and east of the Mono Craters.

Forested land on the east slope of the Sierra Nevada, proximate to Yosemite National Park, have been increasingly managed for recreational and wildlife values, although logging and grazing occurred in certain locations. Higher-elevations above the area of concern are now managed to preserve wilderness values under provisions of the Wilderness Act of 1964. Power has continued to be produced by Southern California Edison at SSP hydroelectric plants described previously, and two small hydroelectric plants have been proposed below the Edison powerhouses on Mill and Lee Vining Creeks.

Along the tributary streams south and southwest of the lake, national forest land predominates with substantial private holdings. Along the June Lake Loop, extensive second home development occurred on subdivided lots. An alpine ski hill was developed. A private owner seeking to augment recreational facilities at June Lake continues to exchange private land acquired in the Mono Basin National Forest Scenic Area for USFS land near June Lake that would not otherwise be available for development.

Upper Owens River Basin. Land along the Upper Owens River continues to be used exclusively for agricultural and recreational activities. Cattle grazing and recreational fishing have been supplemented by a trout-raising enterprise at the Owens Valley Ranch. The landownership pattern has not changed since LADWP purchased property in the 1930s.

Management of LADWP Land

Character of Land. LADWP's land ownership (Figure 3G-4) can be divided into several geographic areas.

Land adjacent to the Town of Lee Vining. Approximately 90 acres of undeveloped LADWP land lie on the terrace adjacent to the town of Lee Vining. These are readily accessed from U.S. 395, and consist of nearly level, sagebrush-scrub, undeveloped terrain. This land has been excluded from the Mono Basin National Forest Scenic Area. No undeveloped private land is present (Mitchel pers. comm.).

Land South of Mono Lake. This land includes the lakeshore near the mouth of Lee Vining Creek, the Rush Creek bottomland, the sparsely vegetated flats of Pumice Valley, and the Cain Ranch along the diverted tributary streams. The total ownership is about 12,500 acres. Access is by U.S. 395, paved County Road 120 to South Tufa Grove, the graveled county road near the lake, the paved June Lake Loop Road, and unsurfaced roads at Cain Ranch. Terrain and vegetation vary considerably, but large areas of gently sloping ground are present. The diverted tributary streams cross this ownership, and, until recently, a substantial acreage was irrigated from the diversion system. Nearly half of this property lies within the Mono Basin National Forest Scenic Area.

Land in the Northwest Corner of Mono Lake. LADWP lands consist of approximately 1,200 acres of gently sloping, sagebrush-scrub land bisected by U.S. 395 and a paved road connecting the highway to the County Park at DeChambeau Creek, Mono Vista Spring, and land northwest of Black Point. This land lies entirely within the Mono Basin National Forest Scenic Area.

Other Land around Mono Lake. Nearly 1,200 acres belonging to LADWP are scattered in six parcels around the perimeter of Mono Lake, in addition to approximately 700 acres owned on the southern half of Paoha Island. Springs occur on several of these properties. One parcel is accessible by a paved highway; the remainder are served by the unimproved, four-wheel drive road that circles the lake. The island is only accessible by boat. All this land is gently sloping, sagebrush-scrub land, except for several marshes.

Land along the Upper Owens River. LADWP owns approximately 7,500 acres of land along the Upper Owens River north of Lake Crowley reservoir (north of the southern tier of sections in T3S, R29E). Most of this land is irrigated meadowland used for grazing, although sagebrush-scrub land is also present. Access is by graveled and dirt USFS roads. Along the river floodplain and approaching the reservoir, much of the land is nearly level and has shallow groundwater.

Land Management Activities during the Diversion Period. LADWP's diversions began in 1940 after construction of small diversion dams on Lee Vining, Parker, and Walker Creeks; a conduit from Lee Vining Creek tying these diversions to Grant Lake on Rush Creek; a dam on Rush Creek substantially enlarging Grant Lake; and a conduit and tunnel through the Mono Craters to the Upper Owens River. Exports to the Upper Owens River began a few months later in 1941.

Operation of the water export system changed the operation of local irrigation diversions, such as at Cain Ranch. The aggregate effect of the changes on local use of LADWP's land was not great, as previously discussed, and this land remained irrigated and in livestock forage production (see "Agriculture" above).

In 1970, LADWP added a second barrel to the aqueduct between Owens Valley and Los Angeles, allowing a significant increase in diversions from Mono Basin. No significant changes in land use were caused by construction of the project, but the increased export capacity was utilized by decreasing irrigation of the more permeable areas of Pumice Valley. In particular, irrigation ceased on a 695-acre area (Winsor pers. comm.) east of U.S. 395 adjacent to the South Tufa Road (Figure 3G-1). This acreage is currently reverting to sagebrush scrub habitat.

Land Management Policies during the Diversion Period. LADWP's primary mandates are to procure water for the City of Los Angeles, protect its water rights, and ensure the quality of the water procured. Other LADWP objectives include administering assets in a way that is cost-effective for the city, maintaining historical resources, permitting compatible land uses including livestock production and dispersed recreation, and cultivating cooperative relationships with local communities. Uses by local communities that would not conflict with other objectives are favorably considered. (Wilson pers. comm., Verble 1989.)

During the diversion period, LADWP's policy was to keep acquired ranch land in ranching use. Livestock grazing and alfalfa production were considered uses compatible with maintenance of water quality if chemicals were not employed (Verble 1989). Other than agricultural reductions associated with protecting range resources and attributable to opening of the second aqueduct barrel previously noted, this effort was successful. (Wilson pers. comm.)

LADWP has also pursued a policy of allowing dispersed recreational day uses on its acquired land. It has required its ranch lessees to keep at least 75% of the leased land open for low-impact dispersed recreational use. Land is not available, however, for camping, campfires, or off-road vehicle use. (Wilson pers. comm., Verble 1989).

Land Ownership Policies. After diversions began, LADWP determined that further purchases of land in Mono Basin and Upper Owens River basin were unnecessary. LADWP has made occasional purchases of land such as Paoha Island, however, to accommodate private owners otherwise unable to sell land. This policy was first applied to commercial properties in Inyo County in the 1930s.

LADWP had determined earlier that disposal of some commercial lots and other town lots, most of which were located in Inyo County, would be appropriate. The Los Angeles City Charter dictates circumstances under which LADWP may dispose of land. Water rights cannot be sold unless mandated by a two-thirds vote of the citizens of Los Angeles. All water and mineral rights must be retained by the city, and easements for all existing facilities must be required. (Verble 1989.)

In 1945, the city attorney interpreted the city charter to imply that sales and leases of LADWP property must be put up for competitive bid. Local citizens, fearful that they would lose access to property they were leasing, prompted the state legislature to pass an act requiring the city to grant a right of first refusal to current lessees. This action effectively prevented sales of occupied properties until 1980 when an agreement to revise procedures was reached. The accord specifies that the city may contract a long-term lease (15 years) with the current lessee and then put the property up for sale by competitive bid, subject to the conditions of the lease. (Verble 1989.)

Present and Future Land Management Policies and Practices. In 1991, LADWP declared a 5-year moratorium on grazing in riparian corridors along the diverted tributary streams to help the process of vegetation recovery from earlier stream dewatering.

LADWP staff has expressed an intent to reduce irrigation of its Mono Basin land by diversions from the four currently diverted streams (Kodama pers. comm.), making up to 8 TAF per year of additional water available for export. In particular, during the driest 43% of future years, some irrigation may occur above the Lee Vining conduit, but none below. During the 27% of ensuing years having near-normal runoff, historical irrigation will occur above the conduit, and some may occur below. During the wettest 30% of following years, historical irrigation will occur above and below the conduit. The planned pursuit of intermittent irrigation may be frustrated by vegetational succession.

No other changes in land management policy have been proposed or adopted by LADWP. Irrigated pasture grazing in wetter years and dryland grazing in drier years could continue on its land. Management for dispersed recreational values could continue. Public consideration has not been given to retaining only water rights and easements and disposing of this land to private parties or governmental agencies, imposing deed restrictions to protect water quality.

Management of the Mono Basin National Forest Scenic Area

In 1984, Congress created the Mono Basin National Forest Scenic Area (Figure 1-1), which includes land surrounding the lake but excludes the town of Lee Vining, reaches of the diverted tributary streams upstream of the lake (including LADWP's diversions), and irrigated pastures of LADWP.

A management plan supported by an environmental impact statement was recently adopted for the Mono Basin National Forest Scenic Area (USFS 1989a, 1989b), and important provisions are described below. The Mono Basin National Forest Scenic Area Visitor Center was opened on an overlook of the lake adjacent to the town of Lee Vining in 1992, also serving as the Mono Basin National Forest Scenic Area headquarters.

Objectives. The objective of the management plan is to protect the area's geologic, ecologic, cultural, scenic, and other natural resources, while allowing recreational, scientific, and other activities consistent with this goal.

Grazing Uses. The objective of the range management element of the management plan is to establish a healthy ecosystem, including wetlands, springs, and riparian zones, through range improvement projects and cooperation with other landowners and by phasing out grazing allotments on public land over time.

As noted previously, unused grazing allotments are to be closed when there is no qualified purchaser of permitted livestock and/or base property. Boundaries of allotments are to be changed to exclude land within the Mono Basin National Forest Scenic Area whenever the permittee is agreeable.

Recreational Uses. The goal of the management plan is to provide a low level of overnight and day-use facilities in the Mono Basin National Forest Scenic Area, with the visitor center as the focal point for interpretation. A developed campground is planned for eventual construction in a forested area (Mono Mills) some distance from the lakeshore. Most dispersed recreational activities are allowed, including motorized use of designated routes, subject to maintenance of an atmosphere of solitude over most of the Mono Basin National Forest Scenic Area.

The eastern side of the lake, generally accessible only by boat or four-wheel-drive vehicles, and the relicted land is to remain as no-development zones. Swimming, boating, and low-impact, dispersed camping are generally allowed, but no developed facilities will be provided on federal land. On relicted land, camping is allowed only in certain areas, subject to permit, and woodfires on relicted land are prohibited.

Land Acquisition and Development of Nonfederal Land. The Mono Basin National Forest Scenic Area plan calls for acquisition of private land as opportunities arise or when proposed development is incompatible with the character of the Mono Basin National Forest Scenic Area.

As noted previously, land can be acquired through purchase, if federal funds are appropriated, or through exchange for other land managed by USFS. Political subdivisions of California, including the City of Los Angeles, may only exchange or donate land to the federal government.

Private property within the Mono Basin National Forest Scenic Area may be acquired without consent of the owner, if the property is being developed or is proposed to be developed in a manner incompatible with the scenic area. In the plan, specific limits are adopted on size and characteristics of development as deemed necessary to maintain the character of the Mono Basin National Forest Scenic Area. The most stringent standards pertain to relicted land. If a development proposed for permit approval to Mono County does not meet these limits, it is found to be incompatible, and the property is subject to federal condemnation at fair market value. LADWP land, as well as private land, is subject to this provision of law.

Lake Level Management. Although the legislation creating the scenic area contains no authorization for direct federal control over lake surface elevations, the management plan addresses lake level management. The plan calls for the USFS to "develop strategies and actions for ensuring a range of water levels between 6,390 [feet] and 6,377 [feet] with a maintenance level near the mid-point of this range" (6,383.5 feet).

Mono County Regulation of Land Use

General Plan Policies. Mono County is responsible for regulating the use of private land and LADWP land in Mono Basin and along the Upper Owens River in accordance with provisions of its general plan.

The draft Mono County General Plan (Mono County Planning Department 1992) calls for "the orderly growth of Mono Basin communities in a manner that retains the small town character, coincides with infrastructure expansion, facilitates economic and community development, and protects the area's scenic, recreational, and natural resources." Development of the Upper Owens River basin is to be limited to guest ranches, related commercial uses, agricultural uses, and residential-support uses. The general plan and zoning are currently being revised.

The General Plan land-use designation for all land owned by LADWP in Mono Basin and along the Upper Owens River, including those surrounding Lee Vining, is "Resource Management" or "Open Space". These designations are intended for land to remain undeveloped or to be developed for resource production only, and allow no more than one dwelling unit per 80 acres.

Pending Developments in the Basins

Mono Basin. Two significant development projects have been proposed for Mono Basin. A specific plan for a recreational-residential development on nearly 880 acres was proposed and approved by Mono County for the Conway Ranch in 1989, although no implementation has occurred and prospects for this project are unknown (Higa pers. comm.). The Conway Ranch is located less than 1 mile northeast of the intersection of U.S. 395 and State Highway 167 north of the lake. This area is not in the Mono Basin National Forest Scenic Area.

The approved plan allows the creation of 250 townhouses; 150 lots for home development; a resort lodge with restaurant, shops, and 150 units; another lodge with 200 units; an 18-hole golf course; and a 30-acre lake. Water and wastewater systems would be constructed, utilizing wells for domestic supply and Wilson Creek streamflow for the lake. (Higa pers. comm.)

A 120-unit "Tioga Inn", to include a restaurant, gas station, mini-mart, and 10 permanent residential units, has been proposed for a site near the intersection of U.S. 395 and Highway 120 south of Lee Vining. Onsite water and wastewater systems are proposed, using a well source. A proposed specific plan accompanied by an EIR is being prepared by the developers, and, in anticipation, the county general plan designation for the site is currently "specific plan". (Higa pers. comm.)

Upper Owens River Basin. One development project has been proposed for the Upper Owens River basin: a major expansion of existing recreational developments on the John Arcularius Ranch. The proposed developments include 50 guest cabins (including the 15 cabins already on the site), a 30-room lodge and restaurant fronting the USFS access road, and four single-family residences. A small equestrian center would also be developed. Onsite water and wastewater systems would be expanded. Irrigation of the ranch's meadowland from the Upper Owens River and cattle grazing would continue. A proposed specific plan has been submitted for the project, and a draft EIR has been circulated for a public comment period (closing December 1992). (Higa pers. comm.)

IMPACT ASSESSMENT METHODOLOGY

Assessment of project impacts focuses on two land use issues: agricultural productivity of lands irrigated at the point of reference and associated likelihood of land ownership or use changes.

Agricultural activities in Mono Basin and Long Valley primarily include sheep and cattle production. Changes in the supply of water available for irrigating pastures would result in livestock production changes in these two areas. For agricultural properties, the objective of the impact analysis is to determine how the water diversion alternatives could affect the productivity of agricultural lands in Mono Basin and Owens Valley. For LADWP agricultural properties, potential changes in ownership or leasing and in land use because of changed agricultural activity are also assessed.

Impact Prediction Methodology

Impact Measurement

The agricultural production from the two areas of concern can be expressed in terms of either animal production or forage production. Determining animal production related to use of the two areas is complicated by the fact that grazing by sheep and cattle is rotated among several different areas to maximize harvesting of forage and avoid subjecting animals to harsh weather conditions. Animal production directly related to use of the two study areas is therefore difficult to estimate. Forage production, however, is more easily estimated and is directly linked to the amount of water available for irrigation. Agricultural impacts were therefore measured in terms of forage production changes resulting from implementation of project alternatives. Economic effects resulting from agricultural production impacts, including production value changes and changes in employment and personal income, were used to assess impact significance, as described in Chapter 18, "Economics".

Impact Prediction

The availability of water for irrigation under the point of reference and for the project alternatives was determined differently for the two areas of concern. For irrigation of LADWP's lands at the Cain Ranch in Mono Basin, the assumptions regarding future irrigation reductions described in Chapter 2 were used. Irrigation below the Lee Vining conduit would be curtailed except in wetter years, so that the average irrigation diversion would fall from 8 TAF/yr at the point of reference and for the No-Restriction Alternative to 1 TAF/yr for all other alternatives.

For irrigation of both private and LADWP lands along the Upper Owens River, the simulations of streamflow for the point of reference scenario and the alternatives were used together with estimates of irrigation diversion demand and irrigation consumption to assess the sufficiency of streamflows for irrigation need. Annual probabilities of insufficient streamflows were examined among the alternatives to determine if reductions in average agricultural productivity would result (see Table 3A-9 and accompanying discussion in Chapter 3A, "Hydrology"). Potential deficits were noted for most alternatives in certain months during the normal minimum flow condition; these deficits were translated into reductions in irrigated acreage. These reductions were adjusted according to the frequency of occurrence of these events.

The following assumptions were made in transforming irrigation use to forage production:

- average annual irrigation demand is 5 af per acre and
- average productivity is 4.5 AUMs per acre on LADWP lands and 3.0 AUMs per acre on private lands along the Upper Owens River.

Estimates of the likelihood of land ownership and use changes under the alternatives were focussed on the potential for LADWP disposal of its lands under each alternative. These estimates were based on the results of the agricultural productivity assessment: if irrigation is substantially reduced, a potential for some land disposal results. If diversions cease, complete land disposal becomes almost certain.

Effects That Cannot Be Predicted

Potential effects on relicted lands around Mono Lake and public land allotments within Mono Basin and Owens Valley are not quantified in the agricultural impact assessment. Grazing on relicted lands is prohibited by USFS as part of its management of the Mono Basin National Forest Scenic Area. Changes in Mono Lake levels and extent of relicted land under the project alternatives should have no substantial effect on amounts of forage available to livestock producers.

Implementation of the project alternatives may have some effect on the utilization of forage on public land allotments. As described in the "Environmental Setting" section of this chapter, allotments are tied to base properties or the livestock that use the allotment. Changes in utilization of LADWP lands in Mono Basin or of LADWP and private ownerships in Owens Valley would not necessarily cause federal allotments to be vacated. Sales of livestock operations caused by reductions in forage production under the project alternatives would likely result in the permits being transferred to the new owners. The likelihood of termination of operations by the Inyo Sheep Company because of loss of Cain Ranch forage is unknown. Current USFS policy is to close allotments when there is no qualified purchaser of permitted livestock or base property belonging to the current permittee. No suitable method of addressing these uncertainties is apparent.

Criteria for Determining Impact Significance

Appendix G of the State CEQA Guidelines states that "a project will normally have a significant effect on the environment if it will convert prime agricultural land to non-agricultural use or impair the agricultural productivity of prime agricultural land". Lands affected by the water diversion alternatives are not considered prime agricultural lands; however, the loss of irrigation water could impair the productivity of these agricultural lands and result in substantial adverse economic effects.

The severity of agricultural production changes resulting from decreased forage production was evaluated relative to countywide agricultural output and the economic effects resulting from production changes. Mono County's agricultural output deviates from year to year based on crop prices, amount of acreage under production, the availability of irrigation water, livestock herd sizes, and crop yields. Changes in production resulting from implementation of project alternatives may not be unusual given the normal fluctuations of the farm economy.

Agricultural production changes occurring under the project alternatives were judged relative to the standard deviation of estimated forage production in Mono County over the past 10 years. Acreages of irrigated pasture and dry rangeland in Mono County remained relatively stable between 1980 and 1989. The standard deviation in estimated forage production over this period was approximately 2,050 AUMs.

Project-related forage production decreases greater than one standard deviation were considered to be substantial. If production changes were considered substantial, economic effects resulting from production changes were evaluated to determine whether production changes would result in substantial adverse economic effects within Mono County. Economic methodology and the criteria used to judge the significance of economic changes caused by agricultural production changes are described in Chapter 18, "Economics." Production changes resulting in substantial adverse economic effects are considered significant project impacts.

The potential for disposal of LADWP lands under each alternative cannot be judged beneficial or substantially adverse. As described in the "Environmental Setting" section, much of this land is suitable for development and could serve several interests (for example, expansion of Lee Vining or opportunities for recreational residences). Much of the land is within the Mono Basin National Forest Scenic Area or along major streams tributary to Mono Lake, and could therefore provide a valuable acquisition to public lands of the scenic area. All such land uses would confer benefits to segments of the public. Developed uses could entail substantial adverse effects on environmental conditions. The nature and magnitude of such impacts, however, are too speculative for further consideration.

SUMMARY COMPARISON OF IMPACTS AND BENEFITS OF THE ALTERNATIVES

As described under "Impact Assessment Methodology", relative land use effects of the alternatives are assessed in this chapter through several key variables:

- amount of acreage irrigated from the four diverted tributaries in Mono Basin and along the Upper Owens River,
- amount of forage produced by these irrigated lands, and
- potential for changes in land ownership and use.

Table 3G-9 provides a summary comparison of the alternatives using these variables.

Irrigated acreage and forage production for each alternative are compared to values for the prediversion and point-of-reference conditions in the table. Table 3G-10 provides the supporting data for this summary. As shown, forage production on affected lands is expected to diminish by over 50% under all alternatives, except the No-Restriction Alternative, because LADWP has apparently chosen to curtail historical irrigation practices below the Lee Vining conduit at the Cain Ranch. Economic effects of this change in agricultural productivity are assessed in Chapter 3N, "Economics", which indicates that this loss is not significant. None of the direct project-related effects are significant adverse impacts; however, the cumulative agricultural effects of the project are considered significant adverse impacts for all alternatives (other than the No-Restriction Alternative). This impact cannot be avoided by SWRCB, because it has no jurisdiction over LADWP's policies for exercise of its riparian water rights.

The substantial reduction in irrigation under most alternatives results in an increased potential for LADWP to dispose of some of its lands in Mono Basin. Much of this land is accessible and developable. Certainly, under the No-Diversion Alternative land disposal would occur. Development of such lands for residential, commercial, and recreational uses may pose a variety of community benefits and environmental impacts that cannot currently be predicted or assessed.

IMPACTS AND MITIGATION MEASURES FOR THE NO-RESTRICTION ALTERNATIVE

Changes in Resource Condition

Irrigated Lands along Diverted Tributaries in Mono Basin

Irrigated lands leased by LADWP to the Mono and Inyo Sheep Companies likely would continue to receive diverted water from Gibbs, Lee Vining, Walker, and Parker Creeks at historical levels. Average annual irrigated acreage and forage production under the No-Restriction Alternative would be similar to levels under point-of-reference conditions (Table 3G-10). Irrigated acreage and forage production would average about 1,750 acres and 7,850 AUMs annually under this alternative. Irrigation from the diverted tributaries in Mono Basin likely could be curtailed during drought to maintain LADWP water export levels. Based on historical (point-of-reference) streamflow conditions, forage production from irrigated pastures could fall to approximately 6,300 AUMs during drought years.

The potential for LADWP to dispose of Cain Ranch lands would remain very low.

Lands Irrigated from the Upper Owens River

Flows in the Upper Owens River through Long Valley under the No-Restriction Alternative would be similar to flows under the point-of-reference scenario during the irrigation season. Under drought conditions, natural forage production would decline in both Mono Basin and Owens Valley study areas.

Under this alternative, the LADWP lessee irrigating from the Upper Owens River north of Lake Crowley reservoir likely would be allowed to continue to irrigate at historical levels. Private landowners with riparian water rights likely would continue to irrigate at levels similar to historical levels.

Average annual irrigated acreage and forage production on lands irrigated from the Upper Owens River would be similar to levels under point-of-reference conditions (Table 3G-10). Irrigated acreage and forage production would annually average 1,821 acres and 6,047 AUMs under this alternative.

Point-of-reference flows in the Upper Owens River during normal minimum flow conditions (Table 3A-9) indicate that drought would have relatively little effect on irrigation and forage production along the Upper Owens River under this alternative.

The potential for LADWP land disposal would remain very low.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (No-Restriction Alternative)

No significant benefits nor adverse impacts would be associated with the No-Restriction Alternative.

IMPACTS AND MITIGATION MEASURES FOR THE TARGET LAKE LEVEL ALTERNATIVES

Changes in Resource Condition

Irrigated Lands along Diverted Tributaries in Mono Basin

As noted previously, at its discretion, LADWP is expected to diminish irrigation below the Lee Vining conduit under these alternatives. The loss of an average of 1,750 acres of irrigated pasture and 7,850 AUMs of forage annually (Table 3G-10) would substantially affect the operations of the Mono and Inyo Sheep Companies. Forage produced by pastures irrigated from the diverted tributaries account for approximately 50% of the forage available to the Mono and Inyo Sheep Companies in Mono Basin. This forage, in combination with forage produced by federal allotments and other leased pasture, provides partial feed for approximately 10,000 sheep during the 5- to 6-month summer grazing season. Loss of irrigated pasture along the diverted tributaries would likely have substantial adverse effects on the Mono and Inyo Sheep Companies because of the loss of revenue caused by smaller herd sizes and increased costs for summer feed. The loss of forage from irrigated pastures would require these operators to either reduce herd sizes by approximately 4,500 sheep or obtain summer forage elsewhere. On the other hand, reduction or elimination of grazing would greatly benefit vegetation and wildlife resources along the tributary streams and adjoining meadows, in turn enhancing visual character and increasing recreation value.

On a regional basis, the loss of irrigated pasture along the diverted tributaries would not be substantial. The project-related decrease in forage would represent approximately 3.2% of the pasture irrigated in Mono County in 1989. The amount of forage produced by irrigated pasture and dry grazing land within the county is unknown but was likely about 170,000-250,000 AUMs in 1989. Based on this estimate, the loss of 7,850 AUMs of forage would represent an estimated 3-5% of the forage produced in Mono County in 1989. This would result in a relatively minor economic effect countywide, as described in Chapter 18, "Economics".

The major reduction in irrigation of LADWP properties at the Cain Ranch could be followed by a decision to dispose of some of these lands, especially where development would not interfere with LADWP aqueduct operations and activities potentially degrading water quality were situated below the aqueduct intake structures (diversions).

Lands Irrigated from the Upper Owens River

Flows in the Upper Owens River under the target lake level alternatives would be adequate during most years to allow for irrigation of pastures along the river. However, in about one in 20 years, streamflow would be insufficient in May, June, and July to sustain point-of-reference irrigation diversions for the higher lake level alternatives; under the 6,377-Ft Alternative, inadequate flows would be limited to 2 months and under the 6,372-Ft Alternative to 1 month.

These low flows would affect at least an estimated 325 of the 1,820 acres typically irrigated from the Upper Owens River, resulting in the average annual loss of 72 AUMs of forage production during these infrequent low-flow conditions.

Irrigated acreage and forage production associated with irrigation diversions from the Upper Owens River would be slightly lower, but similar, to levels under the point-of-reference scenario (Table 3G-10). These estimates, however, may understate the impact on cattle producers along the Upper Owens River. During low water flow years, low water flows may inhibit the ability of gravity-flow ditches to deliver water to pastures on higher grounds away from the river. Lower flows may require ranchers to modify irrigation gates and diversions in order to adequately irrigate during low-flow years. Conversely, less land may be irrigated during low-flow years, decreasing forage production on lands along the Upper Owens River.

Once equilibrium conditions are reached for the higher elevation alternatives, more water may be exported from Mono Basin, increasing flows in the Upper Owens River. This long-term condition would make more water available to irrigators along the Upper Owens River during low-flow years when lake level and tributary streamflows have not fallen below the minimum levels.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (Target Lake Level Alternatives)

- Substantial benefit to vegetation and wildlife along the diverted tributary streams, increasing visual quality and recreational value.

- Reduction in forage production under these alternatives exceeding the average variation in forage production in Mono County but having relatively minor countywide economic effects; the impact is considered less than significant.

- Increased potential for development of rural properties in Mono Basin, a potential significant growth-inducing impact.

Mitigation Measures. The Mono County Board of Supervisors is responsible for identifying and mitigating significant adverse effects of land development. The county has broad authority through general plan and zoning powers to control the type of development. The USFS could acquire lands where proposed development would conflict with the management plan for the Mono Basin National Forest Scenic Area.

IMPACTS AND MITIGATION MEASURES FOR THE NO-DIVERSION ALTERNATIVE

Changes in Resource Condition

Lands Irrigated along Diverted Tributaries in Mono Basin

Under this alternative, irrigation of Cain Ranch lands would also be substantially reduced. Forage production effects would be the same as those described above for the target lake level alternatives (Table 3G-10).

The cessation of Mono Basin exports would leave no reason for the City of Los Angeles to continue ownership or management of its Mono Basin lands. The likelihood of land disposal would be high as development pressure increased or the USFS was funded for expansion of the Mono Basin National Forest Scenic Area. This effect is considered a potentially significant growth-inducing impact of the project.

Lands Irrigated from the Upper Owens River

Under the No-Diversion Alternative, flows in the Upper Owens River would be adequate in most years to irrigate lands typically irrigated from the river. Inadequate flows in May, June, and July would occur about once in 20 years. Forage production effects would be minor and similar to those described above for the target lake level alternatives (Table 3G-10).

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (No-Diversion Alternative)

- Increases development of rural properties in Mono Basin, a significant growth-inducing impact.

Mitigation Measures. See "Target Lake Level Alternatives".

- Causes reduction in forage production exceeding the average variation in forage production in Mono County but having relatively minor economic effects; the impact is considered less than significant.

CUMULATIVE IMPACTS OF THE ALTERNATIVES

Related Impacts of Earlier Stream Diversions by LADWP

During much of the first half of this century LADWP purchased lands in Inyo County and Mono Basin for the purpose of obtaining water rights. The operation of the first Owens Valley aqueduct barrel beginning in 1913 and the second barrel in 1970 idled many acres of former agricultural land. LADWP has also extracted and shipped groundwater pumped from the Owens Valley since the 1920s, which has decreased forage production in Inyo County.

The agricultural economy of the Owens Valley peaked in the 1920s. As more water was shipped to Los Angeles, less water was available for irrigated agriculture. By 1933, LADWP had acquired 95% of the ranchland in the Owens Valley. Although LADWP leased much of its land back to ranchers, restrictions on water use and leases that stipulated that water supplies could be interrupted without prior notification reduced agricultural production and stymied new investment in agriculture. (LADWP 1990.)

Between 1940 and 1968, LADWP leased approximately 30,000 acres of land classified for irrigation in Mono and Inyo Counties; approximately 8,200 acres were located in Mono County and 21,800 acres in Inyo County. The amount of LADWP acreage irrigated annually ranged from approximately 3,000 acres during dry years to 30,000 acres during wet years. In anticipation of the operation of the second LADWP aqueduct in 1970, LADWP reduced the amount of land classified as irrigated in Inyo County from approximately 21,800 acres to 11,600 acres, at the same time modifying leases to provide firmer water allocations to ranchers. Since 1970, irrigated LADWP lands in Mono and Inyo Counties have ranged from 11,000 acres during dry years to 21,000 acres during wet years. (LADWP 1990.)

Mono Basin

As discussed in the "Environmental Setting" section of this chapter, approximately 4,100 acres were irrigated from Lee Vining, Walker, Parker, and Rush Creeks before 1940. An estimated 18,450 AUMs of forage were produced annually on pastures irrigated by the four tributary streams before diversions. Diversions and lease restrictions by LADWP reduced irrigated acreage from approximately 4,100 acres before 1940 to the approximately 1,960 acres available for irrigation in 1989.

Upper Owens River Basin

During the diversion period, Mono Basin exports resulted in higher flows in the Upper Owens River south of the East Portal, which probably supported similar or perhaps greater amounts of irrigated acreage on private lands with riparian water rights. Irrigation of lands currently under lease by LADWP may have declined following acquisition by LADWP. The overall effect of Mono Basin exports on irrigation and forage production in Long Valley has probably been minor.

Related Impacts of Other Past, Present, or Anticipated Projects or Events

Irrigated acreage in Inyo County declined from approximately 23,600 acres in 1940 to 13,000 acres in 1987. Mono County's irrigated acreage decreased from 29,000 acres to 22,100 acres (Table 3G-1), more than three times the acreage lost or LADWP's lands in Mono Basin. Together, Mono and Inyo Counties lost an estimated 17,500 acres of irrigated land between 1940 and 1987, representing one-third of the irrigated acreage in the two counties in 1940.

Actions by the USFS and the U.S. Bureau of Land Management in the management of federal grazing allotments have resulted in decreased use of forage production from non-irrigated rangeland in Mono and Inyo Counties over the years. Grazing on several allotments within Mono and Inyo Counties has been reduced or abolished to improve range conditions or protect wildlife resources.

The creation of the Mono Basin National Forest Scenic Area has tended to reduce grazing on federal lands by restricting grazing on certain relicted lands along the shore of Mono Lake and by changing grazing seasons, livestock distribution, and forage utilization on several federal allotments. In addition, grazing allotments within the Mono Basin National Forest Scenic Area may now be abolished when relinquished by current permitees if evaluations of range conditions indicate that continued grazing could conflict with other resources (USFS 1989b).

Significant Cumulative Impacts

No-Restriction Alternative

No cumulative land use impacts would result from implementation of the No-Restriction Alternative.

All Other Alternatives

- Contribute to a cumulative loss of agricultural production, consisting of a 37% reduction in irrigated acreage in Mono and Inyo Counties since 1940.

Implementation of any other alternative would further reduce irrigated acreage in Mono and Inyo Counties by an estimated 1,760 acres, adding to the estimated 2,100 acres LADWP previously removed from irrigation along the diverted tributaries and the estimated total of 17,500 acres of irrigated land lost in Mono and Inyo Counties between 1940 and 1987. This cumulative loss of an estimated 19,260 acres of irrigated land within Mono and Inyo Counties represents 37% of the irrigated land that existed within these counties in 1940. The agricultural production effects, and resulting effects on agricultural employment and income, cannot be accurately estimated; however, cumulative impacts on production, employment, and agricultural income have likely been substantial and are therefore considered significant.

Mitigation Measures for Significant Cumulative Impacts

The increase in the cumulative loss of agricultural production could be avoided by continuing Cain Ranch irrigation below the conduit. This measure would have to be implemented by the LADWP, because its riparian water rights allowing Cain Ranch irrigation are not subject to the amendment of the city's appropriative rights governed by SWRCB. The consumptive use of this water, about two-thirds of the total diversion of 8 af/yr, would cause LADWP's exports to diminish accordingly, but lake release flows would be unaffected.

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Table 3G-1. Historical Characteristics of Agriculture in Mono and Inyo Counties

	Mono County			Inyo County		
Characteristic	1910	1930	1940	1910	1930	1940
Number of farms	91	76	92	438	218	228
Land in farms (acres)	115,672	66,073	56,700	110,142	94,567	183,564
Average acres/farm	1,271	869	616	252	434	805
Irrigated farms (number)	76	NA	NA	438	NA	NA
Acreage irrigated	49,027	NA	29,020	65,163	NA	23,625
Number of cattle (on farms)	5,301	3,500	9,171	20,308	12,519	15,710
Cattle sold or slaughtered	625	NA	2,687	187	NA	5,074
Number of sheep (on farms)	63,046	24,351	25,600	43,300	45,029	17,016
Sheep sold or slaughtered	19,240	NA	21,589	18,408	NA	12,656

Notes: NA = not available.

Census data are not reported when the number of operators is too small to protect confidentiality of respondents.

Source: U.S. Bureau of the Census 1913, 1932, 1942, 1989.

Table 3G-2. Agricultural Land Use and Crop Production in Mono County: 1974, 1979, 1989

Crop	1974			1979			1989		
	Harvested Acreage	Yield per Acre (tons)	Total Yield (tons)	Harvested Acreage	Yield per Acre (tons)	Total Yield (tons)	Harvested Acreage	Yield per Acre (tons)	Total Yield (tons)
Alfalfa hay	4,219	5.66	23,880	6,170	5.50	33,935	6,850	5.50	37,675
Miscellaneous hay	0	0	0	550	2.50	1,375	1,600	3.75	6,000
Grain	0	0	0	0	0	0	450	1.50	675
Irrigated pasture[a]	7,184	NA	NA	53,400	NA	NA	53,600	NA	NA
Dry grazing land[a]	31,096	NA	NA	37,000	NA	NA	85,000	NA	NA
Miscellaneous vegetables	NA	NA	1,565	0	0	0	0	0	0
Total	42,499	NA	NA	97,120	NA	NA	147,500	NA	NA

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[a] Starting in 1979, irrigated pasture and dry grazing land located on federal properties were included in the countywide totals for irrigated pasture and dry grazing lands.

Note: NA = not available for acreage figures and not applicable for yield and total yields.

Source: Inyo-Mono Department of Agriculture 1975, 1981, 1991. The annual crop and livestock reports for Mono County began in 1975; no data are available for years prior to 1974.

Table 3G-3. Livestock Production in Mono County: 1974, 1979, 1989

Item	1974		1979		1989	
	Number of Head	Production[a] (cwt)	Number of Head	Production[a] (cwt)	Number of Head	Production[a] (cwt)
All cattle and calves	4,770	20,272	12,180	66,675	9,895	54,229
Stockers (gain)	1,500	3,000	1,500	4,500	3,700	12,950
Sheep and lambs	3,375	3,544	27,500	24,750	18,000	16,200
Wool	NA	206	NA	2,200	NA	1,467
Total	9,645	NA	41,180	NA	31,595	NA

Notes: NA = not applicable.
cwt = hundred weight or 100 pounds.

[a] Represents liveweight for cattle, calves, sheep, and lambs; weight gain for stocker cattle; and total weight for wool.

Source: Inyo-Mono Department of Agriculture 1975, 1981, 1991. The annual crop and livestock reports for Mono County began in 1975; no data are available for years prior to 1974.

Table 3G-4. Forage Production on Leased LADWP Lands in Mono Basin

	Irrigated Lands		Dry Grazing Lands		Totals	
Lessee	Acres	AUMs	Acres	AUMs	Acres	AUMs
Inyo Sheep Company	1,844	8,298	7,971	1,070	9,815	9,368
Mono Sheep Company	440	1,560	5,149	485	5,589	2,045
Total	2,284	9,858	13,120	1,555	15,404	11,413

Notes: Forage production is based on normal precipitation years. Years when irrigation supplies are limited may result in decreased AUMs available to lessees. For example, forage production on Inyo Sheep Company properties was reduced from 9,368 AUMs to 8,276 AUMs in 1989 due to drought conditions.

Acreage totals include all LADWP lands leased by Inyo Sheep Company and Mono Sheep Company in Mono Basin.

AUM = animal unit month or the amount of feed or forage required by an animal unit (a cow-calf pair or five ewes) for 1 month (approximately 1,000 pounds per month).

Source: Anderson pers. comm.

Table 3G-5. Forage Production on Federal Grazing Allotments within Mono Basin

Management/ Allotment	Permittee	Grazing Season	Type of Livestock	Animal Unit Months
USFS/Alger Lake	Inyo Sheep Company	7/15-8/31	Ewes	300
USFS/Mono Settlement	Closed			
USFS/DeChambeau Ranch	Closed			
BLM/Mono Sand Flat	Flying M Cattle Company	12/1-5/31	Cow/calf	2,514
BLM/Mono Lake	J. Paesano	7/1-10/15	Ewes	574
BLM/Mono Mills I	Inyo Sheep Company	7/1-10/15	Ewes	2,142
USFS/Mono Mills	Bernal Sheep Company	7/1-8/31	Ewes	1,600
USFS/Evans	Closed			
USFS/June Lake	Inyo Sheep Company	7/1-8/31	Ewes	1,440
USFS/Horse Meadow	Inyo Sheep Company	9/6-9/30	Ewes	105
USFS/Bloody Canyon	F.I.M., Inc.	6/15-9/15	Ewes/lambs	600
Total				9,275

Notes: BLM = U.S. Bureau of Land Management.
USFS = U.S. Forest Service.

<u>Animal Unit Month</u> = the amount of feed or forage required by an animal unit for 1 month (approximately 1,000 pounds per month). An animal-unit generally equals one cow-calf pair, one heifer, one stocker steer, or five ewes.

Sources: Freeman, Primosch, and Porter pers. comms.

Table 3G-6. Estimated Forage Production on Private Lands along the Upper Owens River

Landowner	Acreage			Grazing Season	Estimated AUMs
	Total	Irrigated	Dry		
Owens River Ranch	210	100	110	5/1-10/31	311
John Arcularius Ranch	1,080	50	1,030	5/15-9/15	253
Inaja Land Company	1,234	700	534	4/1-9/30	2,153
Howard Arcularius Ranch	560	500	60	5/1-10/31	1,506
Total	3,084	1,350	1,734		4,223

Notes: Forage production was estimated assuming 3 AUMs per acre of irrigated land and 0.1 AUM per acre of dry grazing land. These estimates do not necessarily correspond to the actual amount of forage harvested by the above ranches.

AUM = animal unit month or the amount of feed or forage required by an animal unit for 1 month (approximately 1,000 pounds per month). An animal unit generally equals one cow-calf pair, one heifer, or one stocker steer.

Sources: Alpers, J. Arcularius, Rossi, and H. Arcularius pers. comms.

Table 3G-7. Forage Production on Leased LADWP Lands along the Upper Owens River

	Irrigated Lands		Dry Grazing Lands		Totals	
Lessee	Acres	AUMs	Acres	AUMs	Acres	AUMs
J&L Livestock Company	471	1,997	2,263	243	2,734	2,240
Cashbaugh Ranch	1,110	2,899	1,398	167	2,508	3,066
4J Cattle Company	425	1,496	3,737	621	4,162	2,117
Total	2,006	6,392	7,398	1,031	9,404	7,423

Notes: Forage production is based on normal precipitation years. Years when irrigation supplies are limited may result in decreased AUMs available to lessees.

AUM = animal unit month or the amount of feed or forage required by an animal unit (a cow-calf pair) for 1 month (approximately 1,000 pounds per month).

Source: Anderson pers. comm.

Table 3G-8. Forage Production on Federal Grazing Allotments in the Upper Owens River Basin

Management/ Allotment	Permittee	Grazing Season	Type of Livestock	Animal Unit Months
USFS/Alpers Canyon	Owens River Ranch	6/1-10/30	Cow/calf	50
USFS/Long Valley	H. Arcularius Ranch	6/6-9/15	Cow/calf	396
		6/6-8/30	Cow/calf	168
USFS/Clark Canyon	J. Arcularius Ranch	5/15-10/30	Cow/calf	231
		7/1-10/30	Heifers	60
USFS/Turner	J&L Livestock	6/6-8/5	Cow/calf	799
BLM/Hot Creek	Cashbaugh Ranch	5/16-10/31	Cow/calf	445
BLM/Wilfred Creek	4J Cattle Company	6/1-10/31	Cow/calf	295
Total				2,444

Notes: AUG = animal unit month or the amount of feed or forage required by an animal unit for 1 month (approximately 1,000 pounds per month). An animal unit generally equals one cow-calf pair, one heifer, or one stocker steer.

Sources: Freeman and Primosch pers. comms.

Table 3G-9. Summary Comparison of Effects of the Alternatives: Land Use

Alternative or Condition	Irrigated Areas (acres)	Forage Production (AUMs)	Probability of LADWP Land Disposal
Point of reference	3,566	13,899	Very low
No restriction	3,566	13,899	Very low
6,372 Ft	1,805	5,975✓	Moderate
6,377 Ft	1,805	5,975✓	Moderate
6,383.5 Ft	1,805	5,975✓	Moderate
6,390 Ft	1,805	5,975✓	Moderate
6,410 Ft	1,805	5,975✓	Moderate
No diversion	1,805	5,975✓	High
Prediversion	5,920	24,500	N/A

Note: Represents forage production and acreage irrigated from the Upper Owens River and the four diverted tributaries in Mono Basin.

No significant project impacts will occur.

✓ Significant cumulative impact.

N/A = no information available.

Table 3G-10. Estimated Average Annual Irrigated Acreage and Forage Production for Project Alternatives

		Alternatives						
	Point of Reference	No Restriction	6,372 Ft	6,377 Ft	6,383.5 Ft	6,390 Ft	6,410 Ft	No Diversion
Mono Basin[a]								
Irrigated acreage	1,745	1,745	0	0	0	0	0	0
Forage production (AUMs)	7,852	7,852	0	0	0	0	0	0
Long Valley[b]								
Irrigated acreage	1,821	1,821	1,805[c]	1,805[c]	1,805[c]	1,805[c]	1,805[c]	1,805[c]
Forage production (AUMs)	6,047	6,047	5,975	5,975	5,975	5,975	5,975	5,975
Totals								
Irrigated acreage	3,566	3,566	1,805	1,805	1,805	1,805	1,805	1,805
Forage production (AUMs)	13,899	13,899	5,975	5,975	5,975	5,975	5,975	5,975

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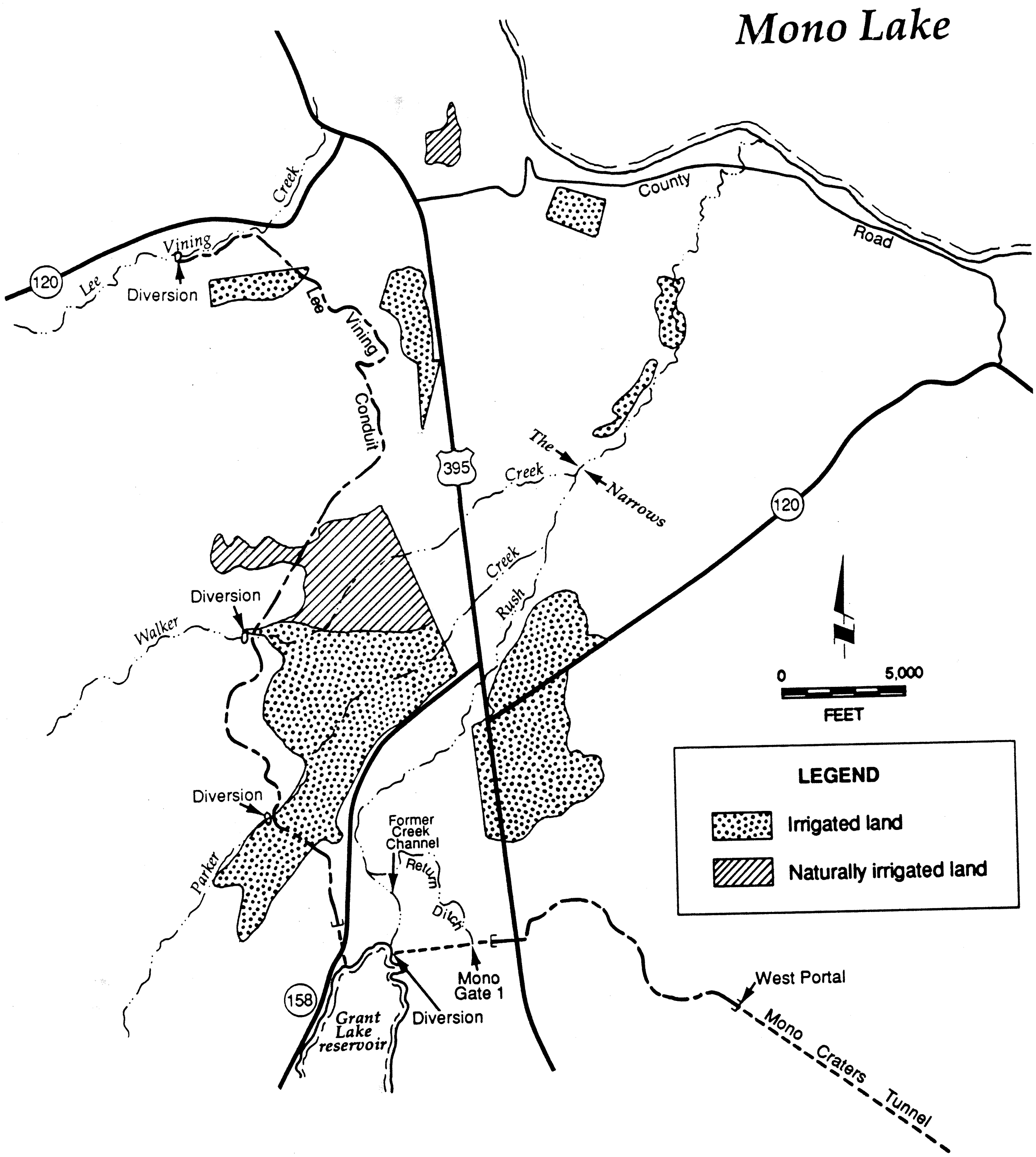
[a] Represents acreage irrigated from the four diverted tributaries in Mono Basin.

[b] Represents acreage irrigated from Upper Owens River between the East Portal and Lake Crowley reservoir.

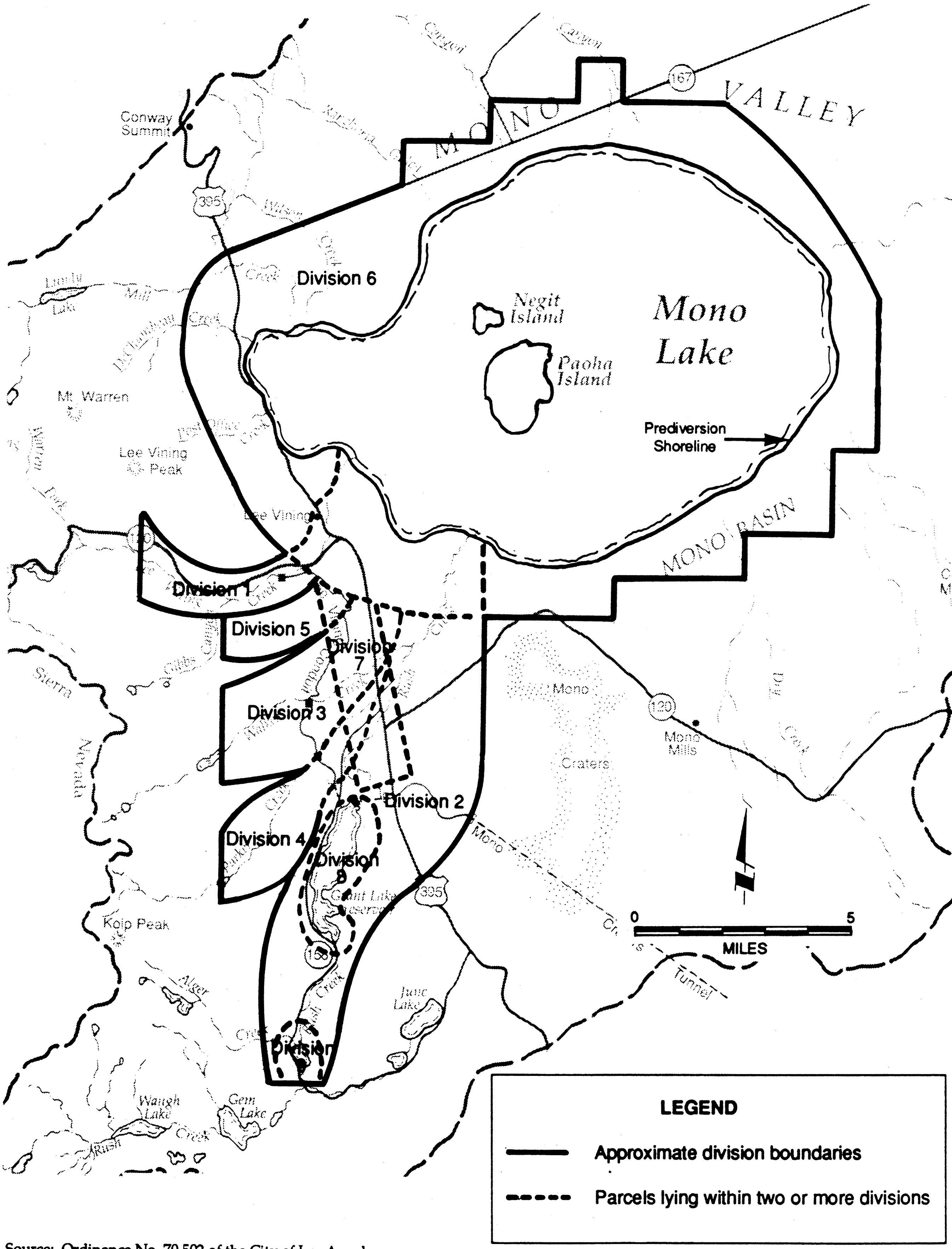
[c] Annual average considering a reduction of 325 acres once per 20 years during normal low streamflow conditions.



Notes: Based on interpretation by EA of 1929 aerial photographs.
In 1941, U.S. 395 was not located as shown.

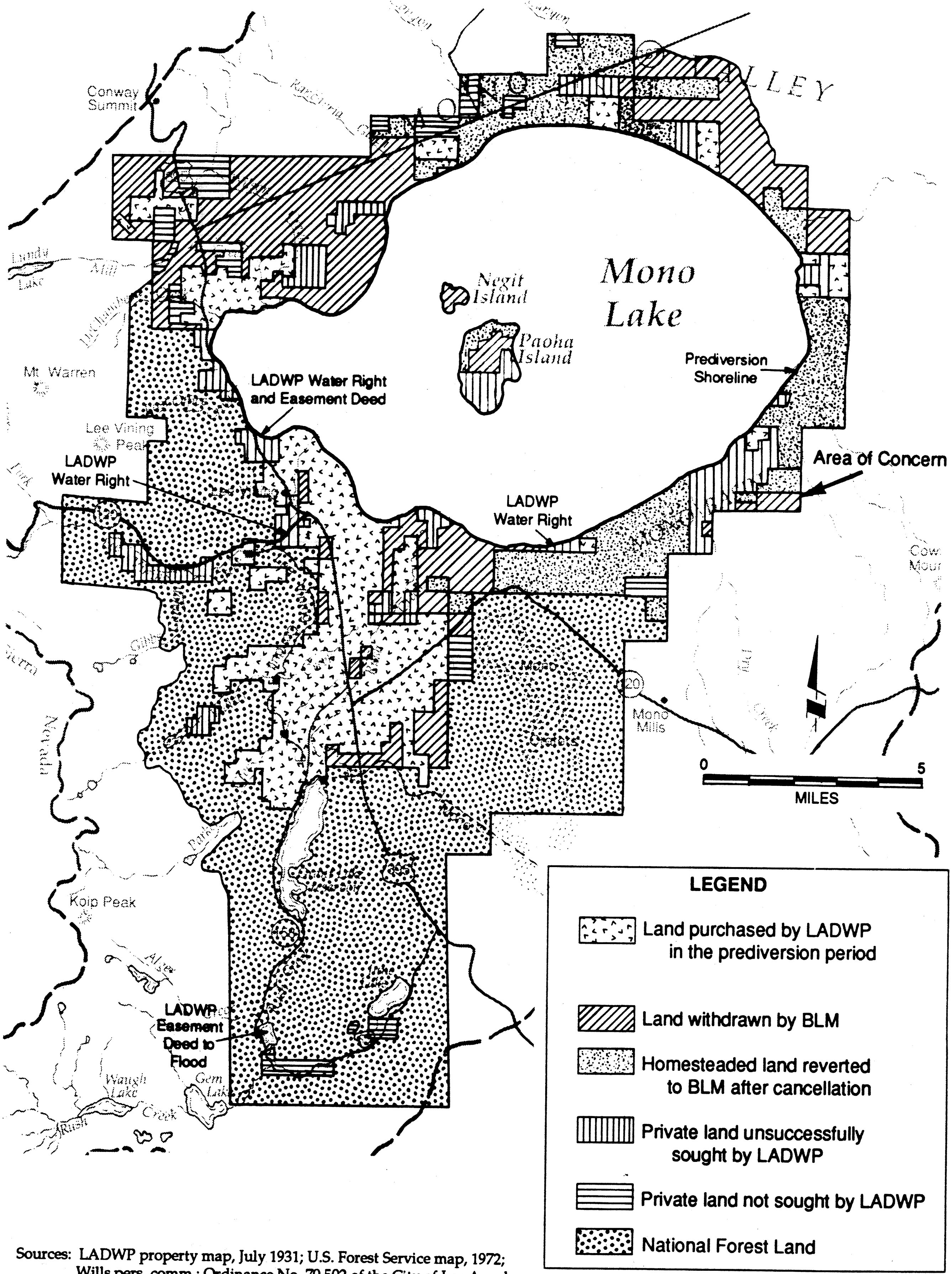
Source: Winsor pers. comm.

Figure 3G-1.
Prediversion Irrigated Land in the Mono Basin



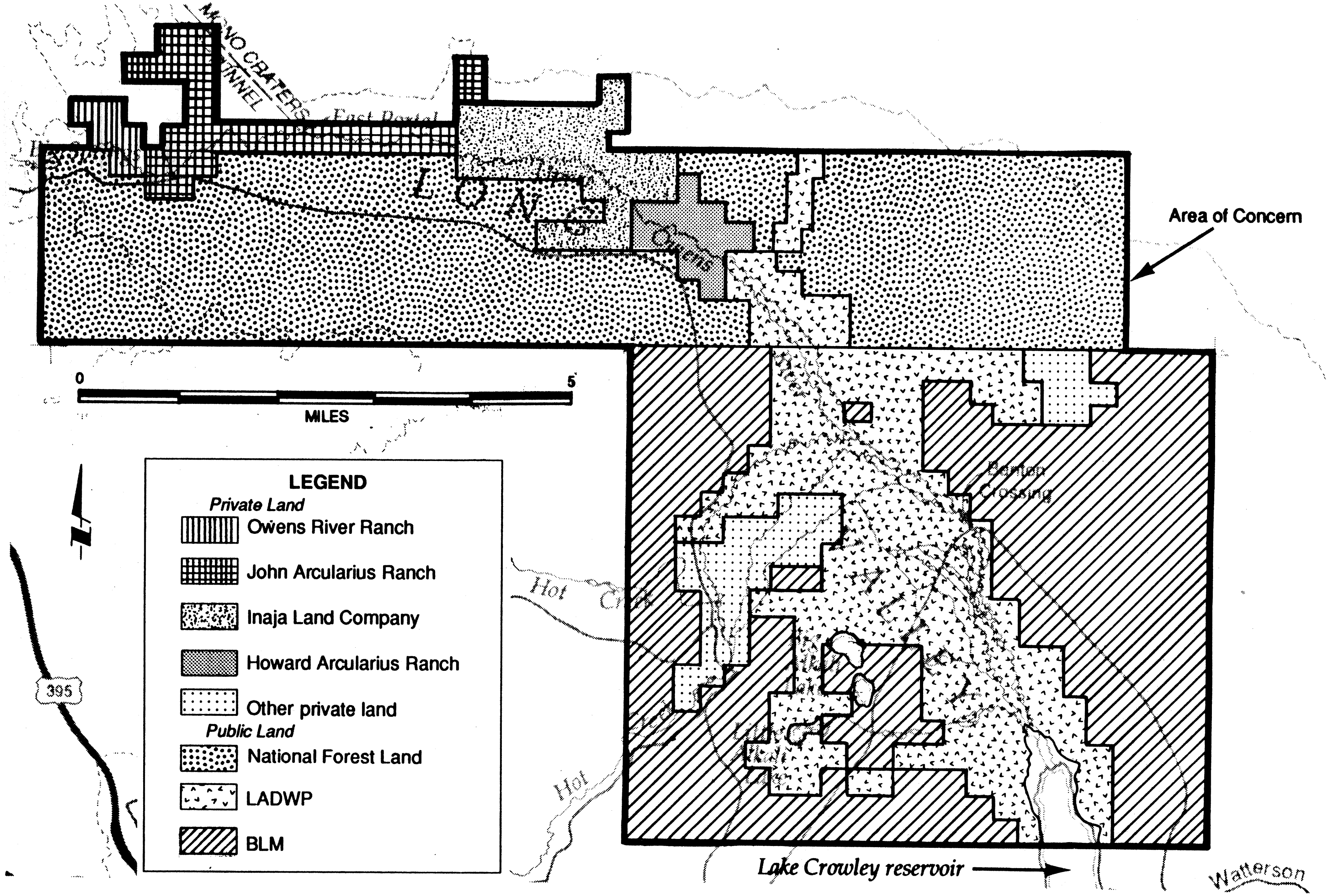
Source: Ordinance No. 70,502 of the City of Los Angeles

Figure 3G-2.
Areas in Mono Basin Proposed for Rights Aquisition by LADWP



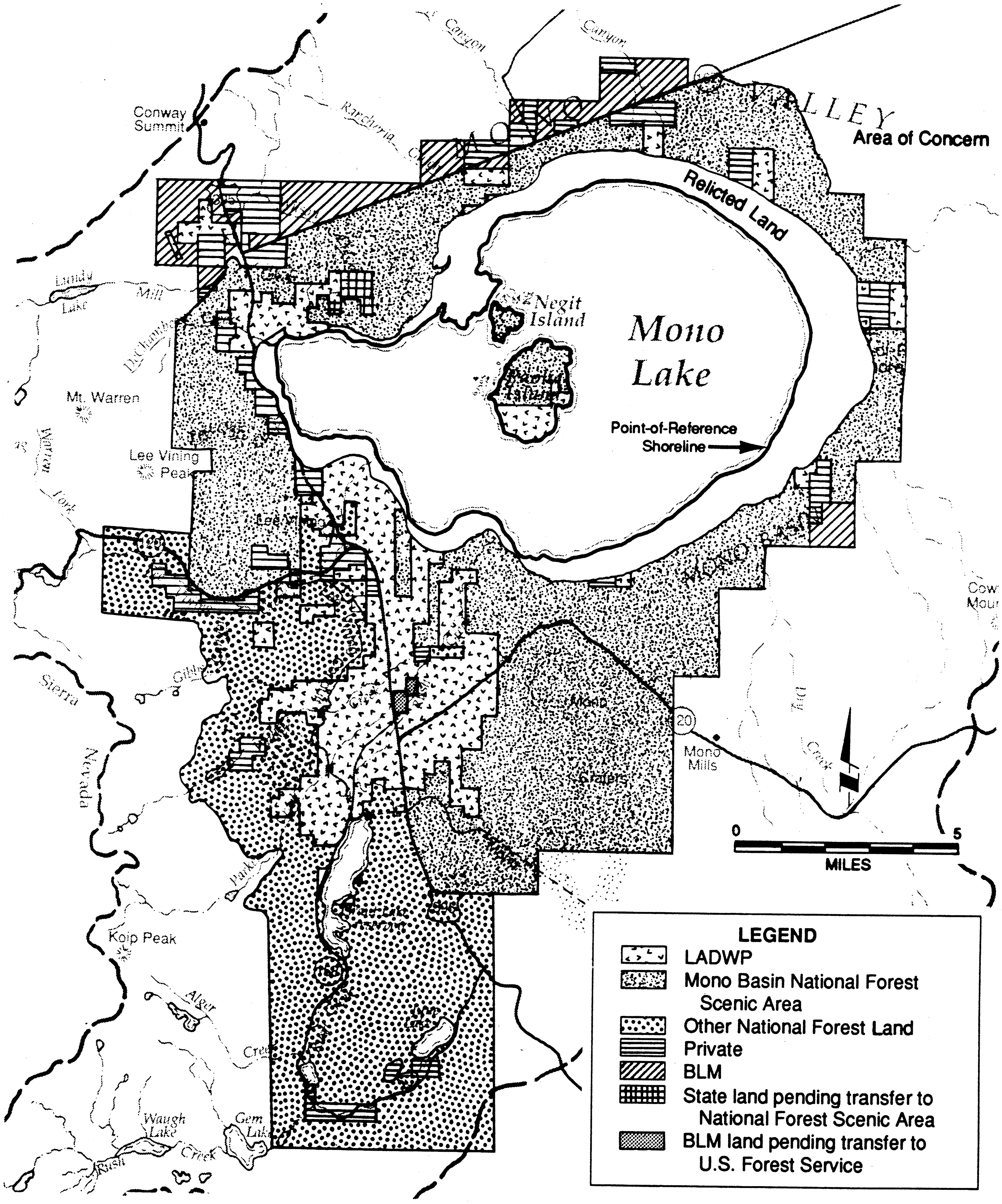
Sources: LADWP property map, July 1931; U.S. Forest Service map, 1972; Wills pers. comm.; Ordinance No. 70,502 of the City of Los Angeles

Figure 3G-3.
Prediversion Land Ownership in the Mono Basin Area of Concern



Sources: U.S. Forest Service maps 1972 and 1987; Wills pers. comm.

Figure 3G-4.
Prediversion and Point-of-Reference Land Ownership in the Upper Owens River Basin

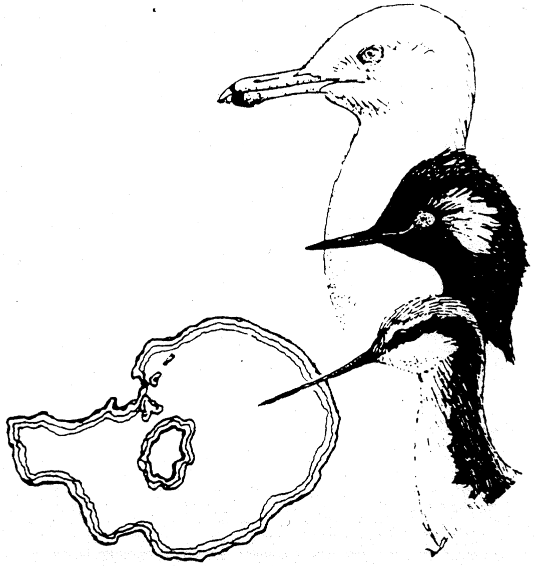


Note: Relicted land is owned by the federal government and the State of California.

Sources: U.S. Forest Service map 1987; Karstaedt pers. comm.

Figure 3G-5.
Point-of-Reference Land Ownership in the Mono Basin
Area of Concern

Chapter 3H. Environmental Setting, Impacts, and Mitigation Measures - Air Quality



MONO BASIN EIR

Prepared by Jones & Stokes Associates

Chapter 3H. Air Quality

This chapter addresses the issue of dust storms at Mono Lake generated from lakebeds exposed by lowering of the water surface. The chapter begins with a comprehensive discussion of air pollution terminology, air quality standards for particulate matter, and air quality management by state and federal authorities for readers not familiar with these subjects. The chapter then describes prediversion conditions, point-of-reference conditions, impact assessment methodology, and impacts and mitigation measures in conformity with the other resource chapters. Appendix N provides more detail on background information summarized here.

BACKGROUND INFORMATION

Air Pollution Terminology

The discussion of air pollution issues affecting Mono Lake requires an understanding of terms that have a technical meaning. At a general level, it is important to understand the distinction between air pollutant emissions and ambient air quality. In addition, the technical terms used to describe suspended particulate matter are especially relevant to air pollution issues affecting Mono Basin.

Emissions and Ambient Air Quality

The term "pollutant emissions" refers to the amount (usually stated as a weight) of specific compounds or materials introduced into the atmosphere by a source or group of sources. In practice, most pollutant emissions data are presented as "emission rates": the amount of pollutants emitted during a specified increment of time or during a specified increment of emission source activity. Typical measurement units for emission rates on a time basis include pounds per hour, pounds per day, or tons per year. Typical measurement units for emission rates on a source activity basis include pounds per thousand gallons of fuel burned, pounds per ton of material processed, and grams per vehicle mile of travel.

The term "ambient air quality" refers to the atmospheric concentration of a specific compound or material (amount of pollutants in a specified volume of air) actually experienced at a particular geographic location that may be some distance from the source of the relevant pollutant emissions. The ambient air quality levels actually measured at a particular location are determined by the interactions among three groups of factors:

- emissions: the types, amounts, and locations of pollutants emitted into the atmosphere;
- meteorology: the physical processes affecting the distribution, dilution, and removal of these pollutants; and
- chemistry: any chemical reactions that transform pollutant emissions into other chemical substances.

Ambient air quality data are generally reported as a mass concentration (e.g., micrograms per cubic meter [$\mu g/m^3$] of air) or as a volume fraction (e.g., parts per million by volume). Concentrations of gaseous pollutants can be described in either mass concentration or volume fraction units. Particulate matter concentrations are almost always reported in mass concentration units ($\mu g/m^3$), although particle count measurements (million particles per cubic foot) are used on rare occasions.

Aerosols and Particulate Matter

Most people would interpret the term "aerosol" as indicating some type of liquid droplet or mist sprayed into the air. Similarly, most people would interpret the term "particulate matter" as implying a solid particle (such as dust or fly ash). Air pollution specialists, however, use the terms "aerosol" and "particulate matter" interchangeably; both terms can refer to either liquid or solid material suspended in the air. In many industrial applications the term aerosol implies small particle sizes with low settling rates; a similar connotation is sometimes evident in air pollution discussions.

Suspended particulate matter is sometimes characterized as a "dispersion aerosol" or a "condensation aerosol" according to the mechanism of formation. Dispersion aerosols are formed by mechanical abrasion (for solid particles), atomization (for liquid particles), or mechanical dispersion (for powdery solids). Condensation aerosols are formed by a phase change of gaseous compounds (e.g., by condensation of saturated or supersaturated vapors) or by chemical reactions of gases to form nonvolatile compounds.

Particle Size Terminology

Size, shape, and density are important physical characteristics of suspended particulate matter. Particle dimensions can be discussed using many different units of measure. The most common size unit used in air pollution discussions is the micrometer or micron. One million microns constitute a meter, and 25,400 microns constitute an inch. Most people cannot distinguish individual particles with a maximum physical dimension smaller than 50 microns.

Most solid particles have fairly complex and irregular shapes, thus complicating any description of physical size. Because many different techniques are used to collect and analyze suspended particulate matter, it is often important to distinguish between the various technical terms and descriptions that are commonly used to describe particle size. Appendix N provides additional information on particle size terminology.

Although particle size terminology implies a physical size measurement, most air pollution discussions of particle size are not based on the physical dimensions of suspended particles. In many cases, particle size terminology is merely used as a convenient shorthand for describing the aerodynamic behavior of suspended particles.

In this assessment, particle size is generally described in terms of the "aerodynamic equivalent diameter" (which is the diameter of a sphere with a density of 1 gram per cubic centimeter that has the same terminal settling velocity in still air as the particle under consideration) but results of studies employing sieve diameters or other particle size terminology are also reported.

Air Quality Standards for Suspended Particulate Matter

Both the State of California and the federal government have established ambient air quality standards for several different pollutants (Table 3H-1). For some pollutants, separate standards have been set for different time periods. Most standards have been set to protect public health. For some pollutants, standards have been based on other values (such as protection of crops, protection of materials, or avoidance of nuisance conditions).

State ambient air quality standards were first established in 1959 and federal ambient air quality standards were first established in 1970. The numerical values of various state and federal air quality standards have been changed several times. In addition, the state and federal ambient air quality standards for suspended particulate matter have undergone a significant change in definition from total suspended particulate matter (TSP) to inhalable particulates (generally designated as PM_{10}), as discussed in Appendix N. Both TSP and PM_{10} are defined primarily by the equipment used to monitor compliance with the standards.

Definition of PM_{10}

PM_{10} represents a sampling of suspended particulate matter that approximates the extent to which suspended particles with aerodynamic equivalent diameters smaller than 50 microns penetrate to the lower respiratory tract (tracheobronchial airways and alveoli in the lungs). Particle size enters into the definition of PM_{10} as a probability distribution, not as a precise particle size limit (see Appendix N for additional discussion).

As a practical matter, PM_{10} can be defined as any particles collected by a certified PM_{10} sampler. In more technical terms, the numerical values of the federal and state PM_{10} standards are applied to suspended particulate matter collected by a certified sampling device having a 50% mass collection efficiency for particles with aerodynamic equivalent diameters of 9.5-10.5 microns and a maximum aerodynamic diameter collection limit smaller than 50 microns. Collection efficiencies are greater than 50% for particles with aerodynamic diameters smaller than 10 microns and less than 50% for particles with aerodynamic diameters larger than 10 microns. The physical dimensions of particles meeting the definition of PM_{10} can vary considerably, depending on the combination of particle shape and density.

Current PM_{10} Standards

State and federal standards for suspended particulate matter have been set for two time periods: a 24-hour average and an annual average of the 24-hour values. The state PM_{10} standards are:

- 50 $\mu g/m^3$ as a 24-hour average and

- 30 $\mu g/m^3$ as an annual geometric mean (a "geometric mean" is the nth root of the product of n observations).

The federal PM_{10} standards are:

- 150 $\mu g/m^3$ as a 24-hour average and
- 50 $\mu g/m^3$ as an annual arithmetic mean.

Air Quality Management

Air quality management responsibilities exist at local, state, and federal levels of government. Local air pollution control programs generally preceded statewide programs, which in turn preceded federal air pollution control programs (Stern 1982). California counties were authorized to regulate air pollution in 1947. State air pollution control programs were first established in California in 1957. The first federal air pollution control programs were authorized in 1965.

Federal Clean Air Act legislation in the 1970s resulted in a gradual merger of local and federal air quality programs, particularly industrial source air quality permit programs. Air quality management planning programs developed during the past decade have generally been in response to requirements established by the federal Clean Air Act. The California Clean Air Act of 1988 is producing additional changes in the structure and administration of air quality management programs in California.

Both the federal and California acts use similar terminology for designating areas that violate or comply with ambient air quality standards. Areas that violate air quality standards are designated as "nonattainment" areas for the relevant pollutants. Areas that comply with air quality standards are designated as "attainment" areas for the relevant pollutants. Areas of questionable status are generally designated as "unclassified" areas.

The Federal Clean Air Act

The federal Air Pollution Control Act of 1955 declared air pollution to be a state responsibility, with federal responsibilities limited to research, education, training, and financial assistance to state programs. The 1963 federal Clean Air Act established a federal role for mediating interstate disputes. The federal role was expanded in 1965 with Congressional authorization for uniform federal emission standards for motor vehicles.

The 1970 federal Clean Air Act amendments greatly expanded the federal role in air pollution control issues, establishing several regulatory programs:

- adoption of national ambient air quality standards,
- approval of state plans to achieve and maintain the national ambient air quality standards,
- adoption of emission standards for motor vehicles,
- adoption of emission standards for major new industrial facilities,
- adoption of emission standards for hazardous air pollutants, and
- approval of construction permits for major new industrial facilities.

The 1977 and 1990 amendments to the Clean Air Act revised and expanded some of the regulatory programs and added a new program involving operating permits for major industrial facilities.

The federal Clean Air Act requires each state to develop, adopt, and implement a plan (state implementation plan) to achieve, maintain, and enforce federal air quality standards throughout the state. These plans must be submitted to and approved by the U.S. Environmental Protection Agency (EPA). In California, local councils of governments and air quality management agencies have had the primary responsibility for developing and adopting elements of the state plan.

Deadlines for achieving the federal air quality standards have been changed several times since the original July 1, 1975 deadline set by the 1970 Clean Air Act.

All areas initially designated as nonattainment for PM_{10} will be classified as moderate nonattainment areas with a December 31, 1994 attainment deadline. Areas subsequently classified as moderate PM_{10} nonattainment areas will have up to 6 years to achieve the federal PM_{10} standards. EPA has discretion to grant up to two 1-year extensions of the initial attainment deadline for moderate PM_{10} nonattainment areas.

Area that cannot meet the initial or extended attainment deadline will be reclassified as serious PM_{10} nonattainment areas. The attainment deadline for serious PM_{10} nonattainment areas must be no later than 10 years from the date on which the area was identified as nonattainment for PM_{10}. EPA has discretion to grant one attainment deadline extension of up to 5 years for serious nonattainment areas.

Section 188(f) of the Clean Air Act also provides that EPA has the discretion to waive PM_{10} attainment deadlines for areas where "nonanthropogenic" sources of PM_{10} contribute significantly to the violations of the PM_{10} standard. Nonanthropogenic emission sources are those natural sources of emissions that are not influenced directly or indirectly by human activity. Examples of nonanthropogenic sources include volcanic eruptions, salt spray in marine areas, smoke from natural forest fires, and windblown dust in undisturbed natural areas.

Anthropogenic emission sources, on the other hand, include any sources with emissions influenced directly or indirectly by human activity. Stensvaag (1991) notes that the U.S. House of Representatives committee report on the Clean Air Act amendments cites dust from the exposed lakebeds of Owens Lake and Mono Lake as examples of anthropogenic emissions because dust storms from these areas are ultimately caused by the human activity of diverting water from streams feeding these lakes.

Federal PM_{10} nonattainment areas in California include:

- the San Joaquin Valley,
- the South Coast Air Basin,
- the Imperial Valley area,
- the Searles Valley area,
- the Coachella Valley area,
- the Mammoth Lakes area (Mono County), and
- the Owens Valley area (Inyo County).

In addition, EPA has identified Sacramento County and San Bernardino County as areas that should receive nonattainment status for PM_{10}; formal designation procedures have not yet been completed.

On January 8, 1993, EPA reclassified the San Joaquin Valley, South Coast Air Basin, Coachella Valley, and Owens Valley from moderate to serious PM_{10} nonattainment areas. Mono Basin has not been formally designated as a federal PM_{10} nonattainment area; however, available monitoring data suggest that a federal PM_{10} nonattainment designation may be warranted. EPA action to designate Mono Basin as a federal PM_{10} nonattainment area is expected during 1993.

The California Clean Air Act of 1988

Responsibility for air quality management programs in California is divided between the California Air Resources Board (ARB), as the primary state air quality management agency, and air pollution control districts (or air quality management districts) as the primary local air quality management agencies. The Great Basin Unified Air Pollution Control District (GBUAPCD) has jurisdiction in Mono and Inyo Counties.

The California Clean Air Act of 1988 establishes a state-level air quality planning process that generally parallels the federal process. The California Clean Air Act, however, focuses on attainment of the state ambient air quality standards, which often are more stringent than the comparable federal standards.

The act specifies that districts shall adopt and enforce rules and regulations to achieve and maintain the state and federal ambient air quality standards and may adopt and implement regulations to reduce or mitigate emissions from indirect and areawide sources of air pollution. The act requires that the state air quality standards be achieved as expeditiously as practicable, but does not set precise attainment deadlines.

Districts must prepare an air quality attainment plan if state air quality standards for carbon monoxide, sulfur dioxide, nitrogen dioxide, or ozone are notated with the district. No locally prepared attainment plans are required for areas that violate the state PM_{10} standards.

The California Clean Air Act differs somewhat from the federal Clean Air Act by emphasizing the control of "indirect and areawide sources" of air pollutant emissions. The California act gives local air pollution control districts explicit authority to develop "area source and indirect source control programs" but it does not define indirect sources, areawide sources, or area sources.

Common practice in the air pollution field would define "area sources" as outdoor, unconfined sources of volatile or windblown emissions, and "areawide sources" as small stationary or mobile emission sources that occur throughout a large geographic area and that are not presently regulated or subject to permit requirements on an individual basis.

Most of the air quality planning provisions of the California Clean Air Act address attainment of the ozone, carbon monoxide, nitrogen dioxide, and sulfur dioxide standards. But the act also specifies that "[n]othing in this chapter restricts the authority of the state board or a district to adopt regulations to control suspended particulate matter, visibility reducing particles, lead . . . ." (California Health and Safety Code Section 40926).

Section 4213 of the California Health and Safety Code provides that the GBUAPCD "may require the City of Los Angeles to undertake reasonable measures, including studies, to mitigate the air quality impacts of its activities in the production, diversion, storage, or conveyance of water. . . . The mitigation measures shall not affect the right of the city to produce, divert, store, or convey water."

ARB has formally designated the Great Basin Valleys Air Basin (Mono and Inyo Counties) as being in violation of the state PM_{10} standards. Two types of PM_{10} problems are recognized in this air basin (California Air Resources Board 1991): extremely high 24-hour PM_{10} concentrations in Inyo County due to windblown soil and salt, much of which originates in the Owens Valley, and high winter concentrations of PM_{10} in the Mammoth Lakes area, due in part to residential wood combustion.

As described in a subsequent portion of this chapter, available monitoring data indicate that the Mono Lake area also experiences periodic violations of the state PM_{10} standards.

PREDIVERSION CONDITIONS

Sources of Information

No ambient air quality monitoring was conducted in Mono Basin before 1979. Consequently, no quantitative data exist that describe air quality conditions in Mono Basin under prediversion conditions. The major existing air quality problem in Mono Basin is produced by windblown particulate matter. Because suspended particulate matter in Mono Basin is derived primarily from barren or sparsely vegetated lands, historical accounts of conditions in Mono Basin allow a qualitative assessment of prediversion air quality conditions.

The most useful historical account of conditions in Mono Basin comes from a reprint of an 1889 report of topographic and geologic investigations undertaken in summer 1883 (Russell 1984). Russell's account includes detailed descriptions of topographic features and visual conditions, as well as extensive geologic interpretations. Proper interpretation of Russell's observations is greatly improved by modern estimates of historical lake elevations. Although Russell estimated the 1883 elevation of Mono Lake as 6,380 feet, the lake was actually at an elevation of about 6,410 feet (Stine 1980, LADWP 1987).

Historical aerial photographs of Mono Lake from 1930 and 1940 provide additional perspective on interpretations drawn from the historical literature.

Historical Information about Mono Basin Conditions

Historical Written Accounts

As discussed in Appendix N, several early visitors referred to the presence of white crusty deposits at Mono Lake during the late 1800s and early 1900s (Russell 1984, Browne 1961, Mining and Scientific Press 1865, Chase 1911). Although many of the writers referred to the deposits as "alkali", a careful examination of these accounts indicates that almost all the references are to tufa and other calcium carbonate deposits.

I. C. Russell's report of geological studies conducted in the early 1880s contains extensive discussions of tufa deposits around Mono Lake (Russell 1984). The report also mentions the presence of active sand dunes and windblown foam produced by whitecaps on the lake. Russell's report is one of the few documents from the prediversion period that distinguishes between tufa deposits and salt deposits. Russell noted the presence of efflorescent salt deposits in only two situations: in the exposed cavities of partially submerged tufa crags and in cavelike recesses in cliffs at the water's edge, especially on Paoha Island. Russell noted that the efflorescent salts were primarily sodium carbonates and sodium sulfates, in contrast to the calcium carbonate of tufa deposits, and that they form on porous substrates exposed to the air as capillary action draws saline water to the surface.

Aerial Photographs from 1930 and 1940

Historical aerial photographs of Mono Lake (Stine pers. comm.) provide additional evidence that efflorescent salt deposits were limited under prediversion conditions. The elevation of Mono Lake was about 6,420 feet in 1930 and about 6,417 feet in 1940. Photographs from 1929 and 1930 are somewhat difficult to interpret as there appears to be some snow on the ground. The photographs from 1940 are easier to evaluate.

Both the 1930 and 1940 photographs show limited amounts of efflorescent salt deposits in two situations: very narrow fringes of efflorescent salts along the edges of some ponds (lagoons) near the lakeshore; and scattered small patches of salt among partially vegetated sand dunes between Bridgeport Creek and Cottonwood Creek, mostly south of the present location of Highway 167. No efflorescent salt is visible in the 1930 or 1940 aerial photographs on the relatively narrow strip of barren sand bordering the north or east shores of the lake.

Ponds with a narrow fringe of efflorescent salt were present near DeChambeau Creek in 1930 but had drained without leaving salt deposits in 1940. Ponds east of the present location of Ten Mile Road were present with narrow fringes of efflorescent salt in both 1930 and 1940.

All other locations showing efflorescent salt deposits in the 1930 and 1940 aerial photographs represent low spots between partially vegetated sand dunes. Recent aerial photographs show only a few small salt deposits in the sand dune and former pond areas, with the largest patches occupying parts of the former ponds east of Ten Mile Road.

Conclusions Regarding Prediversion Air Quality Conditions

Two conditions are notable by their absence in Russell's descriptions of conditions at Mono Lake in 1883: the absence of any accounts of windblown dust, sand, or salt and the absence of any description of significant shore zone efflorescent salt deposits.

Russell was obviously aware of wind erosion processes, as evidenced by his description of drifting sand dunes and windblown foam from the lake on windy days. The description of windblown foam also demonstrates that Russell was present during periods of strong winds. Thus, it is significant that Russell made no mention of blowing salt, sand, or dust.

It is also significant that Russell made little mention of efflorescent salt deposits around the lake, noting only small isolated deposits inside tufa towers and on portions of the shore of Paoha Island. Unlike other early observers, Russell clearly distinguished tufa formations from efflorescent salts, even noting the chemical differences between them. Russell's attention to chemical and mineralogical details makes it unlikely that he found but failed to discuss extensive salt deposits.

The apparent absence of shore zone efflorescent salt deposits would be puzzling if Russell's estimate of the 1883 elevation of Mono Lake (6,380 feet) had been accurate. Present day efflorescent salt deposits occur above the 6,380-foot elevation, with significant salt deposits up to the 6,390-foot elevation. Stine (1980) notes that the Negit Island benchmark left by Russell's party was relocated in 1950 and measured at an elevation of 6,410 feet, 30 feet higher than Russell's estimate of the lake's 1883 elevation.

Available evidence concerning historical lake elevations (see "Prediversion Conditions" in Chapter 3A, "Hydrology") makes it clear that Russell was viewing Mono Lake under conditions typical of the 1870-1890 period. Conditions in 1883 represented lake levels lower than any observed between 1895 and 1950.

Stine's analysis of historical lake levels provides convincing evidence that Mono Lake seldom dropped below 6,400 feet under prediversion conditions. Historical aerial photographs and the present distribution of exposed substrates and efflorescent salt deposits suggest that there were few exposed areas subject to severe wind erosion under prediversion conditions.

The limited salt deposits visible in 1930 and 1940 aerial photographs (when the lake elevation was 6,417-6,420 feet) may have been largely absent when Russell visited Mono

Basin in 1883 with the lake at 6,410 feet. A drop of 3 feet in lake elevation between 1930 and 1940 eliminated the ponds and fringing salt deposits near DeChambeau Creek. Even if present during most of the prediversion period, the salt deposits between Bridgeport and Cottonwood Creeks would have been partially sheltered from wind erosion by the surrounding sand dunes. The small size and scattered distribution of these salt deposits would not have generated the type of large-scale dust episodes that have occurred in recent years.

While Russell's reference to active sand dunes suggests that localized episodes of blowing silt or sand must have occurred, the available evidence suggests that major dust storm events were rare under prediversion conditions. The few dust storm events that did occur under prediversion conditions would have been dominated by silt, clay, and sand particles with only small quantities of salt particles from interstitial salts and water spray off the lake.

ENVIRONMENTAL SETTING

Sources of Information

Temperature and precipitation data for Mono Lake are available in monthly and annual reports published by the National Climatic Data Center. Additional meteorological data are available from LADWP for the Cain Ranch and from the GBUAPCD for Lee Vining and Simis Ranch. The GBUAPCD data for Lee Vining and Simis Ranch provide most of the available information on wind patterns in Mono Basin. Figure 3H-1 shows the locations of the major meteorological and air quality monitoring sites in the Mono Lake area.

Early studies of air quality conditions in Mono Basin were conducted by researchers at the UC Davis (Kusko et al. 1981, Kusko and Cahill 1984, Cahill and Gill 1987). Useful summaries of more recent air quality data collected by the GBUAPCD are published in quarterly and annual data reports by ARB. Additional air quality data are available from GBUAPCD files.

Data from direct measurements of TSP and PM_{10} concentrations are supplemented by photographic data provided by LADWP. LADWP staff have maintained a photographic record of visible dust events since 1980. These photographic data provide a very complete record of conditions at about 2 p.m. each day over an 11-year period.

No comprehensive studies of the physical, chemical, or mineralogical characteristics of erodible substrates, TSP samples, or PM_{10} samples from Mono Basin have been performed. Some of the limited analyses that have been performed are discussed briefly in Appendix N.

No studies of the mineralogy or chemical reactions of salt deposits found in Mono Basin have been performed. Studies conducted in the Owens Valley (Alderman 1985, Smith and Friedman 1986, Smith et al. 1987, Saint-Amand et al. 1986) provide the basis for discussions presented in this document.

No comprehensive studies of wind erosion processes in Mono Basin have been performed. The physics of wind erosion processes have been widely studied, however (see Chepil 1958, Warren 1979, Gillette 1980, World Meteorological Organization 1983, and Zobeck 1991).

Efflorescent salt deposits subject to wind erosion in Mono Basin have been mapped by the staff of GBUAPCD; mapping was based on lakeshore foot transects. Efflorescence and its relation to groundwater in Mono Basin has been studied by Rogers and Dreiss (1991), Balance Hydrologics (1992), and, mostly recently, by SWRCB consultants (Chapter 3C, "Vegetation").

Inferences about the sources and susceptibility of sediments to wind erosion can be derived from the geological literature of Mono Basin (Lajoie 1968; Stine 1992, 1993; U.S. Soil Conservation Service n.d.; U.S. Forest Service n.d.). No soil survey of the relicted lands exists; some USFS and U.S. Soil Conservation Service (SCS) soil mapping for the near-lake environment exists, but it is in preliminary, unreconciled form and is not based on field sampling.

GBUAPCD has conducted portable wind tunnel studies of particulate emission rates in several locations on the northeastern relicted lands. These data are useful in modeling dust emissions from monitored wind speed data (see "Assessment Methodology" section of this chapter) although no measurements of emission rates of powdery efflorescent salts were made.

Mono Basin Meteorology

Temperature, precipitation, and wind patterns affect the condition of substrate surfaces that may be susceptible to wind erosion, and wind is the driving energy of the dust storm phenomenon.

Temperature Patterns

Temperature data from the Mono Lake monitoring station show a typical high desert annual pattern: cold winters and cool summers (Figure 3H-2). Data from the Cain Ranch indicate temperatures about 5° cooler than those recorded at Mono Lake (LADWP 1987). Annual mean temperatures are about 48°F at Mono Lake and 43°F at Cain Ranch. Most of the difference in temperature patterns between Cain Ranch and Mono Lake is attributable to the moderating influence of the lake (LADWP 1987).

Precipitation Patterns

LADWP (1987) presented a precipitation contour map for Mono Basin, suggesting that precipitation averages about 10 inches per year at the western side of Mono Lake and about 6 inches per year at the eastern side of Mono Lake.

Long-term records of precipitation patterns are available from two monitoring sites: Mono Lake (at the northwest corner of the lake) and Cain Ranch (along Rush Creek just upstream from U.S. Highway 395 [U.S. 395]). Average monthly precipitation rates based on a 51-year data record for Cain Ranch show a typical Great Basin pattern of significant precipitation in every month, but with winter (November-March) storm precipitation 3.4 times as great as for summer thunderstorms (Figure 3H-3). Precipitation rates over that period averaged nearly 11 inches per year. The variation in annual precipitation at Cain Ranch is substantial, ranging from 3 to 20 inches (Figure 3H-4). For the 51-year period shown, the longest sequence of wet years (from 1977 to 1983) was followed by the longest sequence of dry years.

Precipitation data have been collected for short periods at a few other locations in Mono Basin. Measurements on the east side of the lake in the Warm Springs area indicate an average precipitation rate of 5.7 inches per year for a 10-year period compared to 12.7 inches per year at the Cain Ranch (1975-1985) (LADWP 1987). Data collected by the GBUAPCD at Lee Vining indicate 8.0 inches of precipitation in 1989 and 9.7 inches in 1990, compared to 5.1 and 6.2 inches in the same period at the Cain Ranch. The data available suggest that precipitation amounts along the west shore of Mono Lake are somewhat higher than precipitation amounts measured at Cain Ranch and that precipitation at the east side of the lake is much lower.

Wind Patterns

The GBUAPCD collects wind pattern data at meteorological stations located in Lee Vining and at Simis Ranch (Figure 3H-1). Hourly average data from late 1985 through 1991 have been analyzed for this EIR. (Wind speed data are missing for the early part of 1986 at both stations, although wind direction data were recorded.) These studies have not attempted to validate the wind data records provided by GBUAPCD or to reconcile instances of extreme discrepancy in concurrent wind speed data for the Lee Vining and Simis Ranch monitoring sites.

Wind Patterns at Lee Vining. As shown in Figure 3H-5, nighttime and early morning winds at Lee Vining are predominantly from the south-southwest. Starting at about sunrise, the winds swing rapidly around through the west to the north. Northerly winds predominate into the early afternoon, when the wind direction begins a gradual swing back through the west to the south-southwest.

Wind speeds at Lee Vining typically drop through the night and early morning hours, reaching a minimum by 7 a.m. Wind speeds increase steadily through the early afternoon hours with the highest wind speeds persisting through the evening hours. Maximum wind speeds typically occur between 4 and 5 p.m. Wind speeds begin to drop after about 7 p.m.

Modest seasonal differences in wind speed are evident at Lee Vining (Table N-1 in Appendix N). Average wind speeds are highest during spring (night and morning hours) and summer (afternoon and evening hours). Very strong winds can occur during any season, although the highest wind speeds generally occur during fall or winter months. The data also suggest some minor seasonality in wind direction patterns.

Wind Patterns at Simis Ranch. As shown in Figure 3H-6, nighttime and early morning winds at Simis Ranch are predominantly from the north. Starting at about sunrise, the winds swing rapidly around through the east to the south. Onshore, southerly winds predominate from midmorning until midafternoon, when the wind direction begins a gradual swing through the west and back to the north.

Wind speeds at Simis Ranch typically drop through the night and early morning hours, reaching a minimum by 7-8 a.m. Wind speeds increase steadily through the afternoon hours. Maximum wind speeds typically occur in the 3-5 p.m. period. Wind speeds begin to drop after about 6 p.m.

Modest seasonal differences in wind speed are evident at Simis Ranch (Table N-2 in Appendix N). Average wind speeds are highest during spring. Very strong winds can occur during any season, although the highest wind speeds generally occur during spring or fall months. The data also suggest some minor seasonality in wind direction patterns.

Comparison of Lee Vining and Simis Ranch Wind Patterns. Lee Vining and Simis Ranch experience very different wind direction patterns. Wind directions are seldom in phase at Lee Vining and Simis Ranch. The differences in wind direction appear to be related to topographic features, with lake effects and upslope/downslope winds exerting strong influences. Lee Vining experiences higher peak wind speeds than does Simis Ranch, although average wind speeds at Lee Vining and Simis Ranch are similar.

Mono Basin Air Quality Conditions

Monitoring Studies by UC Davis

Early studies of air quality conditions in the Owens Valley and Mono Basin were conducted by researchers at the UC Davis. The instrumentation used for those studies and the duration of sample collection episodes preclude direct comparison of the UC Davis data with state or federal ambient air quality standards (see Appendix N).

The UC Davis data suggest that PM_{10} concentrations above the current state 24-hour standard probably occurred in Lee Vining several times during 1980. The 7-day average

PM_{15} concentration of 73.7 $\mu g/m^3$ during the week of June 2-9, 1980 must have included episodes with 24-hour PM_{10} concentrations above the current state standard of 50 $\mu g/m^3$.

GBUAPCD Monitoring Data

Summary of Monitoring Data. TSP and PM_{10} monitoring data for 1979-1991 in the Mono Lake vicinity are summarized in Table 3H-2. No violations of state or federal annual TSP standards have been recorded in Mono Basin. The state 24-hour TSP standard was exceeded at one or more locations in 1979, 1980, and 1982. The federal 24-hour TSP standard was exceeded at one or more locations in 1979, 1980, 1982, and 1985. As noted previously, state TSP standards were replaced by PM_{10} standards in 1983 and federal TSP standards were replaced by PM_{10} standards in 1987.

PM_{10} monitoring did not begin in Mono Basin until 1986. PM_{10} monitoring at Simis Ranch started in October 1986; PM_{10} monitoring at Lee Vining started in March 1988. No violations of state or federal annual PM_{10} standards have been recorded in Mono Basin. The state 24-hour PM_{10} standard was exceeded at the Simis Ranch monitoring site in 1987, 1988, 1989, 1990, and 1991. The state 24-hour PM_{10} standard was exceeded at the Lee Vining monitoring site in 1991. The federal 24-hour PM_{10} standard was exceeded at the Simis Ranch monitoring site in 1989.

Table 3H-2 does not include data from 1992 because monitoring data for the last half of 1992 have not yet been published. Data for the first 6 months of 1992 reveal two exceedances of the state 24-hour PM_{10} standard and one exceedance of the federal 24-hour PM_{10} standard at Simis Ranch.

Table 3H-2 does not provide a complete summary of all TSP or PM_{10} data collected by the GBUAPCD. A limited amount of additional TSP data was collected by the GBUAPCD at the Binderup site (near Simis Ranch) in 1979 and 1980; some of these additional data represent sampling periods longer than 24 hours. Limited PM_{10} sampling was conducted at the base of Cedar Hill in the eastern end of Mono Basin during 1989-1991. In addition, PM_{10} data collected with portable samplers at Warm Springs when dust storms were anticipated are not included in Table 3H-2.

Table 3H-2 includes much of the TSP data collected at the Binderup site. The additional TSP data from the Binderup site do not indicate any TSP concentrations higher than those reported in Table 3H-2. The Cedar Hill site PM_{10} data did not indicate any exceedances of the state or federal 24-hour PM_{10} standards.

Monitoring data from the Warm Springs sampling program are summarized in Table 3H-3. Some of the data collected at Warm Springs involved sampling periods of less than 24 hours. Additionally, some of the 24-hour sampling at Warm Springs was not done on a midnight-to-midnight cycle. Nevertheless, the data suggest that the state 24-hour PM_{10} standard was exceeded at the Warm Springs monitoring site at least once during 1988, at least twice during 1990, at least three times during 1991, and at least three times during the first 6 months of 1992. The Warms Springs monitoring data also indicate that the federal 24-hour PM_{10} standard was exceeded at least once in 1988, at least one in 1990, at least twice in 1991, and at least once during the first 6 months of 1992. These data show that particulate concentrations are usually higher at Warm Springs than at Simis Ranch.

Correlations between TSP and PM_{10} Values. TSP and PM_{10} concentrations have been monitored concurrently at the Simis Ranch site since 1990. Figure 3H-7 illustrates the relationship between paired TSP and PM_{10} samples. On average, PM_{10} concentrations are about 47% of the concurrent TSP concentration. The observed relationships between these two parameters are discussed further in Appendix N.

Seasonality of High PM_{10} Concentrations. PM_{10} monitoring data from Simis Ranch indicate a dual seasonality of high PM_{10} concentrations. Figure 3H-8 shows the maximum PM_{10} concentrations recorded at the Simis Ranch monitoring station according to month. Figure 3H-9 shows the monthly frequency of Simis Ranch PM_{10} samples exceeding the state 24-hour standard.

PM_{10} concentrations above the state 24-hour standard of 50 $\mu g/m^3$ have been recorded primarily during spring (March, April, or May) or fall (September, October, or November) at Simis Ranch. No exceedances of the state 24-hour PM_{10} standard have been reported during summer (June, July, or August).

PM_{10} data from Lee Vining show a seasonality pattern that differs significantly from the Simis Ranch pattern. All recorded exceedances of the state PM_{10} standard occurred during January 1991. Other relatively high PM_{10} concentrations have occurred primarily during winter (December, January, or February).

Frequency of High PM_{10} Concentrations. Modern instrumentation allows automated continuous monitoring of many air pollutants. Monitoring of suspended particulate matter concentrations, however, still requires significant manual efforts for filter preparation, instrumentation calibration and setup, filter collection, and filter analysis. Consequently, it is usually impractical to monitor suspended particulate matter concentrations every day of the year.

Monitoring Conventions. The normal monitoring convention for suspended particulate matter involves collection of a 24-hour sample once every 6 days. On a sampling schedule of 1 day in 6, 83% of the days are not sampled. Since 1989, PM_{10} sampling at the Simis Ranch site has been more intensive than the normal schedule of 1 day in 6. But even in the most intensively sampled year (1990), 68% of the days were not sampled.

Because samples are not collected every day, it is misleading to refer to the number of samples above specific numerical values as if those were the only days exceeding the specified concentration. It is more accurate to discuss the percentage of collected samples that exceed various numerical values. If all months or seasons are represented by an adequate number of samples, it is possible to make reasonable extrapolations to estimate the annual frequency of high PM_{10} concentrations.

PM_{10} monitoring at Warm Springs has been concentrated in spring and fall months, with an effort made to sample on days expected to have strong winds. Because particulate matter sampling at Warm Springs is not intended to provide statistical representativeness, it is difficult to extrapolate the Warm Springs data to days that were not sampled. The following discussion emphasizes data from Simis Ranch and Lee Vining because these monitoring stations are operated throughout the year.

Exceedance Event Patterns. Most PM_{10} samples collected at Lee Vining and Simis Ranch show concentrations well below the state 24-hour PM_{10} standard of 50 $\mu g/m^3$ (Figure 3H-10). Nearly 39% of the Lee Vining PM_{10} measurements are 10 $\mu g/m^3$ or less. Over 55% of the Simis Ranch PM_{10} measurements are 10 $\mu g/m^3$ or less.

Only a few PM_{10} samples from either location have exceeded the state or federal 24-hour PM_{10} standards. Data from Simis Ranch for October 1986 through June 1992 indicate that:

- 3.9% of the PM_{10} samples exceeded the state 24-hour PM_{10} standard of 50 $\mu g/m^3$ and

- 0.5% exceeded the federal 24-hour PM_{10} standard of 150 $\mu g/m^3$.

Data from Lee Vining for 1988-1991 indicate that:

- 0.8% of the PM_{10} samples exceeded the state 24-hour PM_{10} standard and
- no Lee Vining samples exceeded the federal 24-hour PM_{10} standard.

Table 3H-4 summarizes the monthly distribution of PM_{10} samples from Lee Vining and Simis Ranch that exceed the state 24-hour PM_{10} standard. As shown, the Lee Vining station has operated on a more uniform sampling schedule than has the Simis Ranch station. In recent years, the uniform sampling schedule at Simis Ranch has been supplemented by additional sampling during spring and fall. The last column in Table 3H-4 extrapolates available data on a monthly basis to estimate the average monthly exceedances of the state 24-hour PM_{10} standard. The aggregated monthly data suggest three exceedances per year in Lee Vining and 13-14 exceedances per year at Simis Ranch.

Annual trends in PM_{10} exceedances at Simis Ranch (Figure 3H-11) suggest that the frequency of PM_{10} exceedances more than doubled from 1987 (an extrapolated eight exceedances) to 1991 (an extrapolated 21 exceedances). The apparent trend should be viewed with caution because the indicated frequencies reflect limited numbers of PM_{10} samples, particularly for 1987 and 1988. The chance inclusion or omission of a single exceedance event in any year could measurably change the trend pattern.

The estimated monthly pattern of PM_{10} exceedances at Simis Ranch is shown on Figure 3H-12 and is based on the data summarized in Table 3H-4. Although most observers report dust events as being most common in spring, the Simis Ranch station has recorded a slightly higher frequency of events during fall. As with Figure 3H-11, the frequency pattern in Figure 3H-12 is prone to significant changes with the inclusion or omission of a few single events.

Frequency and Seasonality of Low PM_{10} Concentrations. Although attention normally focuses on high PM_{10} concentrations, the occurrence of very low PM_{10} concentrations is informative. Lee Vining and Simis Ranch experience similar frequencies of PM_{10} concentrations between 6 and 10 $\mu g/m^3$ (Figure 3H-13). However, Simis Ranch exhibits a much higher frequency of very low PM_{10} concentrations (between 1 and 5 $\mu g/m^3$).

Simis Ranch and Lee Vining also exhibit different seasonality patterns for very low PM_{10} conditions (Figures N-4 and N-5 in Appendix N). The monthly distribution of very low PM_{10} concentrations at Simis Ranch parallels the monthly distribution of annual precipitation and the probability of frozen ground conditions, but no such meteorological correlation is evident at Lee Vining.

As discussed in a subsequent section, these differences between the Simis Ranch and Lee Vining low PM_{10} data suggest differences in the sources contributing to observed PM_{10} concentrations.

LADWP Photographic Observations of Blowing Dust

In 1980, LADWP began a program to photographically document episodes of windblown dust. At approximately 2:00 p.m. each day, a panoramic sequence of three photographs is taken from the service road along the Lee Vining conduit above U.S. 395 (Figure 3H-1). The photographs are evaluated by LADWP staff and rated on a four-point scale according to the extent of windblown dust: no visible dust, faint windblown dust (mostly dust devils), recognizable windblown dust, and extensive windblown dust. In recent years, the apparent source areas for visible dust also have been recorded (land bridge, north shore, east shore, south shore, west shore, Paoha Island, or Negit Island), as discussed below.

Between March 1980 and February 1991, 3,872 sets of photographs were evaluated and classified, with 118 sets (3%) showing recognizable or extensive dust events. Figure 3H-14 illustrates the annual frequency of significant dust events (recognizable or extensive events in the LADWP classification system). In contrast to the apparent trend shown by the Simis Ranch PM_{10} monitoring data (Figure 3H-11), the LADWP photographic record suggests little change in dust event frequency during recent years. The LADWP photographic record also suggests a noticeable decline in dust event frequency since 1985.

The monthly frequency of significant dust events detected in the LADWP photographic record (Figure 3H-15) is consistent with the qualitative seasonality pattern that most observers describe; that is, dust events are most frequent in spring. The year-to-year variability in seasonal dust event frequencies detected by the LADWP photographic record (Figure 3H-16) suggests that the seasonal pattern of blowing dust events can change significantly from year to year.

Conclusions Regarding the Frequency and Seasonality of Blowing Dust Events

The Simis Ranch PM_{10} monitoring data and the LADWP photographic record data provide different indicators of the frequency and seasonality of significant windblown dust events. These two data sets have different strengths and weaknesses.

The Simis Ranch PM_{10} data provide a quantitative 24-hour integrated measure that can be directly compared to state and federal 24-hour standards. However, the Simis Ranch data represent only one geographic area and do not provide continuous data. The LADWP photographic data provide an extensive long-term record with broad geographic coverage. However, the data available from the photographs is qualitative with respect to the federal and state PM_{10} standards and is representative of only a limited time interval.

Given the different temporal and geographic coverages of the two data sets, it is not surprising that the LADWP photographic data do not correlate strongly with the Simis Ranch PM_{10} data. Figure 3H-17 illustrates that it is futile to attempt to correlate the LADWP photographic ratings with any specific range of PM_{10} concentrations measured at Simis Ranch. The simplest explanation for the lack of correlation between the photographic ratings and measured PM_{10} concentrations at Simis Ranch is that many dust events recorded in the LADWP photographs do not reach the PM_{10} monitors at Simis Ranch. Additionally, dust events leading to violation of the state 24-hour PM_{10} standard at Simis Ranch can occur before or after the LADWP photographs are taken.

The LADWP photographic data probably provide a more reliable indication of seasonal patterns in windblown dust events than do the Simis Ranch PM_{10} data. Neither the Simis Ranch PM_{10} data nor the LADWP photographic data provide a particularly reliable indicator of annual trends in the frequency of dust events. It is possible that dust events have increased in frequency near the Simis Ranch while the frequency of dust events basinwide has remained fairly stable.

Sources of Particulate Matter in Mono Basin

Introduction

Although there have been no comprehensive technical analyses of the relative source contributions to suspended particulate matter in Mono Basin, the major contributing sources can be easily identified. Most suspended particulate matter is produced by wind erosion of exposed soils, sediments, and salt deposits. Declining lake level not only significantly increased the extent of barren substrates around the shore of the lake, it resulted in the appearance of significant efflorescent salt deposits along the northern and eastern shores of the lake. Most observers consider the salt deposits to be the major source of suspended particulate matter during significant dust storm events.

Although most suspended particles will be derived from efflorescent, barren, and sparsely vegetated substrates, some suspended particulate matter will be salt crystals and entrained sediment formed by evaporation of spray droplets produced by wave action on Mono Lake. Biological sources (e.g., vegetation, molds, and fungi) will contribute small quantities of pollen and spores. Combustion processes (e.g., residential and commercial fuel use and motor vehicle exhaust) will also contribute to suspended particulate matter, especially on the west side of the lake. Dust generated by vehicle travel on paved and unpaved surfaces is probably a minor contributor to suspended particulate matter in Mono Basin and is probably more important at the Lee Vining monitoring site than at Simis Ranch. Differences in the seasonality of both high PM_{10} and very low PM_{10} concentrations suggest that Lee Vining is much less influenced by dust storms and more strongly influenced by fuel combustion and vehicle traffic sources than is Simis Ranch.

The high frequency of very low PM_{10} concentrations measured at Simis Ranch indicates that long-distance transport of aerosols from outside Mono Basin is an infrequent contributor to Mono Basin particulate matter concentrations.

Unfortunately, the available data on the physical and chemical characteristics of suspended particulate matter is insufficient to quantify the contributions from different emission sources. The available chemical analyses confirm, however, that suspended particulate matter is predominantly a mix of soil, sediment, and salt particles. Some of the samples show very small amounts of selenium and arsenic, but the mineralogical carriers of these elements cannot be determined from the available data.

Distribution of Major Sources of Observed Dust Storms

GBUAPCD staff have observed numerous major dust events at Mono Lake and have estimated the geographic distribution of source areas of various frequencies (Figure 3H-18). Frequent source areas include a band around the northeastern shore setback from the lake edge, sediments that emerged as the Negit Island land bridge, and the emerged western portion of Paoha Island having very sparse greasewood cover. Less frequent source areas include the eastern lakeshore between Warm Springs and Simon's Spring and lower areas of the land bridge. Least frequent source areas include wet areas near the lake from Black Points to Warm Springs. Most of the source areas exhibit salt efflorescence, but some are especially fine sands and silts.

The locations recorded for "recognizable" and "extensive" dust storms in the LADWP photographic record also characterize source area distribution. Over 70% of the photographed events have been classified by source area. The most frequent source areas observed are along the eastern shore (Figure 3H-19), but the north shore, the land bridge, and Paoha Island are other major sources of "extensive" events. As the percentages in the figure indicate, on the average two source areas contribute to recognizable events and three to four areas contribute to extensive events.

A comparison of Figures 3H-18 and 3H-19 shows that LADWP's "eastshore" includes a substantial portion of GBUAPCD's northeast frequent source area. Together, then, the surveys reveal that the major sources of dust storms are relicted lands around the northern and eastern shorelines, the land bridge, and the west shore of Paoha Island.

Efflorescent Salt Deposits

Chemists define "efflorescence" as the dehydration of a hydrated salt when exposed to air. Some geologists retain this chemical perspective by defining "efflorescent salts" as powdery salts formed by dehydration of hydrated salts. Other geologists, many soil scientists, and this EIR use a less restrictive definition of "efflorescent salts" as any salts produced by evaporation of water at a sediment or soil surface exposed to the air.

Efflorescent salt deposits at Mono Lake are found primarily along the northern and eastern shores of the lake, generally below the 6,390 foot contour (Figure 3H-20). Small scattered deposits are found in other locations. The mineralogy of the Mono Lake deposits has not been studied, but probably has strong similarities to some of the efflorescent salt deposits at Owens Lake. The Mono Lake deposits are probably dominated by sodium carbonates and sodium sulfates, with smaller quantities of sodium chloride. Appendix N presents a discussion of the probable mineralogy of efflorescent salts such as those found at Mono Lake.

Efflorescent salts, virtually nonexistent in the prediversion period, covered an area of 4,975 acres of the relicted lands (65%) at the point of reference. They are light, weak materials typically forming a surface layer up to a few inches thick on underlying lakebed sediments, principally silts and fine sands. The salts are sometimes noncrystalline powdery deposits highly susceptible to wind erosion, or are more often crusted but subject to disturbance by saltating sand. The extreme salinity generally prohibits the colonization of efflorescent areas by plants (Chapter 3C, "Vegetation"), preventing the development of a cover affording protection from wind.

Source of Efflorescence. Efflorescent salts form as saline groundwater rises to the surface of permeable sediments through capillary action and evaporates. The salts, highly susceptible to removal by wind or rain, begin reforming once removed. Sources of evaporating saline water in these sediments may be intruding lake water or saline groundwater draining the adjacent lake basin sediments. Efflorescent salt deposits are seldom found where the groundwater table is more than 10 feet below the ground surface (Saint-Amand et al. 1986).

Test hole data indicate that relatively shallow groundwater flows toward the lake at locations all around the lake. In general, the west end of the lake is characterized by fresh groundwater with steeper slopes and higher flow rates, and the east end has saline water inflowing more slowly along a gentle gradient. Because the eastern end of the lake also has low topographic gradient, a wide zone of sediments with shallow saline groundwater is present in these areas (see Figure U-1 in Appendix U). By and large, these sediments exhibit salt efflorescence.

Because a similar zone of efflorescence was not present in the prediversion period, the phenomena is certainly the result of the reduced lake level. Groundwater draining the extensive basin of former lake sediments, extending up to 8 miles from the lake, may eventually reach a new equilibrium level with the lake surface, reducing or eliminating the efflorescent phenomena. The time interval for such a change to occur is unknown, but based on size and elevation of lakebed deposits in the basin and typical lakebed transmissivities and porosities, it is estimated to be at least hundreds of years (Appendix U).

Other areas of efflorescence, such as the immediate shoreline and portions of the land bridge, may result from simple intrusion of low-lying lakebeds with saline lake water.

In either case, the saline groundwater rises through capillary action to the surface, where it is evaporated, depositing its mineral content, or cooled, precipitating some of the dissolved minerals. The silty lakebeds produce a relatively large zone of capillary rise.

Factors Affecting Wind Erodibility of Salt Deposits. The erodibility of efflorescent salt deposits is determined primarily by their mineralogy and moisture content. As described in Appendix N, the mineralogy of efflorescent salt deposits can change on daily and seasonal cycles controlled by temperature, moisture conditions, and surface evaporation rates.

Table 3H-5 presents a simplified summary of salt deposit erosion susceptibility as influenced by surface temperatures and moisture content. Wet conditions prevent wind erosion regardless of salt deposit mineralogy. Cool salt deposit temperatures and low surface moisture levels favor the development of powdery noncrystalline salts that are highly susceptible to wind erosion. Warm, dry conditions favor the formation of a strongly cemented crust that is highly resistant to wind erosion.

Seasonal patterns of temperature and moisture at Mono Lake are most likely to result in powdery salt deposits during spring or after fall rains. Cemented salt deposits resistant to wind erosion are most prevalent during summer, but summer thunderstorms or unseasonable temperature changes at any time of the year can alter the prevailing condition of the salt deposits. Once eroded by wind or dissolved by rain, salt deposits will reform but may do so in a condition quite different from their previous state. The general seasonal pattern is combined with a diurnal pattern controlled by temperature, humidity, and evaporation. Particularly in spring and fall, the daily temperature cycle can lead to repeated transitions between strongly hydrated salts formed at night and powdery anhydrous salts during the day.

Moisture has geographic effects also. Efflorescent areas closest to the lake may only be infrequent dust emitters (Figure 3H-18) because groundwater is so shallow near the lakeshore that it only infrequently dries sufficiently to deflate. At the Ten-Mile Road area, for example, the lakeshore zone of infrequent emissions (Figure 3H-18) includes a

1,000-foot-wide band of frequently wet efflorescent lands, which extends upslope 8 vertical feet above the lake surface.

Reflecting these factors, a range of salt deposit conditions was observed over a transect from Ten-Mile Road to the lake on April 24, 1992 (Figures 3H-21 and 3H-22). The upper part of the salt deposit was characterized by a thin but hard salt crust, and a thin, weak, buckled crust was present toward the upper middle part of the deposit (Figure 3H-21). The lower middle part of the salt deposit was a relatively thick powder that was drying at the surface (Figure 3H-22); the lower part was wet.

Other Exposed Sediments

Several other unvegetated or sparely vegetated substrate types are widespread around Mono Lake, constituting 6,900 acres. This is an area about 39% greater than the area of efflorescent salts. The areas probably also contribute substantially to emissions during high wind episodes, based on wind-tunnel emission rates measured from some of them by GBUAPCD. The reasons for the lack of vegetation are complex (see Chapter 3C, "Vegetation").

Silty lakebeds with occasional clayey layers deposited by the prehistoric Lake Russell are exposed in streamcuts and presumably underlie many of the surface sands in Mono Basin. Little information is available on the particle sizes and surface distribution of these sediments.

Lakebed silts, clays, and diatomaceous sediments occur on Paoha Island (Chesterman and Gray 1966). Particles in diatomaceous sediments (microscopic silica shells secreted by some types of aquatic algae) have a complex physical structure that incorporates many void spaces. Consequently, diatomaceous particles have a very low density and can be transported long distances once eroded by the wind. As noted previously, the relicted flat on the west side of Paoha Island is a frequent dust storm source area.

Pumice sands are readily apparent along much of the east shore of Mono Lake. Even when ground into sand-sized particles, pumice contains many void spaces (McCrone and Delley 1973), resulting in a very low particle density. Pumice sands will be more subject to wind erosion than might be expected from the physical size of individual particles.

The geology of the volcanic rocks in most of Mono Basin suggests variable density and a low quartz content for sands derived from these sources. Volcanic rocks south of Mono Lake are predominantly rhyolitic ash and include obsidian domes and pumice fields (Scholl et al. 1966, Chesterman and Gray 1966, Stine 1992). Volcanic rocks of Negit Island are andesitic lavas (Chesterman and Gray 1966), and Black Point is a basalt cinder cone (Scholl et al. 1966, Stine 1992). Rhyolite is somewhat less dense than quartz, basalt is more dense, and andesite is essentially the same (Olhoeft and Johnson 1989).

Surface of Mono Lake

Under windy conditions, the surface of Mono Lake is an additional source of suspended particulate matter. Spray droplets released into the air from waves on the surface of Mono Lake include dissolved salts and some fine suspended solids. Evaporation of the water in the spray droplet leaves salt, silt, and clay particles suspended in the air. No measurements of this phenomena have been made at Mono Lake, but the amount is relatively small compared to emissions from efflorescent and sediment sources.

As described by Stine (1992), longshore currents at Mono Lake entrain sediment delivered from the tributary streams. Driven by the prevailing southwest wind, these currents sweep stream-derived sediments eastward along the south shore and north shore (Figure 3H-23). Where these currents meet, an extensive sandy area and dune field extend northeastward from the lakeshore. During windy episodes, local transfer of lake-entrained sediment to terrestrial environments as particulate matter occurs here, but probably through saltation near the ground and not lofting into air. Such saltation may help dislodge adjacent efflorescent salt particles, however.

IMPACT ASSESSMENT METHODOLOGY

Impact Prediction Methodology

Analytical Approach

The major air quality issue to be addressed in this EIR is the extent to which different lake level and streamflow standards might affect the location and extent of erodible substrates, with resulting effects on the magnitude, geographic extent, and general frequency of high concentrations of suspended particulate matter.

Predicting ambient air quality impacts requires consideration of the transport, dispersion, chemical transformation, and removal processes that affect pollutant emissions after their release into the atmosphere. Computer models provide the most practical method for developing quantitative air quality assessments of future conditions. Because air pollution problems at Mono Lake are dominated by physical processes rather than by chemical transformations, Gaussian dispersion models are a logical choice for the analyses in this EIR.

Although Gaussian dispersion models estimate the net effect of atmospheric dispersion processes on emissions, they do not mathematically simulate the physical process of turbulent dispersion. These models employ mathematical extrapolation techniques to estimate pollutant concentrations.

Gaussian dispersion models are generally structured as a series of mathematical terms multiplied together. The initial term in the equation represents the plume centerline concentration at the emission source. This term is multiplied by a series of fractions that reduce the initial concentration value to account for distance of a receptor downwind from the emission source, lateral offset from the plume centerline, and vertical offset from the plume centerline.

Dispersion models calculate pollutant concentrations at particular locations ("receptors" in modeling jargon) by applying appropriate horizontal and vertical dispersion factor equations to the initial pollutant concentration. The proper dispersion factor equations are determined from the position of the receptor relative to both the emission source and the centerline of the pollution plume extending downwind from the emission source.

Only a few Gaussian dispersion models have been structured to address wind-blown particulate matter as the pollutant of concern, although many different models have been developed over the last 15 years. The Fugitive Dust Model (FDM) (Winges 1990) provides a flexible model formulation that is easily applied to conditions at Mono Lake.

The initial FDM computer code was released in 1990 but is based on two other dispersion models that have been used extensively for over a decade: CALINE3 (Benson 1979) and ISCST (Bowers et al. 1979, Wagner 1987). FDM is most useful as an area source model, although it also contains subroutines that evaluate point sources and line sources. The line source and area source subroutines in FDM are based on the CALINE3 line source dispersion model.

The area source subroutines in FDM calculate both ambient concentrations ($\mu g/m^3$) and mass deposition rates (micrograms per square meter per second). Model computations are typically performed for sequences of 1-hour periods, with model results presented as 1-hour, 3-hour, 8-hour, or 24-hour averages. Results can also be averaged over the entire model sequence.

Additional details concerning Gaussian dispersion models in general and the FDM model in particular are presented in Mono Basin EIR Auxiliary Report No. 26 (Jones & Stokes Associates 1993).

Delineation of Areas Contributing to Windblown Particulate Matter

The baseline vegetation and substrate map prepared from 1991 color aerial photographs (see Chapter 3C, "Vegetation") provided the basis for identifying areas near Mono Lake that are probable sources of windblown particulate matter. The vegetation/ substrate categories used for the vegetation mapping were reclassified into particulate matter source area categories. All well-vegetated, tufa, and barren rock areas were treated as being nonerosive. Remaining areas were categorized into background low-emission-rate source areas and high-emission-rate source areas. High-emission-rate source areas were identified by correlation with GBUAPCD's map of major emission source areas.

Background low-emission-rate source areas included:

- the surface of Mono Lake,
- barren basalt sands (Black Point sands),
- small isolated patches of efflorescent salt, and
- other sparsely vegetated or barren substrates (sands and silts).

High-emission-rate source areas were categorized as high, medium, and low frequency. These frequency characterizations generally reflect the relative duration of low moisture conditions in substrates; wet substrates are not subject to wind erosion.

The major low frequency source areas were separated into two categories:

- efflorescent salt deposits and
- other barren substrates.

The major medium frequency source areas were also separated into two categories:

- efflorescent salt deposits and
- other barren substrates.

The major high frequency source areas were separated into three categories:

- efflorescent salt deposits,
- diatomaceous sediments on Paoha Island, and
- other barren substrates.

The emission source categories listed above were assigned various combinations of values representing emission rates, particle size distributions, and particle densities.

All source area delineations were performed at a scale of 1:24,000 (the scale of 7.5-minute topographic quadrangles). The aerial photo base for the vegetation mapping reflects a lake elevation of 6,375.1 feet.

Lake Levels Selected for Modeling

Lake contour overlays were prepared for the nominal lake elevation associated with each alternative. Additional lake contour overlays were prepared for the point-of-reference and prediversion elevations. Most major emission source areas would be under water at a lake elevation of 6,400 feet; only a portion of the Paoha Island major source area and a small section of the Negit Island land bridge would remain exposed at that lake elevation. Consequently, modeling analyses focused on lake elevations below 6,400 feet.

Comparison of lake elevation contours indicated that the extent of major source areas differed only slightly between the aerial photograph base elevation (6,375.1 feet) and the point-of-reference condition (6,376.3 feet). Therefore, the aerial photograph base condition was used as representative of the point-of-reference condition.

Emission Rate Parameters

The FDM model applies particle settling and deposition adjustments to the basic Gaussian dispersion model equations. Thus, source area emissions are characterized by a basic emission rate equation, a particle size distribution, and a particle density.

Wind Erosion Rate Equations. As discussed in Auxiliary Report No. 26, the FDM model was modified to allow selection from five different emission rate equation formats on a source-by-source basis. Equations for the high-emission-rate source areas were derived from analysis of data collected by the GBUAPCD using a portable wind tunnel. Several different equation types provided an adequate fit to the available data. A sigmoidal equation format with a threshold wind speed of 15 mph was used for the high-emission-rate source areas.

The small salt deposits classified as background low-emission-rate source areas also were modeled with a sigmoidal equation. A revised equation was derived by reducing the upper asymptote of the original sigmoidal equation by 50% and increasing the threshold wind speed to 20 mph.

Other terrestrial background low-emission-rate source areas were modeled using third-order polynomial equations derived in a series of steps starting with data from the portable wind tunnel study. Emission rate values from a power function fit of the wind tunnel data were reduced by 70%. The modified equation results were then adjusted to reflect different threshold wind speeds (28 mph for basalt sands and 22 mph for other low emission rate sands). The tentative emission rate values produced in this manner were then used to derive third-order polymonial equations for use in the FDM model.

Salt spray from the surface of Mono Lake was modeled using a third-order polynomial equation derived from analysis of data presented in Blanchard and Woodcock (1980) and Monahan et al. (1983). A multiplier was added to the polynomial equation to reflect the higher salinity of Mono Lake. Blanchard and Woodcock (1980) give 8 mph as a threshold wind speed for salt spray off the open ocean; a threshold wind speed of 10 mph was used for Mono Lake.

Particle Size Distributions for Wind-Eroded Sediments. The FDM model can analyze transport, settling, and deposition of up to 20 particle size classes from each emission source area. As explained in Auxiliary Report No. 26, eight particle size classes were used in the modeling analyses conducted for this EIR. Particle size distributions for salt spray aerosols were derived from data in Blanchard and Woodcock (1980). Particle size distributions for sandy background source areas were derived from data in Pye (1987).

Particle size distributions for other substrate types (salt deposits, diatomaceous sediments, and high-emission-rate sands and silts) were estimated by the SWRCB contractors.

Particle Densities for Mono Basin Sediment Types. Particle densities vary significantly among the different substrates found at Mono Lake (see Auxiliary Report No. 26 for additional details). The FDM modeling analyses performed for this EIR assumed the following particle densities for identifiable substrate categories:

- 2.1 grams per cubic centimeter (g/cm^3) for dry salt aerosols generated by spray from Mono Lake,
- 3.0 g/cm^3 for basalt-derived sands,
- 2.5 g/cm^3 for other sands,
- 0.7 g/cm^3 for diatomaceous substrates on Paoha Island, and
- 2.1 g/cm^3 for efflorescent salts deposits.

Meteorological Data

Meteorological input to the FDM model was derived from Simis Ranch data for 1986-1991 from GBUAPCD files. Hourly meteorological data from the Simis monitoring station were sorted into calendar days, then screened for days with one or more hours of average windspeed of at least 15 mph. Days with missing data were dropped from the analysis. The remaining data set of several hundred days was then evaluated to identify days with different durations of high wind conditions and different wind direction patterns. Fifty days of historical meteorological data were selected for use in the modeling analyses.

Wind speed, wind direction, and air temperature data were taken directly from the monitoring data record. Stability class conditions and mixing height limits were estimated based on wind speed, horizontal wind direction fluctuation, statistics, and time of day.

Assessment of Annual Dust Event Occurrence Frequencies

FMD modeling results provide an indication of the potential magnitude and geographic extent of high PM$_{10}$ concentrations for different meteorological conditions and different lake elevations. For the point-of-reference condition, modeling results presented in the impact assessment section indicate that days having 4 or more hours with wind speeds above 15 mph have the potential for generating PM$_{10}$ concentrations above the state 24-hour standard in an area of at least 5 square miles. However, estimates of the expected frequency of high PM$_{10}$ concentrations must recognize that dust storm occurrence is controlled more by substrate moisture conditions and temperature-related salt crust cementing than by wind speed conditions. Only when substrate conditions are susceptible to wind erosion will wind speed be a good indicator of probable dust generation.

Correlations between wind speed data and PM_{10} monitoring data at Simis Ranch provide one approach for estimating the proportion of windy days when little actual dust is generated. Correlations between the LADWP photographic data and Simis Ranch wind speed data provide a second approach for estimating the proportion of windy days when little actual dust is generated. Both types of correlation analyses are complicated by significant amounts of missing meteorological data and by instances of unexplained major discrepancies in concurrent wind speed data for the Simis Ranch and Lee Vining monitoring stations. Further complications are the limited frequency of PM_{10} monitoring and the limited temporal coverage of the LADWP photographic data.

The Simis Ranch monitoring station collected 376 PM_{10} samples during 1986-1991. Complete wind speed data containing episodes of strong winds (4 or more hours with wind speeds of 15 mph or more) are available for 72 of the days for which PM_{10} data are available. PM_{10} concentrations above 50 $\mu g/cm^3$ were recorded on only 13 of these days. Thus, the Simis Ranch monitoring data suggest that episodes of strong winds will result in high PM_{10} concentrations about 18.1% of the time.

LADWP photographic data for 1986-1991 include 1,491 days when wind speed data are available from the Simis Ranch monitoring station. Average wind speeds for the 1-3 p.m. period exceeded 15 mph on 204 of the days with rated photographs. Only 21 of these windy days had photographs classified as showing recognizable or extensive dust events; the remaining 183 days had photographs rated as showing no visible dust or only faint dust. Thus, the LADWP photographic data suggest that episodes of strong winds will result in significant dust generation only 10.3% of the time.

Criteria for Determining Impact Significance

Air quality impact assessments address a mix of issues regarding physical impacts, regulatory requirements, and policy or program consistency. Because no specific air quality management plan has yet been adopted to address PM_{10} problems in Mono Basin, impact significance criteria used in this EIR focus on physical air quality impacts.

Physical air quality impacts are typically judged to be significant if a project would directly or indirectly:

- cause or contribute to a violation of state or federal ambient air quality standards;

- cause or contribute to noncriteria pollutant concentrations that pose an unacceptable health risk;

- cause or contribute to pollutant concentrations that produce undesirable biological, ecological, material damage, or economic effects;
- bring people into a situation where they will be exposed to air pollutants in concentrations that violate state or federal ambient air quality standards;
- bring people into a situation where they will be exposed to noncriteria air pollutants in concentrations that pose an unacceptable health risk; or
- violate federal, state, or local air quality agency emission limitations for specific pollutants or emission sources.

SUMMARY COMPARISON OF IMPACTS AND BENEFITS OF THE ALTERNATIVES

Water diversions from Mono Basin have significantly lowered the level of Mono Lake, increasing the geographic extent of barren sediments subject to wind erosion. More importantly, however, the lowering of Mono Lake has produced conditions resulting in extensive deposits of efflorescent salt along the northern and eastern shores of the lake. The postdiversion increase in acreage subject to wind erosion and the development of extensive efflorescent salt deposits have significantly increased the magnitude and frequency of dust storm events in Mono Basin. In addition, the presence of erodible efflorescent salt deposits has significantly changed the physical and chemical nature of dust storm events. As discussed in Appendix N, little quantitative data exist to characterize particulate matter associated with dust storm events in Mono Basin.

Air quality effects of the alternatives have been investigated through dispersion modeling analyses as discussed in the assessment methodologies section. The modeling analyses provide comparative indicators of:

- the maximum expected 24-hour average PM_{10} concentration,
- the geographic extent of high PM_{10} concentrations under various meteorological conditions, and
- the duration of strong wind episodes necessary to create the potential for 24-hour average PM_{10} concentrations above state or federal standards.

The potential frequency with which state or federal standards might be exceeded can be assessed qualitatively by considering the three categories of information noted above.

Table 3H-6 provides a summary comparison of the alternatives, the point-of-reference condition, and prediversion conditions using a mixture of quantitative and qualitative measures. Three key variables are addressed in Table 3H-6 for each alternative:

- the maximum expected 24-hour PM_{10} concentration at major public use areas or at existing air quality monitoring locations,
- the maximum geographic area (anywhere in the basin) expected to be affected by PM_{10} concentrations above the state 24-hour standard of 50 $\mu g/m^3$, and
- the estimated annual frequency of 24-hour average PM_{10} concentrations above 50 $\mu g/m^3$ anywhere in the basin.

Several considerations must be noted when examining Table 3H-6:

- Table 3H-6 is based on the median lake elevation at dynamic equilibrium; the transition period to dynamic equilibrium is not considered in the table.
- The alternative names are more indicative of minimum lake elevations than average lake elevations at dynamic equilibrium.
- The maximum PM_{10} concentrations listed in Table 3H-6 are based on public use locations and monitoring station locations, not the absolute maximum concentration generated by a model run.
- The estimated annual frequencies of PM_{10} violations represent the judgment of the SWRCB's consultants (assuming 13-14 violations per year for the point of reference), not a direct model output.

As can be seen in Table 3H-6, the No-Restriction Alternative has more severe air quality noncompliance than the point of reference, the 6,372-Ft Alternative is comparable to the point of reference, and the other alternatives represent conditions that have less air quality degradation than the point of reference. The No-Restriction, 6,372-Ft, 6,377-Ft, and 6,383.5-Ft Alternatives all have significant adverse cumulative air quality impacts. The 6,390-Ft Alternative has the potential for minor air quality noncompliance. The 6,410-Ft and No-Diversion Alternatives do not pose any air quality problems.

Modeling output used to develop Table 3H-6 is summarized in Table 3H-7 and presented in greater detail in Mono Basin EIR Auxiliary Report 26, Air Quality Modeling Procedures and Results. The public use and monitoring station areas used in Table 3H-7 are shown in Figure 3H-24. As is shown in Figure 3H-24, clusters of modeled receptor points have been used to characterize most of the locations referenced in Table 3H-7. These clusters of receptor points have been used to represent zones of significant public use and to minimize an inherent limitation of the FDM model.

The FDM model, like all Gaussian dispersion models, assumes a geographically uniform pattern of wind speed and direction conditions. Wind speed and direction conditions measured at Simis Ranch were applied to the entire Mono Basin. In reality, however, wind speeds and directions will vary at different locations around Mono Lake. Consequently, the FDM model will tend to misrepresent the precise location of dust plumes, with the potential for displacement being greatest for plumes originating a significant distance from Simis Ranch.

Additional discussion of how modeling analyses were applied to each alternative are presented in the following sections of this chapter.

MODELING RESULTS FOR THE POINT-OF-REFERENCE CONDITION

The point-of-reference condition was modeled using data derived from 1990 aerial photographs taken when the lake elevation was 6,375.1 feet. At the mapping scale used for the modeling analyses (1:24000), there are no meaningful differences between the 6,375.1-foot and 6,376.3-foot contours.

Fifty different days of meteorological data were modeled. No single day produced the peak concentration for all 12 of the receptor areas listed in Table 3H-7. Data from June 4, 1988, produced the most extensive dust plume event, the highest PM_{10} concentration for any single receptor point, and the highest PM_{10} concentration for the Simis Ranch area. Other modeled days produced higher PM_{10} concentrations at other locations. Figure 3H-25 shows the modeling results produced using meteorological data from June 4, 1988. Mono Basin EIR Auxiliary Report No. 26 contains additional data generated by modeling the 6,375.1-foot lake elevation.

IMPACTS AND MITIGATION MEASURES FOR THE NO-RESTRICTION ALTERNATIVE

Changes in Resource Condition

The No-Restriction Alternative would allow lake levels to decline significantly from the point of reference, greatly increasing the amount of unvegetated, exposed substrate subject to wind erosion. Lake surface elevations would generally fluctuate between 6,345 feet and 6,365 feet under equilibrium conditions. Fluctuations at higher elevations would occur during the transition to equilibrium conditions.

No FDM modeling analyses were performed at lake elevations below 6,372 feet. It is clear from the modeling analyses for other lake elevations that the No-Restriction Alternative would generate more extensive and more frequent dust storm episodes than would the 6,372-Ft Alternative. The magnitude, frequency, and geographic extent of dust storm events would be greater under the No-Restriction Alternative than under point-of-reference conditions.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures
(No-Restriction Alternative)

- Significantly increases the magnitude, frequency, and geographic extent of dust storm episodes.

Mitigation Measures. No feasible mitigation measures have been identified for stabilizing efflorescent salt and lakebed sediments that constitute the major sources of windblown particulate matter in Mono Basin.

IMPACTS AND MITIGATION MEASURES FOR THE 6,372-FT ALTERNATIVE

Changes in Resource Condition

The 6,372-Ft Alternative would have a relatively narrow range of lake surface elevations under equilibrium conditions. The lake would fluctuate between 6,372 feet and 6,379 feet with a median elevation of about 6,375 feet.

Figure 3H-25 (presented in the discussion of point-of-reference conditions) is applicable to the median lake level for the 6,372-Ft Alternative. Figure 3H-26 shows the modeled dust storm conditions for a 6,372-foot lake level under June 4, 1988 wind conditions. Figure 3H-27 shows modeled dust storm conditions for a 6,377-foot lake level under June 4, 1988 wind conditions.

The magnitude, frequency, and geographic extent of dust storm events would be greater under the 6,372-Ft Alternative than under point-of-reference conditions. As presented previously in Table 3H-7, PM_{10} concentrations above the state 24-hour standard would be possible in many locations, including the South Tufa, Navy Beach, Simis Ranch, Ten Mile Road, Warm Springs, Simon's Spring, and Cedar Hill areas.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,372-Ft Alternative)

- Increases the magnitude, frequency, and geographic extent of dust storm episodes.
- Increases maximum PM_{10} concentrations by 20-25% in the South Tufa area and 25-30% in the Simis Ranch/Ten Mile Road area.

Mitigation Measures. No feasible mitigation measures have been identified.

IMPACTS AND MITIGATION MEASURES FOR THE 6,377-FT ALTERNATIVE

Changes in Resource Condition

The 6,377-Ft Alternative would have a relatively narrow range of lake surface elevations under equilibrium conditions. The lake would fluctuate between 6,376 feet and 6,383 feet with a median elevation of about 6,379 feet.

Figure 3H-25 (presented in the discussion of point-of-reference conditions) is applicable to the low lake level for the 6,377-Ft Alternative. Figure 3H-27 (presented in the discussion of the 6,372-Ft Alternative) shows the modeled dust storm conditions for a 6,377-foot lake level under June 4, 1988 wind conditions. Figure 3H-28 shows the modeled dust storm conditions for a 6,381.3-foot lake level under June 4, 1988 wind conditions.

The magnitude, frequency, and geographic extent of dust storm events under the 6,377-Ft Alternative would be similar to conditions under the point-of-reference. As presented previously in Table 3H-7, PM_{10} concentrations above the state 24-hour standard would be possible in many locations, including the South Tufa, Navy Beach, Simis Ranch, Ten Mile Road, Warm Springs, Simon's Spring, and Cedar Hill areas.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,377-Ft Alternative)

- Causes little change in the magnitude, frequency, and geographic extent of dust storm episodes.

IMPACTS AND MITIGATION MEASURES FOR THE 6,383.5-FT ALTERNATIVE

Changes in Resource Condition

The 6,383.5-Ft Alternative would have a relatively narrow range of lake surface elevations under equilibrium conditions. The lake would fluctuate between 6,383 feet and 6,389 feet with a median elevation of about 6,386 feet.

Figure 3H-29 shows the modeled dust storm conditions for a 6,383.5-foot lake level under June 4, 1988 wind conditions. Figure 3H-30 shows the modeled dust storm conditions for a 6,387-foot lake level under June 4, 1988 wind conditions.

The magnitude, frequency, and geographic extent of dust storm events under the 6,383.5-Ft Alternative would be less than conditions under the point-of-reference. As presented previously in Table 3H-7, PM_{10} concentrations above the state 24-hour standard would be possible in the South Tufa, Navy Beach, Simis Ranch, Ten Mile Road, and Warm Springs areas.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,383.5-Ft Alternative)

- Significantly decreases the magnitude and geographic extent of dust storm episodes.
- Decreases maximum PM_{10} concentrations by 30% in the South Tufa area, by 40-80% in the Simis Ranch/Ten Mile Road area, and by 20-40% in the Warm Springs area.
- Causes modest decreases in the frequency of dust storm events for Mono Basin as a whole.

IMPACTS AND MITIGATION MEASURES FOR THE 6,390-FT ALTERNATIVE

Changes in Resource Condition

The 6,390-Ft Alternative would have a relatively narrow range of lake surface elevations under equilibrium conditions. The lake would fluctuate between 6,389 feet and 6,395 feet with a median elevation of about 6,392 feet. The transition to equilibrium conditions, however, may take 30 years.

Figure 3H-31 shows the modeled dust storm conditions for a 6,390-foot lake level under June 4, 1988 wind conditions. The dust plume contours in Figure 3H-31 look identical to those in Figure 3H-30. This similarity in contours is due to the spacing of modeled receptor points and the procedures used by the computer program that produced the figures. As indicated as Table 3H-7, a lake level of 6,390 feet would in fact adversely affect a smaller area than would a lake level of 6,387 feet.

After reaching equilibrium conditions, the magnitude, frequency, and geographic extent of dust storm events under the 6,390-Ft Alternative would be significantly less than conditions under the point of reference. As presented previously in Table 3H-7, only a few PM_{10} episodes above the state 24-hour standard would be expected in major public use areas or at existing monitoring stations. Modeling results indicate the potential for limited areas of high PM_{10} concentrations along the east side of the lake and on Paoha Island.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,390-Ft Alternative)

- Gradually reduces the magnitude, frequency, and geographic extent of dust storm episodes during the 30-year transition to equilibrium lake level conditions.
- After transition to dynamic equilibrium, significantly decreases the magnitude, frequency, and geographic extent of dust storm episodes; few violations of state PM_{10} standards expected at major public use areas or at existing monitoring stations.

IMPACTS AND MITIGATION MEASURES FOR THE 6,410-FT ALTERNATIVE

Changes in Resource Condition

The 6,410-Ft Alternative would have a relatively narrow range of lake surface elevations under equilibrium conditions. The lake would fluctuate between 6,408 feet and 6,415 feet with a median elevation of about 6,411 feet. The transition to equilibrium conditions, however, may take 80 years.

Figure 3H-32 shows the modeled dust storm conditions for a 6,400-foot lake level under June 4, 1988 wind conditions. No FDM modeling of higher lake levels was performed.

After reaching equilibrium conditions, the magnitude, frequency, and geographic extent of dust storm events under the 6,410-Ft Alternative would be significantly less than conditions under the point of reference. As presented previously in Table 3H-7, no PM_{10} concentrations above the state 24-hour standard would be expected in major public use areas or at existing monitoring stations. Modeling results indicate the potential for very limited areas of high PM_{10} concentrations on Paoha Island.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,410-Ft Alternative)

- Gradually reduces the magnitude, frequency, and geographic extent of dust storm episodes during the 80-year transition to equilibrium lake level conditions.

- After transition to dynamic equilibrium, significantly decreases the magnitude, frequency, and geographic extent of dust storm episodes; no violations of state PM_{10} standards expected at major public use areas or at existing monitoring stations.

IMPACTS AND MITIGATION MEASURES FOR THE NO-DIVERSION ALTERNATIVE

Changes in Resource Condition

The No-Diversion Alternative would have a modest range of lake surface elevations under equilibrium conditions. The lake would fluctuate between 6,424 feet and 6,436 feet with a median elevation of about 6,427 feet. The transition to equilibrium conditions, however, may take more than 100 years.

No FDM modeling was performed for lake levels above 6,400 feet. No significant source areas for fugitive dust emissions would remain exposed at lake levels above 6,410 feet.

After reaching equilibrium conditions, all fugitive dust-related violations of state and federal PM_{10} standards would be eliminated.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (No-Diversion Alternative)

- Gradually reduces the magnitude, frequency, and geographic extent of dust storm episodes during the 100-year transition to equilibrium lake level conditions.
- After transition to dynamic equilibrium, eliminates all fugitive dust-related violations of state and federal PM_{10} standards.

CUMULATIVE IMPACTS OF THE ALTERNATIVES

Cumulative impacts reflect the overall impact of LADWP's Mono Basin water diversions. No other projects or activities are known to have contributed to the dust storm phenomena at Mono Lake. Cumulative air quality impacts have been assessed by comparing conditions under the alternatives with prediversion conditions as summarized in Table 3H-7.

Significant Cumulative Impacts

No-Restriction Alternative

The No-Restriction Alternative would allow the lake to decline to levels below 6,365 feet, greatly increasing the amount of unvegetated, exposed substrate subject to wind erosion. No FDM modeling analyses were performed for lake elevations below 6,372 feet. However, it is clear from the modeling analyses for other lake elevations that the No-Restriction Alternative would generate more extensive and more frequent dust storm episodes than would the other alternatives. Modeling results for the other alternatives indicate that the No-Restriction Alternative would produce significant violations of the state and federal 24-hour PM_{10} standards at several locations in Mono Basin, including the South Tufa, Simis Ranch, Ten Mile Road, Warm Springs, Simon's Spring, and the Cedar Hill areas.

6,372-Ft Alternative

As is indicated by the summary of FDM modeling results presented in Table 3H-7, the 6,372-Ft Alternative would generate extensive dust storm episodes. Modeling results for the 6,372-Ft Alternative indicate that violations of the state and federal 24-hour PM_{10} standards would be likely in several portions of Mono Basin, including the South Tufa, Simis Ranch, Ten Mile Road, Warm Springs, Simon's Spring, and the Cedar Hill areas. The 6,372-Ft Alternative would have significant and unavoidable cumulative air quality impacts.

6,377-Ft Alternative

As is indicated by the summary of FDM modeling results presented in Table 3H-7, the 6,377-Ft Alternative would generate extensive dust storm episodes. Modeling results for the 6,377-Ft Alternative indicate that violations of the state and federal 24-hour PM_{10} standards would be likely in several portions of Mono Basin, including the Simis Ranch, Ten Mile Road, Warm Springs, Simon's Spring, and the Cedar Hill areas. Modeling results also suggest the possibility of occasional violations of the state PM_{10} standard in the South Tufa area. The 6,377-Ft Alternative would have significant and unavoidable cumulative air quality impacts.

6,383.5-Ft Alternative

As is indicated by the summary of FDM modeling results presented in Table 3H-7, the 6,383.5-Ft Alternative would generate significant dust storm episodes. Dust storm episodes would be less frequent and less severe than conditions for lower lake levels, but would still occur several times a year. Modeling results for the 6,383.5-Ft Alternative indicate that violations of the state 24-hour PM_{10} standards would be likely in several portions of Mono Basin, including the South Tufa, Navy Beach, Simis Ranch, Ten Mile Road, Warm Springs, and Simon's Spring areas. Violations of the federal 24-hour PM_{10} standard would be most likely in the Warm Springs, Simis Ranch, and Ten Mile Road areas. The 6,383.5-Ft Alternative would have significant and unavoidable cumulative air quality impacts.

6,390-Ft Alternative

As is indicated by the summary of FDM modeling results presented in Table 3H-7, the 6,390-Ft Alternative would have a limited potential to generate dust storm episodes once the lake reached equilibrium conditions. The 30-year transition period to equilibrium lake levels would, however, have dust storm episodes of variable intensity. After reaching equilibrium conditions, few PM_{10} concentrations above the state 24-hour standard would be expected in major public use areas or at existing monitoring stations. Modeling results indicate the potential for limited areas of high PM_{10} concentrations along the east side of the lake and on Paoha Island.

The 6,390-Ft Alternative would have significant and unavoidable cumulative air quality impacts during the transition to equilibrium lake levels, but would bring Mono Basin very close to (and possibly into) attainment of the state and federal PM_{10} standards.

6,410-Ft Alternative

As is indicated by the summary of FDM modeling results presented in Table 3H-7, the 6,410-Ft Alternative would have little or no potential to generate dust storm episodes once the lake reached equilibrium conditions. At least the first half of the 80-year transition period to equilibrium lake levels would, however, have dust storm episodes of variable intensity. After reaching equilibrium conditions, no PM_{10} concentrations above the state or federal 24-hour standard would be expected in major public use areas or at existing monitoring stations. The mapped distribution of major fugitive dust source areas indicates that equilibrium lake levels would cover essentially all major dust sources.

The 6,410-Ft Alternative would have significant and unavoidable cumulative air quality impacts during part of the transition to equilibrium lake levels, but would eventually bring Mono Basin into attainment of the state and federal PM_{10} standards.

No-Diversion Alternative

The No-Diversion Alternative would have little or no potential to generate dust storm episodes once the lake reached equilibrium conditions. At least the first half of the 100-year transition period to equilibrium lake levels would, however, have dust storm episodes of variable intensity. After reaching equilibrium conditions, no fugitive dust-related PM_{10}

concentrations above the state or federal 24-hour standard would be expected in Mono Basin.

The No-Diversion Alternative would have significant and unavoidable cumulative air quality impacts during part of the transition to equilibrium lake levels, but would eventually bring Mono Basin into attainment of the state and federal PM_{10} standards.

Mitigation Measures for Significant Cumulative Impacts

No practical mitigation measures have been identified for stabilizing efflorescent salt and lakebed sediments that constitute the major sources of windblown particulate matter in Mono Basin.

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Table 3H-1. Ambient Air Quality Standards Applicable in California

			Standard, as parts per million		Standard, as micrograms per cubic meter		Violation Criteria	
Pollutant	Symbol	Averaging Time	California	National	California	National	California	National
Ozone	O_3	1 hour	0.09	0.12	180	235	If exceeded	If exceeded on more than 3 days in 3 years
Carbon monoxide	CO	8 hours	9.0	9	10,000	10,000	If exceeded	If exceeded on more than 1 day per year
		1 hour	20	35	23,000	40,000		
(Lake Tahoe only)		8 hours	6	--	7,000	--		
Nitrogen dioxide	NO_2	Annual average	--	0.053	--	100		If exceeded
		1 hour	0.25	--	470	--	If exceeded	
Sulfur dioxide	SO_2	Annual average	--	0.03	--	80		If exceeded
		24 hours	0.04	0.14	105	365	If exceeded	If exceeded on more than 1 day per year
		1 hour	0.25	--	655	--		
Hydrogen sulfide	H_2S	1 hour	0.03	--	42	--	If equaled or exceeded	
Vinyl chloride	C_2H_3Cl	24 hours	0.010	--	26	--	If equaled or exceeded	
Inhalable particulate matter	PM10	Annual geometric mean	--	--	30	--	If exceeded	
		Annual arithmetic mean	--	--	--	50		If exceeded
		24 hours	--	--	50	150		If exceeded on more than 1 day per year
Sulfate particles	SO_4	24 hours	--	--	25	--	If equaled or exceeded	
Lead particles	Pb	Calendar quarter	--	--	--	1.5		If exceeded on more than 1 day per year
		30 days	--	--	1.5	--	If equaled or exceeded	

Notes: All standards are based on measurements at 25° C and 1 atmosphere pressure.
National standards shown are the primary (health effects) standards.

Table 3H-2. Summary of Recent Particulate Matter Monitoring Data for the Mono Basin Area

		Total Suspended Particulate Matter (TSP)													Inhalable Particulate Matter (PM_{10})							
Monitoring Station	Parameter	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1984	1985	1986	1987	1988	1989	1990	1991
Lee Vining - 6 NNW	Peak 24-hour value ($\mu g/m^3$)	100	131	32																		
	Annual geometric mean ($\mu g/m^3$)	21.7	14.6	9.4																		
	Annual arithmetic mean ($\mu g/m^3$)	ND	ND	ND																		
	Number of 24-hour samples	50	38	19																		
	% of samples above federal standard	0.0%	0.0%	0.0%																		
	% of samples above state standard	2.0%	2.6%	0.0%																		
Lee Vining - Caltrans	Peak 24-hour value ($\mu g/m^3$)			64	60	61	97	324	100	124	70								41	37	41	78
	Annual geometric mean ($\mu g/m^3$)			29.5	21.2	44.9	26.1	40.4	30.5	29.3	39.4								13.7	12.0	11.7	12.5
	Annual arithmetic mean ($\mu g/m^3$)			ND	ND	ND	ND	ND	ND	ND	ND								15.3	13.6	13.6	15.1
	Number of 24-hour samples			54	53	2	38	58	57	58	5								48	60	62	58
	% of samples above federal standard			0.0%	0.0%	0.0%	0.0%	3.4%	0.0%	0.0%	0.0%								0.0%	0.0%	0.0%	0.0%
	% of samples above state standard			0.0%	0.0%	0.0%	0.0%	12.1%	1.8%	3.4%	0.0%								0.0%	0.0%	0.0%	3.4%
Mono Lake - Binderup	Peak 24-hour value ($\mu g/m^3$)	481	1,825	113																		
	Annual geometric mean ($\mu g/m^3$)	102.1	44.2	1.0																		
	Annual arithmetic mean ($\mu g/m^3$)	ND	ND	ND																		
	Number of 24-hour samples	11	24	1																		
	% of samples above federal standard	18.2%	12.5%	0.0%																		
	% of samples above state standard	36.4%	20.8%	100.0%																		
Mono Lake - Simis	Peak 24-hour value ($\mu g/m^3$)			10	673	20	41		17				314	230			13	58	71	272	120	100
	Annual geometric mean ($\mu g/m^3$)			6.5	15.6	13.4	26.2		14.9				20.6	17.8			10.0	10.7	10.9	10.3	7.7	9.6
	Annual arithmetic mean ($\mu g/m^3$)			ND	ND	ND	ND		ND				ND	ND			10.1	14.6	14.5	15.4	12.7	13.4
	Number of 24-hour samples			5	34	3	7		2				107	86			8	47	44	73	117	87
	% of samples above federal standard			0.0%	2.9%	0.0%	0.0%		0.0%				0.9%	0.0%			0.0%	0.0%	0.0%	1.4%	0.0%	0.0%
	% of samples above state standard			0.0%	2.9%	0.0%	0.0%		0.0%				3.7%	4.7%			0.0%	2.1%	2.3%	2.7%	4.3%	5.7%
Bodie	Peak 24-hour value ($\mu g/m^3$)																			96	35	11
	Annual geometric mean ($\mu g/m^3$)																			6.0	4.4	4.4
	Annual arithmetic mean ($\mu g/m^3$)																			15.0	6.7	5.2
	Number of 24-hour samples																			11	25	13
	% of samples above federal standard																			0.0%	0.0%	0.0%
	% of samples above state standard																			9.1%	0.0%	0.0%
Mammoth - June Lakes	Peak 24-hour value ($\mu g/m^3$)	400																				
	Annual geometric mean ($\mu g/m^3$)	54.1																				
	Annual arithmetic mean ($\mu g/m^3$)	ND																				
	Number of 24-hour samples	22																				
	% of samples above federal standard	13.6%																				
	% of samples above state standard	36.4%																				

Notes: ND = no data available.
$\mu g/m^3$ = micrograms per cubic meter.
Previous federal TSP standards: 75 $\mu g/m^3$, annual geometric mean; 260 $\mu g/m^3$, 24-hour average; TSP standards changed to PM_{10} standards in 1987.
Previous state TSP standards: 60 $\mu g/m^3$, annual geometric mean; 100 $\mu g/m^3$, 24-hour average; TSP standards changed to PM_{10} standards in 1983.
Current federal PM_{10} standards: 50 $\mu g/m^3$, annual arithmetic mean; 150 $\mu g/m^3$, 24-hour average.
Current state PM_{10} standards: 30 $\mu g/m^3$, annual geometric mean; 50 $\mu g/m^3$, 24-hour average.

Sources: California Air Quality Data 1989-1991.

Table 3H-3. Summary of PM_{10} Monitoring Data Collected at Warm Springs

Start Date	Start Time	Sampling Duration (minutes)	End Date	End Time	PM_{10} Concentration (micrograms/ cubic meter) Unadjusted	Adjusted[a]
4-7-88	2:08 p.m.	847	4-8-88	4:15 a.m.	88	36
5-4-88	5:00 p.m.	1,440	5-5-88	5:00 p.m.	64	45
5-16-88	2:30 p.m.	1,441	5-17-88	2:31 p.m.	405	245
3-17-90	12:00 a.m.	1,423	3-17-90	11:43 p.m.	1	1
5-19-90	10:45 a.m.	797	5-20-90	12:02 a.m.	10	6
5-20-90	11:10 a.m.	763	5-20-90	11:53 p.m.	1	1
5-21-90	1:45 p.m.	620	5-22-90	12:05 a.m.	81	35
5-22-90	1:56 p.m.	607	5-23-90	12:03 a.m.	11	5
5-23-90	11:45 a.m.	741	5-24-90	12:06 a.m.	306	156
10-31-90	10:00 a.m.	843	11-01-90	12:03 a.m.	9	5
11-13-90	2:00 p.m.	599	11-13-90	11:59 p.m.	19	8
11-17-90	12:00 a.m.	1,440	11-18-90	12:00 a.m.	4	4
12-10-90	3:10 p.m.	525	12-10-90	11:55 p.m.	283	103
4-19-91	2:45 p.m.	552	4-19-91	11:57 p.m.	10[b]	4
4-30-91	12:45 p.m.	671	4-30-91	11:56 p.m.	202[b]	94
5-8-91	12:00 a.m.	1,439	5-8-91	11:59 p.m.	389	389
5-12-91	12:00 a.m.	1,449	5-13-91	12:09 a.m.	8	8
5-13-91	1:50 p.m.	607	5-13-91	11:57 p.m.	0[b]	0
5-16-91	2:00 p.m.	536	5-16-91	10:52 p.m.	586[b]	218
5-29-91	1:00 p.m.	565	5-29-91	10:25 p.m.	8[b]	3
6-5-91	12:00 a.m.	1,428	6-5-91	11:48 p.m.	13	13
9-21-91	12:00 p.m.	720	9-22-91	12:00 a.m.	16[b]	8
9-26-91	1:30 p.m.	631	9-27-91	12:01 a.m.	5[b]	2
9-27-91	1:00 p.m.	648	9-27-91	11:48 p.m.	11[b]	5
10-16-91	12:00 a.m.	1,432	10-16-91	11:52 p.m.	10	10
10-22-91	12:00 a.m.	1,419	10-22-91	11:39 p.m.	23	23
10-25-91	12:00 a.m.	1,432	10-25-91	11:52 p.m.	4	4
11-8-91	1:10 p.m.	665	11-9-91	12:15 a.m.	7[b]	3
11-27-91	12:00 a.m.	1,446	11-28-91	12:06 a.m.	14	14

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[a] Adjusted values calculated for a midnight-to-midnight period by using the unadjusted PM_{10} value for the period actually monitored and 0 micrograms per cubic meter for the period not directly sampled.

[b] Unadjusted values back-calculated for dates when only the adjusted values was reported.

Notes: $\mu g/m^3$ = micrograms per cubic meter.
GBUAPCD = Great Basin Unified Air Pollution Control District.
Current federal PM_{10} standards: 50 $\mu g/m^3$, annual arithmetic mean; 150 $\mu g/m^3$, 24-hour average.
Current state PM_{10} standards: 30 $\mu g/m^3$, annual geometric mean; 50 $\mu g/m^3$, 24-hour average.

Source: Great Basin Unified Air Pollution Control District files.

Table 3H-4. Monthly Distribution of PM_{10} Exceedances

Month	Number of PM_{10} Samples, 1986-1992	Number of Samples >50 $\mu g/m^3$	Maximum Measured PM_{10}	Percentage of Samples >50 $\mu g/m^3$	Extrapolated Monthly Exceedances
Lee Vining Monitoring Station					
January	20	2	78	10	3.1
February	17	0	37	0	0.0
March	26	0	20	0	0.0
April	24	0	22	0	0.0
May	26	0	19	0	0.0
June	25	0	19	0	0.0
July	18	0	18	0	0.0
August	21	0	41	0	0.0
September	20	0	36	0	0.0
October	21	0	20	0	0.0
November	20	0	41	0	0.0
December	19	0	36	0	0.0
Annual	257	2	78	0.8	3.1
Simis Ranch Monitoring Station					
January	30	1	69	3	1.0
February	27	0	38	0	0.0
March	29	1	54	3	1.1
April	41	4	493	10	2.9
May	59	3	100	5	1.6
June	40	0	38	0	0.0
July	25	0	25	0	0.0
August	27	0	50	0	0.0
September	40	1	58	3	0.8
October	40	2	68	5	1.6
November	26	4	120	15	4.6
December	27	0	43	0	0.0
Annual	411	16	493	3.9	13.5

Sources: California Air Quality Data, Volumes XVIII-XXIV.
Great Basin Unified Air Pollution Control District files.

Table 3H-5. Summary of Temperature and Moisture Effects on Wind Erosion Potential of Efflorescent Salt Deposits

Substrate Temperature Range	Surface Moisture Conditions	Salt Deposit Condition
Below 50°F	Wet/moist	Nonerosive wet surface; strongly hydrated salt crystals
	Dry	Highly erosive anhydrous powder
50-65°F	Wet/moist	Nonerosive, moist weak crust
	Dry	Nonerosive, hard crust (primarily carbonate salts) or Erosive, weak, fragmenting crust (mixed carbonate and sulfate salts) or Highly erosive anhydrous powder (predominantly sulfate salts)
Above 65°F	Wet/moist	Nonerosive moist crust
	Dry	Nonerosive cemented crust

Notes: Salt deposit condition presumes that sodium sulfate and sodium carbonate/bicarbonate salts are dominant. A high sodium chloride content will produce a nonerosive cemented crust under all temperature conditions.

Table 3H-6. Summary Comparison of Effects of the Alternatives: Air Quality

Alternative or Condition	Maximum 24-Hour Average PM_{10} Concentration for Major Public Access Areas or Monitoring Station Locations	Potential Geographic Extent of PM_{10} Concentrations above State Standards	Relative Frequency of PM_{10} Concentrations above State Standards
Point of reference	970 $\mu g/m^3$	About 56,000 acres	13-14 events/year
No restriction	Over 1,100 $\mu g/m^3$*√	Over 65,000 acres*√	More than 15 events/year*√
6,372-Ft	About 970 $\mu g/m^3$√	About 56,000 acres	About 13-14 events/year√
6,377-Ft	About 850 $\mu g/m^3$√	About 29,500 acres	Fewer than 13 events/year√
6,383.5-Ft	About 650 $\mu g/m^3$√	About 16,000 acres	Fewer than 10 events/year√
6,390-Ft	About 75 $\mu g/m^3$?	About 3,000 acres	About 1-2 events/year?
6,410-Ft	Below 50 $\mu g/m^3$	None expected	Fewer than 1 event/year
No diversion	Below 50 $\mu g/m^3$	None expected	Fewer than 1 event/year
Prediversion	Below 50 $\mu g/m^3$	None expected	Fewer than 1 event/year

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* Significant adverse project impact.

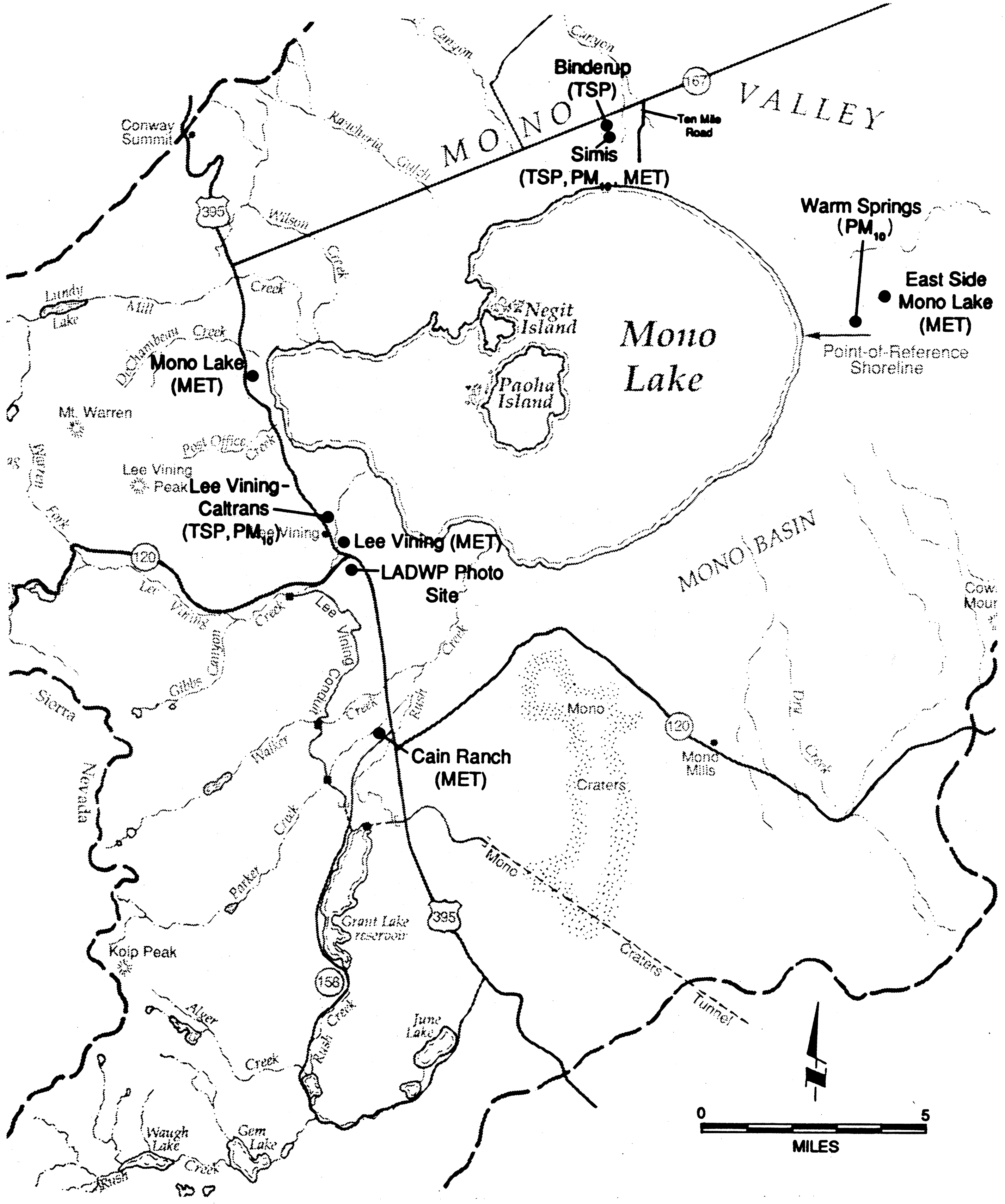
√ Significant adverse cumulative impact.

? Potential significant adverse cumulative impact; modeling indicates state PM_{10} standard would be slightly exceeded.

Table 3H-7. Summary of FDM Modeling Results

Parameter	Lake Level							
	6,372-Ft	6,375.1-Ft	6,377-Ft	6,381.3-Ft	6,383.5-Ft	6,387-Ft	6,390-Ft	6,400-Ft
Source area acreage								
High-emission-rate areas	7,297	5,604	5,208	2,652	2,443	1,223	635	205
Lake	34,891	34,891	34,891	34,891	34,891	34,891	34,891	34,891
Low-emission-rate areas	5,536	5,536	5,536	5,536	5,536	5,536	5,536	4,391
Modeled days out of 50 with any receptor concentrations above								
50 µg/m³	49	49	49	49	49	49	49	34
150 µg/m³	40	39	38	36	36	34	30	9
Receptor count								
$PM_{10} > 50$ µg/m³	233	224	214	161	153	78	44	20
$PM_{10} > 100$ µg/m³	180	156	148	70	62	29	15	4
$PM_{10} > 150$ µg/m³	139	107	100	39	38	17	8	2
$PM_{10} > 200$ µg/m³	105	81	73	30	28	13	7	1
$PM_{10} > 500$ µg/m³	42	31	30	10	8	3	2	0
Maximum episode PM_{10} (µg/m³)								
Highest receptor point	1,761.7	1,526.9	1,519.7	1,428.2	1,428.2	1,158.0	1,158.0	281.0
Navy Beach area	88.1	87.8	87.8	87.8	87.8	87.8	87.8	58.8
South Tufa area	119.6	100.1	91.7	69.0	69.0	69.0	69.0	46.8
Lee Vining area	17.0	14.6	13.8	8.9	8.9	6.7	6.7	6.4
Lee Vining Tufa area	24.3	20.9	19.7	13.8	13.8	10.1	9.3	7.5
Old Marina area	21.8	21.8	21.8	21.8	21.8	21.8	21.8	19.9
County Park area	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.7
Black Point parking lot area	47.3	42.3	39.9	18.9	19.1	16.4	16.4	16.3
Simis Ranch area	312.3	264.5	262.8	174.8	170.4	67.7	49.3	35.0
Ten Mile Road area	794.8	626.9	609.7	382.5	381.3	105.2	104.3	72.5
Cedar Hill area	90.9	66.9	62.6	32.7	28.1	19.2	7.6	5.2
Warm Springs area	1,094.4	1,044.5	973.4	831.1	784.8	626.1	126.2	42.2
Simon's Spring area	576.4	576.4	567.9	30.5	30.5	30.5	30.5	22.2

Notes: State 24-hour PM_{10} standard is 50 µg/m³.
Federal 24-hour PM_{10} standard is 150 µg/m³.
See Figure 3H-24 for receptor area locations.



Notes: Parameters monitored at each site are shown in parentheses; see text for definitions. MET refers to temperature, precipitation, or wind speed data.

Figure 3H-1.
Meteorological and Air Quality Monitoring Locations

MONO BASIN EIR

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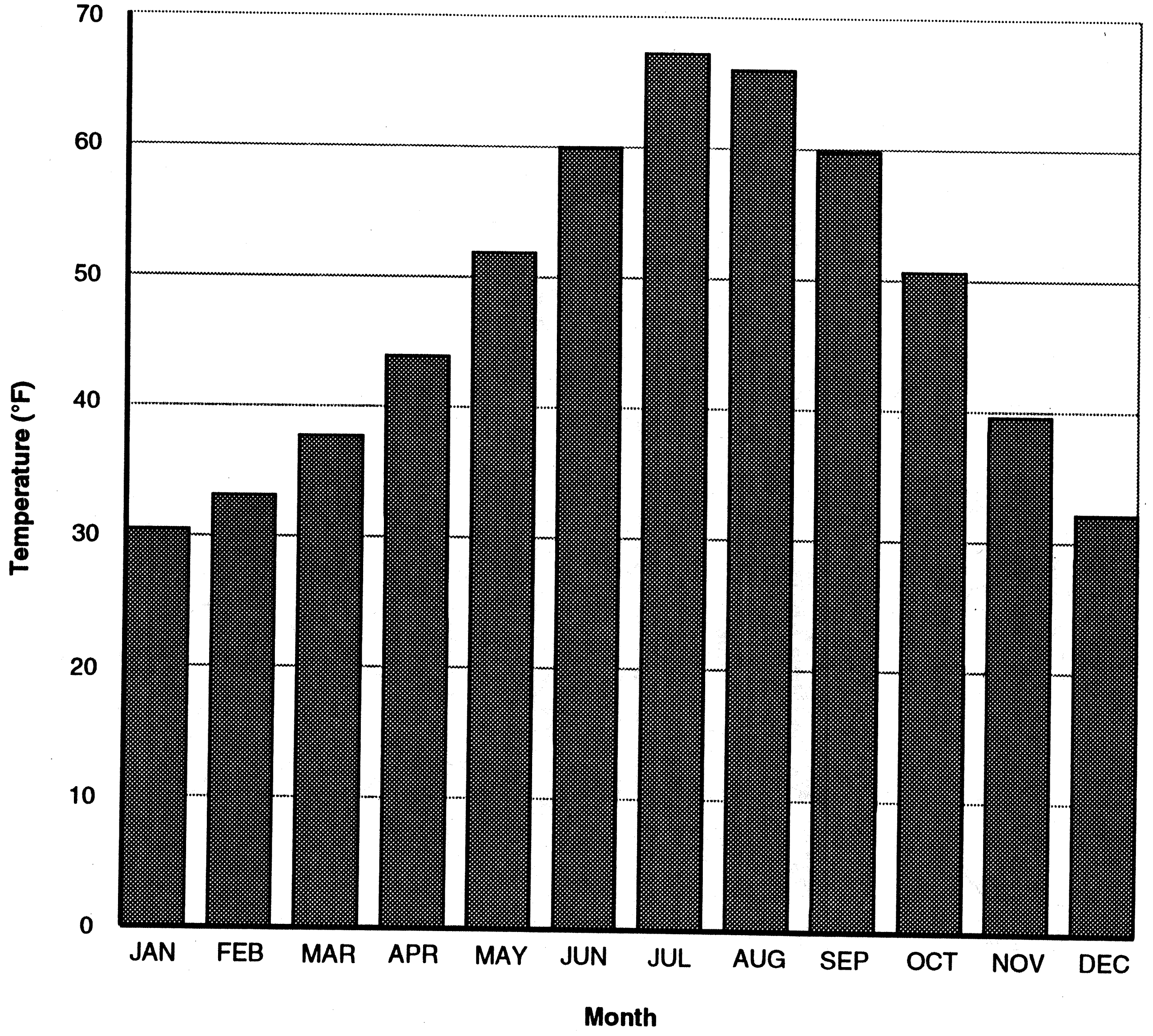


Data Source: Climatological Data: California 91(13)

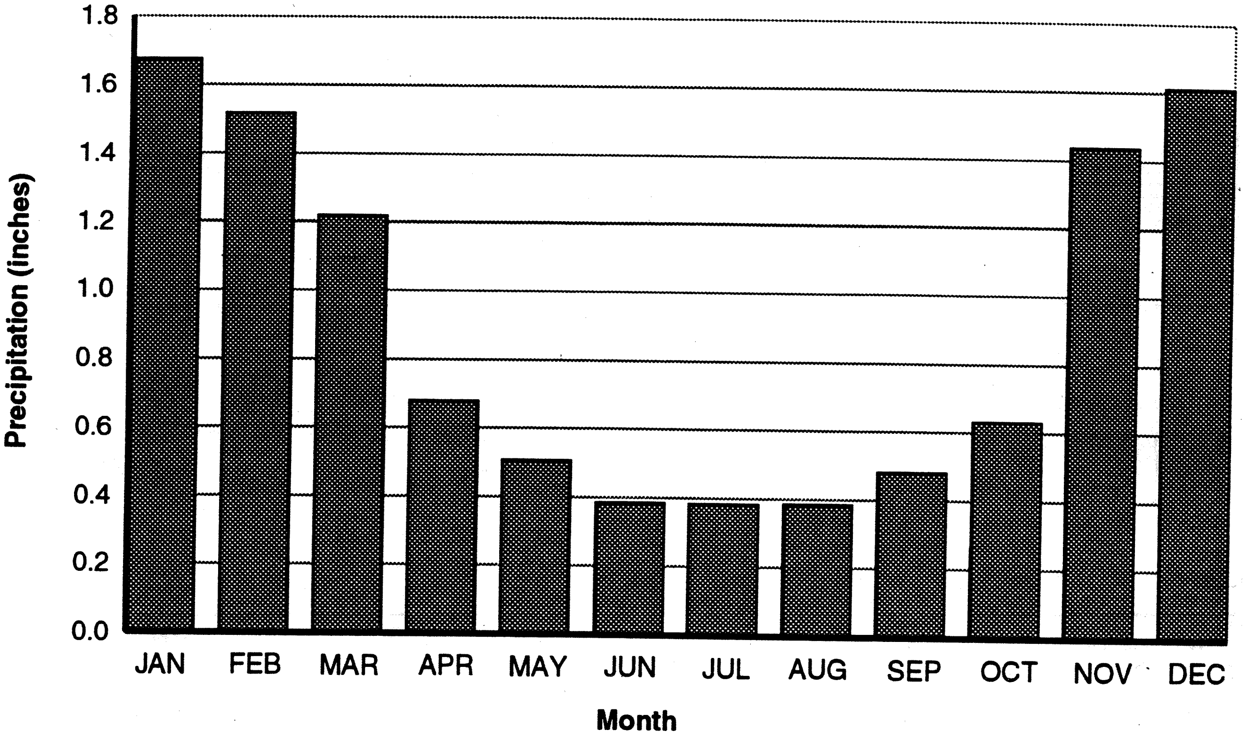
Mono-28

Figure 3H-2.
Average Monthly Temperatures at Mono Lake, 1951-1980

MONO BASIN EIR

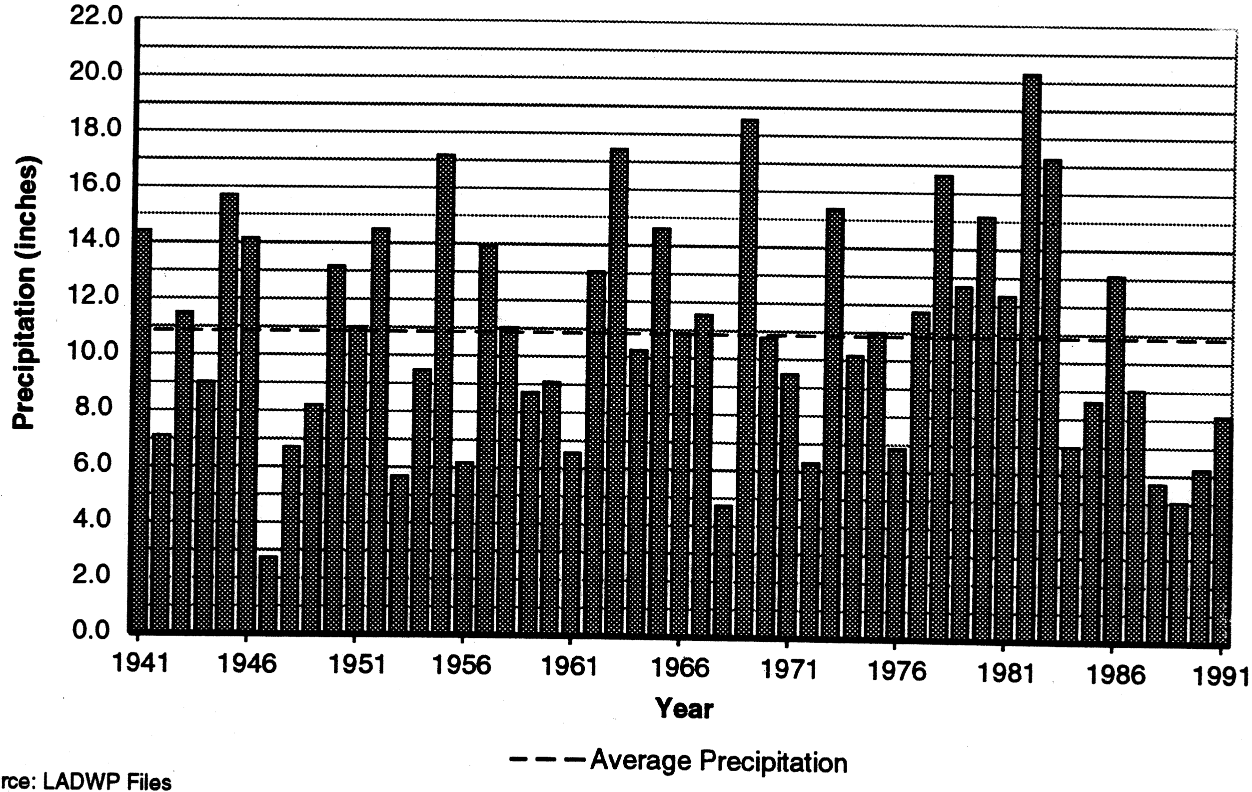
Prepared by Jones & Stokes Associates

Figure 3H-3.
Average Monthly Precipitation at Cain Ranch, 1941-1991

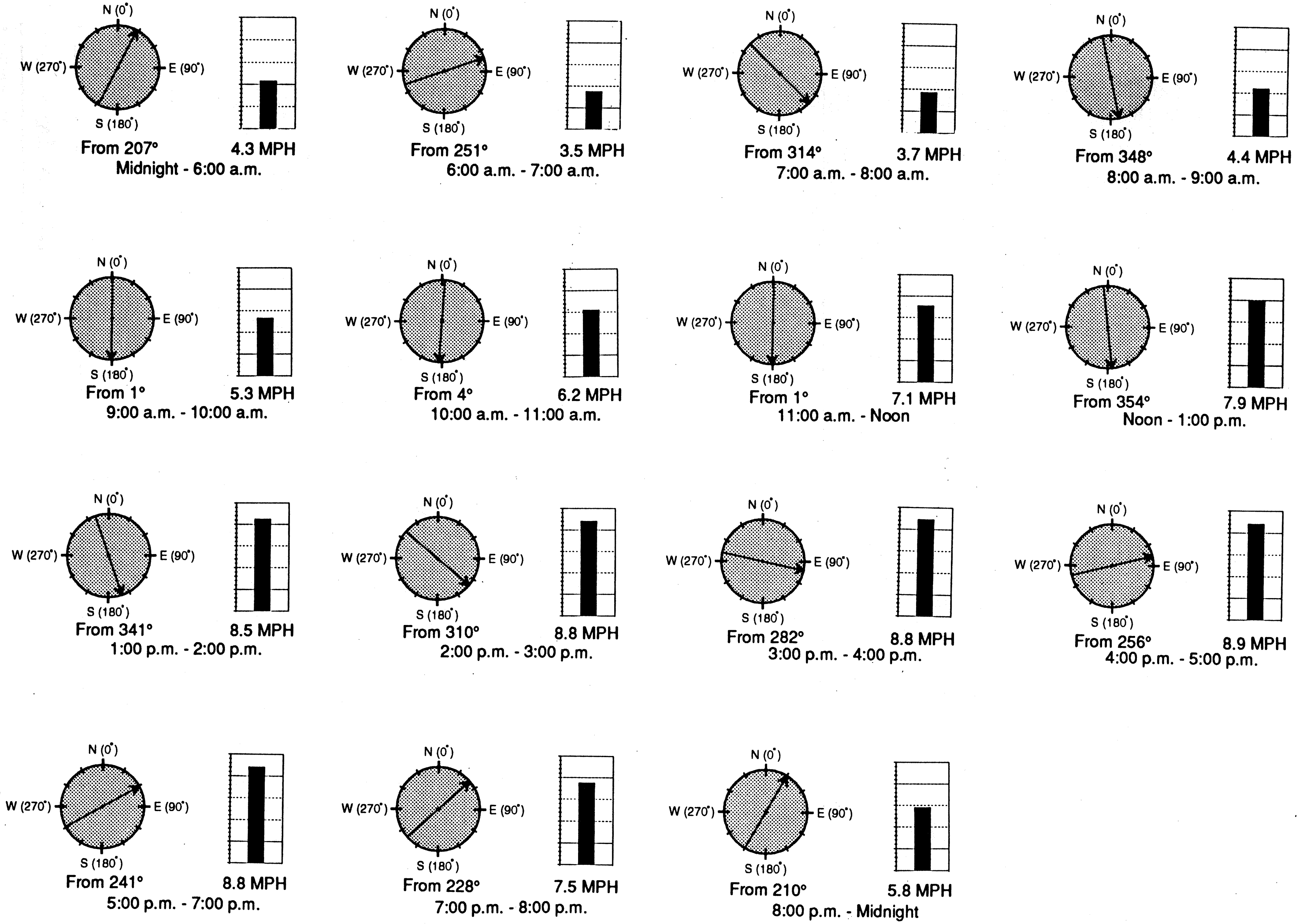


Data Source: LADWP Files

Figure 3H-4.
Annual Precipitation at Cain Ranch, 1941-1991



Data Source: LADWP Files

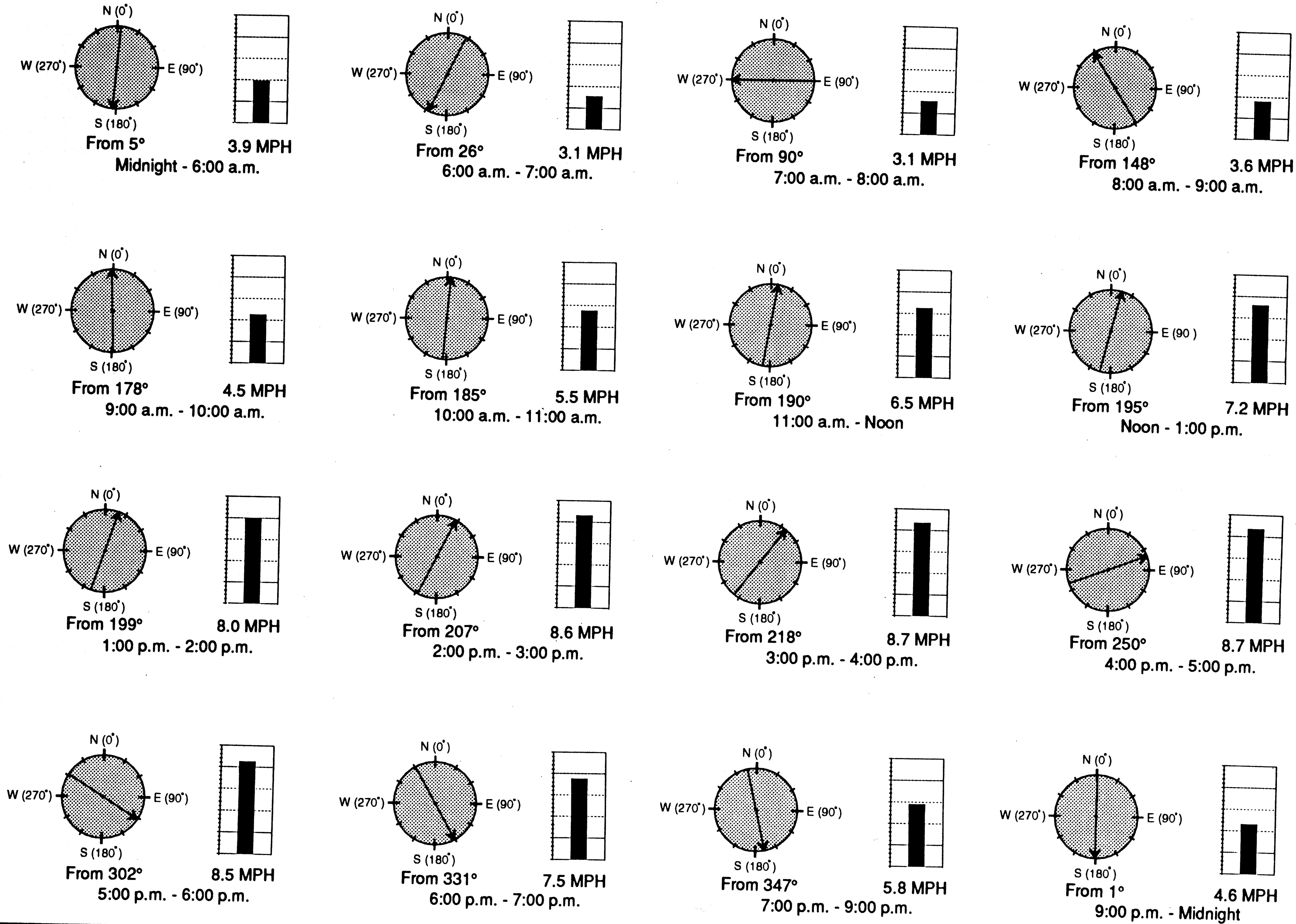


Data Source: GBUAPCD Files

Figure 3H-5.
Average Time-of-Day Wind Patterns for the Lee Vining Monitoring Site, 1986-1991

MONO BASIN EIR

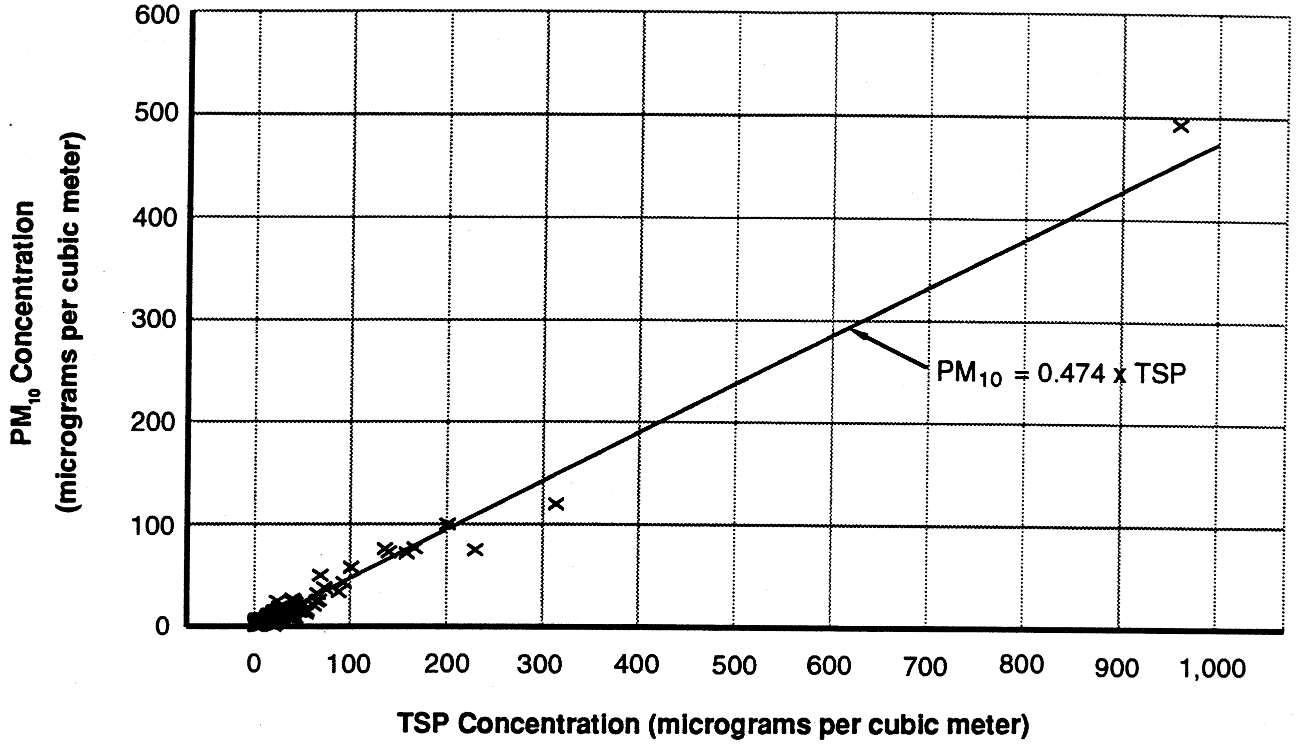
Prepared by Jones & Stokes Associates



Data Source: GBUAPCD Files

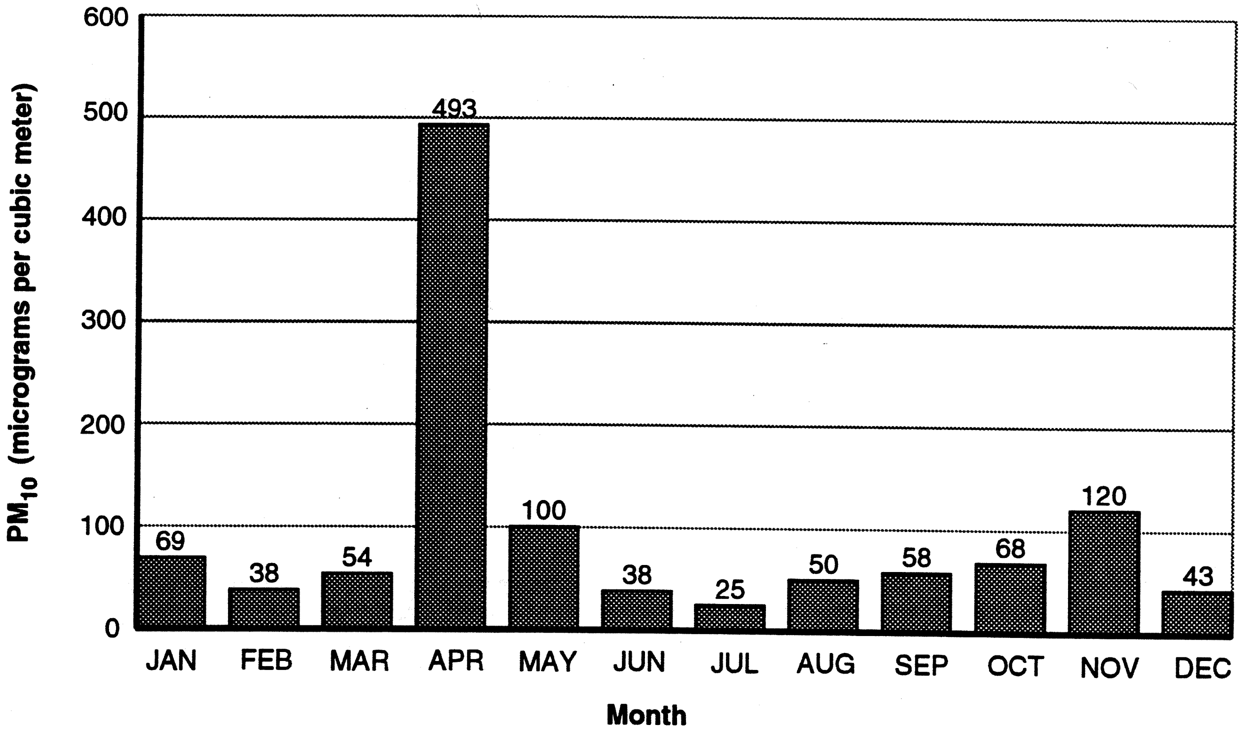
Figure 3H-6.
Average Time-of-Day Wind Patterns for the Simis Ranch Monitoring Site, 1986-1991

Figure 3H-7.
Simis Ranch PM_{10}/TSP Relationship, May 1990-June 1992



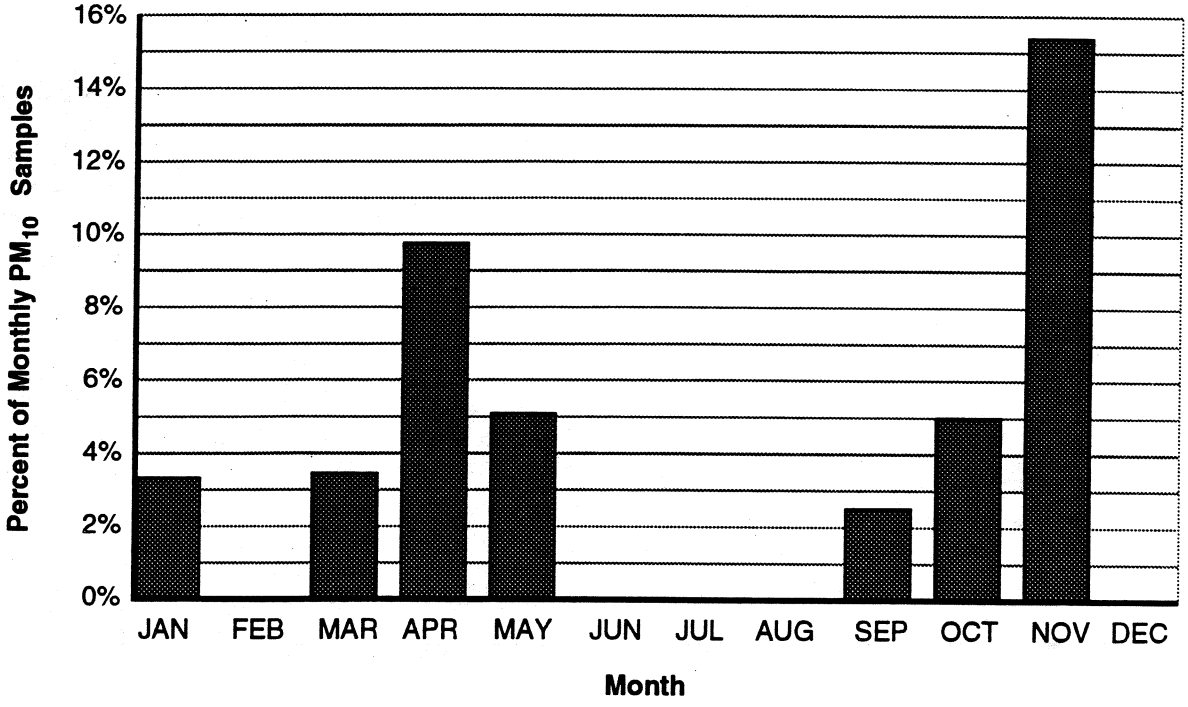
Data Source: California Air Quality Data, Volumes XVIII-XXIV

Figure 3H-8.
Maximum Measured PM_{10} by Month for Simis Ranch, October 1986-June 1992



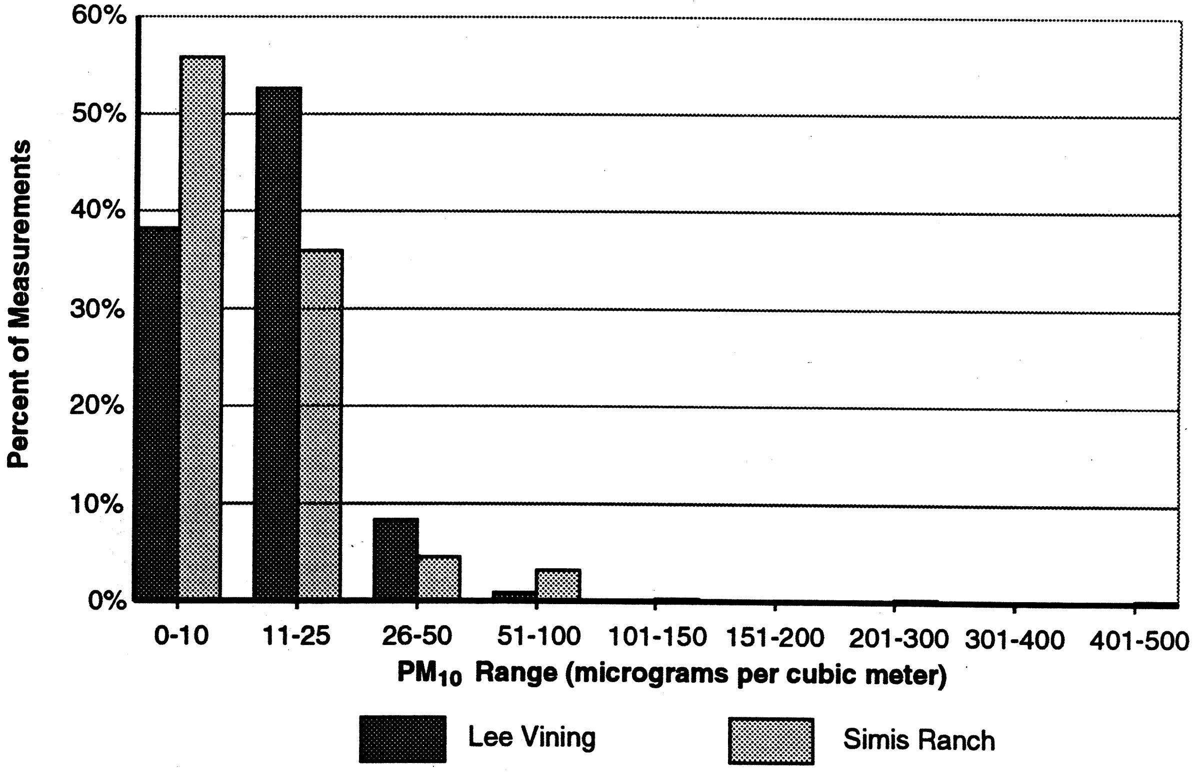
Data Source: California Air Quality Data, Volumes XVIII-XXIV and GBUAPCD Files

Figure 3H-9.
Monthly Pattern of Measured PM_{10} Exeedances for Simis Ranch, October 1986-June 1992



Data Source: California Air Quality Data, Volumes XVIII-XXIV and GBUAPCD Files

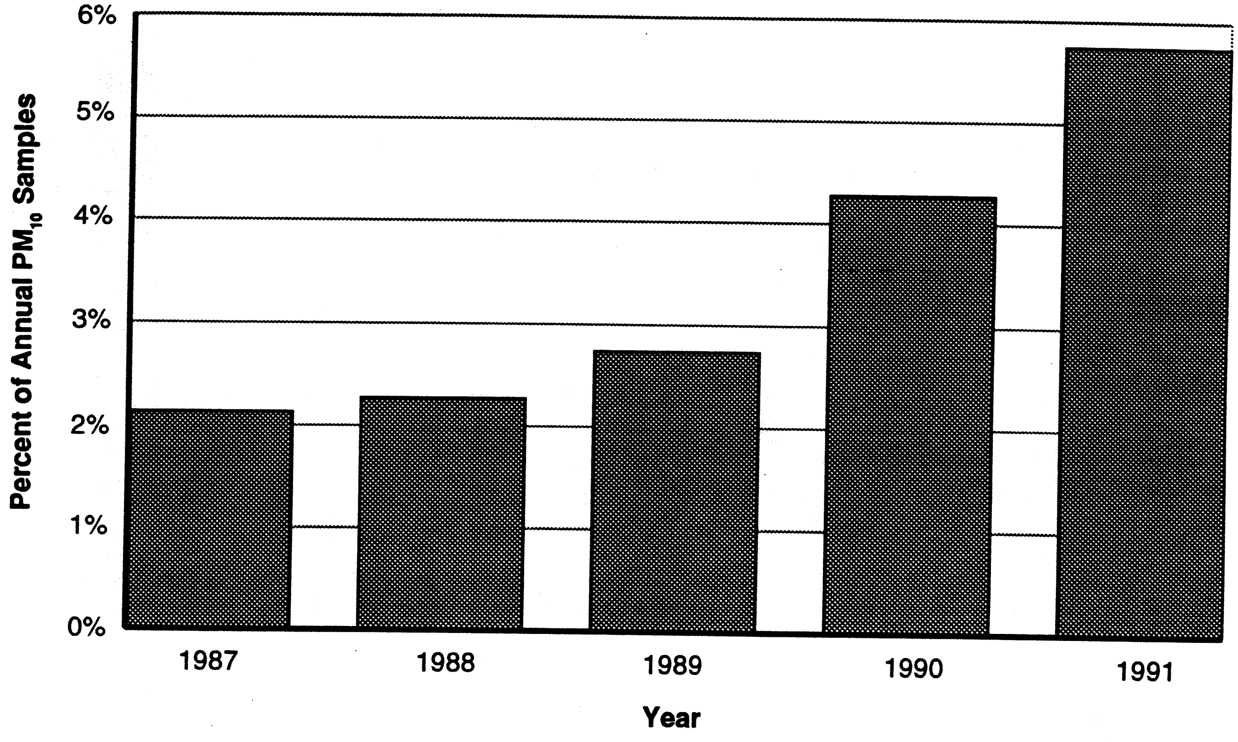
Figure 3H-10.
Frequency of Measured PM_{10} Values, October 1986-June 1992



Data Source: California Air Quality Data, Volumes XVIII-XXIV and GBUAPCD Files

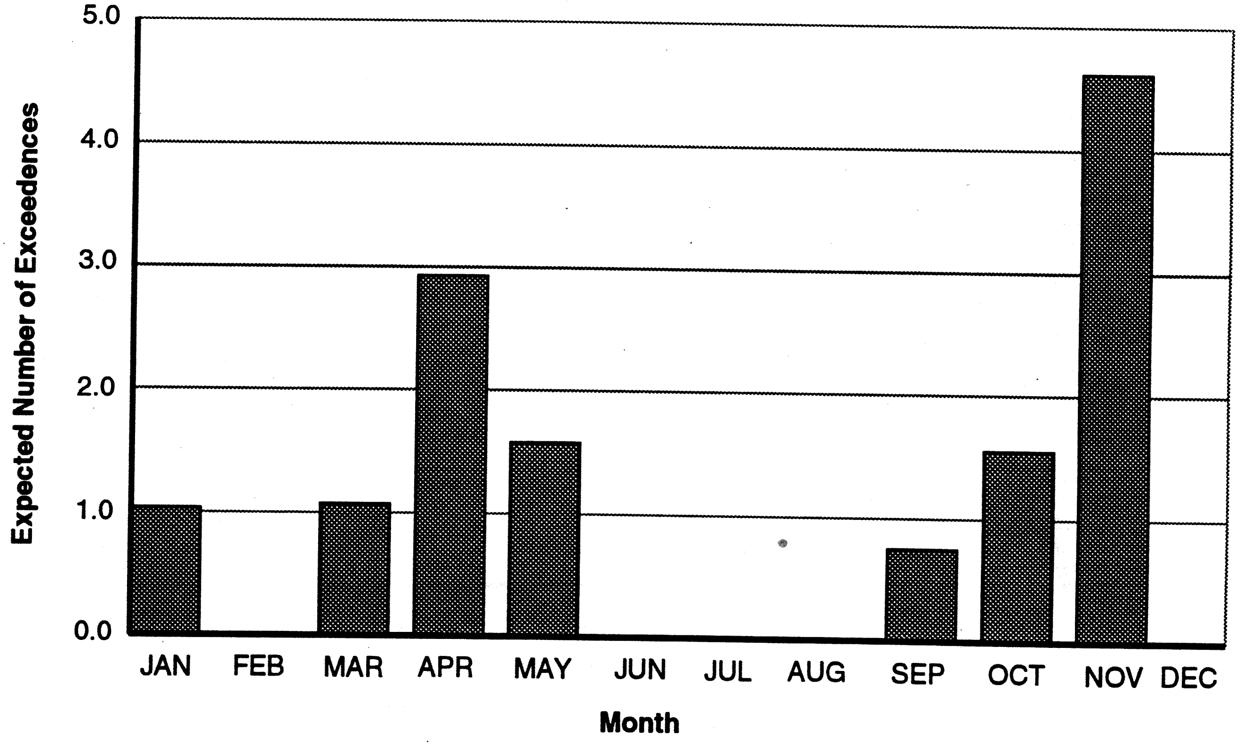
Mono-32

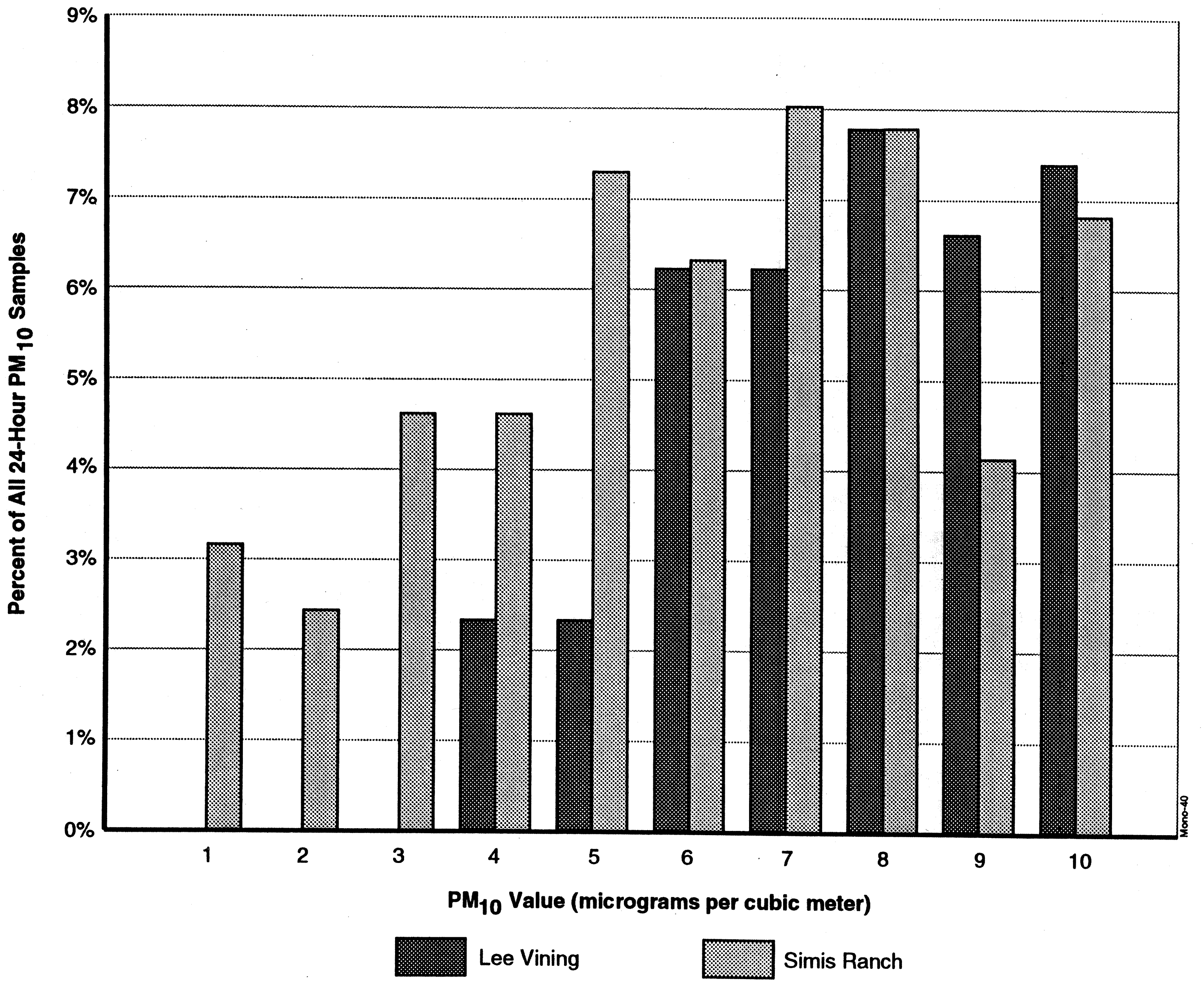
Figure 3H-11.
Annual Trends in Measured PM_{10} Exceedances at Simis Ranch Monitoring Site



Data Source: California Air Quality Data, Volumes XXIX-XXIII and GBUAPCD Files

Figure 3H-12.
Estimated Pattern of PM_{10} Exceedances at Simis Ranch Monitoring Site

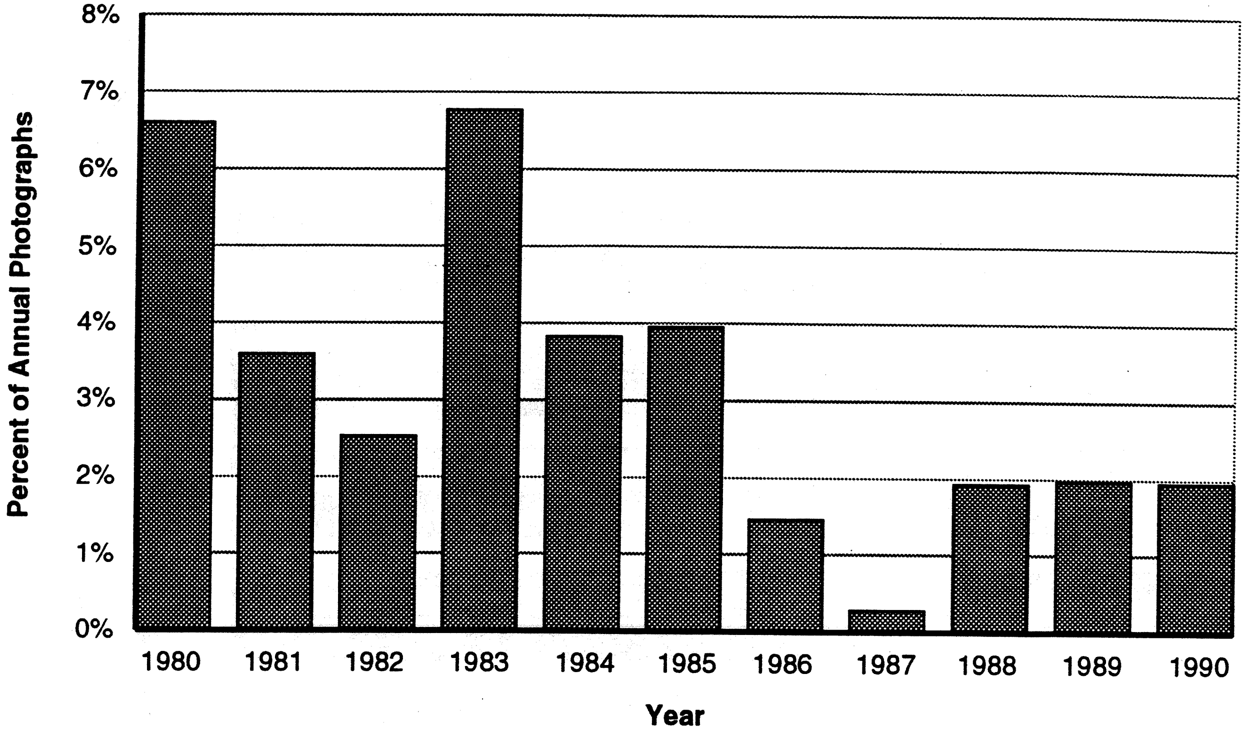




Data Source: California Air Quality Data, Volumes XXIX-XXIII and GPUAPCD Files

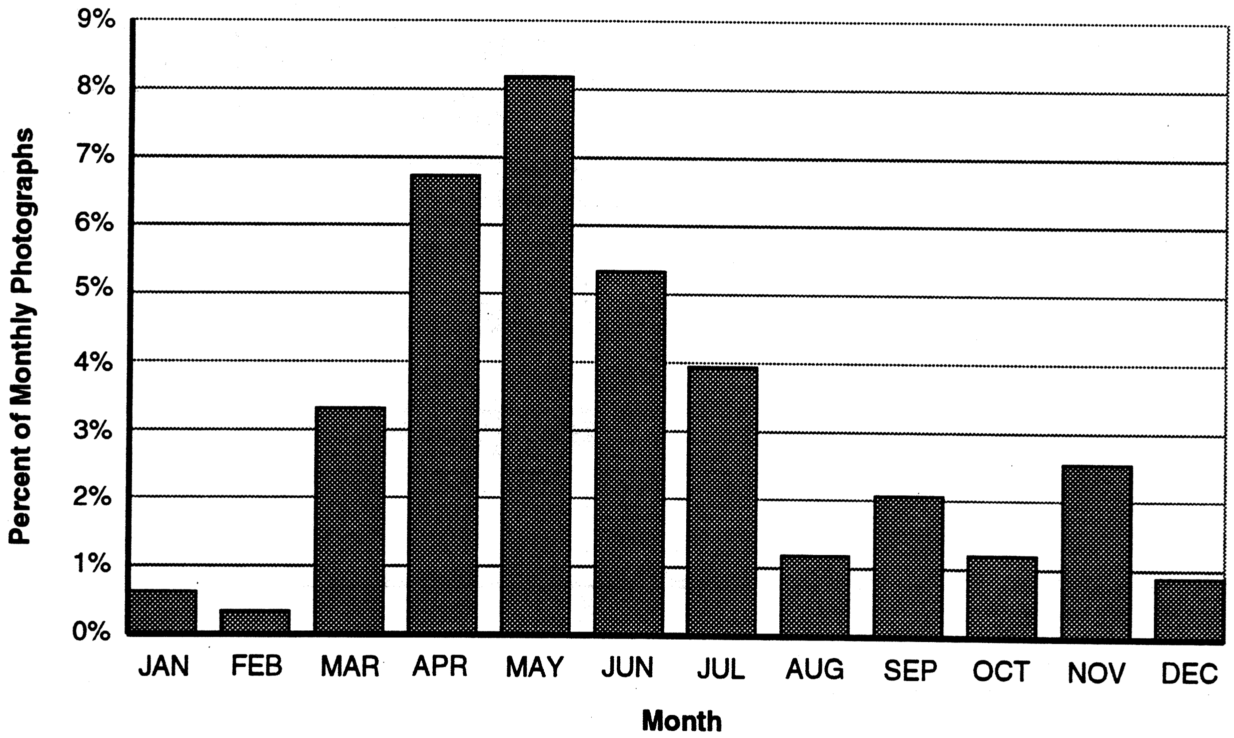
Figure 3H-13.
Frequency of Low PM_{10} Values at Lee Vining and Simis Ranch

Figure 3H-14.
Annual Frequency of Dust Events in LADWP Photographs, March 1980-December 1990



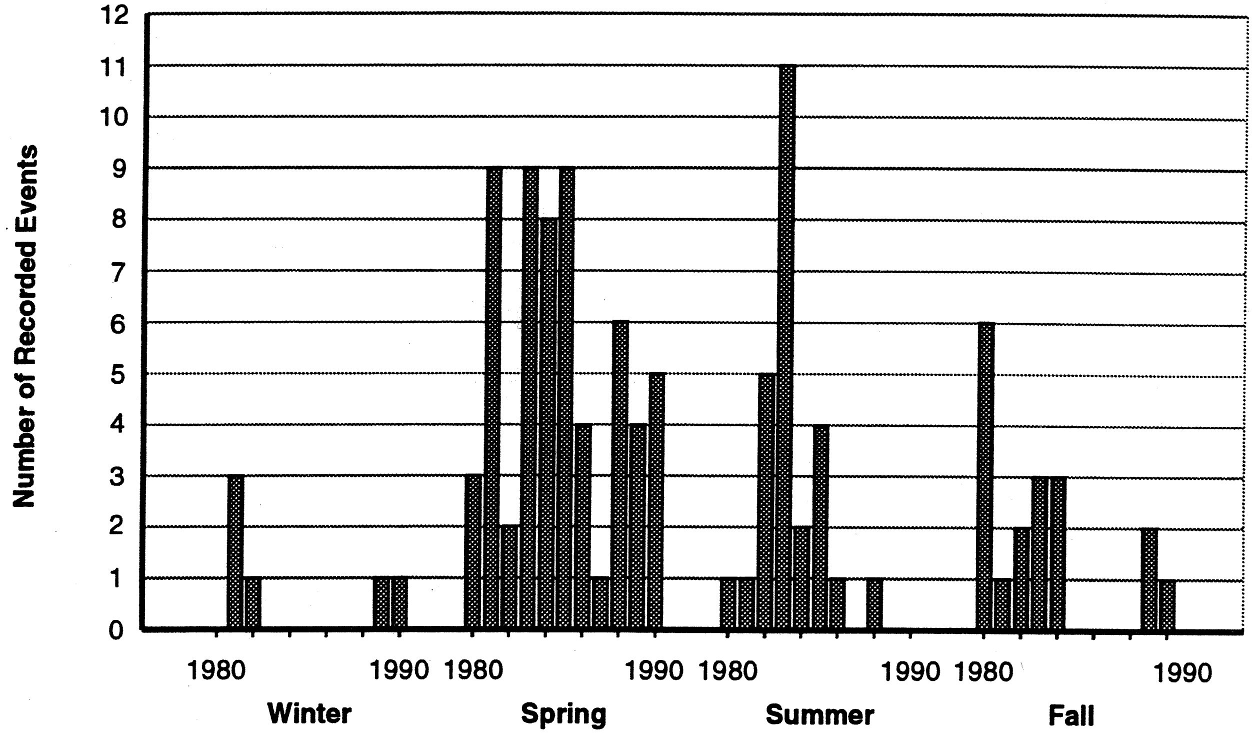
Data Source: LADWP Files

Figure 3H-15.
Monthly Frequency of Dust Events in LADWP Photographs, March 1980-February 1991



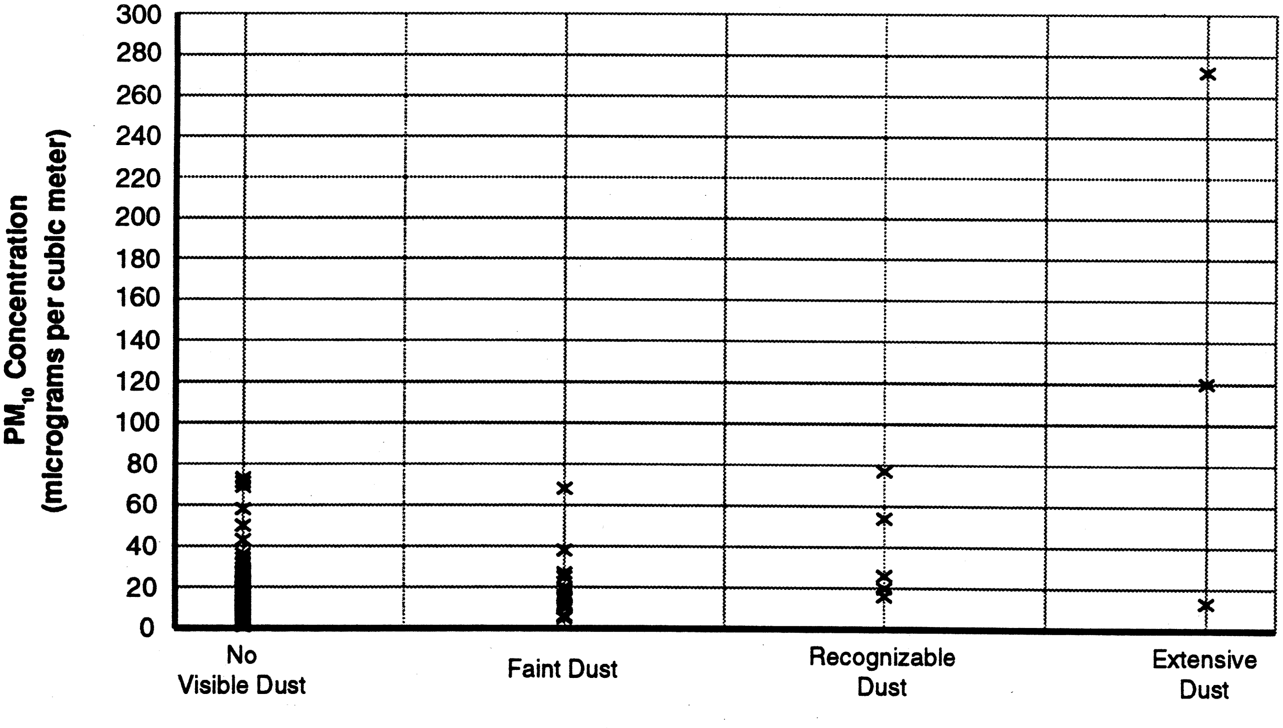
Data Source: LADWP Files

Figure 3H-16.
Seasonal Occurrence of Dust Events Recorded in LADWP Photographs, March 1980-December 1990

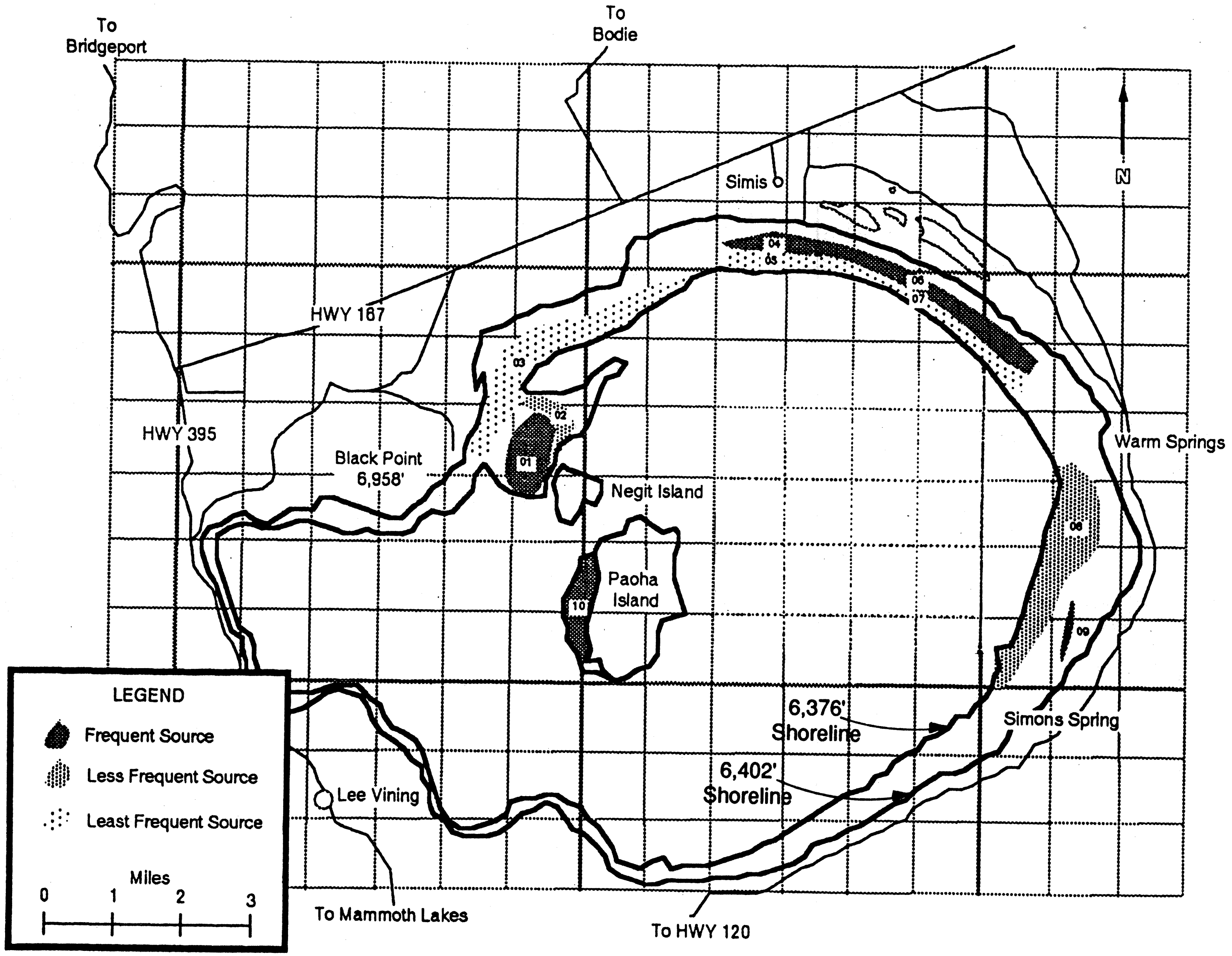


Data Source: LADWP Files

Figure 3H-17.
LADWP Photograph Ratings on Days When PM_{10} Was Measured at Simis Ranch



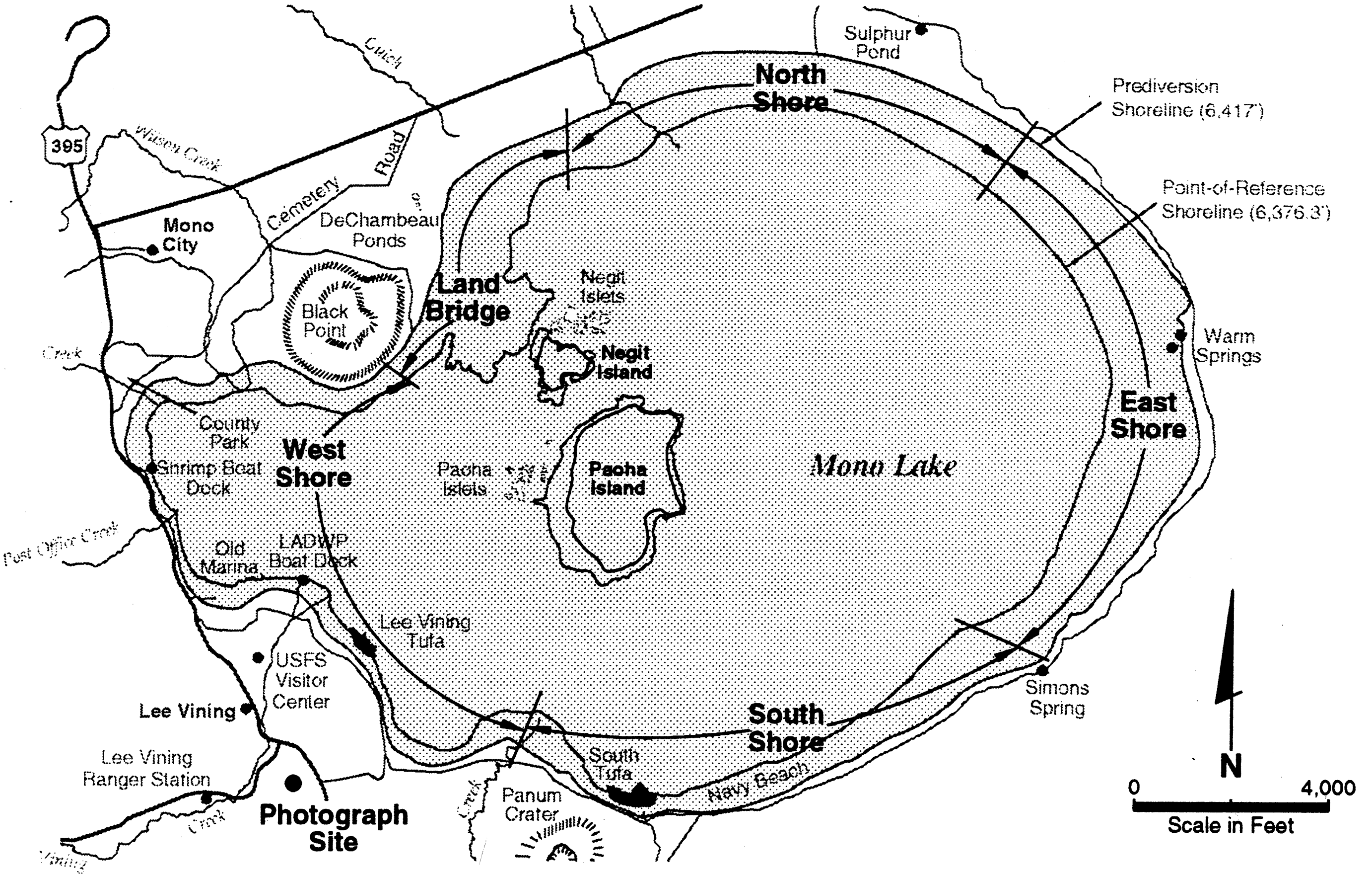
Data Source: LADWP Files



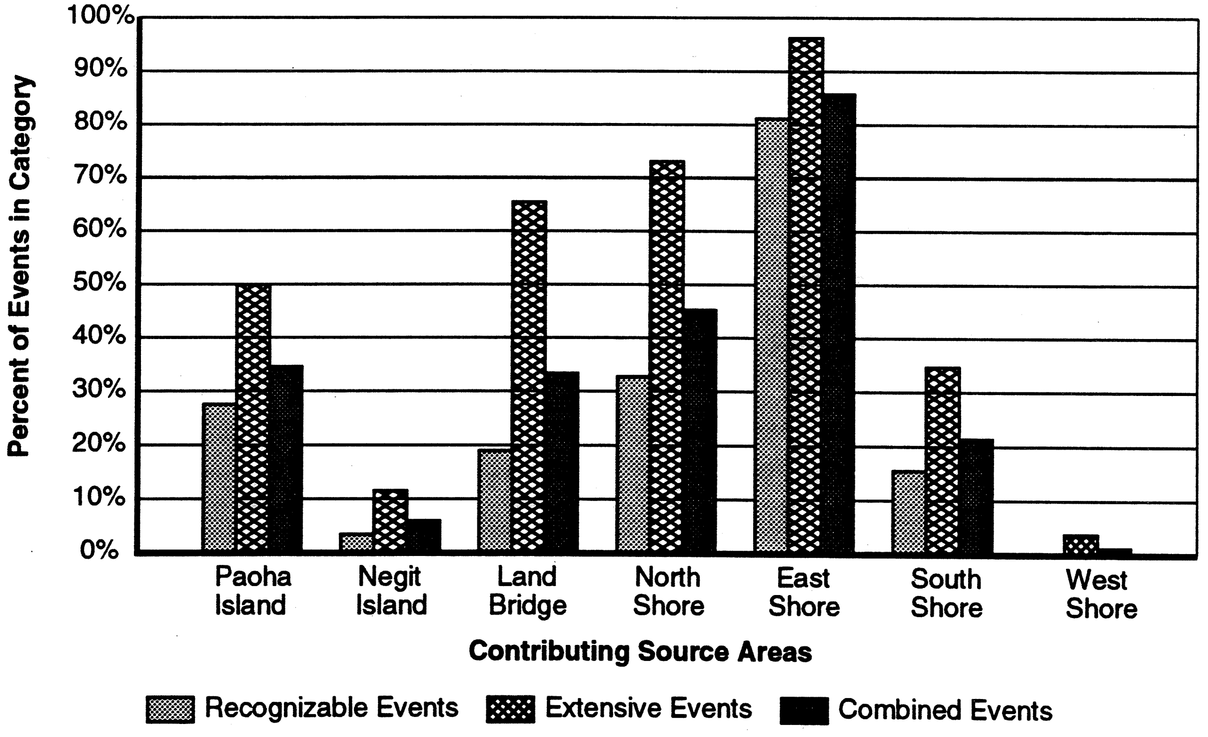
Source: GPUAPCD 1990

Figure 3H-18.
Approximate Source Areas during Dust Storms
Observed by GBUAPCD

Locations of Source Areas



Frequency of Source Area Contributions to Significant Dust Events



Note: Percentages add to more than 100% because more than one source area contributes to most dust events.

Source: LADWP Files

Mono-45

Figure 3H-19.
Geographic Distribution of Dust Storms
Recorded by LADWP Daily Photographs

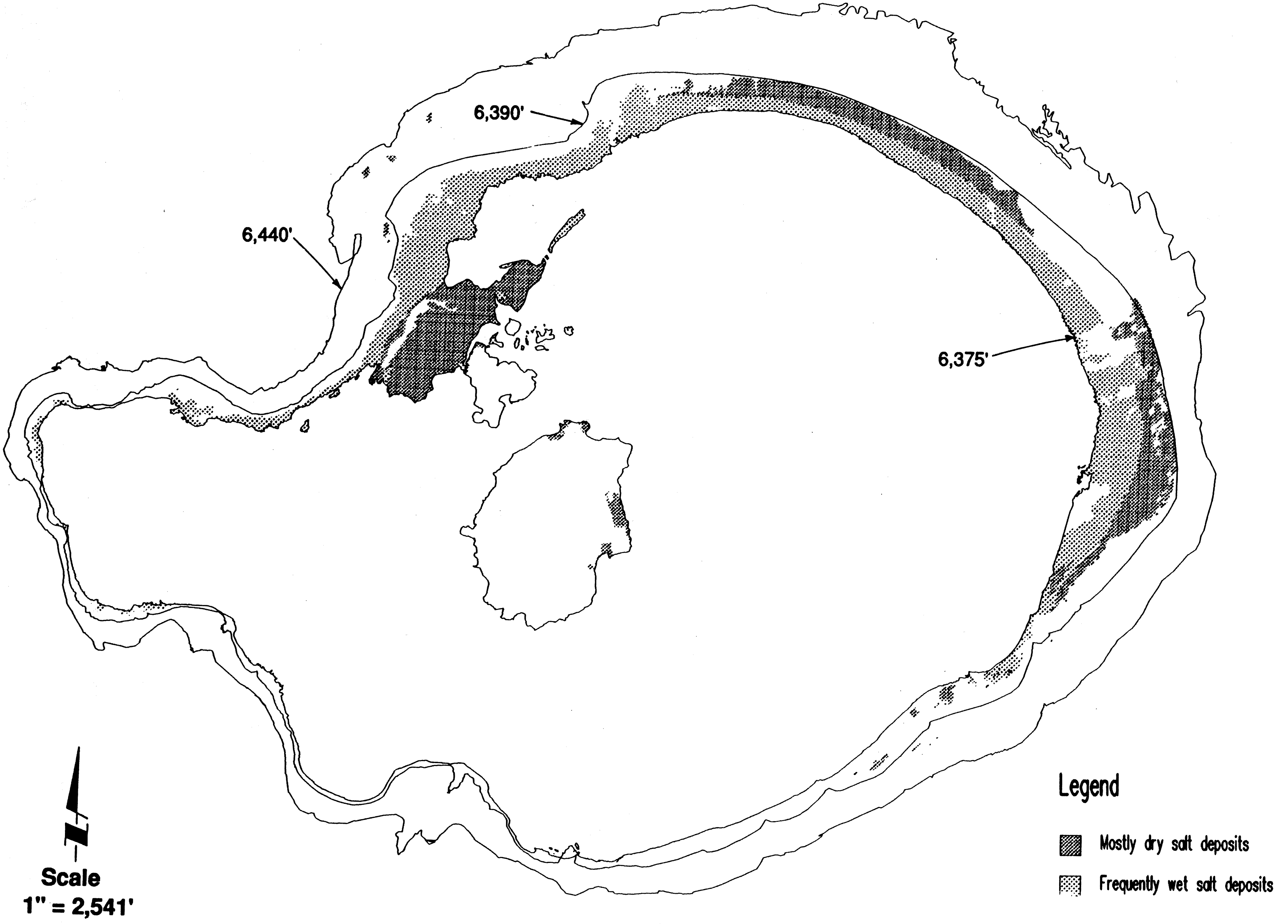
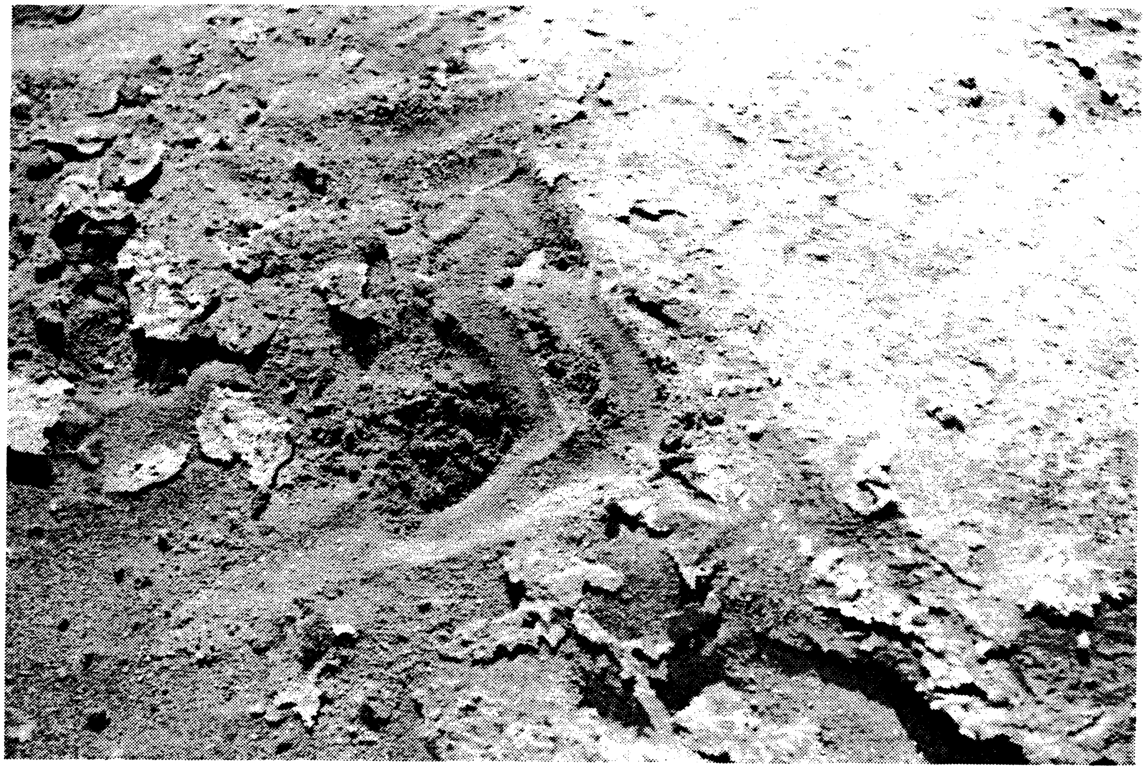
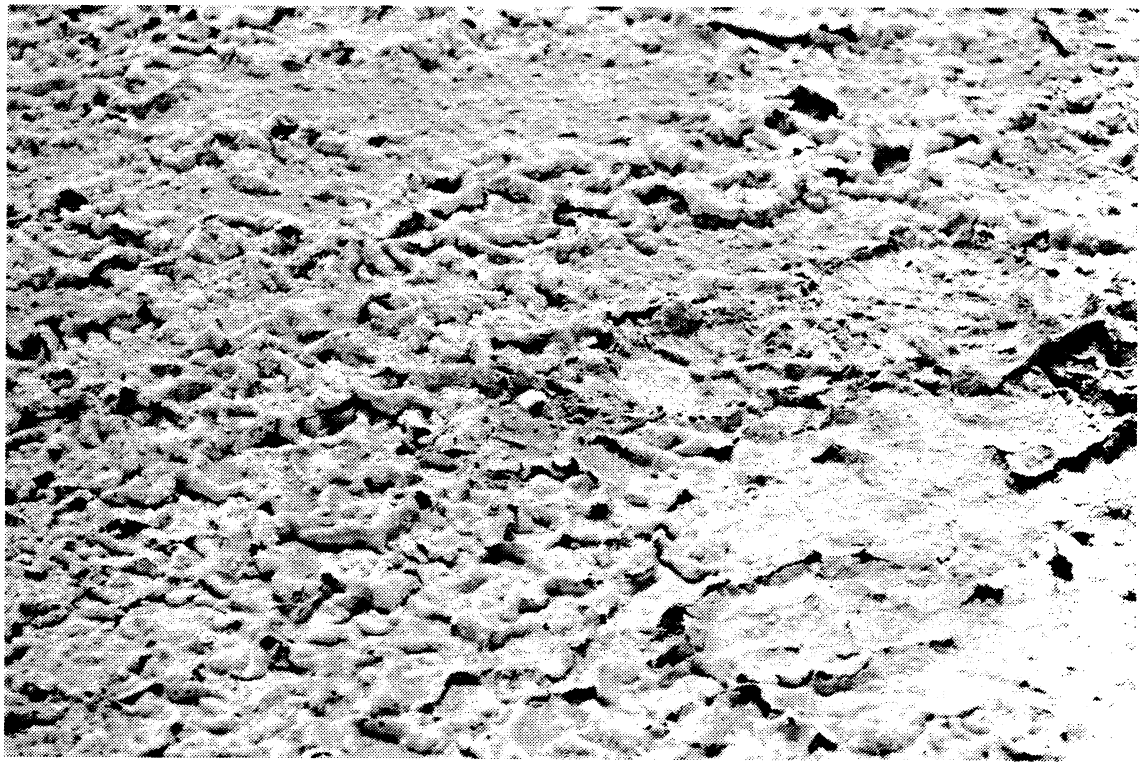


Figure 3H-20.
Distribution of Efflorescent Salt Deposits at Mono Lake



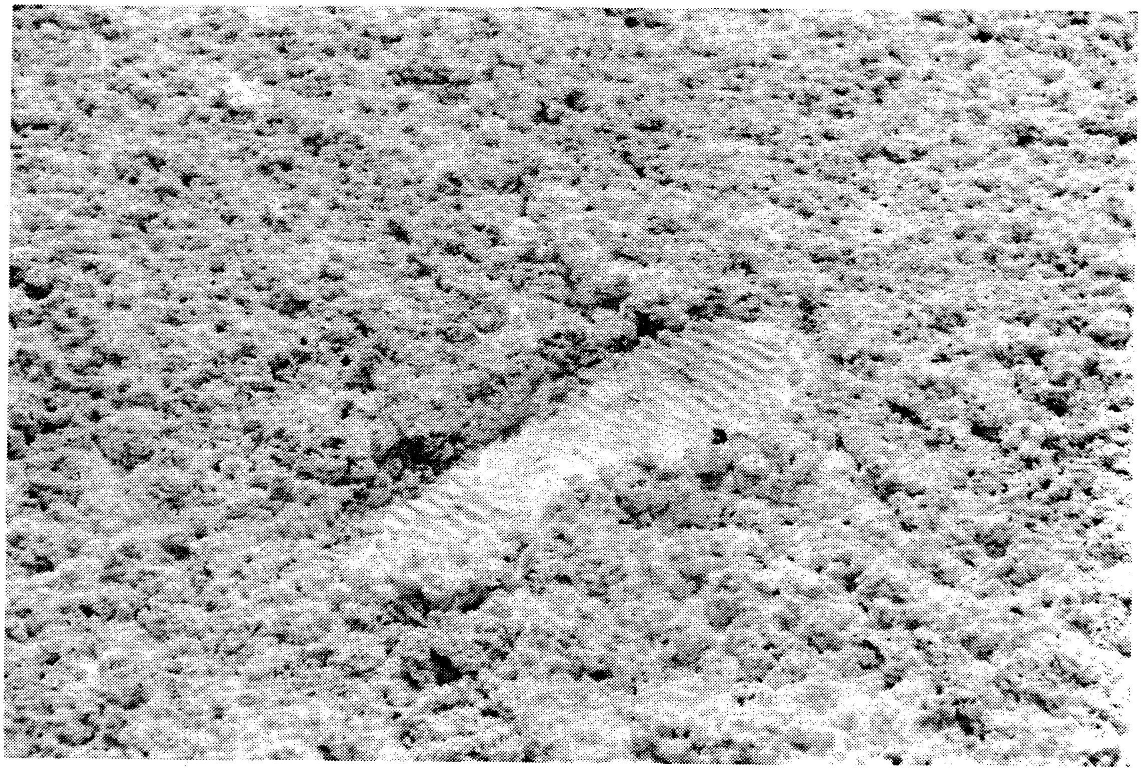
Thin, firm salt crust, upper end of salt deposits



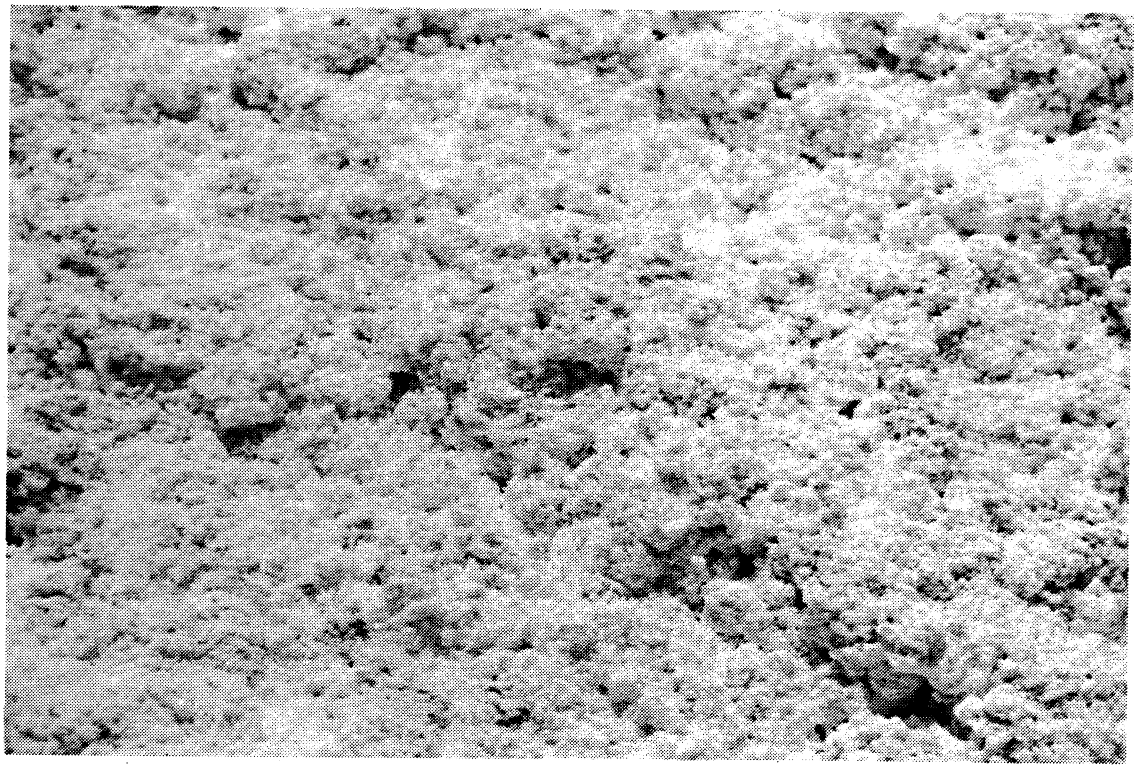
Thin, buckled, fragile salt crust, middle portion of salt deposits

Note: Photographs were taken below Ten Mile Road on April 24, 1992.

Figure 3H-21.
Crusted Salt Deposits



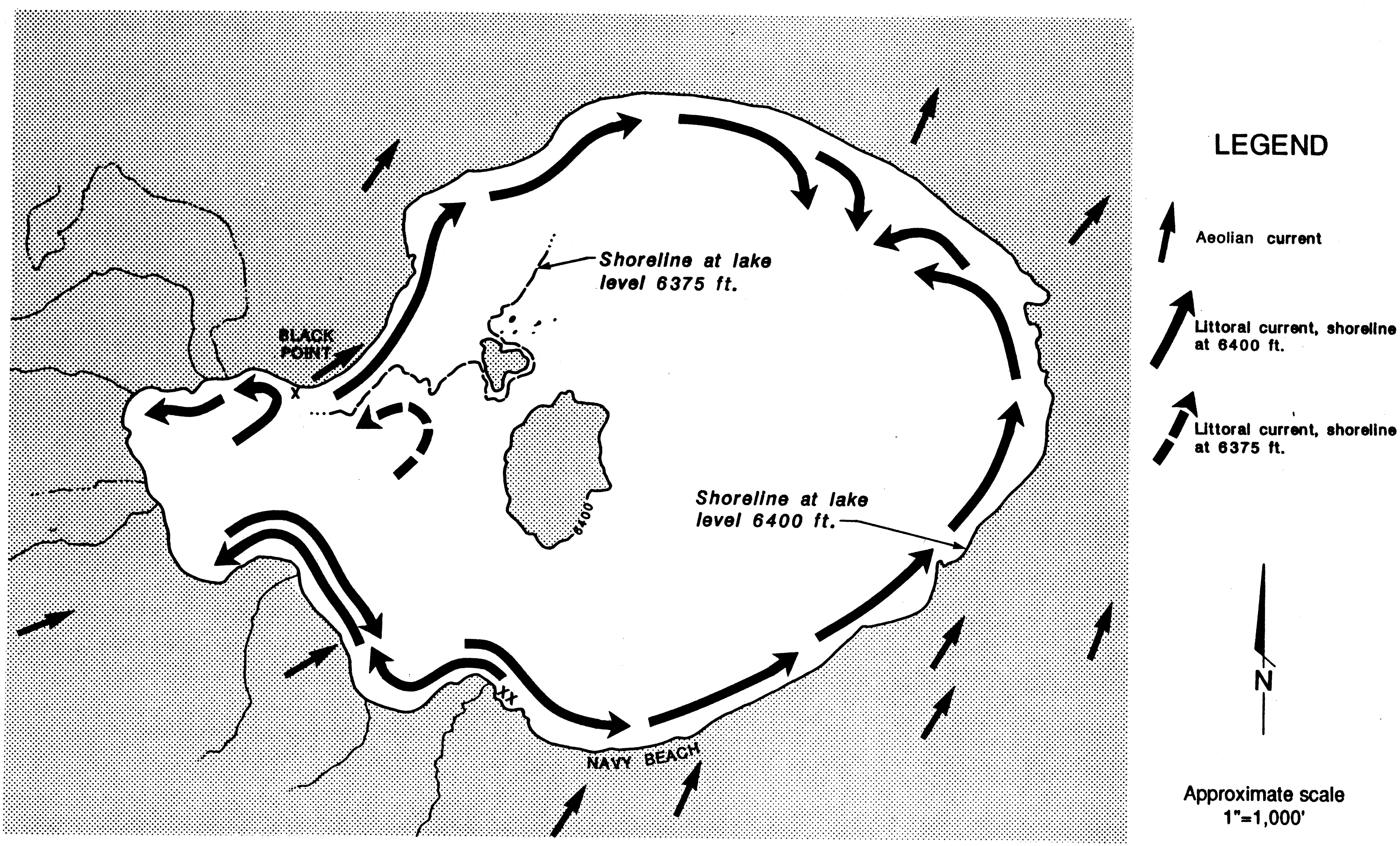
Thick, powdery deposit, lower portion of salt deposits



Thick, powdery deposit, same area as preceding photograph

Note: Photographs were taken below Ten Mile Road on April 24, 1992.

Figure 3H-22.
Powdery Salt Deposits



Source: Stine 1992

Figure 3H-23.
Littoral Currents of Mono Lake

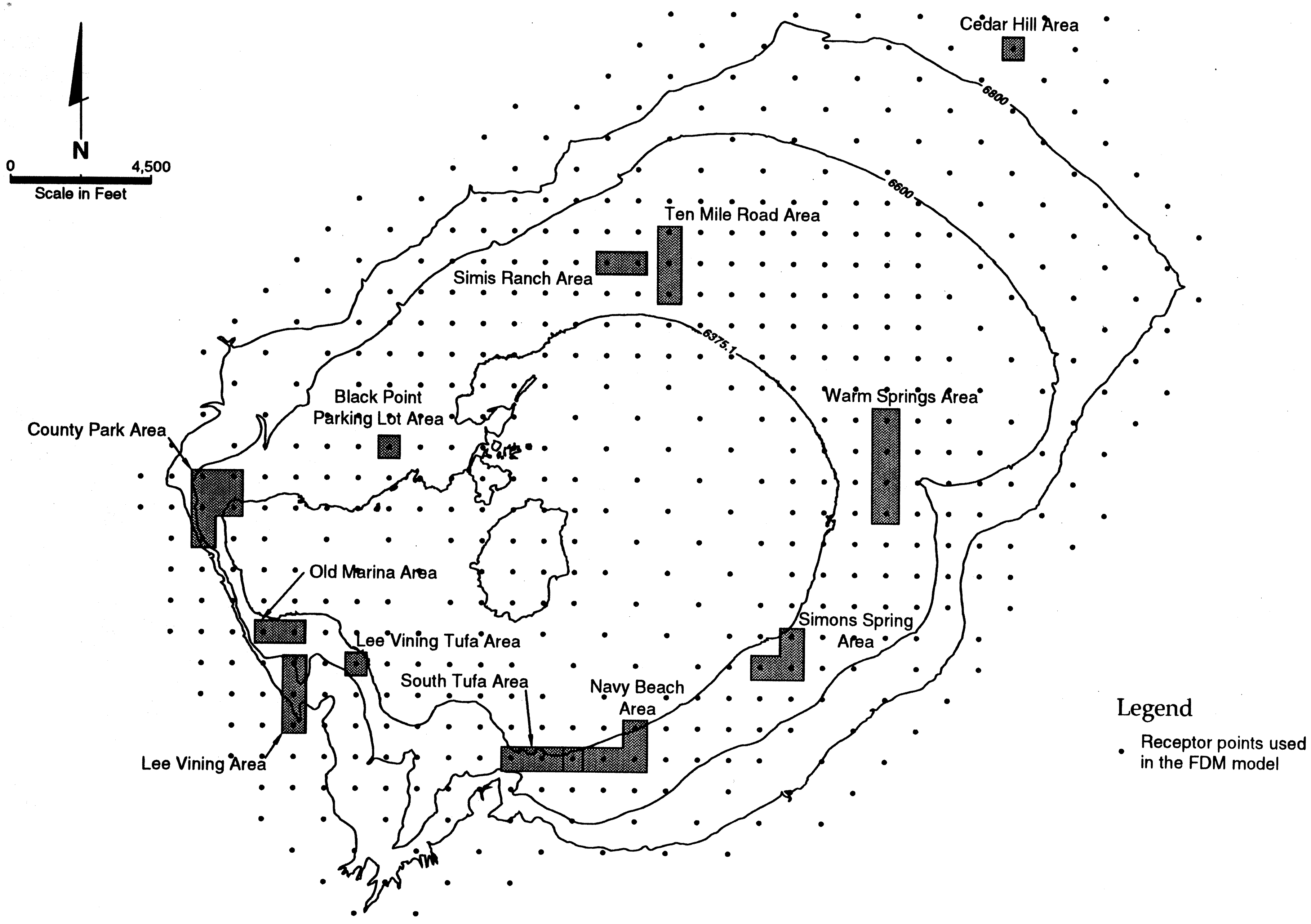
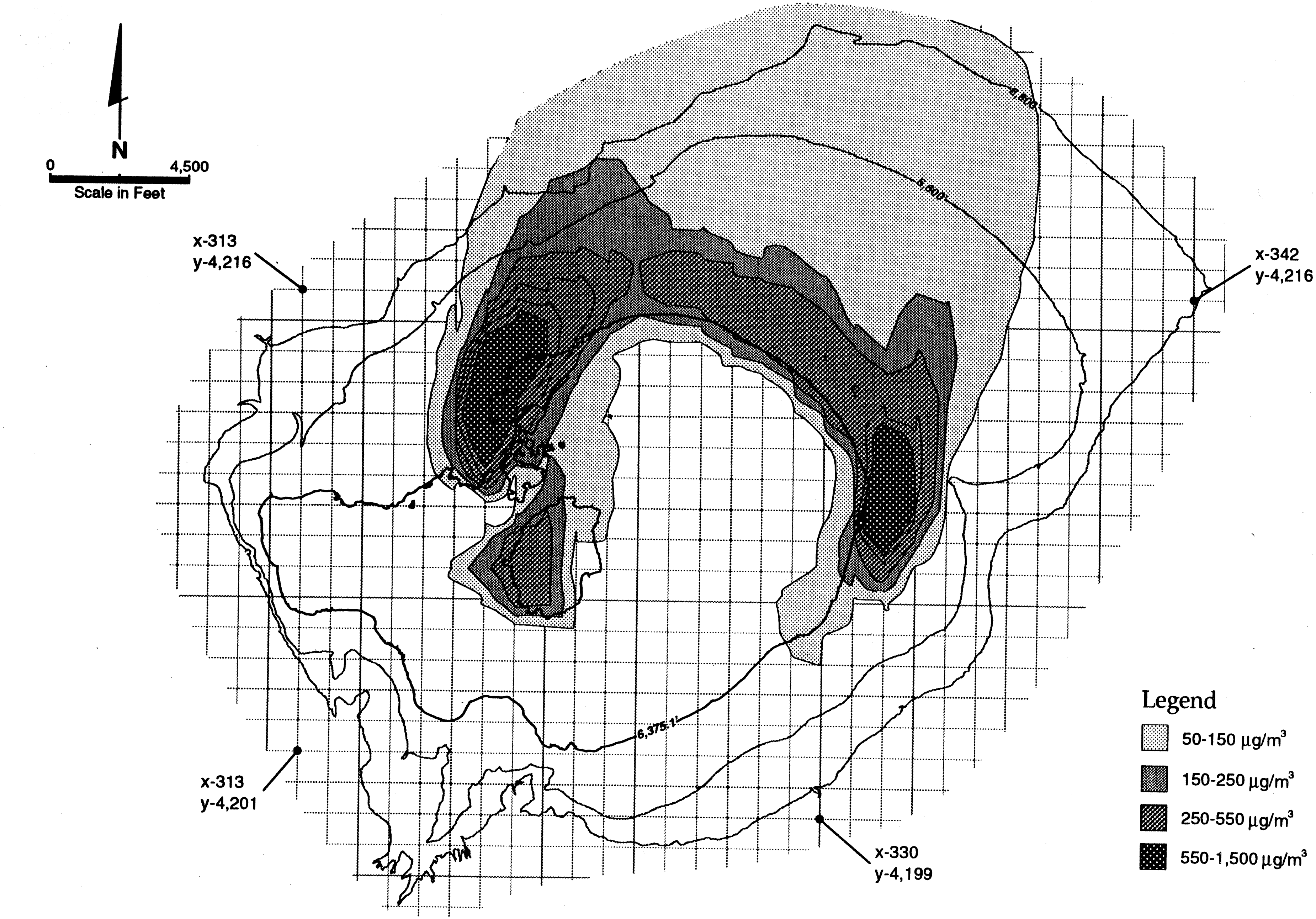
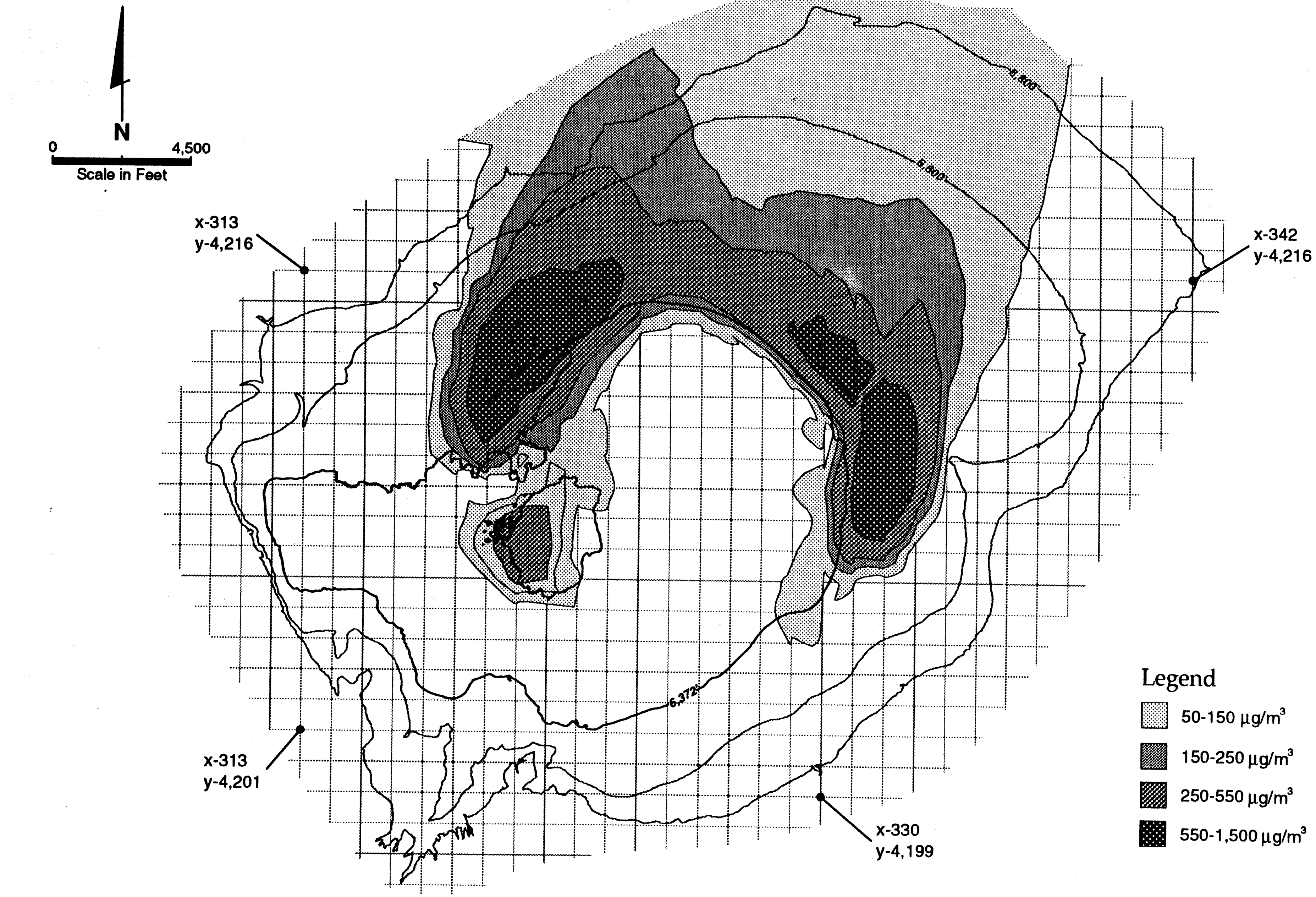


Figure 3H-24.
Receptor Areas Referenced in Summary Tables of FDM Modeling Results



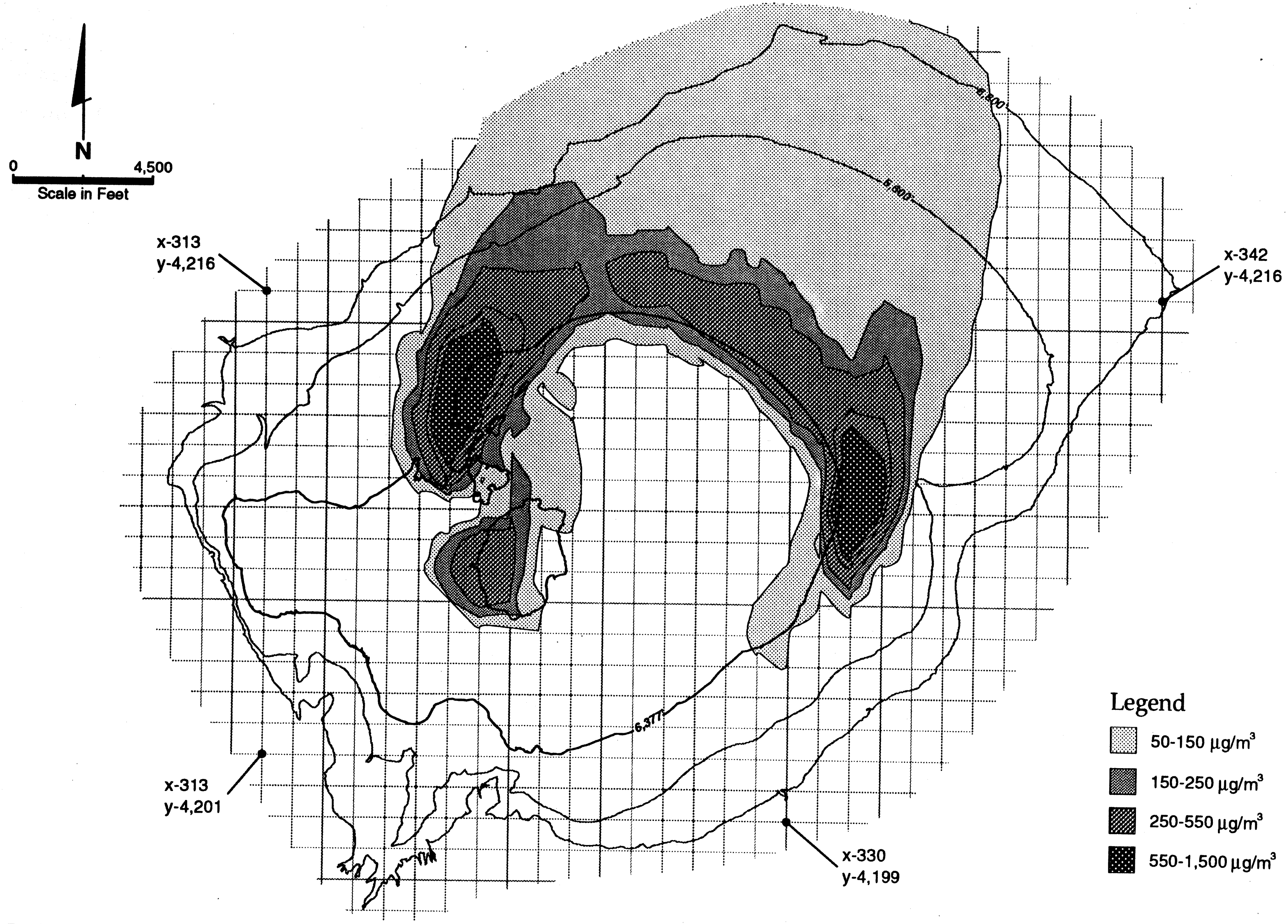
Note: The UTM grid system is displayed in kilometers.

Figure 3H-25.
FDM Modeling Results for a Lake Elevation of 6,375.1 Feet on the Maximum Episode Day



Note: The UTM grid system is displayed in kilometers.

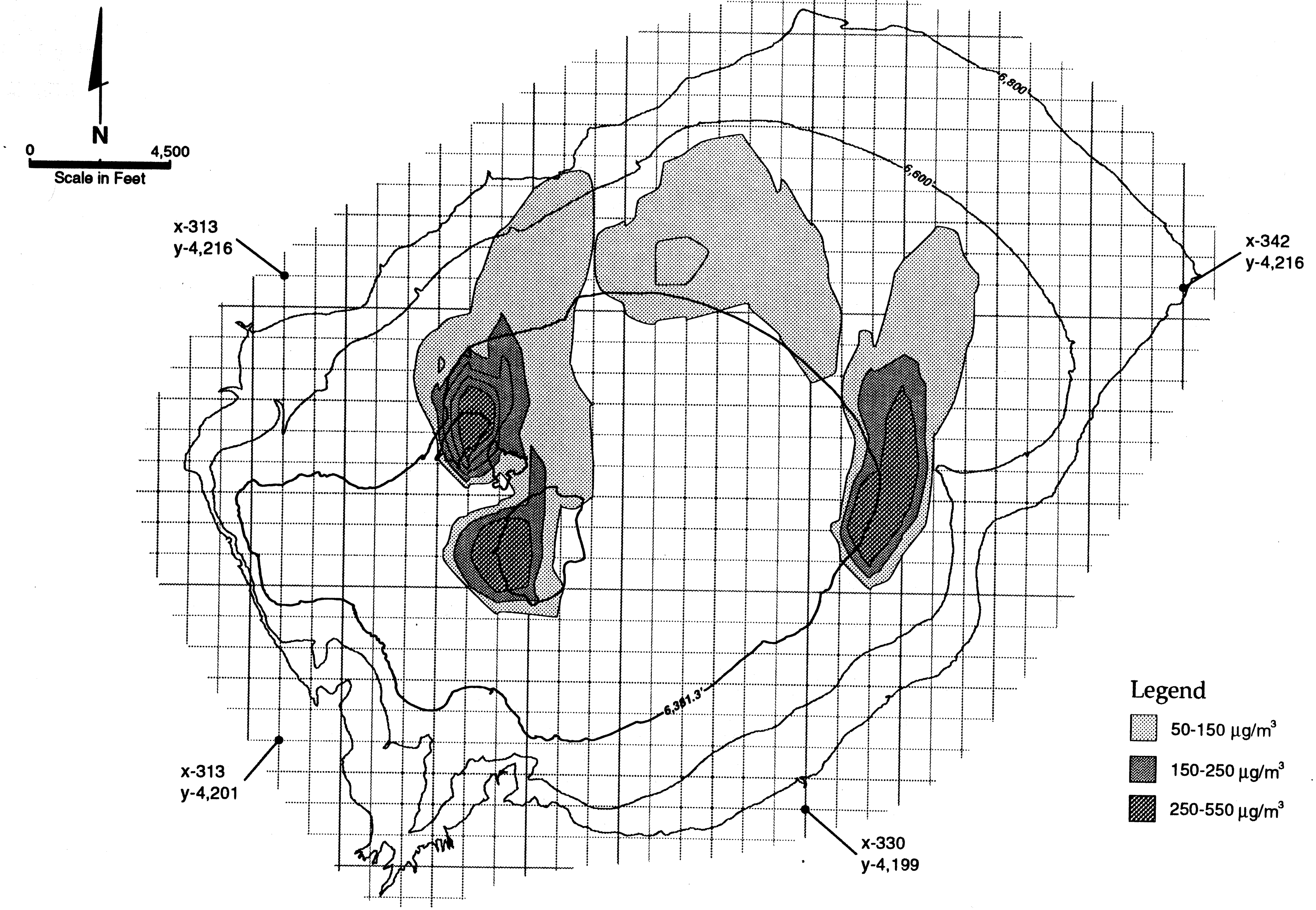
Figure 3H-26.
FDM Modeling Results for a Lake Elevation of 6,372 Feet on the Maximum Episode Day



Note: The UTM grid system is displayed in kilometers.

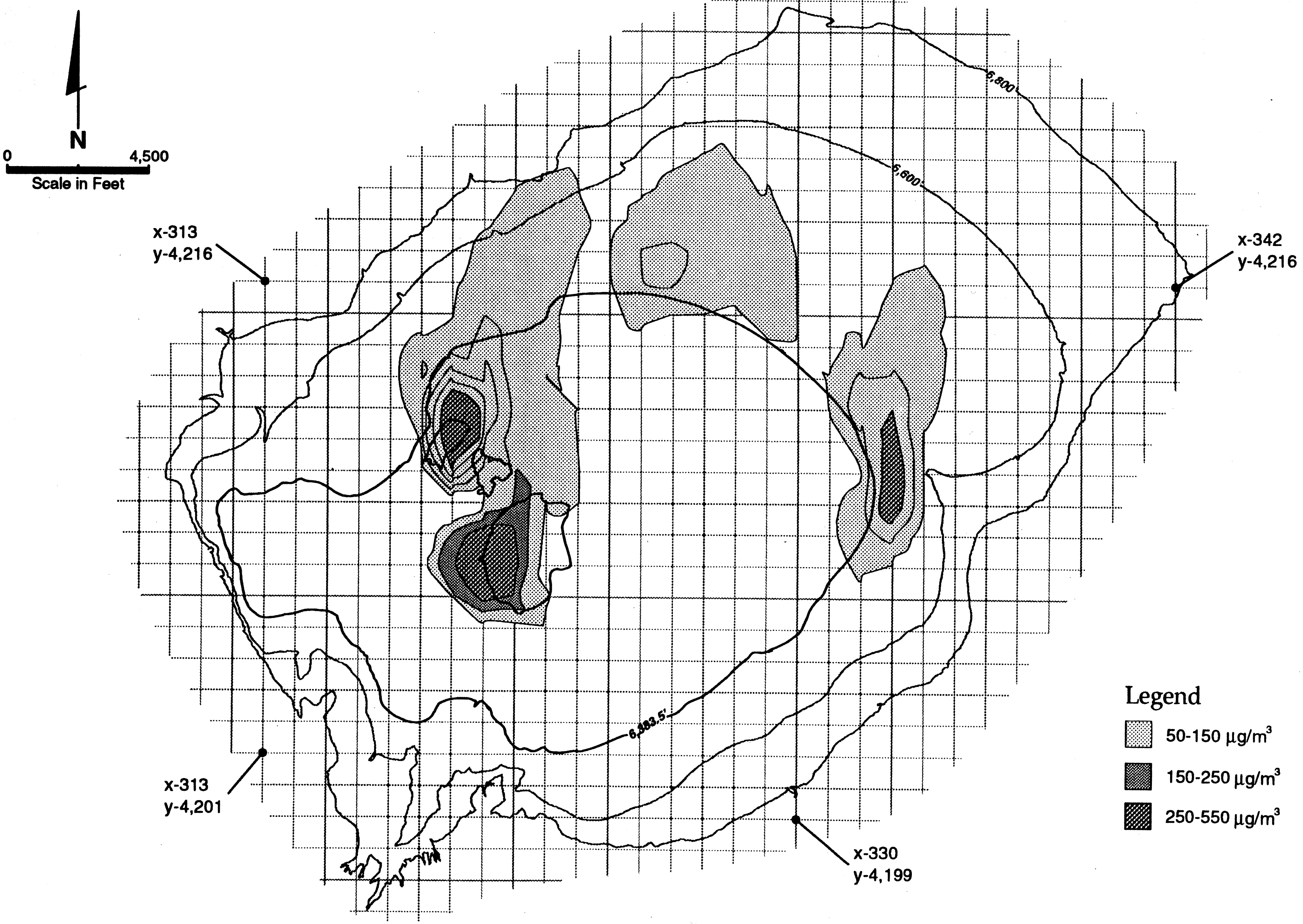
Mono-103

Figure 3H-27.
FDM Modeling Results for a Lake Elevation
of 6,377 Feet on the Maximum Episode Day



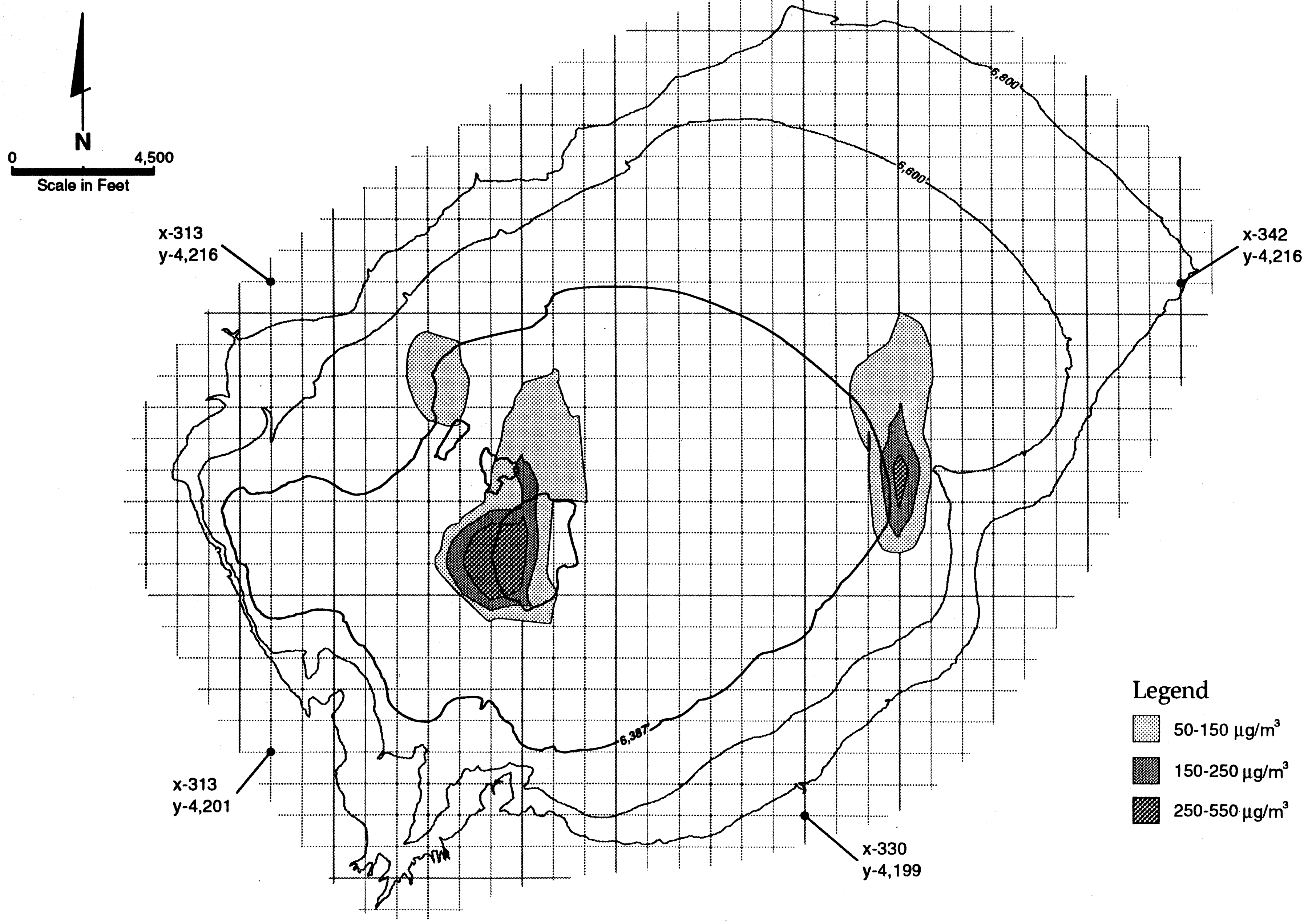
Note: The UTM grid system is displayed in kilometers.

Figure 3H-28.
FDM Modeling Results for a Lake Elevation of 6,381.3 Feet on the Maximum Episode Day



Note: The UTM grid system is displayed in kilometers.

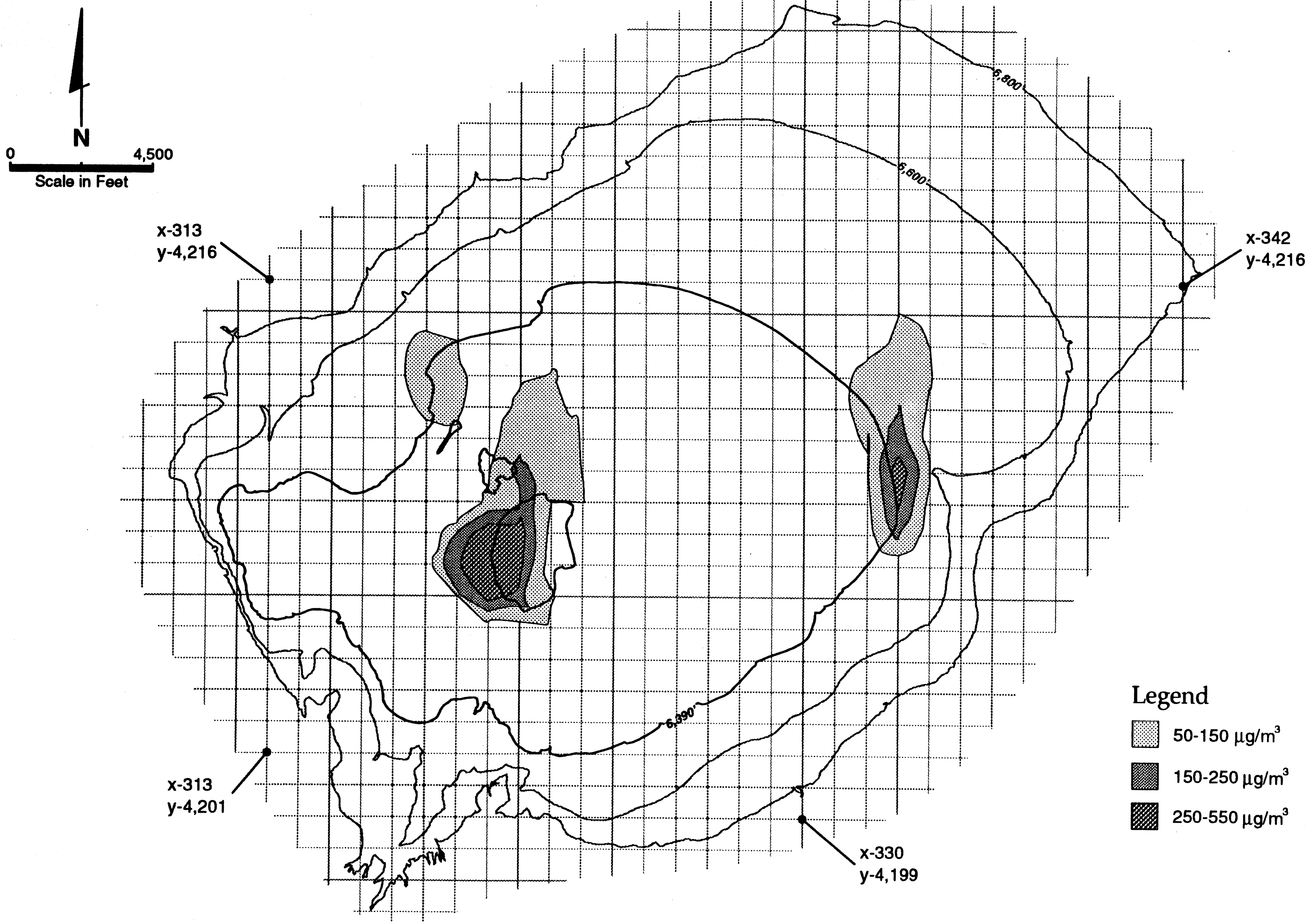
Figure 3H-29.
FDM Modeling Results for a Lake Elevation of 6,383.5 Feet on the Maximum Episode Day



Note: The UTM grid system is displayed in kilometers.

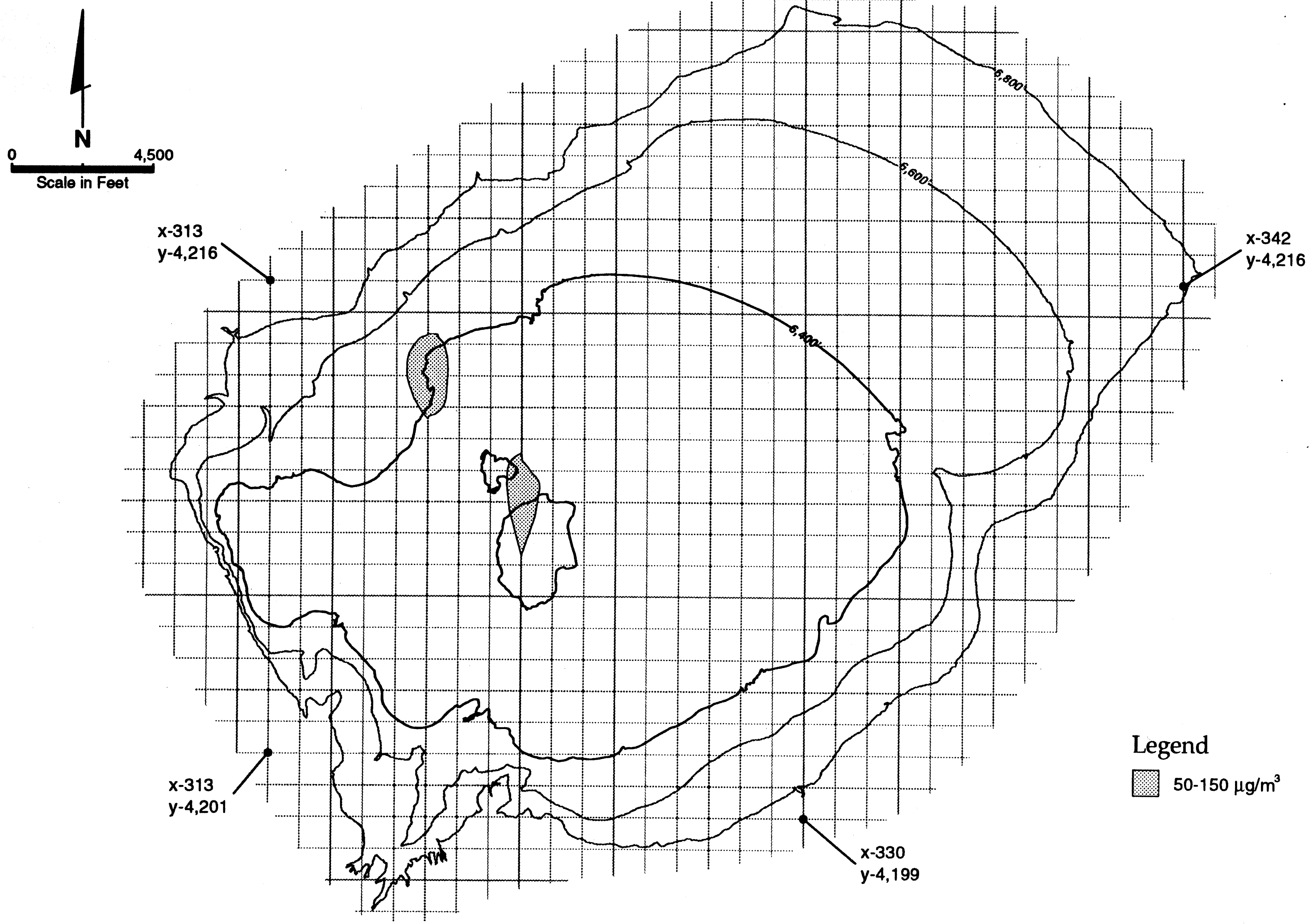
Mono-106

Figure 3H-30.
FDM Modeling Results for a Lake Elevation of 6,387 Feet on the Maximum Episode Day



Note: The UTM grid system is displayed in kilometers.

Figure 3H-31.
FDM Modeling Results for a Lake Elevation of 6,390 Feet on the Maximum Episode Day

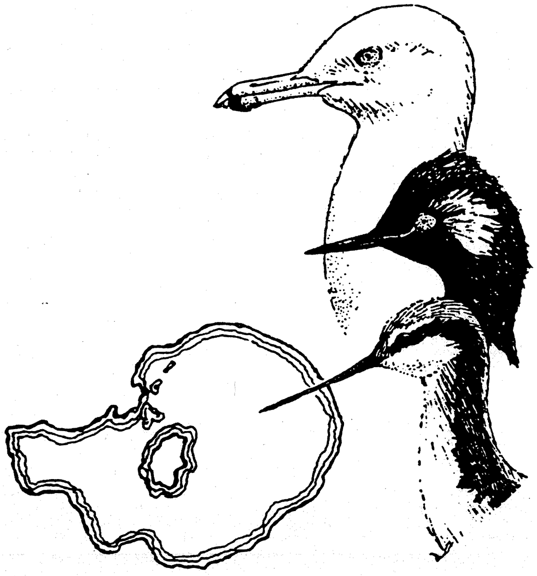


Note: The UTM grid system is displayed in kilometers.

Mono-108

Figure 3H-32.
FDM Modeling Results for a Lake Elevation of 6,400 Feet on the Maximum Episode Day

Chapter 3I. Environmental Setting, Impacts, and Mitigation Measures - Visual Resources



MONO BASIN EIR

Prepared by Jones & Stokes Associates

Chapter 3I. Environmental Setting, Impacts, and Mitigation Measures - Visual Resources

This chapter describes the visual resources of the portions of Mono Basin and Owens River Basin that have been or could be affected by LADWP water diversions from Mono Basin. It describes these resources as they existed before diversions from Mono Basin began in 1940, as they existed in more recent years, and as they exist under the point-of-reference conditions for this EIR. Additional background information on the visual resources in these basins can be found in the Mono Basin EIR auxiliary report, "Visual Resources", available from SWRCB.

Potential impacts of the project alternatives and available mitigation measures are presented in later portions of this chapter. Potential visual impacts of the project alternatives along the Lower Owens River are not considered significant and are not evaluated here. The information in this chapter is organized by major basin (Mono Basin and Upper Owens River Basin).

PREDIVERSION CONDITIONS

The appearance of the landscape evolves over time in response to natural forces and human activities. After settlement of the study area began in 1852, many of the changes in the visual environment resulted from human activities. The visual conditions that existed in the study area before water diversions began in 1940 are described below.

Sources of Information

SWRCB consultants reviewed available literature that contains descriptions of the physical setting of Mono Basin during prediversion times. One of the most complete and detailed descriptions is that given by Israel Russell, which has been reprinted (Russell 1984 [1889]) from the Eighth Annual Report to the United States Geological Survey 1889. Other works reviewed include those by Browne (1961), Calhoun (1984), Chase (1911), Fletcher (1987 [c1887]), Gaines (1989), La Braque (1984), and Muir (1987 [c1911]).

SWRCB consultants interviewed other researchers conducting studies for the EIR and Dr. Scott Stine, who has written reports to the SWRCB about riparian vegetation, tufa groves, and islands during prediversion times (Stine 1991, 1992a, 1992b). Other knowledgeable individuals also were interviewed, including Ilene Mandelbaum (Mono Lake

Committee), David Carle (California Department of Parks and Recreation, Tufa State Reserve), and Randy Neudeck (Los Angeles Department of Water and Power).

Finally, photographs depicting the Mono Basin, including Mono Lake and its environs, were examined. Some of these photographs appeared in the published sources named above. However, most were included in the extensive collection of historic photographs in the possession of the Mono Lake Committee. Many of these photographs were the work of Burton Frasher. Others were taken by Wallis McPherson and others.

Mono Basin

Historical Impressions

John Muir described Mono Basin as "a country of wonderful contrasts, hot deserts bordered by snow-laden mountains, cinders and ashes scattered on glacier-polished pavement, frost and fire working together in the making of beauty" (Muir 1987 [c1911]).

In 1909, J. Smeaton Chase described Mono Basin as follows: "It was a weird yet fascinating land through which we drove. Mono Lake and the region surrounding it are unique within the United States". He reported the lake surface to be 80 or 90 square miles in extent, and observed that, in ancient times, the lake was much larger and the old shorelines were still plainly marked on the higher ground. He mentioned two islands and a number of islets that "lie out in the middle of the lake", and noted that the lakeshores were whitened with alkaline incrustations. He described the road he was traveling as "deep in sand, merging into interminable wastes of sage and greasewood brush. Here and there lay huge isolated tufae, covered with ugly blisters, knobs, and corrugations". Chase reported the existence of

> one or two little settlements along the lake-side, situated naturally where streams from the mountains enter the lake. The hamlets are quite idyllic spots, riotously verdant, with neat houses and every appearance of modest prosperity. Thickets of wild rose 6 feet high, and heavy crops of alfalfa, clover, and timothy give proof of the magical effect of water upon this otherwise dreary desert. [Chase 1911.]

J. Ross Browne visited Mono Basin between 1863 and 1865. He described the scene one evening from Lawrence's Ranch.

> We sat on the front porch, overlooking the whole magnificent panorama outspread before us. The glowing atmosphere hung over the lake like a vast prismatic canopy. Myriads of aquatic fowl sported on the glassy surface of the water, which reflected the varied outlines and many-colored slopes of the surrounding mountains. Trees, rocks, islands and all visible objects were duplicated with wonderful clearness and accuracy. . . . A soft, delicious air,

> fragrant with the odors of wildflowers and new-made hay, made it a luxury to breathe (Browne 1961 [c1865]).

Browne observed that the shores of the lake near the water had a whitish color, because of calcareous (tufa) deposits. Describing old, tufa-encrusted shorelines, he noted that "on the eastern shore low plains or alluvial bottoms, encrusted with alkali, show in distinct curvicular rims, composed of calcareous deposits, the gradual retrocession of the lake to its present level". Referring to the presence of tufa deposits, he states that "white columns and elaborate facades, like those of the ruined temples of Greece, stand on the desert shore to the north. Archways and domes and embattlements are represented with astonishing fidelity". (Browne 1961 [c1865].)

Browne also noted the abundance of alkali fly larvae. According to his description, "a curious and rather disgusting deposit of worms, about 2 feet high and three or four in thickness, extends like a vast rim around the shores of the lake". Browne noted two islands and described them as being situated a few miles from shore. In addition, he reported that immense swarms of gulls visit these islands and that "myriads upon myriads of them hover over the rocks from morning till night, deafening the ear with their wild screams, and the water is literally covered by them for a circle of many miles". (Browne 1961 [c1865].)

Perhaps the most comprehensive early account of Mono Basin landscape is that prepared by Israel Russell, noted geologist, after studying Mono Basin and nearby Lahontan drainage from 1881 to 1883. His accounts were published in the Eighth Annual Report of the U.S. Geological Survey in 1889 (Russell 1984 [c1889]). On entering Mono Basin from the east (Aurora) in 1881, Russell said

> We obtain an extended view embracing nearly the entire Mono Basin, and are much impressed with the magnificence of the High Sierra which limits the landscape to the south. . . . In front of us stretches a sloping, featureless plain, with scattered clumps of cedars and dunes of drifting sand. In the middle distance there rests upon the desert plain what appears to be a wide sheet of burnished metal, so even and brilliant is its surface. It is Mono Lake. At times the waters reflect the mountains beyond with strange distinctness and impress one as being in some way peculiar, but usually their ripples gleam and flash in the sunlight like the waves of ordinary lakes. . . . But the feature in the landscape that absorbs the attention and overshadows all else is the vast mountain mass which rises abruptly from the southern border of the lake and forms a portion of the far famed High Sierra. The level plain of water in the foreground, broken by islands in the middle distance and washing the bases of the mountains which form its distant shore, furnish a base from which to estimate vertical distances and aids one in comprehending the grandeur and magnitude of the scene. (Russell 1984 [c1889].)

Landforms and Tufa Deposits

The elevation of the lake and its surface area fluctuate naturally according to climatic conditions. In historical times, the surface elevation varied between a low of 6,404 feet occurring around 1862 and a high of 6,428 feet in 1919 (Stine 1981, 1987). From about 1885 to 1948, the lake surface was consistently above 6,414 feet. At these levels, Paoha and Negit Islands were distinct and appeared to stand near the middle of the lake, some distance from the nearest shore (Figure 3I-1).

Tufa deposits, the majority of which form on the bottom of the lake where freshwater springs emerge and mix with the saline waters of the lake, became exposed as the surface elevation of the lake declined. Some tufa formations were exposed within the range of lake levels before diversions began in 1940. The elevation at which the lake stood at any particular time determined how much tufa could be seen, either on land or rising in the lake above the water's surface. Most of the visually valued formations seen today near the shore or standing in the lake were submerged, however, in 1940.

Russell (1984 [c1889]) reported rugged crags and towerlike masses of calcareous tufa at several locations in the 1880s. Ancient formations were found at higher elevations, back some distance from the lake's north shore and also in the vicinity of Warm Springs. Younger, less weathered formations also were known. Some with rounded or domelike shapes existed on land or were partially submerged in the vicinity of Black Point. Tufa towers with a tubular or trunklike appearance were found at locations on the lake's south shore.

Russell may have been referring to an area near the presently exposed South Tufa grove when in the 1880s he described tubular lithoid tufa on the southern shore of the lake, about a mile east of the end of the Mono Craters:

> Several acres at this locality are covered with irregular tubular trunks, from a few inches to five or 6 feet in height, with a diameter of 6 or 8 inches. . . . The formation as a whole resembles a forest of gnarled and contorted trunks and stumps changed to stone. . . . The impression which this imitation forest leaves on the mind is that it is in some way weird or uncanny. The silent and motionless trunks with their uncouth shapes recall Dante's description of the wood of suicides. This fancy is heightened by the proximity of a sea whose flowerless shores seem scarcely to belong to the habitable earth. (Russell 1984 [c1889].)

These small tufa structures were apparently not the larger towers, bulwarks, and domes that now constitute the South Tufa grove (Stine 1992a).

The presence of near-shore alkali flats along the east shore prior to 1941, as alluded to by Browne (1961 [c1865]) and others, is unclear. Some confusion of alkaline evaporite deposits with calcareous or tufa deposits apparently occurs in the historical literature. The presence and size of alkali flats in any given year was probably not extensive compared to present conditions. Because the formation of dust storms with resulting loss of regional visibility is attributable to the exposure of extensive alkali flats, dust storms probably occurred infrequently during the prediversion period (see Chapter 3H, "Air Quality").

Wildlife

Large concentrations of several species of birds were a part of the prediversion Mono Lake landscape (see Chapter F, "Wildlife"). J. Ross Browne commented that "during the winter months the waters of the lake are literally covered with swans, geese, brant, ducks, and smaller aquatic fowl. It is incredible the number of these birds that appear after the first rains" (Browne 1961 [c1865]). Likewise, Russell stated that "in the autumn and early winter, the lake surface is literally darkened with countless numbers of ducks, geese, swans, gulls, grebes, and other aquatic birds, attracted thither by the brine shrimps and larvae" (Russell 1984 [c1889]). Mono Lake was a major stopover point for waterfowl and shorebirds migrating through the Great Basin before 1940. Wildlife was also abundant along the riparian stream corridors before 1940. Wildlife in the prediversion period was an important visual element of the Mono Lake environment.

Vegetation

The basin's natural vegetation was influenced by early settlement, cattle and sheep grazing, and irrigation of pastures. By the 1890s, nearly 4,000 acres of irrigated land in Mono Basin produced hay, grain, and vegetable crops (Fletcher 1987 [c1887]). The few streams and numerous springs, particularly on the west side of the lake, supported riparian vegetation and meadow lands (Figure 3I-2). Prior to 1941, vegetation on the west side of the lake extended to the water's edge. When the lake rose, shoreline vegetation was inundated (Figure 3I-3). Prediversion vegetation resources, both around the lake and along the tributary streams, are described in Chapter 3C, "Vegetation".

As today, the riparian vegetation along Lee Vining Creek and Rush Creek and its tributaries was in marked contrast to the vastly predominant scrub communities throughout the basin. On Lee Vining Creek, the riparian vegetation along the stream corridor upstream of U.S. Highway 395 (U.S. 395) to the LADWP diversion point looked essentially the same prior to 1941 as it does today. Below (northeast of) U.S. 395 was a broad, continuous, dense riparian forest of cottonwoods and willows that filled the floodplain along the creek, reaching from toe to toe of the steep bluffs and extending toward the lake several hundred yards below the county road. Conifers also were scattered in among the willows and cottonwoods (Figure 3I-4) (Stine 1991). Riparian vegetation along lower Rush Creek in the prediversion period is shown in Figure 3I-4.

The riparian vegetation that existed along Rush Creek varied along different reaches of the stream. Dense willow thickets occurred among meadows below the county road to within 1,000 feet of the lakeshore. Above the county road, a dense, continuous, wide cottonwood-willow forest extended upstream for several miles to an area of rock outcrop and rapids known as the narrows. Several large, wet meadows also occurred in this reach, which provided a strong visual contrast to the adjacent sagebrush vegetation. From "the ford" on Rush Creek to "the narrows", the stream lies in a wide-floored valley between steep bluffs. Springs, which may have been enhanced by irrigation upslope, may have helped to support the wet meadows and riparian vegetation, at least locally (Stine 1991).

A narrow band of cottonwood-willow woodland along both sides of the stream extended from the narrows upstream almost to U.S. 395. Scattered Jeffrey pine also were present. Upstream of the highway, a wider riparian forest of cottonwoods, willows, and conifers extended for 0.7 mile. This corridor narrowed again in the upper reach below Grant Lake reservoir. Above the pre-1940 Grant Lake reservoir, willow and aspen dominated the stream community. (Stine 1991.)

Human-Made Features

Early development in Mono Basin was in the form of ranches and farms (see Chapter 3G, "Land Use"). In addition to a concentration of homesteads located around Mill Creek and the northwest corner of the lake, at least 10 homesteads were established by about 1890 on lower Lee Vining, Walker, and Rush Creeks and along the shore of the lake between Lee Vining Creek and Rush Creek. A narrow-gauge railway between Mono Mills and Bodie ran along the eastern shore of the lake and began operation in 1882 (Fletcher 1987 [c1887]). A wagon road and toll station along the west side of the lake (Figure 3I-5) later was improved and realigned, evolving into the present-day U.S. 395. In 1909, a road from Tioga Pass was opened, providing a connection between Yosemite Valley and Mono Basin. In the mid-1920s, lots were first laid out and sold in the townsite of Lee Vining. Near the lake, the Tioga Lodge and the Mono Inn were developed.

Grant Lake reservoir, which was naturally formed by a glacial moraine, was dammed before 1940 to provide local irrigation water. Between 1935 and 1940, the reservoir was enlarged by LADWP as part of the aqueduct project. The dam, now 87 feet high at its maximum from its base to crest, was about 25 feet high in the prediversion period and was located about one-quarter mile upstream from the present dam site.

Upper Owens River Basin

As today, the area along the Upper Owens River, from East Portal downstream to Lake Crowley Reservoir was used for cattle ranching in the prediversion period. With the exception of recent summer cabin development, the area's appearance prior to diversions was similar to its appearance today. Scattered small patches of willows, meadows, marshes, and irrigated pastures bordered the stream and occupied most of the valley bottom north of Benton Crossing. South of this crossing, extensive meadow-marsh vegetation extended quite a distance from the river due to lateral inflows from several tributary streams.

Construction of the Lake Crowley dam first began in the mid-1920s but was suspended prior to completion. The dam was completed around 1940, creating Lake Crowley Reservoir with a surface area of approximately 4,000-5,000 acres. As today, this water body was surrounded by open, rolling sagebrush communities and meadowlands and was nearly devoid of shrubs and trees.

ENVIRONMENTAL SETTING

Sources of Information

SWRCB consultants reviewed available and relevant published sources, including those by the California Department of Parks and Recreation (DPR), LADWP, USFS (Mono Basin National Forest Scenic Area Comprehensive Management Plan and the Final Environmental Impact Statement on the Comprehensive Management Plan), and the U.S. Bureau of Land Management (BLM) (Bishop Area Resource Management Plan and Environmental Impact Statement, adopted in 1992). Other literature reviewed included publications by the Community and Organization Research Institute (CORI) (1988), Gaines (1989), and the National Research Council (1987).

Direct observations of existing conditions were made at various times throughout summer 1991. An extensive field reconnaissance was made in fall 1991 to observe and record existing conditions over the entire study area.

SWRCB consultants conferred with resource specialists on the study team and Dr. Scott Stine regarding resource conditions relevant to visual resources. Agency personnel with knowledge of the visual resources of Mono Basin were consulted, including Nancy Upham (Mono Basin National Forest Scenic Area), Ted Rickford (Inyo National Forest), and David Carle (DPR, Tufa State Reserve). Randy Neudeck and Steven McBain (LADWP) and knowledgeable individuals at the Mono Lake Committee, particularly Ilene Mandelbaum and Sally Miller, also were consulted.

Mono Basin

In 1984, Congress designated 116,000 acres of Mono Basin as the Mono Basin National Forest Scenic Area, the first of its kind in the National Forest System. The Scenic Area is managed by the USFS's Inyo National Forest. The enabling legislation identifies the protection of scenic values as a priority (U.S. Forest Service 1989a, 1989b). The BLM, which previously had responsibility for managing the entire area, now manages the land outside the Scenic Area to the north and east. Since 1982, the State of California has managed the land exposed by declining lake levels (the "relicted" lands); this area has been designated as the Mono Lake Tufa State Reserve.

Visual Character of Mono Basin

Mono Basin encompasses two dissimilar physiographic provinces, the Sierra Nevada and the Great Basin. The basin is recognized as a sensitive, fragile visual resource, with a landscape character typical of the Great Basin but greatly enhanced by the presence of Mono Lake. Elevations range from less than 6,400 feet at Mono Lake to more than 13,000 feet along the Sierran Crest. The lake occupies about 65 square miles of the 700-square-mile basin, currently extending 13 miles from east to west and 8 miles from north to south. The visual character of Mono Lake is shown in Figure 3I-6.

West of the lake, the sparsely forested eastern escarpment of the Sierra Nevada drops steeply almost to the shore of Mono Lake, interrupted by steep-sided canyons occupied by perennial streams. The range rises more than 6,000 feet above the lake and is the most visually dominant landform in the basin. Snow is usually visible on the range, either covering the upper elevations or in isolated fields below north-facing cliffs. South of the lake, the Mono Craters rise 2,500 feet above a pumice- and ash-covered plain and are visually prominent from most locations near the lake. North of the lake, the Bodie Hills, a relatively low, old volcanic range covered in places with coniferous woodland, rise about 2,000 feet above the basin floor. Cowtrack Mountain and the Anchorite Hills form the basin's eastern boundary.

Mono Lake is the largest and most visually dominant water feature in Mono Basin. The Sierra Nevada, seen as a backdrop, vastly increases the lake's visual value. The surface of the lake is highly reflective and mirrors surrounding elevated landforms. In calm summer conditions, the water is clear and usually reflects the vivid blue of the sky; in winter, the lake may appear green.

Various elements associated with the lake also are important visually, including Black Point and Paoha and Negit Islands (U.S. Forest Service 1989a). Paoha Island is low and dome shaped, with rugged topography and strikingly light color. In contrast, Negit Island is almost black and consists of two domes, four lava flows, and a cinder-breccia cone. Black Point, a 13,000-year-old volcano on the lake's northern shore, is a large, 585-foot-high, steep wave-cut dome of dark cinder that is often seen as an element related to the two nearby islands. The land bridge that exists between Negit Island and the north shore is a predominant visual feature of present-day Mono Lake. This feature can be seen from many points in the basin.

Tufa formations scattered around the lake's current shoreline are a unique scenic resource of the basin. Lithoid tufa towers form groves of often spectacular, varied structures resembling slender pinnacles, castlelike towers, or craggy boulders. Several groves of smaller scale, intricately formed, fragile sand tufas are also scattered around the lake.

Large areas covered with salt deposits, known as playas or alkali flats, line portions of the lake's northeast shoreline. Within these areas, noticeable concentric rings circling portions of the shoreline indicate former lake levels. The alkali flats, which are almost 1 mile wide in places, contribute to occasional large dust storms in the basin. Other prominent and varied landform elements include a 10-square-mile area of small sand dunes northeast of the lake; a sheer bluff, up to 80 feet high, cut by wave action, along the southwest shore; and ancient beach terraces and berms, formed by the waves during the last ice age when Mono Lake was 700 feet above the lake's present level, now visible as horizontal lines or bands.

Nearly 300 bird species have been identified at Mono Lake, including 98 species of water birds. Large populations of several species of migratory and nesting birds, including California gull, eared grebe, Wilson's phalarope, and red-necked phalarope, use the lake as nesting habitat or as a stopover site during migration. These birds are sometimes readily visible in large concentrations to visitors in the basin. Alkali flies, an important prey for these bird concentrations, feed on algae in shallow areas of the lake in dense swarms and are a visually conspicuous element of the lake shoreline.

Wetlands at various places around the lake, usually near the shore, add visual variety and contrast with the brushland and playa surrounding the lakeshore, especially in late summer when the dominant saltgrass is a rich green and in fall when it turns yellow. Coniferous woodlands, located primarily around the periphery of Mono Basin on some of the higher terrain, are a less prominent visual element. Low, sparse juniper woodland covers an area northeast of the lake and portions of the Bodie Hills and extends in long, irregular belts toward the lake. Other portions of the Bodie Hills are brushy to their summits.

The lake's scenery, including the appearance of the tufa towers, benefits from unusual or dramatic lighting conditions, such as low-angle sunlight very early or late in the day; mist; a calm, reflective lake surface; snow; or dramatic cloud forms over the surrounding ranges. Popular images of Mono Basin suggest that water-based tufa is the most popular visual element. The lake itself, often with the Sierra Nevada as a backdrop, and birds also are common images. The black color of Negit Island, contrasted with the almost white color of Paoha Island, is also a popular subject.

Riparian vegetation, occasionally interspersed with conifers, occurs along the tributary streams and in patches along irrigation ditches. Where riparian vegetation is still present in lush, dense stands, it is a strongly positive visual element in the landscape, adding variety in form, line, and color and contrasting with the surrounding sagebrush scrub vegetation. The smaller streams have meandering courses through willow thickets and meadows. The larger streams flow through recently disturbed floodplains where remnant riparian thickets alternate with broad unvegetated cobble deposits. About 2,000 acres of meadow add visual variety to the slopes near Walker and Parker Creeks between the diversion conduit and U.S. 395.

Landforms surrounding Grant Lake reservoir on Rush Creek vary from a steep, rugged canyon at the south end of the reservoir to rolling hills on the north end. The dam impounding Grant Lake reservoir is a large structure, but it is not visually dominant when viewed from most locations, such as major roads or use areas. The water surface of the reservoir is subject to drawdown, resulting in a barren shore zone during certain periods of the year. Buildings serving public boating activities are located on a peninsula midway along the reservoir.

Important human-made components of Mono Basin include the small town of Lee Vining; scattered buildings, mostly residences and ranch and commercial structures; overhead utility lines; road cuts; diversions and buried pipeline routes of the Los Angeles water supply system; paved and unpaved roads; quarries; and other water and power developments. Land in the basin purchased by the city to acquire water rights remains largely undeveloped. The extensive federal lands in the basin are generally managed to preserve their natural landscape character.

Mono Lake

This section describes the potentially affected landscape elements at Mono Lake and identifies sensitive viewers and observation points for viewing the lake. Locations of many of the landscape elements at Mono Lake are shown in Figures 1-1 and 1-2 in Chapter 1.

Potentially Affected Landscape Elements. The visual character of landscape elements at Mono Lake that could be affected by changing lake levels is described in this section. These elements include:

- the lake surface, waters, and shoreline;
- islands;
- tufa groves;
- alkali flats;
- pumice blocks;
- birds;
- alkali flies;
- lakeside vegetation; and
- human-made features.

Lake Surface, Waters, and Shoreline. The lake's surface is one of the most important visual elements in Mono Basin. Because Mono Basin has no outlet, variations in precipitation and runoff naturally control the lake's surface elevation (refer to Chapters 2, "Project Alternatives", and 3A, "Hydrology"). When diversions began in 1940, the lake surface covered about 86 square miles (54,900 acres); in 1989, coverage was reduced to about 66 square miles (42,400 acres). Figure 3I-7 shows the lake as it appeared from the Wilson Tufa Grove (along the northwest shore) in 1968, when the lake surface was at approximately 6,388 feet, and in 1982, when it was at its historical lowstand of approximately 6,372 feet.

The lake's water varies in clarity and color over the year, depending on the population density of algae. In summer, visibility through the water extends to a depth of 25-35 feet, and the lake surface reflects the sky's color. In winter, visibility drops to approximately 1.5-3 feet, and the lake shows a range of green colors, depending on wind conditions and the consequent reflectivity of the surface (California Department of Parks and Recreation 1987, NAS 1987, Gaines 1989).

Islands. Paoha is the largest of the lake's islands, currently covering about 3 square miles (see Figure 3I-8). The old lake-bottom sediments forming the island are white (gray when wet) in most lighting conditions. The island has a low, domed profile rising 312 feet above the current lake level (6,373 feet). Vegetation is not a strong visual element on Paoha Island, and no human-made features are visible from the mainland.

A small cluster of islets off the western shore of Paoha Island, at current lake levels, vary in size from more than 10 acres to isolated single rocks. The islets are light colored and often appear as an extension of Paoha Island; they did not appear above the lake surface until about 1961, when the lake surface had dropped to about 6,395 feet (Stine 1992b). As the lake dropped further, more islets have been exposed.

Negit Island currently covers about 0.4 square mile. The majority of the island is composed of very dark brown or charcoal gray lava, and the base of the island is a light tan, buff color. In places, a distinct horizontal line divides the two colors. The topography of Negit Island is striking, consisting of a flat-topped, steep-sided cone rising about 220 feet above the current lake surface. Vegetation appears on certain portions of the cinder cone as a sparse to moderately dense growth of brush. No human-made elements are visible on Negit Island from the mainland.

Negit Island becomes a peninsula of the mainland near Black Point when the lake surface drops to 6,375 feet (1.2 feet below the point-of-reference elevation). The emerging land bridge is composed of a wide, flat expanse of lake sediments along its northwest side and is a conspicuous visual element at lake levels below about 6,390 feet.

A cluster of islets, including Twain and Java, lie off the northeast shore of Negit Island. At current lake levels, the islets vary in size from about 16 acres to isolated single rocks. The islets are white (from the coating of alkaline or tufa deposits), except for the medium brown high points of a few of the larger islets. The highest islets have always been above the lake surface during historic times. Twain and Java Islets become land bridged when the lake surface drops to 6,372 feet. (Stine 1992b.)

Tufa. Groups of tufa towers and sand tufa deposits are scattered around Mono Lake's shores. The towers, which range in height from a few inches to 10-25 feet, are unusual light gray or white rock formations of spines, pinnacles, or knobs rising abruptly from the shore or near-shore lakebed. Some old tufa deposits appear at higher elevations, much farther back from the current lakeshore. Tufa towers are formed when calcium-bearing freshwater springs well up through the alkaline lake water, which is rich in carbonates.

The tufa deposits at Mono Lake are a significant scenic resource. While tufa is found in other alkaline bodies of water, the variety and quantity of Mono's towers is unique (California Department of Parks and Recreation 1987). The deposits have been described as a distinctive scenic resource of the basin, a significant scenic attraction, and picturesque (NAS 1987). They contribute to Mono Lake's unique aesthetic qualities and are important scenic resources to many viewers (CORI 1988). Most currently visible portions of the major groups of tufa towers (tufa groves) have been exposed by the receding lake and are a designated and protected scenic resource (the focus of the Mono Lake Tufa State Reserve).

Figure 3I-9 shows the locations of important tufa deposits at the lake (Stine 1992a). The tufa groves stand at elevations varying from 6,368 feet to 6,430 feet. Table 3I-1 shows the general visibility of each of the nine tufa tower groves at three lake levels: the historic high level (6,428 feet), the level when diversions started (6,417 feet), and the level at the 1989 point of reference (6,376 feet). During the temporary rise in lake elevation from 6,372 feet in 1982 to 6,381 feet in 1986, wave action at the advancing shoreline undercut the soft sediment at the bases of many tufa towers at the South Tufa grove, and the towers toppled.

The Mono Lake County Park tufa grove, also known as the DeChambeau Creek tufa grove (Figure 3I-10), is reached easily by a boardwalk. The tufa structures are older and more rounded or domelike in most cases than those at the Lee Vining or South Tufa groves (see Figures 3I-11 and 3I-12). The currently visible portion of the Old Marina grove (Figure 3I-10) is of moderate size and is both water and land based. A boardwalk provides partial access. There are several relatively tall castlelike structures, but many are in the form of craggy boulders that grade imperceptibly into tufa-covered pumice blocks.

The Lee Vining grove is large and spectacular. It is currently both water and land based. The tufa structures here are varied, with numerous tall, slim pinnacles that show little evidence of damage from human use or weathering. Public access into the tufa grove is not convenient and may serve to limit the number of persons who visit here as compared to tufa groves at South Tufa, the Old Marina, and the Mono Lake County Park.

South Tufa is the largest of the visible Mono Lake tufa groves. It is currently both land and water based. Access is easy via a well-used trail leading from the large parking lot. The structures are varied, with many being tall and dramatic in form. These tufa deposits are relatively young and may have formed after irrigation began in the upslope Pumice Valley in 1920 as percolating irrigation waters reached the lake (Stine 1992a). They are shallow rooted and susceptible to undercutting by wave action during rises in lake level.

The Wilson Creek tufa grove lies near the mouth of Wilson Creek east of the Mono Lake County Park tufa grove. Access is difficult; a locked gate associated with a quarry operation near the lake requires approach by foot and public use of the area is therefore limited. The grove contains the "benchmark tufa", which have been photographed at different lake levels and which provide a striking visual record of the fall in lake surface elevation. At the point of reference, all the tufa towers at this grove are completely land based; the bases of these formations lie at elevations between 6,383 and 6,386 feet (Stine 1992a). One of the few remaining freshwater ponds remaining around the lake (the "gull bath") also occurs here.

The Simon's Spring grove is widely scattered and contains relatively few structures overall, arranged in small subgroups. All the structures are land based, some as far as one-quarter mile from the shore. Access is relatively difficult. The structures are somewhat varied in form.

Several concentrations of sand tufa occur on the south and southeast shores of Mono Lake (Figure 3I-13). Sand tufa consists of intricate, irregular, small-scale forms, usually in the shape of tubes, columns, and walls, groups of which are sometimes topped by caplike or rooflike structures. These structures formed, not on the surface of the submerged lakebed, but within the sand beneath the lakewater. As the lake level has fallen, the sand tufa structures have been revealed by wind erosion of the surrounding sand.

Sand tufa, which consists of small structures of calcium carbonate cemented sand, is always land based and usually is 3-4 feet high or reaches heights in excess of 6 feet (Figure 3I-13). The estimated elevations of their bases range from 6,390 feet to 6,432 feet. The structures are very fragile and susceptible to damage from human use and destruction from rising lake waters. Because of their small size and location back from the lakeshore, they are not nearly so well known or sought out as tufa towers. However, sand tufas are actively sought by photographers, who value them highly. Almost all sand tufa formations were under the sands of the lakebed at the time of the historic high lake level; most were still beneath the lakebed at the beginning of diversions (lake level 6,417 feet).

Alkali Flats. Alkali flats, also known as playa, salt flats, or exposed lakebed, are a readily evident visual element around portions of Mono Lake's shores, especially along the northeastern shores and between Negit Island and Black Point and the east shore, as well (Figure 3I-14). An area of lesser salt deposits also extends east from Navy Beach. Areas of exposed alkali flats have widened as the lake has declined. These flats are almost 1 mile wide in places as compared to a relatively narrow band before diversions began. When dry at the surface, they are a vivid white, and when wet, they darken to light tan or gray. These flats are widest where the shoreline is flattest. Some amount of playa is considered by some to provide definition to the lake (NAS 1987).

Alkali flats contribute to dust storm episodes in the basin (Figure 3I-15). High winds, generally blowing from the southwest, pick up salts and mineral sediments and carry them for long distances. The dust often originates on the alkali flats, especially those on the northeast and east shores of the lake, northwest of Negit Island, and on Paoha Island. Dust storm episodes occur throughout the year but are most frequent in spring. They can abbreviate sight-seeing activities and experiences. Obscuring views of landforms, they are highly visible from many areas when they occur. The dust storm phenomenon is described in Chapter 3H, "Air Quality".

Pumice Blocks. Substantial portions of the current shoreline area of Mono Lake are littered with pumice blocks, which impart an unusual texture to the shoreline. The blocks are covered with tufa deposits and thus are typically very light in color. They vary in dimensions from less than a foot to many feet (Figure 3I-16). At higher lake elevations associated with prediversion conditions, no pumice blocks were present above the shoreline.

The major location of visible pumice blocks is the west and northwest shores of the lake from Old Marina to the mouth of Cottonwood Creek. (Stine 1992a.) Pumice blocks are probably a minor visual element when compared to tufa towers and other important visual characters.

Birds. Large populations of several species of migratory and nesting birds are found at Mono Lake (refer to Chapter 3E, "Wildlife"). These birds occur in large concentrations that often can readily be observed by viewers. Although some of the bird populations may be concentrated at times in remote areas of the lake, many can be seen in large numbers at the accessible lakeshores (especially where there is freshwater inflow) feeding on the brine shrimp and alkali flies.

Four bird species currently use Mono Lake in large numbers: California gull, eared grebe, Wilson's phalarope, and red-necked phalarope. The snowy plover also is present but not in large numbers; however, the population that uses Mono Lake represents 11% of the California population. Approximately 40,000-65,000 California gulls currently use Mono Lake for nesting. The gulls arrive in March and April, nest from May through July, and depart in early August. An estimated 750,000 eared grebes are found at Mono Lake during fall, using the lake as a stopover site during their migration.

About 90,000-125,000 Wilson's phalaropes are estimated to use Mono Lake during migration, with 70,000-80,000 present at one time. The birds begin arriving in mid-June to late June and begin to depart near the end of July. About 50,000-65,000 red-necked phalaropes use Mono Lake as a stopover on their fall migration. They begin to arrive in early July to mid-July. Populations increase until early August, remaining high until early September. Most are gone by mid-October. The phalarope populations concentrate along the western and northern portions of the lake when the lake surface elevation was at or higher than the point-of-reference elevation but recently shifted to the eastern portion of the lake as the lake surface has dropped. Concentrations on the eastern portion of the lake are much less accessible to recreational visitors. Many other species of birds are readily and commonly observed, including Brewer's blackbirds, violet-green swallows, killdeer, ravens, sandpipers, and nesting osprey. Birds are a constant element of the Mono Lake environment.

Alkali Flies. Adult alkali flies, after emergence from Mono Lake, concentrate on Mono Lake's shoreline in such numbers that they become visually conspicuous. At peak populations, the flies settle on a strip of shore several feet wide, immediately adjacent to the water's edge, so that even from a distance the area may appear black. These flies are not attracted to humans or animals; they feed on algae in shallow areas of the lake. It is uncertain whether the magnitude of alkali fly concentrations has changed since diversions began. (See Chapter 3E, "Aquatic Productivity".)

Lakeside Vegetation. The exposed Mono Lake shoreline and lakebed supports marsh, meadow, grass, and scrub vegetation that is verdant during the summer growing season and mostly dormant and golden brown throughout the long fall and winter. Trees are generally absent. Vegetation is extensive and continuous along the west shore from

Mono Lake County Park south to Old Marina where wide green swaths fringe the lake margin. Elsewhere, the shoreline's scattered, small to relatively extensive wetlands provide color interest and visual diversity with green, luxuriant patches interspersed among unvegetated alkali and sand flats.

Wetland vegetation adds diversity, variety, and interest to the semi-arid scenery surrounding the lake because of its dense, lush quality and relatively vivid color. Most wetlands along the west half of the shoreline are associated with tufa groves. Wetlands are spotty and less prominent along the eastern shoreline, with the exception of Simon's Spring and Warm Springs.

Vegetation along the western shoreline below U.S. 395 and the northwest shoreline to Black Point consists of extensive marsh and meadow wetlands. Wide bands of willow scrub encircle the upper margin of these wetlands and are especially dense around Mono Lake County Park and the Mill and Wilson Creek delta. The lake margin is bordered by a narrow, unvegetated fringe where alkali crusts form a whitish contrasting band when viewed against the green wetlands and blue lake.

Smaller meadow, marsh, and willow wetlands are associated with the Lee Vining and South Tufa groves. Large wetlands in the less accessible and less visible northern and eastern shoreline include Simon's Spring, Warm Springs, and an extensive band from the mouth of Cottonwood Creek west to the Wilson Tufa Grove at the base of Black Point.

The Simon's Spring wetland extends from the historic high stand down almost to the present shoreline. Tufa towers aligned on a fault jut into the wetland, forming a visually pleasing craglike parapet. The Warm Springs wetland is less extensive; it is mostly separated from the lake by a wide alkali flat. Likewise, the wetland band along the north shore west of Cottonwood Creek is narrow and separated from the lake by a wide alkali flat. Drier areas surrounding these wetlands and alkali flats support saltgrass and other species that provide visual interest, especially by their rich golden brown color during winter and spring.

Dryland shrubs encircling the Mono Lake shore generally occur above the zone of wetlands and alkali and sand flats. Except for the western shoreline from Black Point to Old Marina, the shoreline is encircled by rabbitbrush scrub that provides a golden yellow floral display during late summer. Occasional greasewood scrub stands occur along the southern shoreline near the lake and on Paoha and Negit Islands. Great Basin sagebrush scrub community encircles the entire shoreline area above the elevation of the lake's historic high stand (6,428 feet). This gray-colored shrub vegetation adds color and diversity to the Mono Lake scene.

Since diversions began, the extent of wetlands vegetation has increased (see Chapter 3C, "Vegetation").

Human-Made Features. Most human-made features in Mono Basin are at some distance from the lake and not directly affected by change in lake elevation. The only existing human-made features that are visually associated with the lake are the brine shrimp processing plant with its boat dock south of Mono Lake County Park and the parking lots, restrooms, and boardwalks/trails with their associated interpretive signs at Mono Lake County Park, Old Marina, South Tufa, and Navy Beach. The shrimp plant buildings are small scale and inconspicuous, and the boat dock can be viewed as a natural arrangement of rocks. The boardwalks and signs of Mono Lake County Park are small and inconspicuous to serve the recreational viewer of the lake.

Noticeable changes in the built environment that have occurred since diversions began are the mostly small developments and isolated residences scattered along State Route (SR) 167 and U.S. 395 north and south of Lee Vining (Figure 3I-17). Roads and overhead utility lines also contrast with the natural qualities in parts of the basin (Figure 3I-18). These changes, however, were not the result of stream diversions, and the acquisition of land by LADWP for diversion purposes may have actually limited the amount of such changes (see Chapter 3G, "Land Use"). Most of the powerlines creating visual impacts along U.S. 395 and SR 167 have been removed.

Viewers and Key Observation Points. Different types of viewers have differing levels of expectations, knowledge, and concern about the lake and its visual environment. Their focus on the lake environment, number of viewers, and duration of exposure also vary. These factors combine to give specific levels of visual concern, or visual sensitivity.

The three main types of viewers of the Mono Lake environment are local residents, destination recreationists, and travelers through the area. Table 3I-2 identifies the factors and resulting levels of visual sensitivity. In general, travelers through Mono Basin are considered to have high concern for visual quality, whereas local residents and destination recreationists have very high concern.

Mono Basin can be seen from many different viewpoints. However, the vast majority of viewers concentrate at only a few locations, principally developed recreation sites near the south, west, and northwest shores of Mono Lake and along U.S. 395, which runs north and south along the west side of the lake at the base of the Sierra Nevada.

Five locations have been identified from which most of the public views the lake and its setting: the Mono Lake Vista Point (highway overlook) on U.S. 395 below Conway Summit, the Mono Lake County Park, U.S. 395 adjacent to the Old Marina, the Mono Basin National Forest Scenic Area Visitor Center (opened in spring 1992), and the South Tufa area. Less visited locations include the southeast side of Black Point, SR 167 northeast of the lake, the Bodie Road north of the lake, the four-wheel-drive road around the east side of the lake, SR 120 east of Mono Craters, Panum Crater, points north of Grant Lake reservoir on Highway 158, and the town of Lee Vining.

Following is a brief description of the character of the five key viewpoints and the character of the view from each location. Lake-level simulations were prepared at each of these locations, as shown in Figure 3I-19. The descriptions of the following viewpoints do not detail the actual experience of the area or site by visitors, but are meant to characterize visual features from those viewpoints.

Conway Summit. This observation point is a roadside overlook on U.S. 395 just south of Conway Summit with some minor information/interpretive facilities. Many viewers stop at this popular location, although the typical duration of view is relatively short (15 minutes or less). The viewpoint is elevated 1,500 feet above the lake and is about 4.25 miles from the nearest shoreline. The vertical view angle to the lake is therefore steep.

The view offers a wide, sweeping panorama of almost the entire basin, dominated in the center by the lake, but extending far to the east along the southern face of the Bodie Hills, around the east end of the basin, along the south side of the lake bounded farther south by Cowtrack Mountain, to the Mono Craters, to the community of Lee Vining and along the west shore of the lake, bounded by the steep rise of the Sierra Nevada. The lake's islands, Paoha and Negit, are seen beyond and to the east of Black Point.

The white alkali land bridge and east shore are prominent also. The Conway Ranch, a historical ranching operation, and two housing developments (Conway Ranch and Mono City) are visible in the middle ground of the scene, set on a broad plain in the northwest corner of the basin. A view from this observation point at the approximate point-of-reference lake elevation is shown in Figure 3I-20.

Mono Lake County Park. This viewpoint is reached from Cemetery Road, east of U.S. 395 at the northwest corner of Mono Lake. Facilities include a parking lot, restrooms, picnic tables, and a boardwalk trail with interpretive signs. The many viewers here have generally a moderate duration of view (usually 15 minutes or longer). The boardwalk trail slopes down from an elevation 65 feet above the lake to the water level.

The distance to the shoreline from the parking lot is 0.5 mile. The viewpoint from the parking area is of the parking lot and the remaining park facilities. A dense band of riparian vegetation in the area between the park and the lake screens views to the lake.

Past the band of riparian vegetation and along the boardwalk trail, the lake is fully revealed and dominates the view. From the boardwalk, the focal points are the tufa deposits, the lake, and islands; a residential development immediately east is also evident. The scene from the boardwalk is characterized by the riparian vegetation and wet meadow in the foreground. Toward the lake, several land-based tufa deposits are visible. The flat terrain extending from Black Point is highly visible, along with various tufa deposits standing out in the water, and a playa area that forms the very northwest corner of the lake. U.S. 395 is visible at the base of the Sierra Nevada. The Mono Craters, although quite distant, are dramatic visual elements beyond the south shore of the lake. Paoha Island can be seen near the left edge of the visible portion of the lake. Negit Island is mostly obscured by Black Point. The boardwalk is an excellent location for bird watching. A view from this observation point under the approximate point-of-reference conditions is shown in Figure 3I-21.

U.S Highway 395 at the Old Marina. This observation point is along U.S. 395 where it passes near the west shore of the lake, south of Mono Lake County Park and north of Lee Vining. All travelers north-south through Mono Basin pass this location and can pull off to the side of the road for viewing. The viewpoint is approximately 110 feet above the surface of the lake and about 0.5 mile from the nearest point to the shore. The vertical view angle to the lake is therefore moderate to steep.

Views from this area are focused along the entire west shore and extend north to Mono Lake County Park and northwest to Black Point. The Bodie Hills form the north boundary of the scene. The large exposed alkali flat north of Negit Island is visible. Negit Island is in full view, its dark color contrasting with the light tan and buff of Paoha Island. The Old Marina tufa formations stand at the southwest corner of the lake. The near shore, in the immediate foreground, is littered with pumice blocks, which give a unique texture to the shore. To the west, the Sierra Nevada rises abruptly from U.S. 395, its face featuring varied densities of conifer with some open areas and rock outcrops. The vegetation patterns in this area are varied and interesting; the west shore has numerous springs and seeps and therefore a rich texture of wetland vegetation interspersed with dryland species. In addition, an abundance of bird life can be observed in this area. A view from this observation point under approximate point-of-reference conditions is shown in Figure 3I-22.

Mono Basin National Forest Scenic Area Visitor Center. The visitor center is located at the end of a short spur road heading east off U.S. 395, about one-third mile north of Lee Vining. Opened in 1992, the visitors center provides a full range of facilities. It is expected to attract many visitors who probably will visit for a moderate duration. The best view is from the patio on the east side of the building, which is about 325 feet above the lake and a distance of 1 mile from the nearest shore.

The viewing experience from the visitor center is dramatic and unique because it offers a relatively near view of the lake, but also a relatively elevated view as compared with many other key viewing locations. The viewer is able to take in panoramic views of the basin, beginning with the east face of the Sierra Nevada to the west. The entire west shore is revealed, including the interesting vegetative patterns created by the wetland communities found there. The northwest corner of the lake is in view, including the area at Mono Lake County Park. Interesting vegetative patterns, created by larger trees, are visible at and behind the county park. Some of the development at Mono City can be seen on a low ridge in the distance. The land bridge and alkali flats north of Negit Island are also visible. Negit Island is very dark in color, and Paoha Island is fully exposed, as are the small islets off its northwest corner. The far eastern lake shore is obscured by the upper portions of Paoha Island. The southeast shore of the lake, visible off the southern tip of Paoha Island, is seen against a backdrop of relatively uniform hills. Subtle horizontal lines or bands on these hills indicate former beach terraces. To the south, the view of the lake surface is cut off by a bench to the east of Lee Vining Creek in the foreground, but above it is a striking view of the White Mountains forming the horizon some 50 miles distant. The Mono Craters are also prominent features on the southern horizon.

The main focal points from the visitors center are the tufa at Old Marina, the lake surface, and, from left to right, Black Point, Negit Island, and Paoha Island. Lower Lee Vining Creek and its riparian corridor create a major focal point. A view from this observation point under approximate point-of-reference conditions is shown in Figure 3I-23.

South Tufa. This observation point, located near the south shore of the lake, is reached from Highway 120, 5 miles from U.S. 395. Facilities include a parking lot, a 1-mile self-guided nature trail, interpretive exhibits, toilets, and picnic tables. This location is visited more often than any other at the lakeshore. The duration of view of most of these visits is moderate to long. The parking lot is about 40 feet above the lake and about 0.25 mile distant, which provides a low vertical view angle. The main visual attraction here is the large tufa group, which is mostly land based at the point-of-reference lake level and the shoreline. However, water-based tufa is probably of greater focal interest than land-based tufa. Panoramic views are visible from the shore over and through the tufa, including the east face of the Sierra Nevada, Black Point, and Paoha Island (Negit Island is mostly hidden behind Paoha Island), against a backdrop of the Bodie Hills toward the west and north. The view to the east is open and expansive. South Tufa is the main site where visitors experience Mono Lake's water, shrimp, flies, birds, tufa, and vistas.

The focus of the viewpoint is the tufa, and, to a lesser extent, the surface of the lake, the island and the Sierra Nevada. The scene, strongly influenced by the tufa, is highly diverse. A view from this observation point under approximate point-of-reference conditions is shown in Figure 3I-24.

Diverted Tributary Streams

This section describes the potentially affected landscape elements along the diverted tributary streams and other landscape elements that comprise the visual character along the diverted tributary streams. It also identifies the key observation points for viewing the streams.

Potentially Affected Landscape Elements. The visual character of certain landscape elements along the diverted tributary streams could be affected by changing streamflows. These elements include channel and floodplain characteristics, streamflow characteristics, riparian vegetation, and irrigated pastureland. Streamflow characteristics of the diverted tributary streams are discussed in Chapter 2, "Project Alternatives", and Chapter 3A, "Hydrology". Channel characteristics and riparian vegetation are discussed in detail in Chapter 3C, "Vegetation".

Channel and Floodplain Characteristics. The channels of Lee Vining and Rush Creeks are varied in character. In places, especially in their lower reaches, the creeks are relatively wide and shallow, even braided, with much of the streambed in the lower reaches composed of cobbles. Near the lakeshore, Rush Creek and, to a lesser extent, Lee Vining Creek have cut their channels deeply (incised) into the unconsolidated floodplain sediments during the diversion period, creating new floodplains up to 20 feet below the prediversion floodplains.

Broad cobbly bars without topsoil and often scant vegetation occur where the floods of the 1960s caused major alterations of stream morphology. Three such cobble deposits occur on Rush Creek (just above the old highway bridge, upstream of the narrows, and between the county road and the lake), and another occurs on Lee Vining Creek near the county road crossing. The visual character of unvegetated cobble deposits contrasts with the vegetated riparian and upland landscapes that predominated when diversions began.

The channels of Walker and Parker Creeks are small, being only a few feet wide. Above U.S. 395, Parker Creek and, to a lesser degree, Walker Creek are very sinuous, creating interesting visual patterns and supporting a mosaic of riparian and meadow vegetation along their banks. Figures 3I-25, 3I-26, 3I-27, and 3I-28 show some of the channel and vegetation characteristics of Lee Vining, Walker, Parker, and Rush Creeks, respectively.

Streamflow Characteristics. After several decades of dewatering due to the diversions, flows were restored to Parker and Walker Creeks in 1990. Flows in Rush and Lee Vining Creeks, earlier quite low or absent, were enhanced gradually in the 1980s. The high streamflows that occur during snowmelt and the low streamflows that occur during late summer and fall have generally been moderated through flow releases since diversions began.

The visual effects of flowing water within a stream channel are strongly positive. The quantity of the flow is visually less important than the presence of flowing water. If streamflow tends to fill the channel (i.e., bank to bank), increases in the amount of water beyond that quantity may do little to further improve visual quality. After being shown photographs of Rush Creek at 20, 60, and 100 cfs, visitors to Rush and Lee Vining Creeks were asked in a 1991 survey which (if any) of the streamflow conditions was most appealing to them for their primary recreation activity. Of the visitors interviewed, 5% indicated that they preferred 20 cfs, 36% preferred 60 cfs, 43% preferred 100 cfs, and 15% had no preference.

Riparian Vegetation. Riparian vegetation has a positive visual effect on the landscape, adding variety of shape, texture, and color. Figures in Appendix P show the extent of existing riparian vegetation along the creeks in 1989, although additional riparian growth has occurred in some areas since then.

As described in Chapter 3C, "Vegetation", existing riparian vegetation on Lee Vining Creek from several miles above the diversion to just below U.S. 395 consists of a rather dense, irregular belt of forest consisting of conifers, hardwoods, and willow scrub. From a third of a mile below U.S. 395 to the lakeshore, riparian vegetation is sparse, consisting of clusters of cottonwoods and willows that survived dewatering or established recently. Sagebrush scrub, with charred stumps and fallen logs of cottonwood and pine, dominates most of the area formerly occupied by dense cottonwood-willow forest. Near the county road, vegetation is more continuous along the main channel, although it is still in an early stage of recovery from the unrestricted diversion period. Many 10- to 20-foot-tall cottonwoods and a few isolated and visually conspicuous conifers occur near the county road. Clumps of willow scrub and small cottonwoods are found on the creek delta near the lake. The lower Lee Vining Creek riparian community of today is significantly different than the prediversion community in density, diversity, and complexity.

Along Walker Creek above its diversion point is a dense, clearly defined stand of mature aspen. Below the diversion, the aspen ends abruptly, and the creek is lined with a corridor of dense but drought-stressed willow scrub, with a few scattered aspens and conifers. At its crossing of U.S. 395, Walker Creek has only a low, sparse growth of willow scrub along its immediate banks.

Directly above its diversion point, Parker Creek is bordered by a wide zone of moderately dense willow scrub with scattered conifers and aspen. Below the diversion, the vegetation is very similar to that on Walker Creek.

Below the Grant Lake reservoir dam, Rush Creek flows through a variety of landforms, each with different patterns of vegetation. Along the permanently dewatered reach just below the dam, former riparian vegetation is mostly dead. Below the return ditch (where flows are returned to the channel), a narrow strip of mixed riparian vegetation borders the stream descending through a ravine. Below, a broader strip of willow scrub and cottonwood forest with scattered pines extends to an area above the old highway bridge. From here to U.S. 395, vegetation is mostly absent. A narrow, nearly continuous strand of willows and young cottonwoods borders the stream to the narrows.

From the narrows to an area one-half mile upstream of the county road, the Rush Creek bottomlands support remnants of the extensive prediversion riparian forest. Dense thickets of willow and mountain rose, with an occasional mature cottonwood, are present. Most of the prediversion meadows remain, but are reduced in area and are dry rather than wet meadows.

Mature vegetation is absent from the deeply incised segment from the county road to the lakeshore, but willow seedlings have established extensively across the current floodplain. The visual character of lower Rush Creek and its delta has substantially changed because of the lowering of lake level during the diversion period.

Irrigated Pastureland. Irrigated pastureland is a landscape element that could be affected by streamflow changes. Approximately 2,000 acres of irrigated pastureland occurs west of U.S. 395 adjacent to Walker and Parker Creeks.

Other Landscape Elements - Human-Made Features. Other landscape elements that make up the visual character of the diverted tributary streams are the human-made features, primarily components of the Los Angeles Aqueduct. One conspicuous feature is the gravel road over the buried Lee Vining conduit from Lee Vining Creek to Grant Lake reservoir. The road appears as a straight, horizontal line across sagebrush-covered slopes west of U.S. 395. It is evident from U.S. 395, and less so from locations east of the highway.

The dam at Grant Lake reservoir, a large structure 87 feet high at its maximum and approximately 700 feet long, also is readily evident, although it generally does not appear as a dominant feature within the visual context of the surrounding natural topographic features. A bypass ditch is immediately downstream of the dam that, as seen from the road, is a relatively unobtrusive feature. On the reservoir side of the dam, a concrete structure where diverted water is delivered into the reservoir and the intake structure that conveys water out of the lake are visible, along with two rather small buildings (gage houses) at the dam.

Grant Lake reservoir, enlarged by the construction of the present dam over its prediversion condition, is easily visible from points within its topographic basin, primarily from the road on the west side of the reservoir. Less conspicuous components of the aqueduct system include the concrete diversion structures on Lee Vining Creek, Parker Creek, and Walker Creek. These features are generally visible only within their immediate vicinity; viewers must approach to within a few hundred feet or closer to see them.

Viewers and Key Observation Points. Because the highway does not pass along the diverted tributary streams, views of the streams from U.S. 395 are limited to the vicinity of the crossings of the four streams. The number of viewers from the highway is very high, but the visitors may not notice the Walker and Parker Creek crossings at all.

The June Lake Loop road passes near Rush Creek for some distance, affording relatively distant viewing. SR 120 to Yosemite crosses Lee Vining Creek and passes near it upstream of the town of Lee Vining, providing some additional views. The number of viewers from these roads is moderate to high, respectively. Lower Lee Vining Creek also is plainly visible from the new Mono Basin National Forest Scenic Area Visitor Center near town and from several locations in the town of Lee Vining and is thus apparent to both the relatively small number of local residents and the high number of travelers visiting the center or staying in overnight accommodations.

Improved and primitive unsurfaced roads provide closer viewing of the diverted tributary streams. The county road along the lake, providing secondary access from U.S. 395 to South Tufa, is the most heavily used and crosses both Lee Vining and Rush Creeks at their deltas. A public road passes along the Rush Creek bottomlands for several miles from U.S. 395 to the county road, but it is used infrequently. Roads open to the public on LADWP lands provide views of and access to Parker, Walker, and Rush Creeks in several places, and these roads also are relatively lightly used. Most sustained views of the diverted tributary streams are by fly fishers and other recreationists reaching the streams by these roads and walking their streambanks. The total number of such users is moderate.

Grant Lake Reservoir

This section describes the potentially affected landscape elements at Grant Lake reservoir, describes other landscape elements that comprise the visual character, and identifies the key observation points for viewing the reservoir.

Potentially Affected Landscape Elements. The landscape elements that are potentially affected by fluctuating reservoir levels at Grant Lake reservoir include shorelines and vegetation. Reservoir levels are discussed in Chapter 3A, "Hydrology", and vegetation characteristics are discussed in Chapter 3C, "Vegetation".

Shoreline. The shoreline of Grant Lake reservoir is generally composed of coarse sands, gravels, and cobbles. The highest possible level of water, corresponding to the elevation of the spillway of the dam, is immediately evident. The water surface, however, rarely reaches this highest elevation; the water level is almost always drawn down, often far down below this level. Historical records of the surface elevation of Grant Lake reservoir from 1970 to 1989 show a typical pattern of low water elevation in spring, an abrupt rise in early summer, followed by a slower decline. Over the 20-year period between 1970-1989, high levels were reached as early as April or as late as November, but most often in June. Low levels usually have occurred in April, but occasionally as early as December or as late as May. The average annual drawdown has been 32 feet.

Vegetation. Vegetation patterns around the south end of the reservoir are varied and visually interesting, with conifers and aspen above the unvegetated drawdown zone, juniper on parts of the hillside, and a large grove of aspen on the east-facing slope. North of this point, vegetation becomes simpler, generally a uniform growth of sagebrush scrub. The pattern is varied only by plantings (including mature trees) around the recreational developments about 1.5 miles from the reservoir's upstream end.

Other Landscape Elements. Other landscape elements that comprise the visual character at Grant Lake reservoir include landform and human-made features.

Landform. The south end of Grant Lake reservoir is enclosed by a steep and rugged canyon from which Rush Creek issues. Beyond the reservoir to the south is a highly scenic landscape, given visual variety by the many broken, angular rock outcrops on the canyon walls. As the viewer moves north, the valley changes character, grading into smoother, more rolling hillsides with even slopes. A low, mounded landform stretches across the valley 1.5 miles from its upper end. North of this point, the slopes forming the valley become progressively lower, smoother, and less varied, giving the impression of a topographic bowl, an unexceptional but visually pleasant landform.

Human-Made Features. At the south end of the reservoir are a few minor recreational facilities, parking lots, and interpretive signs. The main concentration of human-made elements is at the peninsula that extends into the reservoir from its west shore. Here are extensive recreation facilities, including campsites, picnic grounds, a cafe, boat rental, boat ramps, and miscellaneous buildings. When the reservoir is drawn down, these may be far from the water. The only structures at the northern end are the dam, a rock-faced structure that appears similar to rocky portions of the drawn down shoreline, and two gage houses.

Viewers and Key Observation Points. The viewpoint along the main, paved road at the peninsula that extends into Grant Lake reservoir from its west shore is typical of most viewpoints at the reservoir, although its extreme southern end is more rugged and scenic. This viewpoint is the site of a concentration of recreational facilities, including a campsite, picnic ground, cafe, and boat rental facilities. The number of viewers here is high, particularly because the highway along the reservoir is part of the scenic June Lake Loop, and the duration of view, on average, is moderate. The view is of the moderately steep topographic bowl, open at its north end, which holds the reservoir. The reservoir is visually dominant as it fills most of the floor of the valley. The drawn down shore of the reservoir is evident. Vegetation is moderately varied, with a mosaic of shrubs and talus on the hillsides. Planted trees are found around the recreational facilities. The diversity of the scenes is moderate. The dam, the drawn down shoreline of the reservoir, and some of the recreational facilities are artificial intrusions into an otherwise natural setting (Figure 3I-29).

Relevant Plans and Policies

Four government agencies have responsibility for managing the lands within Mono Basin. The agencies' plans and policies that are relevant to visual resources are briefly outlined in the following sections.

U.S. Forest Service. The USFS has responsibility for managing Mono Basin National Forest Scenic Area (Scenic Area) (Figure 3J-1). The USFS has published its goals, standards, guidelines, management practices, and specific actions for the Scenic Area in 1989 Scenic Area Final Comprehensive Management Plan (U.S. Forest Service 1989a), which was accompanied by a final environmental impact statement (U.S. Forest Service 1989b). The Scenic Area is administered by the Inyo National Forest.

The Land and Resource Management Plan for the Inyo National Forest applies to the Scenic Area and other USFS lands in Mono Basin. These other areas are west and south of the Scenic Area, sometimes abutting it directly, or separated from it by areas of private land or land owned by LADWP.

Visual Resources Goal. The legislative direction for the Scenic Area is to protect its natural resources, including its scenic resources, while allowing recreational and other appropriate activities. The USFS examined several alternative approaches for managing the Scenic Area. The alternative selected emphasizes ecological, interpretive, and scenic values based on a lake elevation between 6,377 feet and 6,390 feet, with a maintenance level near the midpoint of this range (i.e., elevation 6,383.5 feet). The basic visual resource goal selected for the Scenic Area is to maintain and enhance the visual resource.

Visual Management System. The USFS uses its nationwide Visual Management System (VMS) to formulate goals and apply standards for managing visual resources in the Scenic Area.

As a first step, the VMS defines "variety classes" for all Scenic Area landscapes. The greater the variety, the greater the visual value of the landscape, assuming other conditions are equal. Three classes are defined: distinctive, common, and minimal. The highest class, distinctive, refers to those areas where features, including water features, are of unusual or outstanding visual quality. Distinctive variety class landscapes are usually not common in a surrounding region. Common variety class scenery typically includes forested lands on rolling terrain, with a few vegetative or topographic variations. Minimal variety class lands are generally expansive and brush-covered with little variation. Mono Basin is typical of most Great Basin landscapes, with a high percentage of minimal variety class land. About 46% of Scenic Area lands are classified as distinctive, 11% common, and 42% minimal, excluding the surface area of Mono Lake.

The VMS also defines "visual sensitivity" levels for viewers as the measure of the potential impacts of actions affecting concern for scenic quality. The levels related to the types of viewers (recreationists) and the importance of the viewpoint and number of viewers. Most Scenic Area lands are visually sensitive primarily due to the high visibility of the landscape and the many observation points that are the locations of visually sensitive (usually recreational) viewers. Ninety percent of the Scenic Area is Sensitivity Level 1 (most sensitive), 6% is Sensitivity Level 2 (moderately sensitive), and 4% is Sensitivity Level 3 (least sensitive). Sensitivity Level 1 observation points include:

- U.S. 395 and SRs 120 and 167;
- Lundy Canyon Road;
- Cemetery Road (from U.S. 395 to Mono Lake County Park);
- the Mono Basin National Forest Scenic Area Visitor Center; and
- South Tufa, Panum Crater, Navy Beach, Old Marina, Mono Basin County Park and Black Point visitor sites.

Variety class and visual sensitivity are considered together to yield visual quality objectives (VQOs). VQOs define degrees of acceptable alteration of the natural landscape and range from highly restrictive to relatively permissive. In descending order of restrictiveness, they are Preservation, Retention, Partial Retention, Modification, and Maximum Modification. The VQOs that have been applied to Scenic Area lands in their current condition are listed in Table 3I-3, with the permissible constraints or management activities of each and the percentage of the Scenic Area that each occupies.

USFS also inventoried existing visual conditions (EVCs) for the Scenic Area. These conditions describe the degree to which the natural appearance of the landscape has been altered. There are five EVCs that generally relate to the VQOs. The types, with their general degree of disturbance and the percentage of the Scenic Area that each occupies, are shown in Table 3I-4.

Visual Absorption Capability (VAC) is the degree to which the landscape can absorb land-disturbing activities, usually by vegetative or topographic screening. The Scenic Area has a low capability of visually absorbing land-disturbing activities. Screening vegetation is frequently sparse, and areas near the lake contain relatively little topographic relief. Many views encompass nearly the entire basin. About 6% of the Scenic Area has a high VAC, 48% a moderate VAC, and 46% a low VAC.

Management Practices. Based on the results from applying the Visual Management System, the USFS formulated policies concerning management practices in the Scenic Area to meet the basic visual goal. These policies are as follows:

- Meet the VQOs of retention or partial retention for all public lands according to specified land use zones.
- Maintain or enhance the size and diversity of all riparian zones, aspen stands, and meadows in the most sensitive and moderately sensitive areas.
- Plant and maintain vegetation at developed sites to provide screening and a natural-appearing setting.
- Prohibit additional overhead utility corridors within or through areas of most visual sensitivity.
- Encourage the undergrounding or relocating of existing utility lines to minimize visual impacts in specific areas.
- Work with Mono County and other interested parties to identify existing visually detracting uses in the Scenic Area and implement mitigation as feasible.

Based on USFS (1989b) information, successful application of the management practices would result in VQOs within the Scenic Area of 80% Retention and 20% Partial Retention. Future visual conditions using the EVC criteria previously described would be as follows: Type I, Untouched Landscape, 44%; Type II, Changes Unnoticed, 26%; Type III, Minor Disturbances, 20%; Type IV, Disturbances, 6%; and Type V, Major Disturbances, 3%. These percentages, which do not equal 100% due to rounding, are not substantially different from those for the current EVCs (Table 3I-4).

The USFS also established guidelines to assess compatibility of proposed commercial uses or developments on private lands with the purposes of the Scenic Area. These guidelines are designed to protect natural resources, including visual resources.

U.S. Bureau of Land Management. The BLM is responsible for most of the public land to the north and east of the National Forest Scenic Area. BLM-managed land serves as a backdrop for Scenic Area views and includes the Bodie Hills, the eastern portions of Mono Basin, and Cowtrack Mountain. Visual resource management along travel corridors to the Scenic Area and Bodie State Park is recognized as important. The BLM has identified its general management intentions and Visual Resource Management (VRM) objectives in the 1992 final Bishop Resource Area Management Plan and EIS.

The BLM evaluated several management approaches for the resource area and selected one that seeks to provide a balance between developing resources and protecting or enhancing environmental values, including scenic values. The management approach also will preserve certain public lands in their natural condition and will provide for outdoor recreation, among other uses. Riparian vegetation will be protected. Specific management intentions for the BLM-managed portion of the periphery of the Scenic Area include protecting and enhancing scenic values and providing opportunities for dispersed recreation.

The BLM defines four VRM classes, but all the BLM-managed public land surrounding the Mono Basin National Forest Scenic Area is VRM Class II. The objectives of this class are as follows:

> Retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen from key observation points, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color and texture found in the predominant natural features of the characteristic landscape.

California Department of Parks and Recreation. The California Department of Parks and Recreation (DPR) is responsible for managing lands within the Mono Lake Tufa State Reserve (within the Scenic Area and below 6,417 feet elevation on lands adjacent to nonfederally held parcels). State Reserves consist of areas embracing Outstanding Natural or Scenic characteristics of statewide significance. DPR policy for managing state reserves calls for protection of ecological, scientific, and natural values. The purpose of state reserves is to preserve native ecological associations, unique fauna or floral characteristics, geological features, and scenic qualities in a condition of undisturbed integrity. Physical features may be established in state reserves to further research or to provide for guarded public visitations, but should be kept to a minimum as necessary and irreparable damage to the natural or physical values must be avoided. DPR does not have a formal visual analysis system corresponding to the USFS's VMS. No campgrounds or other such types of development are permitted. (Carle pers. comm.)

Los Angeles Department of Water and Power. LADWP manages several parcels of land in the Scenic Area, as well as the Cain Ranch on upstream reaches of Rush, Parker, and Walker Creeks. The agency's policies to preserve visual quality limit signs and billboards.

Upper Owens River Basin

The potentially affected visual resources in Upper Owens River basin include the Upper Owens River and Lake Crowley reservoir. The lands adjacent to these resources are managed for multiple uses. In addition to being elements of the Los Angeles water conveyance system, these water features support grazing and recreational use, the latter resulting in many visually sensitive viewers in the area.

The Upper Owens River basin is a broad, relatively featureless valley through which the Upper Owens River flows. The floodplain near the East Portal is one-quarter mile wide, widening through broad meadowlands downstream toward the relatively shallow reservoir. The valley is bounded by moderately steep, moderately rugged hills on its north side, rising 3,000 feet above the valley floor. To the east, west, and southwest are more gently sloping hills, forming a broken and irregular topography rising gradually to almost 2,000 feet above the valley floor.

Upper Owens River

This section describes the potentially affected landscape elements along the Upper Owens River, describes other landscape elements that comprise the visual character of the Upper Owens River, and identifies sensitive viewers and key observation points for viewing the river. (A map of the Upper Owens River area is shown in Figure 1-4 in Chapter 1.)

Potentially Affected Landscape Elements. The visual character of certain landscape elements could be affected by changing streamflows. These elements include channel characteristics, streamflows, and vegetation, including irrigated pasturelands.

Channel Characteristics. The Upper Owens River has a relatively low gradient, meandering extensively with multiple cutoffs and oxbows, dividing into two or more parallel channels as it progresses downstream. The channels are typically wide and shallow, and their beds are composed of silts, sands, and gravels. These conditions are in contrast to the presence of undercut banks, diverse substrates, and narrower and deeper channels in the preaugmented flows from Mono Basin (EBASCO Environmental et al. 1993).

Streamflows. Since diversions began from Mono Basin, the average flows in the Upper Owens River have increased substantially because the river channel now serves as a conveyance facility for the Los Angeles water supply system. In general, the flows below the East Portal are two to three times as great as those above it and fluctuate over a proportionately greater range. Chapter 3A, "Hydrology", and Chapter 3C, "Vegetation", describe the flow characteristics of the river.

Vegetation. Above the East Portal, the vegetation of the valley floor is varied. Lower stream terraces support meadows with bands of mature conifers randomly scattered among willows concentrated along the river. Sagebrush and rabbitbrush inhabit higher terraces bordering the stream.

Below the East Portal, the vegetation along the banks of the Owens River and on the valley floor is mostly a uniform grassy meadow, wet in places, which is irrigated and is grazed by cattle. The only woody riparian vegetation here consists of scattered willow stands immediately below the East Portal. Local ranchers claim that because of more alkaline soil types below East Portal, riparian vegetation was historically sparse (Arcularias pers. comm.). This flat, grassy valley floor is flanked by low, level or rolling benches covered by sagebrush and rabbitbrush, which occasionally extend to the riverbanks (see Figure 3I-30). Approximately 1,350 acres of irrigated pasturelands occur mostly within a 1-mile-wide swath along the river from East Portal to Lake Crowley reservoir.

Other Landscape Elements. Other landscape elements that comprise the visual character of the Upper Owens River basin include certain human-made features. Human-made features are present but inconspicuous in most of the river valley and include many cattle fences and other ranch facilities, typically consisting of small groups of buildings. A prominent transmission line on wood H-frame structures crosses the valley about midway between East Portal and Lake Crowley reservoir. An active landfill is located on a low bench southwest of Benton Crossing, but it is not highly visible.

Viewers and Key Observation Points. A moderate number of recreationists visit both private and public land along the Upper Owens River to hunt and fish. Local residents and destination recreationists are the two main types of viewers of the landscape elements in the Upper Owens River. Both viewer types are considered to have high concern for scenic quality. Travelers on U.S. 395 are not expected to be affected by potential project-related visual changes.

Lake Crowley Reservoir

This section describes the potentially affected landscape elements at Lake Crowley reservoir, described in the "Other Landscape Elements" section, that affect the visual character of Lake Crowley reservoir, and identifies sensitive viewer and key observation points.

Potentially Affected Landscape Elements. The visual character of certain landscape elements could be affected by fluctuating reservoir levels. These elements include shoreline and lake surface and vegetation.

Shoreline and Lake Surface. The shoreline of Lake Crowley reservoir is composed of sands and sedimentary bluffs (Figure 3I-31). Although it is difficult to perceive in the distance from U.S. 395, much of the shoreline is evident from every vantage point around the reservoir. Drawn down reservoirs are sometimes regarded as visually displeasing presumably because they do not appear natural. However, boaters, anglers, or other water-dependent recreationists using a drawn down reservoir apparently find the adverse visual effect to be acceptable.

Records of the surface elevation of Lake Crowley reservoir from 1970 to 1989 show an irregular drawn down pattern, with a typical (but not invariable) low water level in winter or spring, and an abrupt rise to an early summer high, followed by a slower drop (refer to Chapter 3A, "Hydrology"). Over the 20-year period of record, high levels were reached most often in June or July, with highs in March, April, and May common. Low levels typically occurred October-March, but occasionally later in the spring. High elevations reached the spillway during only 2 years of the 20-year period of record. During 10 other years, however, the high water elevation was within a few feet of the maximum level. The average low over the period of record was about 18 feet below maximum level.

Vegetation. Vegetation around Lake Crowley reservoir is a sagebrush and rabbitbrush community, with a few small meadows near the lake margins. This same brush community extends from the lake in all directions except upstream along the Upper Owens River, which is bordered by meadows and marshes. The surrounding hills and the Sierra Nevada have sparse to dense conifer cover.

Other Landscape Elements. Other landscape elements that comprise the visual character of Lake Crowley reservoir include landforms and human-made elements.

Landform. Lake Crowley reservoir is set in a bowlike landform extension of the southeast Upper Owens River basin. Overall, it is relatively featureless and expansive, bounded on the east by moderately rugged hills rising steadily to 1,000 feet or more above the valley floor. The 600-foot-deep, narrow Owens River gorge leads east from the southeast corner of the bowl. To the south and southwest is the steep, rugged face of the Sierra Nevada. To the northwest are moderately rugged hills rising to about 1,500 feet above the valley floor to create a varied and irregular topography. In the immediate vicinity of the reservoir, most landforms are low rolling hills. Occasional bluffs rise steeply from the east and northwest shores of the reservoir. These sometimes show unvegetated, white vertical faces of eroded sediment (see Figure 3I-31).

Human-Made Features. Scattered pockets of residential and other development occur along U.S. 395 where it passes Lake Crowley reservoir to the south and southwest. A small group of recreation-related buildings are located at the reservoir's south boat landing; some of them have an industrial appearance. The dam that forms the lake is an earthen structure armored with coarse rock. Associated with it are several small industrial-type buildings, as well as security fences, electrical distribution lines, and a spillway structure.

Viewers and Key Observation Points. The number of local residents potentially affected is low; the number of destination recreationists potentially affected is relatively high. Lake Crowley Campground, a developed recreation site located west of U.S. 395, is a popular destination site between the fishing season opener in late April and Memorial Day weekend. Most visits are associated with fishing and general leisure. Recreational viewers are located primarily around Lake Crowley reservoir and at Benton Crossing where camping is also popular (see Chapter 3J, "Recreation Resources").

Relevant Plans and Policies

Three government agencies have responsibility for managing the lands within the Upper Owens River basin. The agencies' plans and policies that are relevant to visual resources are briefly outlined in the following sections. They are not applicable to the private lands along the river from the East Portal to a point several miles downstream.

Los Angeles Department of Water and Power. LADWP is responsible for managing all the lands surrounding Lake Crowley reservoir and along more than one-half of the Upper Owens River below the East Portal. The agencies' policies concerning visual resources limit affecting signage and billboards.

U.S. Forest Service. The Upper Owens River, from above East Portal to a point about 5 miles above Lake Crowley reservoir, is within the Inyo National Forest boundary, but the land along the potentially affected river segment is entirely privately owned. Lands immediately to the north forming the background of the river valley are USFS lands managed with a VQO of Partial Retention.

U.S. Bureau of Land Management. BLM is responsible for managing public lands south of the National Forest boundary. It adopted a management approach for the Upper Owens River basin that is similar to the policy described above for lands in Mono Basin. All the BLM-managed public land in this area is designated VRM Class II, which was described above for Mono Basin.

IMPACT ASSESSMENT METHODOLOGY

Changes in water exports from Mono Basin will affect visual resources in Mono Basin and Upper Owens River basin. Specific areas where visual resources will be affected include Mono Lake, the lower tributaries, Grant Lake reservoir, Upper Owens River, and Lake Crowley reservoir.

This section describes the methods used to analyze impacts on visual resources at these areas and to assess the significance of these impacts.

Impact Prediction Methodology

The analysis of visual resources impacts focuses on determining the effects of the water diversion alternatives on the scenic quality of affected resource areas. Scenic quality can be thought of as the perceived property of the visual environment that relates to beauty and the impressions formed about the degree of excellence.

An important consideration in evaluating effects on scenic quality is how the character of a landscape is altered. Landscape character is defined as the perceived combined effect of different visual elements (or objects) that gives a landscape distinction and through which it becomes recognized and identified. The influence of a particular visual element on landscape character depends largely on the visual strength it demonstrates.

The basic steps of the visual resource assessment to determine impacts on scenic quality include:

- identifying important landscape elements that will be visually changed by the diversion alternatives,
- determining whether the contribution of each element to scenic quality is positive (enhances scenic quality) or negative (diminishes scenic quality) and how strong the effect is,
- determining the relative importance of each landscape element in terms of its influence on scenic quality,
- identifying the extent of change to important landscape elements and evaluating the collective influence of the changes on landscape character and scenic quality, and
- evaluating changes in the visual environment of the affected area relative to criteria for determining significant impacts.

The approach typically used for assessing impacts and for managing visual resources on lands managed by the USFS is the Visual Management System (VMS). The VMS was developed for analyzing the visual effects of resource management actions that entail potential increased evidence of human activity (e.g., such as the introduction of roads or electrical transmission lines, or significant changes in landscape elements, such as altered vegetation patterns associated with timber harvests). Because this project involves hydrologic-related changes to the visual environment that a casual observer might perceive as natural, direct application of VMS procedures to assess the visual impacts of this project is not considered appropriate; however, certain premises embodied in VMS do apply for the analysis. These premises, which address the landscape itself, viewers of the landscape, and modifications to the landscape are as follows:

- The landscape
  - Diverse landscape character is important.
  - Retention of landscape character is desirable.
  - The capacity of the landscape to absorb change without loss of character is variable.

- Viewers of the landscape
  - Viewers have expectations regarding the image of the landscape.
  - Expectations are related to identifiable regions.
  - Viewers expect a natural-appearing landscape character.
  - Viewer concern for scenic quality varies by type of viewer.
  - The duration of the viewing experience is critical.
  - The focus of the viewer's attention is critical.
  - The number of viewers is critical.

- Landscape modifications
  - The visual impact and character of management activity is critical.
  - Alteration of character in landscapes with little variety may be desirable.

The visual impact assessment for this evaluation considers long-term, near-term, and drought effects of the diversion alternatives. The long-term analysis focuses on changes to the landscape that occur at dynamic equilibrium, which includes the normal range of fluctuations in lake level and streamflows for each project alternative. The near-term analysis considers the transition period for the alternatives (i.e., the time frame needed to achieve dynamic equilibrium under the normal range of fluctuations). Infrequent extremes in lake levels and streamflows are evaluated in the drought analysis.

The assessment methods for analyzing impacts at each affected area within Mono Basin and Upper Owens River basin are described below.

Mono Lake

Landscape elements at Mono Lake that will be visibly changed include the following:

- lake surface area,
- water-based tufa,
- land-based tufa,
- sand tufa,
- alkali flats,
- pumice blocks,
- islands,
- islets,
- regional visibility,
- visually conspicuous birds,
- visually conspicuous alkali flies and brine shrimp,
- wetland vegetation near the lakeshore, and
- human-made (built) features.

A survey of visitors to Mono Lake was conducted to obtain judgments of scenic quality of scenes depicting Mono Lake at different lake levels, to determine preference for those scenes, and to identify key elements that affect scenic quality. (Additional details of the survey are included in Appendix V.) Actual photographs at lake surface elevation of 6,374.5 feet (the level in September 1991), and simulated scenes representing the appearance of the landscape under four different lake surface elevations (6,372 feet, 6,380 feet, 6,390 feet, and 6,410 feet) were prepared at five popular locations: South Tufa grove, the Mono Lake County Park, the Mono Lake vista point along U.S. 395 near Conway Summit, the new Mono Basin National Forest Scenic Area Visitors Center, and along northbound U.S. 395 near Old Marina. One set of these simulations, depicting alternative lake levels along U.S. 395 near Old Marina, is shown in Figure 3I-32; a complete set of the simulations is included in Appendix V.

Survey respondents were asked to judge the scenic beauty of each of the 25 scenes on a scale from 1 to 10. Respondents were then asked to view five variations of one scene and indicate their preferences by ranking the five images in order of preference. Finally, respondents were asked to rate the importance of each element to the overall scenic beauty of Mono Basin. This question allowed for identifying elements that were perceived by the public to contribute positively to the scenic quality and those perceived to have a minimal contribution or to detract from scenic beauty. The 10 elements evaluated by respondents included birds, land-based tufa, wetland vegetation near the lakeshore, alkali flats, water-based tufa, alkali flies and brine shrimp, islands and islets, exposed pumice blocks, human-made elements near the lakeshore (boardwalks and interpretive displays), and sand tufa.

Results of the survey suggest that no pattern is clearly identifiable by which the public judges scenic beauty of the 25 test scenes. The results also indicate that the higher surface elevations are preferred, except for lake elevation 6,410 feet where tufa towers, pumice blocks, and wetland vegetation in the foreground are totally inundated. The results further indicate that tufa towers, especially those that are surrounded by water at their base; visually conspicuous birds; and sand tufa are judged by the public to be the most important positive elements relative to scenic quality. Other elements judged as important to scenic quality include islands, near-shore wetland vegetation, and pumice blocks.

The next step was to identify whether changes to the elements would be positive or negative. This evaluation was performed primarily from analysis of the public perception survey data. Where appropriate, professional judgments of the SWRCB consultants, based on direct observations made in the field and knowledge gained through consulting with agency personnel and other experts, reviewing published sources, and studying the conditions depicted in the 25 simulated scenes of the lake, contributed to identifying positive and negative elements.

The relative importance to landscape character and scenic quality of different elements was determined by studying the results of the public perception survey and changes revealed in the 25 simulated scenes. The consequences of the alternatives from vantage points not represented by the simulated scenes also were considered. Approximate thresholds for these elements to protect scenic quality and preserve landscape character were then established.

The change in each element resulting from alternative lake levels was then identified and evaluated in terms of its consequences or influence on scenic quality of Mono Basin. The status of important landscape elements at these points was determined from resource inventories and from the impact analyses performed for different affected resources. Historical accounts and descriptions of Mono Basin also were examined.

Finally, the summary effect on scenic quality was evaluated relative to the impact significance criteria. Beneficial effects on scenic quality were also identified. The landscape conditions at the point of reference were compared to historical landscape conditions to identify changes between the prediversion period and 1989.

Lower Tributary Streams

The assessment of visual resource impacts on Lee Vining, Parker, Walker, and Rush Creeks followed a similar but more simplified process. Landscape elements that could be visibly changed include:

- streamside vegetation,
- streamflow, and
- irrigated pastureland.

Data on the extent and type of streamside vegetation affected, streamflow levels, and acres of irrigated pasture under each project alternative were reviewed. Based on review of the ranges of probable impacts and their relationship to scenic quality, streamside vegetation was determined to be is the most important element in assessing potential impacts on scenic quality. The changes in streamside vegetation were then identified as adverse, neutral, or positive and evaluated in terms of their potential impact on scenic quality. These effects were then evaluated relative to the visual impact criteria to assess their significance.

Grant Lake Reservoir

The assessment of visual resource impacts at Grant Lake reservoir followed similar procedures. Landscape elements that could be visibly changed include:

- shoreline vegetation and
- exposed land from drawdown of the reservoir.

Data on the pattern and extent of drawdown of the reservoir and potential shoreline vegetation effects of project alternative relative to point-of-reference conditions were reviewed. Based on review of the ranges of probable impacts and their relationship to scenic quality, exposed land from drawdown of the reservoir was determined to be the key element in assessing potential impacts on scenic quality. The amount of land inundated and exposed in wet years when the reservoir is drawn down was determined for each alternative because this zone will be generally devoid of vegetation. The impacts of these effects on scenic quality were then evaluated relative to the impact criteria to assess their significance.

Upper Owens River

Landscape elements along the Upper Owens River that could be visibly changed by the diversion alternatives are:

- streamside vegetation,
- streamflow, and
- irrigated pasture.

Data on the extent and type of streamside vegetation affected, streamflow levels, and acres of irrigated pasture for each project alternative were reviewed. Similar to the lower tributaries, streamside vegetation was determined to be the most important element in assessing potential impacts on scenic quality based on the ranges of probable effects. The changes in streamside vegetation were then identified as adverse, neutral, or positive and evaluated in terms of their potential impact on scenic quality. These impacts were then evaluated relative to the visual impact criteria to assess their significance.

Lake Crowley Reservoir

Landscape elements at Lake Crowley reservoir that could be visibly changed by the diversion alternatives include:

- shoreline vegetation and
- exposed land from drawdown of the reservoir.

Data on the pattern and extent of drawdown of the reservoir and potential shoreline vegetation effects of project alternative relative to point-of-reference conditions were reviewed. Similar to Grant Lake reservoir, exposed land from drawdown of the reservoir was determined to be the key element in assessing potential impacts on scenic quality. The amount of land exposed when the reservoir is drawn down to different levels and the drawdown period was determined for each alternative. The impacts of these effects on scenic quality were then evaluated relative to the impact criteria to assess significance.

Criteria for Determining Significant Adverse Impacts

To determine the significance of adverse visual resource impacts, expected changes in key landscape elements were evaluated relative to the visual impact significance criteria described below.

A project alternative is considered to have a significant adverse impact on scenic quality if one of the following conditions would occur:

- total inundation or toppling of more than 10% of tufa towers at visually important locations, or destruction of existing sand tufa at Mono Lake;
- greater than 10% reduction in nesting capacity of gulls or a major change in the observability of visually important species;
- major changes to other landscape elements;
- loss of streamside vegetation along the lower tributaries that is substantially noticeable;
- increase in reservoir drawdown at Grant Lake reservoir or Lake Crowley reservoir that results in a substantially noticeable increase in barren lakeshore, assumed to occur with a doubling of vertical drawdown; and
- loss of streamside vegetation along the Upper Owens River that is substantially noticeable.

Possible changes to VQO's and the BLM's visual resource management classes also were considered in establishing these criteria. Because none of the alternatives, with the possible exception of the No-Restriction Alternative, would result in visual resource impacts that would be inconsistent with the visual resource goals of these management systems, changes were not evaluated using the systems.

SUMMARY COMPARISON OF IMPACTS AND BENEFITS OF THE ALTERNATIVES

As described above in the "Impact Assessment Methodology" section, relative visual resource effects of the alternatives are assessed in this chapter through several key variables:

- inundation and erosion of tufa towers and sand tufa at Mono Lake;
- numbers of visually conspicuous birds at Mono Lake;
- changes to other landscape elements at Mono Lake (i.e., Negit Island, wetland vegetation, alkali flats, pumice blocks, and dust storms);
- amount of riparian vegetation along the lower tributary streams and the Upper Owens River;

- exposed lake area from drawdown of Grant Lake and Lake Crowley reservoirs; and

- the overall effect of changes to these landscape features on scenic quality at each affected area.

Table 3I-5 provides a summary comparison of the alternatives using these variables. Values of the variables for each alternative are compared to values for prediversion and point-of-reference conditions. Those values representing significant adverse conditions or significant adverse changes from the point-of-reference condition are indicated with an asterisk. Table 3I-6 provides supporting information about effects of tufa tower toppling and submergence for each important tufa grove.

Significant adverse impacts on scenic quality at Mono Lake would occur from destruction or reduced exposure of tufa if the 6,390-Ft, 6,410-Ft, or the No-Diversion Alternatives were implemented. Significant reductions in scenic quality from declines in populations of visually conspicuous birds would occur at Mono Lake if the No-Restriction or the 6,372-Ft Alternatives were implemented. Implementation of the No-Restriction Alternative also would result in a significant loss of scenic quality along the lower tributaries because of substantial reductions in riparian vegetation. Visually significant increases in drawdown at Lake Crowley reservoir would occur for the higher lake level alternatives. A discussion of these and other visual effects of the project alternatives is provided in the following sections of this chapter.

IMPACTS AND MITIGATION MEASURES FOR THE NO-RESTRICTION ALTERNATIVE

Changes in Resource Conditions

Changes in resource conditions at Mono Lake, lower tributaries, Grant Lake reservoir, Upper Owens River, and Lake Crowley reservoir are described in this section. Long-term, near-term, and drought effects are considered for each area; however, near-term and drought effects are reported only when the impacts are substantially different from long-term changes.

Mono Lake

Long-Term Changes. The key landscape elements for determining the impact on scenic quality at Mono Lake are tufa (including towers and sand tufa) and visually conspicuous birds. The effects of the No-Restriction Alternative on these and other visual elements at Mono Lake under long-term (i.e., dynamic equilibrium) conditions are described below.

Tufa. Tufa towers are the most important landscape element contributing positively to the landscape character and scenic quality of Mono Lake. Under the No-Restriction Alternative, most or all of the towers that protrude above the water's surface under point-of reference conditions would become land based. Additional, currently submerged towers would become visible. Sand tufa would not be affected because it lies entirely above an elevation of 6,390 feet.

Visually Conspicuous Birds. Under the No-Restriction Alternative, large decreases would occur in the numbers of visually conspicuous birds at Mono Lake. Gulls could abandon nests, and grebes and phalaropes could bypass the area during their migration. Populations of gulls would be most affected, but grebes and phalaropes would also be affected.

Other Landscape Elements. The effects of the No-Restriction Alternative on other landscape elements are described below.

- Islands - Under this alternative, Negit Island would be joined to the mainland along its entire northwest side and would appear to be a mainland peninsula.
- Wetland vegetation - The amount of wetland vegetation near the lakeshore would decrease by approximately 2,500 acres (from about 2,800 acres to about 300 acres).
- Alkali flats - Alkali flats would nearly double in area to about 9,500 acres and would become substantially more noticeable.
- Pumice blocks - The total area of exposed pumice blocks under average conditions would increase by about 3,400 acres (from about 1,600 acres to 5,000 acres), thereby strengthening the landscape character.
- Regional visibility - Dust storms would occur more often and extend over greater areas, reducing visibility and limiting views and the appearance of the landscape on the east and north sides of the lake.

Influence on Scenic Quality. Reductions in the number of birds at Mono Lake would have an adverse effect on landscape character and scenic quality. Also, increased areas of alkali flats that provide striking evidence of the lake's recession and the appearance of Negit Island as a feature of the lake's north shore rather than as an island would have negative effects.

Although the preservation of tufa and extensive exposure of pumice blocks would work toward strengthening the landscape character, the reduction in numbers of visually conspicuous birds, combined with other negative influences, is considered to have a significant adverse impact on scenic quality.

Near-Term Changes. As the lake moves toward dynamic equilibrium, land-based tufa would gradually appear. The numbers of visually conspicuous birds would begin to decrease when the lake elevation falls below 6,375 feet. Significant reductions would occur in gull populations when the lake drops below 6,374 feet because of continued predator opportunities created by the land bridge, and in grebe and phalarope populations when the lake drops below 6,360-6,370 feet.

Mono Lake Tributary Streams

Long-Term Changes. The key landscape element for determining the impact on scenic quality along the lower tributaries is riparian vegetation. Under the No-Restriction Alternative, substantially less woody riparian vegetation would exist along Rush Creek and Lee Vining Creek. The loss of vegetation would be considered a significant adverse impact on scenic quality.

Near-Term Changes. Changes in riparian vegetation occur over time in response to flows in the tributary streams. Over the near term, recovery of degraded riparian habitat that began after initial stream rewatering would decline under the No-Restriction Alternative, and the decline would likely continue in the long term.

Grant Lake Reservoir

The key landscape element for determining the impacts on scenic quality at Grant Lake reservoir is the unvegetated shore zone resulting from drawdown of the reservoir. Under the No-Restriction Alternative, total drawdown in a wet water year would be about 20 vertical feet, or about 10 feet less than under the point of reference. The effect on scenic quality is considered to be moderately beneficial.

Upper Owens River

The key landscape element for determining the impact on scenic quality along the Upper Owens River is riparian vegetation. Implementation of the No-Restriction Alternative may result in a minor loss of riparian vegetation below East Portal because of high export flows. Grazing probably has a more important effect.

Lake Crowley Reservoir

The key landscape element for determining the impact on scenic quality at Lake Crowley reservoir is exposed lake bottom and lakeshore resulting from drawdown of the reservoir. Under the No-Restriction Alternative, drawdown in a wet water year would be about 4 vertical feet, or about the same as under the point-of-reference scenario, having no effect on scenic quality.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (No-Restriction Alternative)

- Large reductions in the number of visually conspicuous birds at Mono Lake.
- Substantial loss of riparian vegetation along the lower tributaries.
- Moderate decrease in barren drawdown zone at Grant Lake reservoir.

Mitigation Measures. No feasible mitigation measures are available.

IMPACTS AND MITIGATION MEASURES FOR THE 6,372-FT ALTERNATIVE

Changes in Resource Conditions

Mono Lake

Tufa. Under this alternative, the bases of approximately 3% of the Lee Vining Creek tufa grove towers would emerge from the lake. Neither towers at South Tufa nor sand tufa would be affected.

Visually Conspicuous Birds. Under the 6,372-Ft Alternative, the nesting capacity of California gulls at Mono Lake would be reduced by 5,000-7,000 nests, or about 16%, because the land bridging would allow predator access. Additionally, phalaropes would concentrate in the remote east side of the lake, where they are much less likely to be observed by visitors, for foraging purposes.

Other Landscape Elements

- Islands - Under typical conditions, Negit Island would be joined along its entire northwest side to the mainland. Under the point of reference lake surface elevation of 6,376.3 feet, however, only a narrow channel of shallow water separates Negit Island from the mainland so that it appears to be connected to the mainland at longer viewing distances and from points at or near the elevation of the lake. The visual change under this alternative is therefore not significant.

- Lakeshore wetland vegetation - The amount of wetland vegetation near the lakeshore would increase slightly by about 100 acres.

- Alkali flats - Approximately 3,900 acres of alkali flats, on average, would be exposed, which is a decrease of approximately 1,500 acres compared to point-of-reference conditions. Most of the alkali flats lie along the north and east shores of the lake, which are less visited by the public.

- Pumice blocks - The total area of exposed pumice blocks under average conditions would slightly increase by approximately 200 acres (from about 1,600 acres to around 1,800 acres). Most of this increase would be along the north shore of the lake near Black Point and Negit Island. These areas are accessible to the public but are not heavily visited compared to the South Tufa grove and the Mono Lake County Park.

- Regional visibility - The frequency and extent of dust storms would be similar to point-of-reference conditions.

Influence on Scenic Quality. The most important consequence of this alternative to scenic quality would be the substantial decreases in visually conspicuous birds. The anticipated reduction of 5,000-7,000 nests for California gulls and the shift of migratory phalaropes from the visitor-accessible west side of the lake to the relatively inaccessible east side (and therefore generally out of view) would affect landscape character. This is considered a significant adverse impact on scenic quality.

Mono Lake Tributary Streams

A slight increase in the extent of riparian vegetation along the diverted tributary streams would occur under this alternative because of increased streamflow and consequent water table effects, compared to the point of reference streamflows. This difference would not be noticeable to visitors. However, under both this alternative and the point of reference, expansion of the riparian vegetation would be expected from ongoing restoration activities.

Grant Lake Reservoir

Under the 6,372-Ft Alternative, drawdown in a wet water year would be about 27 vertical feet, or about the same as under the point-of-reference scenario, which would not affect scenic quality.

Upper Owens River

Implementation of the 6,372-Ft Alternative may result in minor loss of riparian vegetation below East Portal because of high export flows. Grazing probably has a more important effect.

Lake Crowley Reservoir

Under the 6,372-Ft Alternative, drawdown of Lake Crowley reservoir in a wet water year would be about 6 feet, or 2 feet more than under the point-of-reference scenario. The visual effect would be adverse, but it is not considered significant.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures
(6,372-Ft Alternative)

- Reductions in the number of visually conspicuous birds at Mono Lake.

  Mitigation Measures. No feasible mitigation measures are available.

IMPACTS AND MITIGATION MEASURES FOR THE 6,377-FT ALTERNATIVE

Changes in Resource Conditions

Mono Lake

Tufa. Under this alternative, 1-2% of tufa towers at South Tufa would be toppled by wave action when the lake climbs to its highest levels. On average, the bases of a few percent of the tufa towers at the South Tufa, County Park, and Lee Vining groves would be inundated. No towers would become completely submerged, and sand tufa would not be affected.

Visually Conspicuous Birds. Under the 6,377-Ft Alternative, gull nesting capacity would be greatly increased during most years, allowing expansion of the population to continue if regional conditions allow. During periods of prolonged drought, however, nesting would be disrupted by predators crossing to islets over temporary land bridges. Phalaropes would become more widely distributed around the lake in response to food availability, thus becoming accessible to the majority of visitors who frequent the western portions of the lake.

Other Landscape Elements

- Islands - Under typical conditions, Negit Island would not be connected to the mainland by a land bridge. However, similar to point-of-reference conditions, only a narrow channel of shallow water would separate it from the mainland, so that it would appear to be connected from most viewpoints.

- Lakeshore wetland vegetation - The amount of wetland vegetation near the lakeshore would decrease slightly by approximately 200 acres (from 2,800 acres to 2,600 acres).

- Alkali flats - Approximately 1,500 acres of alkali flats, on average, would be exposed, which is a major decrease of approximately 3,900 acres compared to point-of-reference conditions.

- Pumice blocks - The total area of exposed pumice blocks under typical conditions would decrease by approximately 700 acres (from about 1,600 acres to around 900 acres). Most of this decrease would be along the north shore of the lake near Black Point and Negit Island. These areas are accessible to the public but are not heavily visited compared to the South Tufa grove and the Mono Lake county park.

- Regional visibility - Dust storms would occur, on average, slightly less frequently than under point-of-reference conditions, but their extent would be reduced by about 50%.

Influence on Scenic Quality. The overall impact on scenic quality from changes to landscape elements described above would be small.

Drought Effects. Under the 6,377-Ft Alternative, the lake surface elevation could fall to 6,373 feet during periods of extreme drought. Under these conditions, Negit Island would be joined to the mainland, gull nesting capacity would diminish, and phalaropes would be concentrated on the east side.

Mono Lake Tributary Streams

A slight increase in the extent of riparian vegetation along the diverted tributary streams would occur under this alternative because of increased streamflow and consequent water table effects, compared to the point-of-reference streamflows, but this effect would be offset by inundation of establishing riparian vegetation by the lake. The net effect would be little change in the extent of riparian vegetation. Under both this alternative and the point of reference, however, expansion of the riparian vegetation would be expected from ongoing restoration activities.

Grant Lake Reservoir

Under the 6,377-Ft Alternative, drawdown in a wet water year would be about 17 vertical feet, slightly more than one-half as much as under the point-of-reference scenario. This would be considered a moderate visual benefit.

Upper Owens River

Under this alternative, a minor loss of riparian vegetation below East Portal may result because of high export flows. Continuing grazing on the private lands along the river, however, may have a more important effect.

Lake Crowley Reservoir

Under the 6,377-Ft Alternative, as under the 6,372-Ft Alternative, drawdown of Lake Crowley reservoir in a wet water year would be about 6 feet, or 2 feet more than under the point-of-reference scenario. The visual effect would be adverse, but it is not considered significant.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,377-Ft Alternative)

- Moderate reduction in drawdown at Grant Lake reservoir elevation.

Mitigation Measures. No feasible mitigation measures are available.

IMPACTS AND MITIGATION MEASURES FOR THE 6,383.5-FT ALTERNATIVE

Changes in Resource Conditions

Mono Lake

Tufa. Under this alternative, 3-5% of tufa towers at the South Tufa Grove would be toppled by wave action when the lake climbs to its highest levels. On average, 10% of the tufa towers at the Lee Vining grove and 5% at the County Park grove would be totally submerged. In addition, the bases of many tufa towers would be inundated: 100% of the Old Marina grove, 50% of the Lee Vining grove, 30% of the County Park and Wilson groves, and 5-9% of the South Tufa grove. Sand tufa would not be affected.

Visually Conspicuous Birds. Under the 6,383.5-Ft Alternative, gull nesting capacity would be greatly increased, allowing expansion of the population to continue if regional conditions allow. Phalaropes would become more widely distributed around the lake in response to food availability, thus becoming accessible to the majority of visitors who frequent the western portions of the lake. The number of migratory ducks using Mono Lake would probably increase as lake-fringing freshwater habitats increase from 1 to an estimated 6 acres.

Other Landscape Elements

- Islands - Under this alternative, Negit Island would be separated from the mainland by about 1 mile; it would therefore have a distinct island appearance.
- Lakeshore wetland vegetation - The amount of wetland vegetation near the lakeshore would decrease by approximately 500 acres (from 2,800 acres to about 2,300 acres).
- Alkali flats - Approximately 500 acres of alkali flats, on average, would be exposed, which is a major decrease of approximately 4,900 acres, compared to the point of reference.
- Pumice blocks - The total area of exposed pumice blocks under typical conditions would decrease substantially by approximately 1,470 acres (from about 1,600 acres to around 130 acres). A portion of the remaining areas of exposed pumice blocks would be located along the heavily visited and highly visible west shore.
- Regional visibility - Dust storms would occur less frequently than under point-of-reference conditions, and their extent would be reduced by about 70%.

Influence on Scenic Quality. Some losses of important positive features (i.e., tufa towers and near-shore wetland vegetation) would occur under this alternative. Reduction of alkali flats and Negit Island's appearance would benefit scenic quality. None of these effects is considered significant, and the net offsetting nature of the effects would result in little net change from the point of reference.

Mono Lake Tributary Streams

A slight decrease in the extent of riparian vegetation along the diverted tributary streams would occur under this alternative because of offsetting effects of increased streamflow and lake inundation. The net effect would be little change in the extent of riparian vegetation. Under both this alternative and the point of reference, however, expansion of the riparian vegetation would be expected from ongoing restoration activities.

Grant Lake Reservoir

Under the 6,383.5-Ft Alternative, Grant Lake reservoir drawdown in a wet water year would be about 4 vertical feet, compared to 30 feet under the point-of-reference scenario. This would be considered a major visual benefit.

Upper Owens River

Under this alternative, a minor loss of riparian vegetation below East Portal may result because of high export flows. Continuing grazing on the private lands along the river, however, may have a more important effect.

Lake Crowley Reservoir

Under the 6,383.5-Ft Alternative, drawdown of Lake Crowley reservoir in a wet water year would more than double to about 9 feet, compared to 4 feet for the point-of-reference scenario. The visual effect would be significantly adverse.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,383.5-Ft Alternative)

- Offsetting losses of tufa and wetland vegetation, gains in Negit Island's appearance, and reduced alkali flats and dust storms.
- Substantial reduction in drawdown at Grant Lake reservoir.
- Substantial increase in drawdown at Lake Crowley reservoir.

Mitigation Measures. None may be available except for choosing another alternative. However, once a lake level alternative is selected, the aqueduct model could be used to evaluate different reservoir operation rules intended to reduce the unvegetated drawdown zone.

IMPACTS AND MITIGATION MEASURES FOR THE 6,390-FT ALTERNATIVE

Changes in Resource Conditions

Mono Lake

Tufa. Under this alternative, 50% of tufa towers at the South Tufa grove would be toppled by wave action when the lake climbs to its highest levels. On average, 18% of the tufa towers at the Lee Vining grove and 5% at the County Park grove would be totally submerged. Additionally, the bases of many tufa towers would be inundated: 100% of the Old Marina grove, 60% of the Lee Vining Creek grove, 40% of the County Park and Wilson groves, and 20% of the South Tufa grove. All currently visible sand tufa would be destroyed once the lake surface climbs to its higher levels, but new sand tufa may appear in the scarp faces cut by wave erosion.

Visually Conspicuous Birds. The effects on visually conspicuous birds under this alternative would be similar to the effects under the 6,383.5-Ft Alternative, except that the number of migratory ducks using Mono Lake would probably increase even more as lake-fringing freshwater habitats increase from 1 acre to an estimated 16 acres.

Other Landscape Elements

- Islands - Similar to the 6,383.5-Ft Alternative, under this alternative Negit Island would have a distinct island appearance.
- Lakeshore wetland vegetation - The amount of wetland vegetation near the lakeshore would decrease by approximately 800 acres (from 2,800 acres to 2,000 acres).
- Alkali flats - Approximately 400 acres of alkali flats, on average, would be exposed, which is a major decrease of approximately 5,000 acres, compared to the point of reference.
- Pumice blocks - Under typical conditions, pumice blocks would not be exposed, a decrease of about 1,600 acres.
- Regional visibility - Extensive dust storms would be terminated under this alternative. Violations of the state and federal air quality standards may still occur, but these would be primarily the result of natural events, heightened somewhat by the salt emissions from the few hundred acres of alkali flats that remain exposed.

Influence on Scenic Quality. The distinct appearance of Negit Island some distance from shore, and decreases in dust storms that would otherwise reduce regional visibility, would have a beneficial effect on scenic quality. However, substantial reductions of important tufa features, including toppling of 50% of the tufa towers at South Tufa grove, widespread tufa submergence, and destruction of sand tufa, would have a substantial adverse effect. Overall changes to scenic quality under the 6,390-Ft Alternative would be significantly adverse.

Mono Lake Tributary Streams

A slight decrease in the extent of riparian vegetation along the diverted tributary streams would occur under this alternative because of offsetting effects of increased streamflow and lake inundation. The net effect would be little change in the extent of riparian vegetation. Under both this alternative and the point of reference, however, expansion of the riparian vegetation would be expected from ongoing restoration activities.

Grant Lake Reservoir

Under the 6,390-Ft Alternative, Grant Lake reservoir drawdown in a wet water year would be about 4 vertical feet, compared to 30 feet under the point-of-reference scenario. This would be considered a major visual benefit.

Upper Owens River

Under this alternative, a minor loss of riparian vegetation below East Portal may result because of high export flows. Continuing grazing on the private lands along the river, however, may have a more important effect.

Lake Crowley Reservoir

Under the 6,390-Ft Alternative, drawdown of Lake Crowley reservoir in a wet water year would nearly double to over 7 feet, compared to 4 feet for the point-of-reference scenario. The visual effect would be significantly adverse.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,390-Ft Alternative)

- Substantial loss of the tufa resource.

Mitigation Measures. None available except for choice of a lower lake level alternative.

- Substantial reduction in drawdown at Grant Lake reservoir
- Substantial increase in drawdown at Lake Crowley reservoir

Mitigation Measures. None may be available except for choice of another alternative. However, once a lake level alternative is selected, the aqueduct model could be used to evaluate different reservoir operation rules intended to reduce the unvegetated drawdown zone.

IMPACTS AND MITIGATION MEASURES FOR THE 6,410-FT ALTERNATIVE

Changes in Resource Conditions

Mono Lake

Tufa. Under this alternative, all tufa towers at the South Tufa grove would be toppled by wave action when the lake climbs to its highest levels. On average, all tufa towers at South Tufa grove, Lee Vining grove, and Old Marina grove would be totally submerged. At the County Park grove, 90% of the towers would be completely submerged; and at Wilson grove, 30% would be totally submerged and 65% would be basally inundated. All currently visible sand tufa would be destroyed once the lake surface climbed to its higher levels, but new sand tufa may appear in the scarp faces cut by wave erosion.

Visually Conspicuous Birds. The effects on visually conspicuous birds under this alternative would be similar to the effects under the 6,383.5-Ft Alternative, except that the number of migratory ducks using Mono Lake would probably increase even more as lake-fringing freshwater or brackish habitats increase substantially from 1 acre to an estimated 260 acres.

Other Landscape Elements

- Islands - Similar to the 6,383.5-Ft and 6,390-Ft Alternatives, under this alternative Negit Island would have a distinct island appearance.
- Lakeshore wetland vegetation - The amount of wetland vegetation near the lakeshore would decrease substantially by approximately 2,000 acres.
- Alkali flats - Approximately 160 acres of alkali flats, on average, would be exposed, which is a decrease of approximately 5,240 acres compared to the point of reference.
- Pumice blocks - Under typical conditions, pumice blocks would not be exposed, a decrease of about 1,600 acres.
- Regional visibility - Extensive dust storms would be terminated under this alternative and violations of the state and federal air quality standards may not occur at all.

Influence on Scenic Quality. The most important consequence of this alternative to scenic quality would be the near-complete loss or inundation of tufa towers and sand tufa, causing a great change in the landscape character of Mono Lake.

Although the near elimination of alkali flats, the distinct appearance of Negit Island some distance from shore, and decreases in dust storms that would otherwise reduce regional visibility would have a beneficial effect on scenic quality, the near-complete loss of the tufa resource would be a significant adverse impact on scenic quality at Mono Lake.

Mono Lake Tributary Streams

A slight decrease in the extent of riparian vegetation along the diverted tributary streams would occur under this alternative because of offsetting effects of increased streamflow and lake inundation. The net effect would be little change in the extent of riparian vegetation. Under both this alternative and the point of reference, however, expansion of the riparian vegetation would be expected from ongoing restoration activities.

Grant Lake Reservoir

Under the 6,410-Ft Alternative, Grant Lake reservoir drawdown in a wet water year would be about 4 vertical feet, compared to 30 feet under the point-of-reference scenario. This would be considered a major visual benefit.

Upper Owens River

Under this alternative, little or no loss of riparian vegetation below East Portal would occur because export flows would be low. Continuing grazing on the private lands along the river, however, could cause losses.

Lake Crowley Reservoir

Under the 6,390-Ft Alternative, drawdown of Lake Crowley reservoir in a wet water year would double to 8 feet, compared to 4 feet for the point-of-reference scenario. The visual effect would be significantly adverse.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,410-Ft Alternative)

- Substantial loss of the tufa resource

Mitigation Measures. None available except for choosing a lower lake level alternative.

- Substantial reduction in drawdown at Grant Lake reservoir.
- Substantial increase in drawdown at Lake Crowley reservoir.

Mitigation Measures. None may be available except for choosing another alternative. However, once a lake level alternative is selected, the aqueduct model could be used to evaluate different reservoir operation rules intended to reduce the unvegetated drawdown zone.

IMPACTS AND MITIGATION MEASURES FOR THE NO-DIVERSION ALTERNATIVE

Changes in Resource Conditions

Mono Lake

Tufa. Effects would be similar to those of the 6,410-Ft Alternative.

Visually Conspicuous Birds. Effects would be similar to those of the 6,410-Ft Alternative.

Other Landscape Elements

- Islands - Effects would be similar to those of the 6,410-Ft Alternative.
- Lakeshore wetland vegetation - The amount of wetland vegetation near the lakeshore would decrease by approximately 2,400 acres to 400 acres.
- Alkali flats - No alkali flats would remain exposed, which is a decrease of approximately 5,400 acres, compared to the point of reference.
- Pumice blocks - All exposed pumice blocks would be inundated.
- Regional visibility - Effects would be similar to those of the 6,410-Ft Alternative.

Influence on Scenic Quality. Effects would be similar to those of the 6,410-Ft Alternative.

Mono Lake Tributary Streams

Effects would be similar to those of the 6,410-Ft Alternative.

Grant Lake Reservoir

Under the No-Diversion Alternative, Grant Lake reservoir would remain full and no drawdown would occur. This would be considered a major visual benefit.

Upper Owens River

Effects would be similar to those of the 6,410-Ft Alternative.

Lake Crowley Reservoir

Under the No-Diversion Alternative, drawdown of Lake Crowley reservoir in a wet water year would more than double to 9 feet, compared to 4 feet for the point-of-reference scenario. The visual effect would be significantly adverse.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (No-Diversion Alternative)

- Substantial loss of the tufa resource.

Mitigation Measures. None available except for choosing a lower lake level alternative.

- Substantial reduction in drawdown at Grant Lake reservoir.
- Substantial increase in drawdown at Lake Crowley reservoir.

Mitigation Measures. None may be available except for choosing another alternative. However, once a lake level alternative is selected, the aqueduct model could be used to evaluate different reservoir operation rules intended to reduce the unvegetated drawdown zone.

CUMULATIVE IMPACTS OF THE ALTERNATIVES

The analysis of cumulative impacts focuses on effects at Mono Lake, the lower tributaries, and the Upper Owens River. Cumulative visual effects were not analyzed for Grant Lake or Lake Crowley reservoirs because reservoir drawdown, which was used to evaluate impacts, is cyclical and does not have cumulative effects on visual resources.

Related Impacts of Earlier Stream Diversions by LADWP

Mono Lake

Several changes in landscape features near Mono Lake have occurred as a result of stream diversions by LADWP since 1940.

Around the time that diversions commenced, several freshwater ponds were maintained near the lakeshore near the mouths of Rush and Lee Vining Creeks. The ponds supported large numbers of migratory waterfowl, including ducks and geese. As the lake surface elevation dropped over time because of diversions by LADWP, the freshwater ponds could no longer be maintained and eventually were abandoned. The numbers of waterfowl that once visited these ponds declined substantially.

As the lake surface elevation and surface area declined as a result of the LADWP diversions, alkali flats were exposed and the frequency of dust storms increased, which reduced regional visibility.

As the lake became smaller, the distance separating Negit Island from the mainland decreased, diminishing Negit Island's appearance as a true island surrounded by water. When the lake surface declined to about 6,376 feet, a landbridge connecting Negit Island to the mainland was exposed.

The declining lake surface also gradually exposed most of the tufa towers at the South Tufa, Lee Vining, DeChambeau, and Wilson groves. When the surface elevation dropped below 6,390 feet, sand tufa was exposed and pumice blocks began to appear. Also, the acreage of near-shore wetland vegetation greatly increased as the lake surface declined, although the character of these wetlands lacked the species richness and maturity of the older, prediversion wetlands that had previously existed.

Tributary Streams. The dewatering of the tributary streams after diversions began resulted in significant reductions in riparian vegetation along the streams. Stream channel incision occurred in the lower reaches of Rush and Lee Vining Creeks as the surface elevation of Mono Lake declined, causing further losses of vegetation.

Upper Owens River

During the diversion period, streamflows in the Upper Owens River were augmented about 200% on the average, so that streamflows were three times the prediversion levels. These flows caused some channel changes, possibly resulting in channel straightening. Wetland and riparian losses resulted from these changes (Chapter 3C, "Vegetation"), but vegetative losses probably also occurred from cattle grazing. The overall vegetative changes did not substantially degrade the visual resource. The stream's appearance changed because of the increased flows, which enhanced visual quality in drought years when little or no natural flows would have been present.

Related Impacts of Other Past, Present, or Anticipated Projects or Events

Mono Lake

Prediversion wetlands were a well-established, prominent feature of the northwest area of the lake. These wetlands were fed largely by water used to irrigate pastures associated with private ranches.

Diversion of water from Mill Creek (by parties other than LADWP) left the stream dry for extended periods, which resulted in a substantial loss of streamside riparian vegetation, especially along the reach approximately 1 mile upstream of Mono Lake.

Two significant development projects are planned in Mono Basin. One development would be approximately 400 residential units, a resort lodge with restaurant, shops, golf course, and a 30-acre lake on approximately 880 acres of land northeast of the intersection of U.S. 395 and SR 167. The second proposal is a mixed-use development, including a motel, gas station, mini-mart, and 10 residences. Neither development is expected to result in changes to landscape features affected by the project alternatives.

Tributary Streams

Habitat restoration work along Rush and Lee Vining Creeks to promote fisheries has had some effects on visual quality. During construction, some riparian vegetation has been destroyed for fish habitat structures, construction access, and stockpiling of spawning gravels or other materials. These disturbances are limited both spatially and temporally.

Habitat restoration has involved some planting of riparian vegetation along lower Lee Vining Creek, which, if successful, will enhance visual quality. Additional efforts to promote vegetation recovery from the period of dewatering and stream incision will have further visual resource benefits.

Upper Owens River

Expansion of the existing development on the John Arcularius Ranch, including new guest cabins, a guest lodge and restaurant, and four single-family residences, has been proposed. Expansion would not result in changes to landscape features affected by the project alternatives.

Significant Cumulative Impacts

No-Restriction Alternative

The No-Restriction Alternative would result in a significant cumulative adverse impact on scenic quality at Mono Lake because of major declines in visually conspicuous birds, the appearance of Negit Island as joined to the mainland, extensive increases in areas of alkali flats, and increases in the frequency and extent of dust storms that cause reductions in regional visibility. Although the increased exposure of tufa towers, sand tufa, and pumice blocks that, under prediversion conditions were completely inundated by the lake, would have a positive influence on scenic quality, these effects would not offset the negative influences on scenic quality.

A further decrease in riparian vegetation along the lower tributaries because of stream dewatering and incision would result in a significant cumulative adverse impact on scenic quality.

6,372-Ft Alternative

In contrast to the prediversion condition, the tufa resource would remain visible and accessible, the gull population would be reduced, phalaropes would be difficult to observe, Negit Island would be joined to the mainland, wide alkali flats would border portions of the lake, extensive areas of pumice blocks would be visible, frequent and extensive dust storms would occur, and riparian vegetation along the tributary streams would be diminished.

6,377-Ft Alternative

In contrast to the prediversion condition, the tufa resource would remain visible and accessible, the gull population would be reduced during droughts, Negit Island would appear to be part of the mainland, wide alkali flats would border portions of the lake, some areas of pumice blocks would be visible, frequent and extensive dust storms would occur, and riparian vegetation along the tributary streams would be diminished.

6,383.5-Ft Alternative

In contrast to the prediversion condition, the tufa resource would largely remain visible and accessible, wide alkali flats would border portions of the lake, a few areas of pumice blocks would be visible, fairly frequent and extensive dust storms would occur, and riparian vegetation along the tributary streams would be diminished.

6,390-Ft Alternative

In contrast to the prediversion condition, some of the tufa resource would remain visible and accessible, and riparian vegetation along the tributary streams would be diminished.

6,410-Ft Alternative

In contrast to the prediversion condition, riparian vegetation along the tributary streams would be diminished.

No-Diversion Alternative

In contrast to the prediversion condition, riparian vegetation along the tributary streams would be diminished.

Mitigation Measures for Significant Cumulative Impacts

Most of the negative influences on scenic quality at Mono Lake can be mitigated only by choosing a different lake level alternative.

The losses of prediversion riparian vegetation along the tributary streams, which would remain significant under all alternatives (and would increase under the No-Diversion Alternative) can only be partially mitigated onsite. Watering of overflow channels and plantings in selected locations can partially recover the losses during the diversion period. Additional offsite compensation would be required for full mitigation. A mitigation program for this purpose is described in Chapter 3C, "Vegetation".

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Table 3I-1. General Visibility of Tufa Groves at Selected Lake Levels

	Tufa Grove Base Elevation[b] (feet)		Lake Elevation (feet)	
Tufa Grove[a]	High	Low	1941 Start of Diversions (6,417)	1989 Point of Reference (6,376)
Mono Lake County Park	6,415	6,370	PV	VWB, LB
Post Office Creek	6,400	6,400	NV	VLB
Old Marina	6,425	6,374	PV, VWB	VWB, LB
Lee Vining Creek	6,404	6,368	NV[b]	VWB, LB
South Tufa	6,406	6,368	NV[b]	VWB, LB
East of Navy Beach	6,408	6,408	NV, PV	VLB
Simon's Spring	6,430	6,380	VWB	VLB
Warm Springs	6,430	6,430	VLB	VLB
Bridgeport Creek	6,417	6,380	PV	VLB
Wilson Creek	6,386[c]	6,830[c]	PV[c]	LB[c]

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[a] A common maximum height of 15 feet is assumed.
[b] Source: NAS 1987 (corrected from field observation in a few cases).
[c] Stine 1992a.

Notes:
LB = land based.
NV = not visible (except possibly the tops of a few towers).
PV = partially visible (fully or primarily water based).
VLB = visible, primarily land based.
VWB = visible, primarily water based.

Table 3I-2. Relative Visual Sensitivity of Viewer Groups

Characteristics of Viewer Groups	Viewer Groups Local Residents	 Destination Recreationists	 Travelers Through
Expectations, knowledge, and concern about the Mono Lake environment	Very high	High	Moderate
Focus on the Mono Lake environment	Moderate	Very high	Moderate
Numbers of viewers	Low	High	Very high
Duration of view	Long	Moderate	Short
Resulting visual sensitivity	Very high	Very high	High

Table 3I-3. Visual Quality Objectives for the Mono Basin National Forest Scenic Area

VQO Classification	Constraints	Percent of Scenic Area
Preservation	Management activities are prohibited	0
Retention	Activities must not be visually evident; the landscape must retain a natural appearance	46
Partial retention	Activities must be visually subordinate to natural character of landscape	50
Modification	Activities may be visually dominant but must conform to natural character of landscape	3
Maximum modification	Activities may be visually dominant but not the primary focal point	1

Note: VQO = visual quality objective.

Source: Derived from acreage data in the Final EIS for the Comprehensive Management Plan for the Mono Basin National Forest Scenic Area (USFS 1989b).

Table 3I-4. Existing Visual Conditions of the Mono Basin National Forest Scenic Area

EVC	Degree of Disturbance	Percent of Scenic Area
Type I	Untouched landscape	42
Type II	Changes unnoticed	24
Type III	Minor disturbances	21
Type IV	Disturbances	9
Type V	Major disturbances	4

Note: EVC = existing visual condition.

Source: Derived from acreage data in the Final EIS for the Comprehensive Management Plan for the Mono Basin National Forest Scenic Area (USFS 1989b).

Table 3I-5. Summary Comparison of Effects of the Alternatives: Visual Resources

	Mono Lake										Tributary Streams		Grant Lake Reservoir		Upper Owens River		Lake Crowley Reservoir	
Alternative or Condition	South Tufa Towers Toppled	Tufa Towers Submerged	Sand Tufa Effects	Birds	Negit Island	Wetland Vegetation (acres)	Alkali Flats (acres)	Pumice Blocks (acres)	Dust Storms (number per per year)	Change in Scenic Quality	Riparian Vegetation	Change in Scenic Quality	Drawdown Zone (vertical feet)	Change in Scenic Quality	Riparian Vegetation	Change in Scenic Quality	Drawdown Zone (vertical feet)	Change in Scenic Quality
Point of reference	Some	Extensive emergence	Exposed	Large populations of gulls, grebes, and phalaropes	Appears to be joined to mainland	2,800	5,400	1,600	13-14		336 acres		30		4 acres		4	
No restriction	No additional losses	Additional emergence	No change	Large population decreases or lake abandonment*	Joined to mainland	300	9,500	5,000	>15	Adverse* (birds)	160 acres	Adverse*	20	Moderate benefit	Loss	Minor adverse	4	None
6,372 Ft	No additional losses	Bases of small percentage emerged	No change	Gull nesting capacity reduced 16%; phalaropes restricted to east side*	Joined to mainland	2,900	3,900	1,800	13-14	Adverse* (birds)	Slight increase	Neutral	27	Neutral	Loss	Minor adverse	6	Minor adverse
6,377 Ft	Small percentage toppled	Bases of a small percentage submerged	No change	Gull nesting capacity greatly increased; phalaropes more widespread	Appears to be joined to mainland	2,600	1,500	900	<13	Neutral (offsetting effects)	Little change	Neutral	17	Moderate benefit	Loss	Minor adverse	6	Minor adverse
6,383.5 Ft	Larger percentage toppled	Total submergence of up to 10%; base submergence of up to 50%	No change	Gull nesting capacity greatly increased; phalaropes more widespread; migratory duck habitat somewhat increased	Distinct island appearance	2,300	500	130	<10	Beneficial	Slight decrease from lake inundation	Neutral	4	Major benefit	Loss	Minor adverse	9	Adverse*
6,390 Ft	50% toppled*	Total submergence of up to 18%*; base submergence of up to 60%	Destroys all now protruding; may be new cliff-face exposures*	Gull nesting capacity greatly increased; phalaropes more widespread; migratory duck habitat somewhat increased	Distinct island appearance	2,000	400	0	1-2	Adverse* (tufa)	Slight decrease from lake inundation	Neutral	4	Major benefit	Loss	Minor adverse	7	Adverse*
6,410 Ft	100% toppled*	Total submergence of 30-100%*	Destroys all now protruding; may be new cliff-face exposures*	Gull nesting capacity greatly increased; phalaropes more widespread; migratory duck habitat greatly increased	Distinct island appearance	800	160	0	<1	Adverse* (tufa)	Slight decrease from lake inundation	Neutral	4	Major benefit	Little or no loss	Neutral	8	Adverse*

Table 3I-5. Continued

	Mono Lake										Tributary Streams		Grant Lake Reservoir		Upper Owens River		Lake Crowley Reservoir	
Alternative or Condition	South Tufa Towers Toppled	Tufa Towers Submerged	Sand Tufa Effects	Birds	Negit Island	Wetland Vegetation (acres)	Alkali Flats (acres)	Pumice Blocks (acres)	Dust Storms (number per per year)	Change in Scenic Quality	Riparian Vegetation	Change in Scenic Quality	Drawdown Zone (vertical feet)	Change in Scenic Quality	Riparian Vegetation	Change in Scenic Quality	Drawdown Zone (vertical feet)	Change in Scenic Quality
No diversion	100% toppled*	Total submergence of 30-100%*	Destroys all now protruding; may be new cliff-face exposures*	Gull nesting capacity greatly increased; phalaropes more widespread; migratory duck habitat greatly increased	Distinct island appearance	400	0	0	<1	Adverse* (tufa)	Slight decrease from lake inundation	Neutral	0	Major benefit; appear as natural lake	Little or no loss	Neutral	9	Adverse*
Prediversion	All submerged			Gull nesting capacity large; phalaropes probably widespread; duck habitat and population large	Distinct island appearance	400	0	0	<1		492 acres		0		16 acres		Unknown	

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* Substantial change relative to point of reference.

Table 3I-6. Effects on Tufa Towers Compared to the Point of Reference

		Tufa Towers Submerged (%)[a]				
Alternative or Condition	South Tufa Grove Towers Toppled (%)	South Tufa Grove	County Park Grove	Lee Vining Grove	Wilson Grove	Old Marina Grove
No restriction	0	0	0	0	0	0
6,372 Ft	0	0	0	-3[b]/0	0	0
6,377 Ft	1-2	2/?	5/0	3/0	0	?
6,383.5 Ft	3-5	5-9/?	30/5	50/10	30/0	100/?
6,390 Ft[c]	50*	20/?	40/5	60/18*	40/0	100/?
6,410 Ft[c]	100*	100/100*	100/90*	100/100*	65/30*	100/100*
No diversion[c]	100*	100/100*	100/100*	100/100*	765/30*	100/100*

---

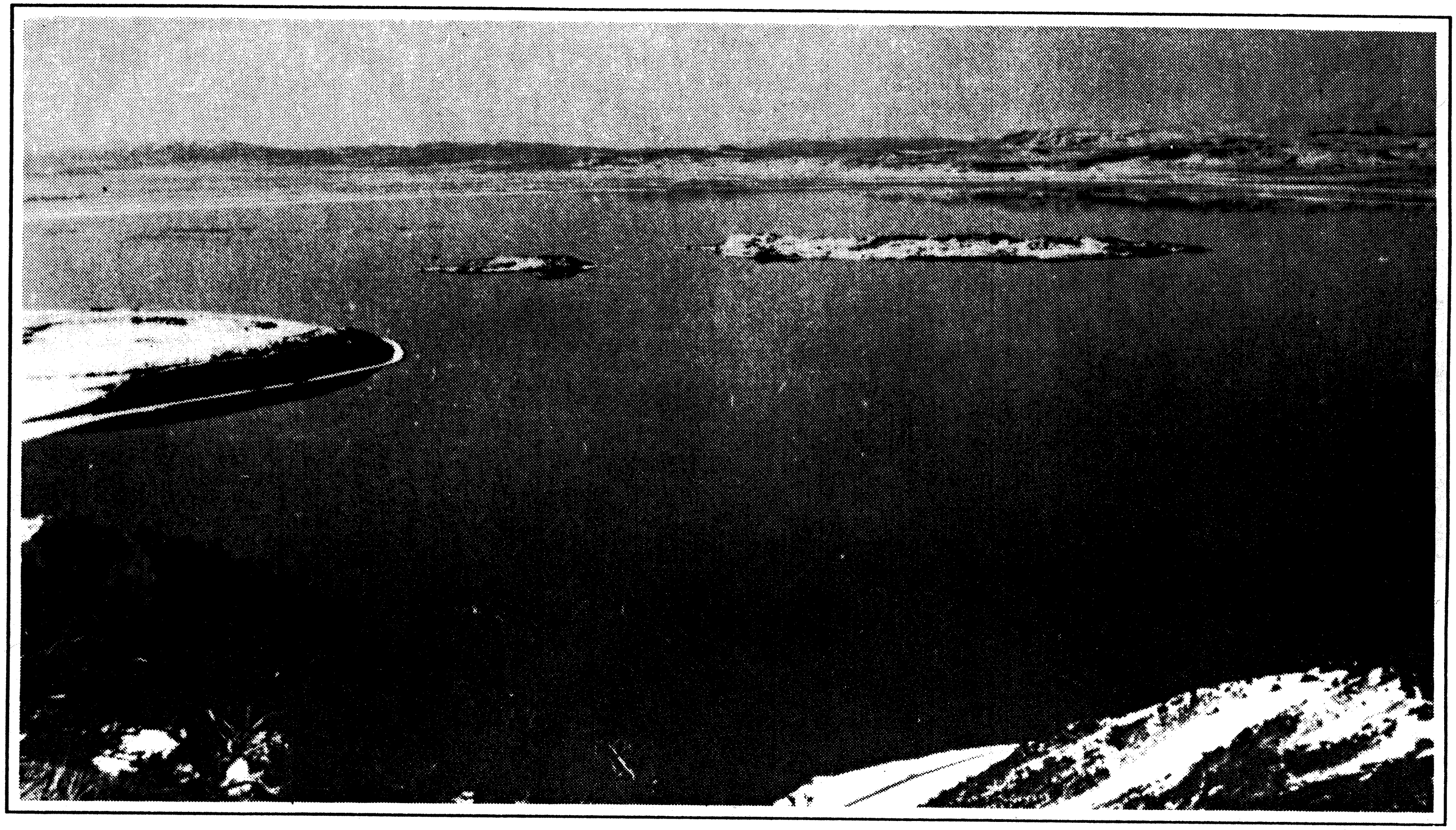
* Significant adverse impact (more than 10% totally inundated or toppled and inundated).

[a] First figure is for tower base submergence; second figure is for total tower submergence.

[b] Emergence.

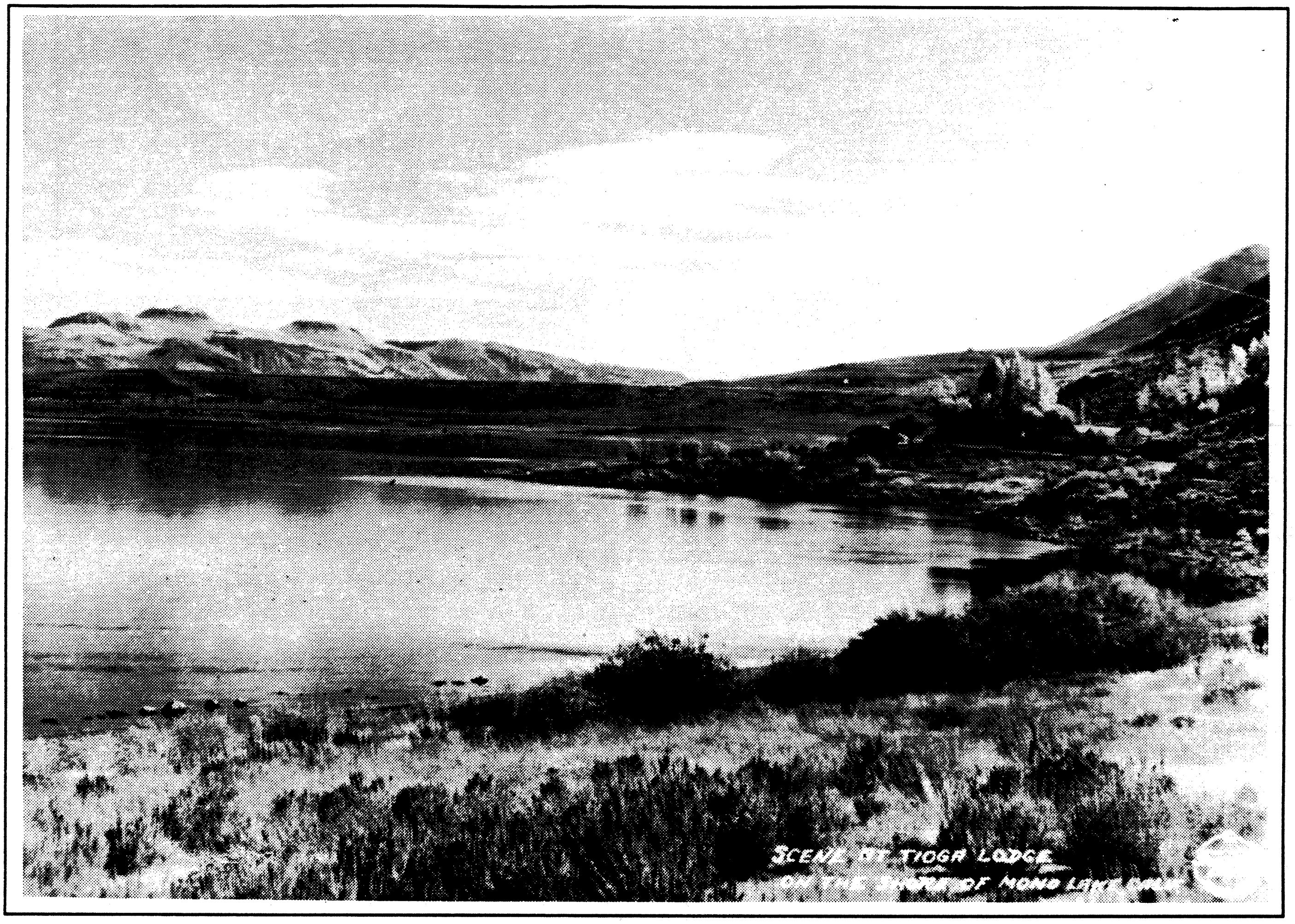
[c] All sand tufa would be destroyed under these alternatives.

Source: Developed from Stine 1992a (Mono Basin Auxiliary Report No. 9).



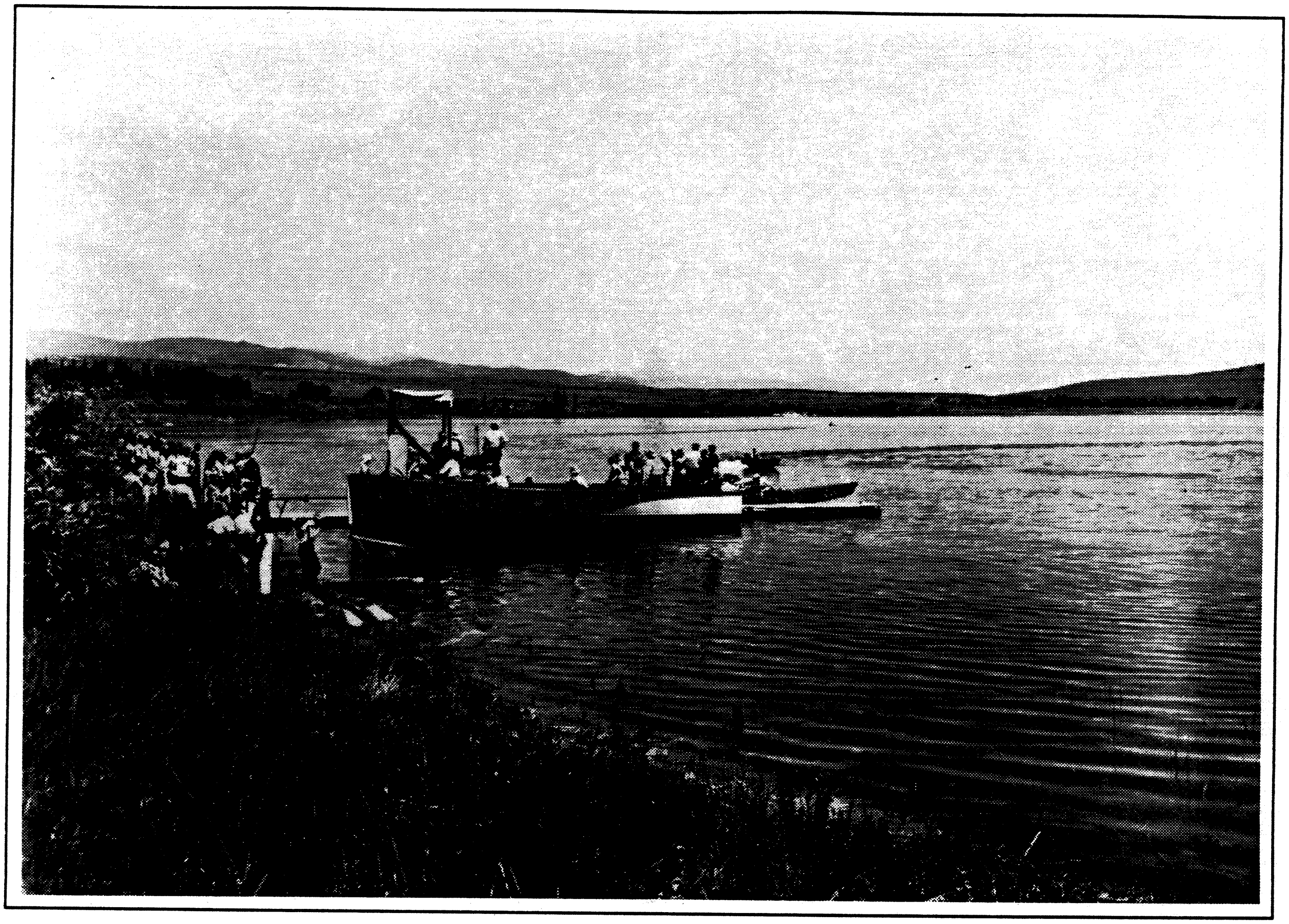
1922
Wallis McPherson collection

Figure 3I-1.
Negit and Paoha Islands in the Prediversion Period



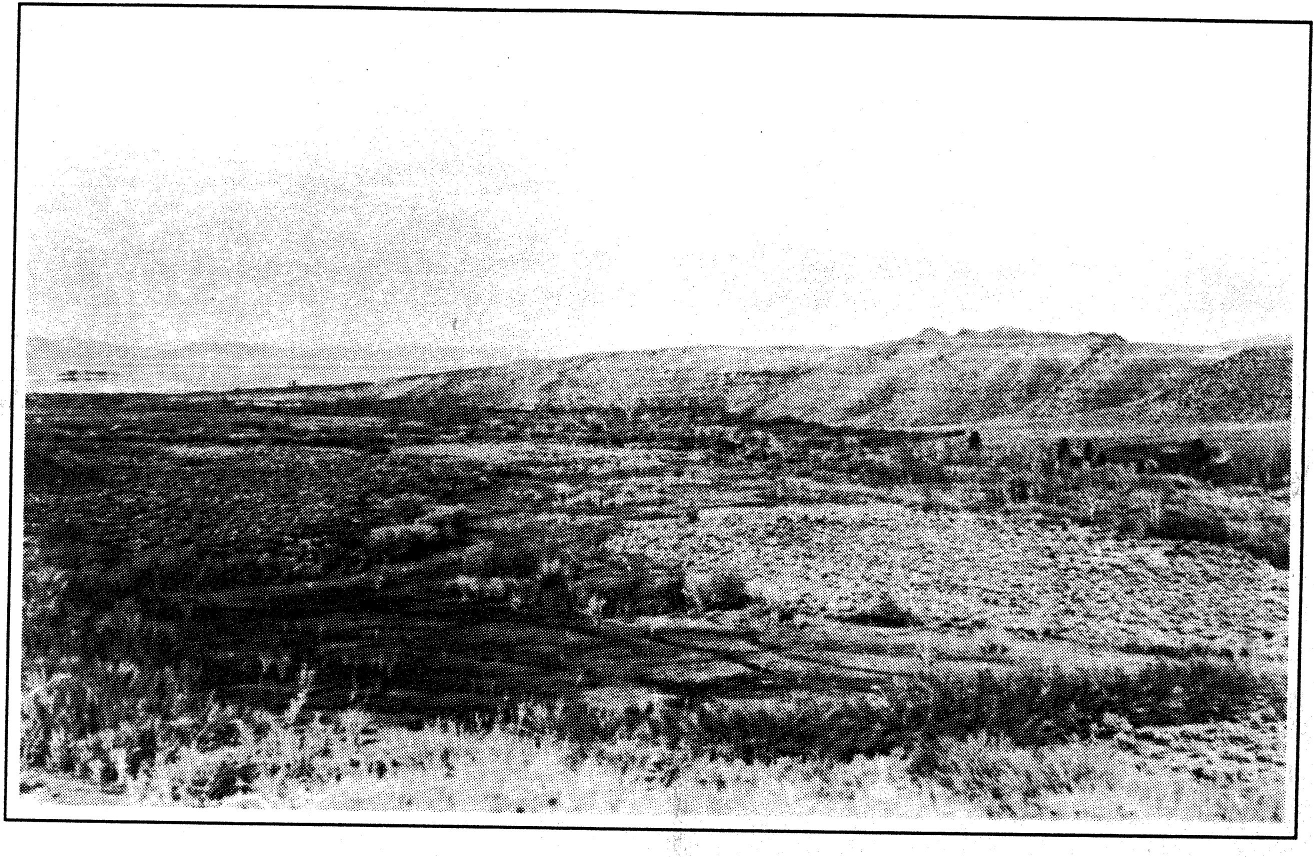
ca. 1932-1933
Burton Frasher, Sr. photograph
© Frashers Fotos

Figure 3I-2.
North Lakeshore Vegetation in the Prediversion Period



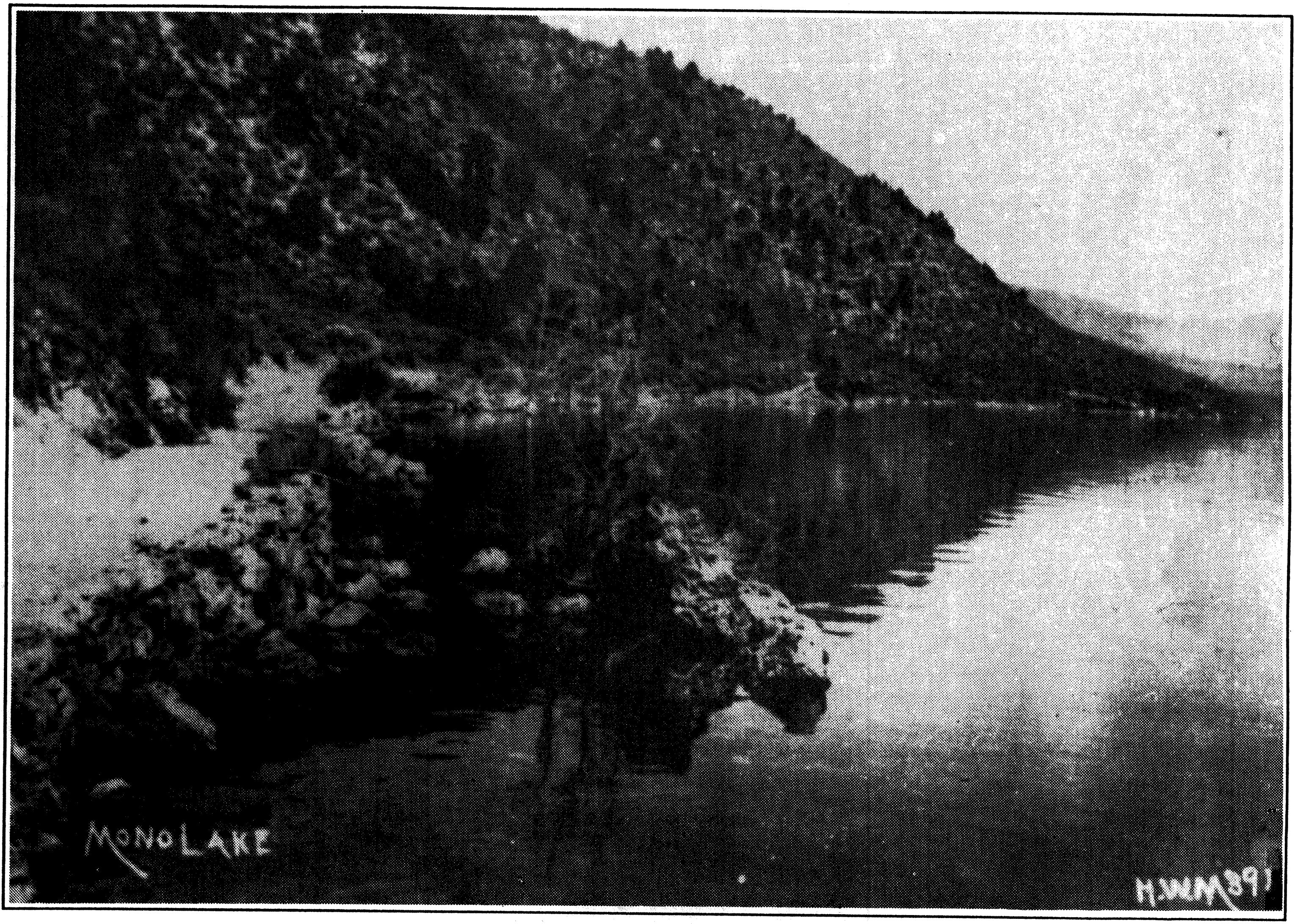
1938
Burton Frasher, Sr. photograph

Figure 3I-3.
Inundated Shoreline Vegetation in the Prediversion Period



March 1934
Leland Ford photograph

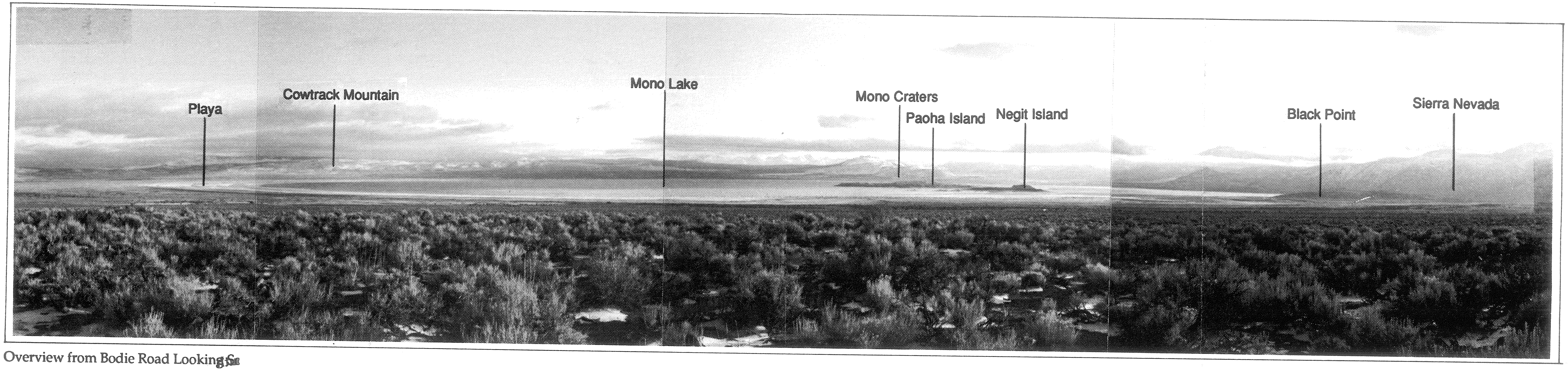
Figure 3I-4.
Lower Rush Creek Riparian Vegetation
in the Prediversion Period



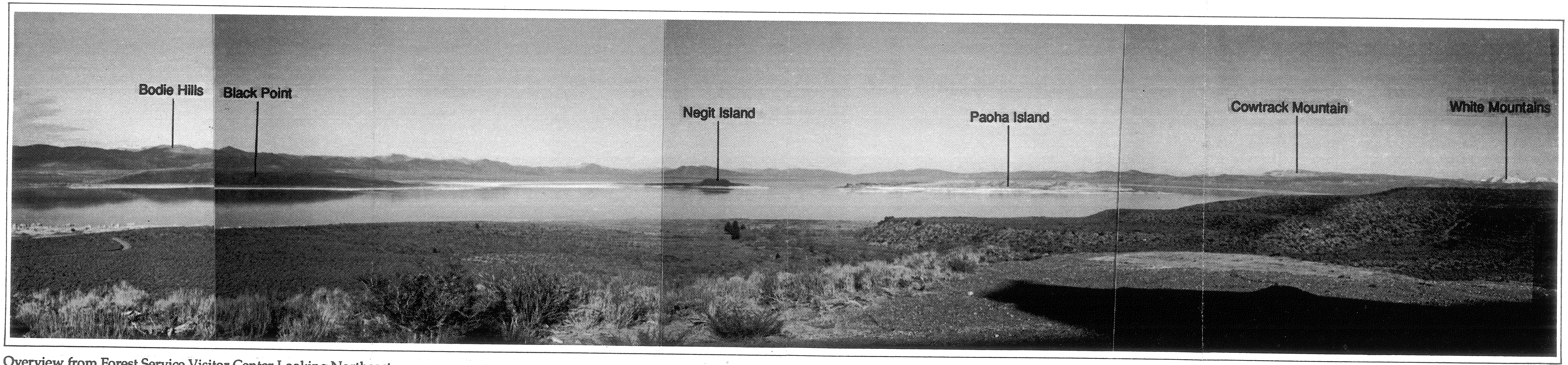
ca. 1915–1922
Mono Lake Committee collection

Figure 3I-5.
Wagon Road, West Side of Mono Lake in the Prediversion Period

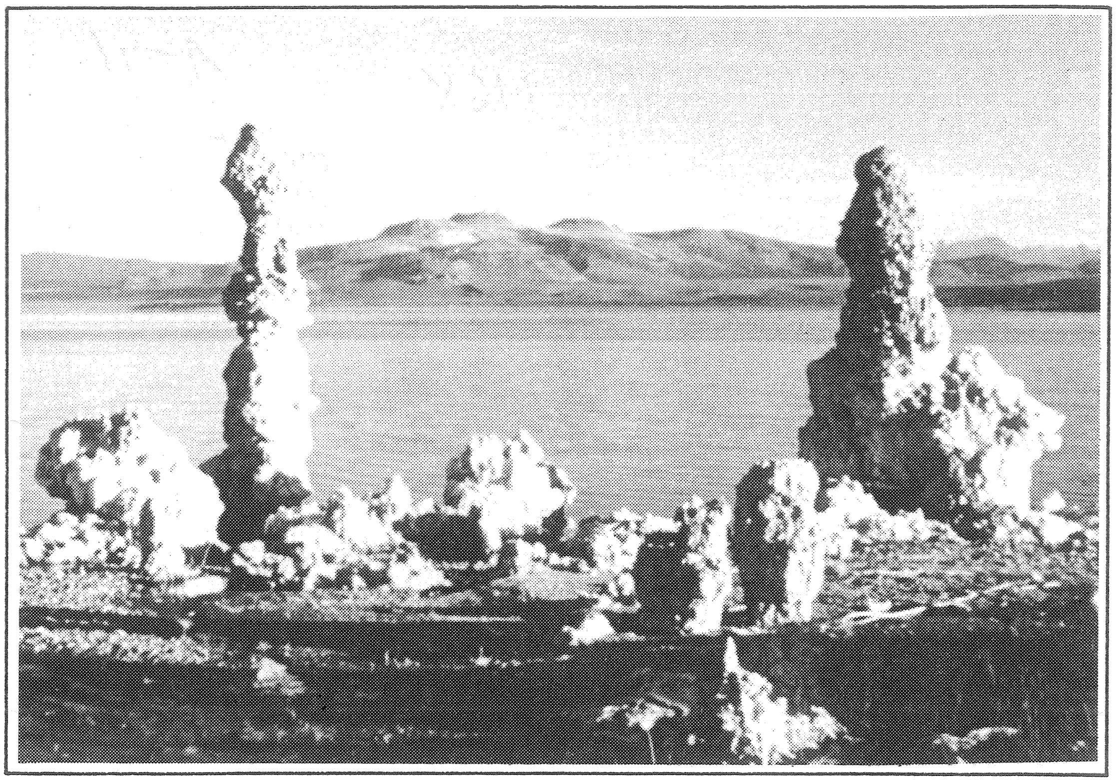
Figure 3I-6.
Visual Character of Mono Lake



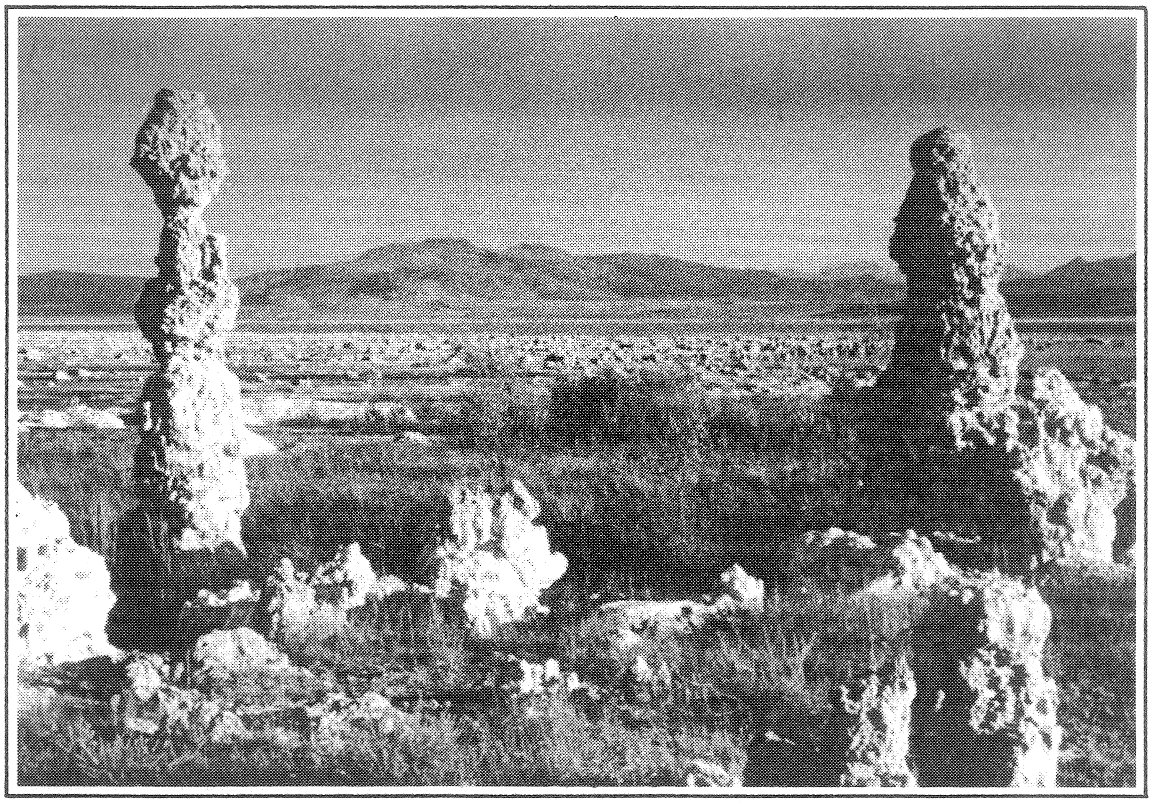
Overview from Bodie Road Looking S[illegible]



Overview from Forest Service Visitor Center Looking Northeast



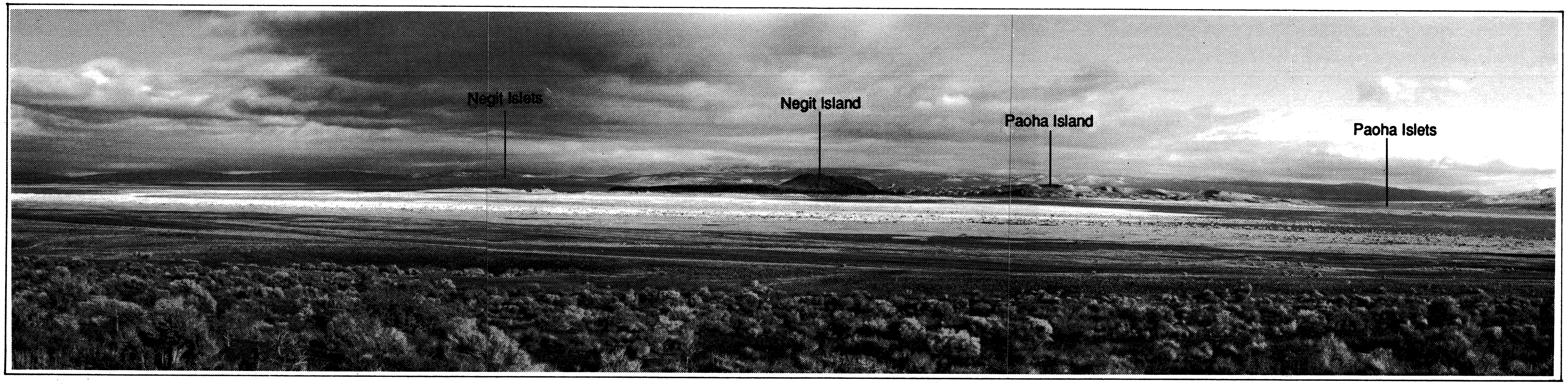
1968 Mono Lake Committee collection



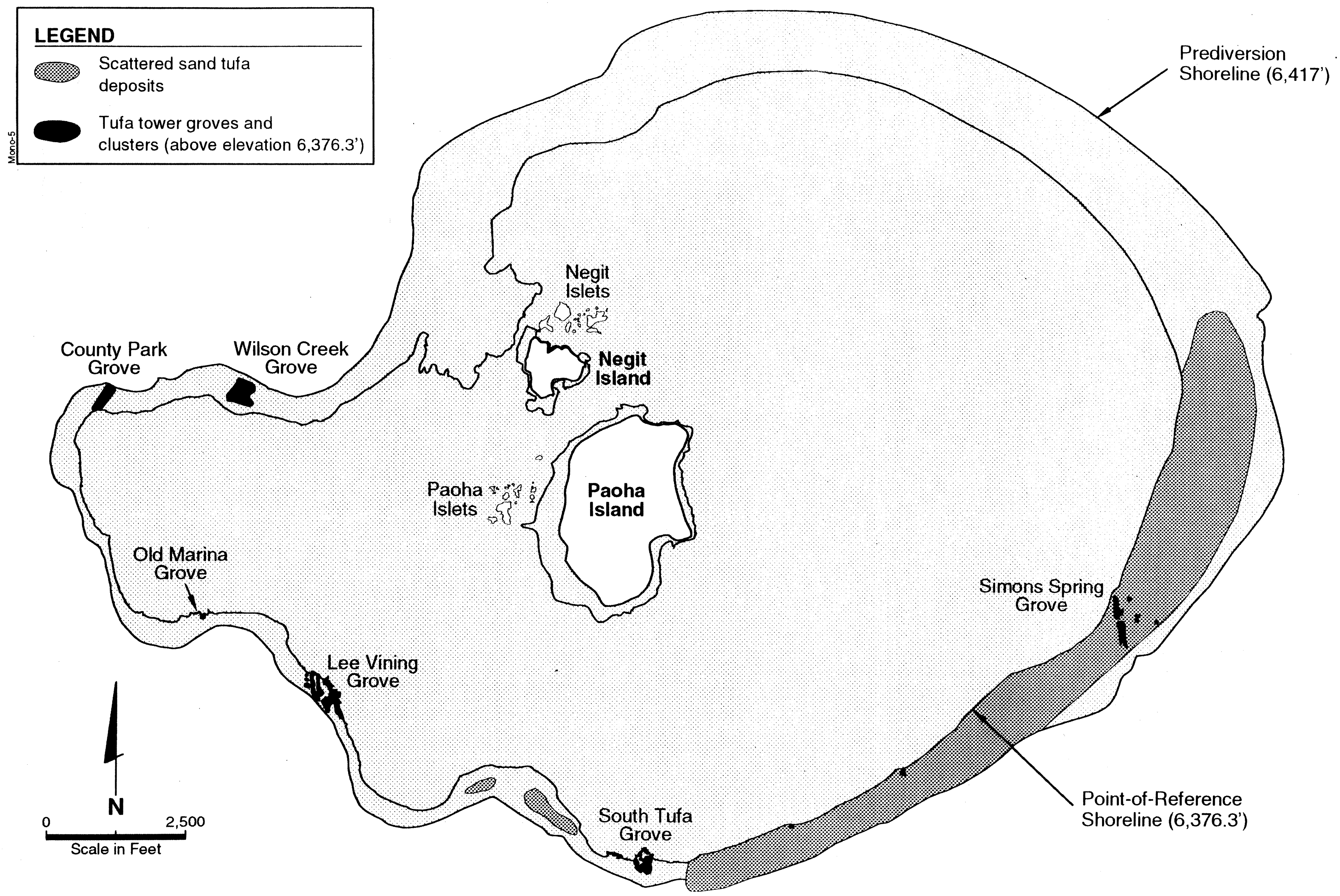
1982 Mono Lake Committee collection

Figure 3I-7.
View of Mono Lake from Wilson Creek Tufa Grove along the Northwest Shore in 1968 and 1982

Figure 3I-8.
Mono Lake Islands and Islets

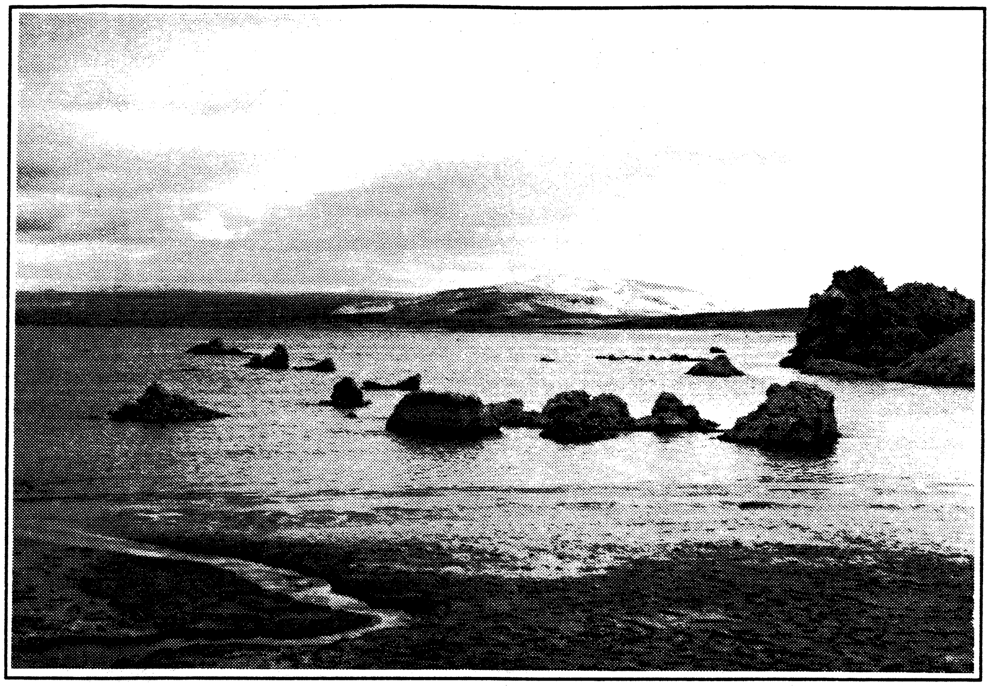


View from South Side of Black Point

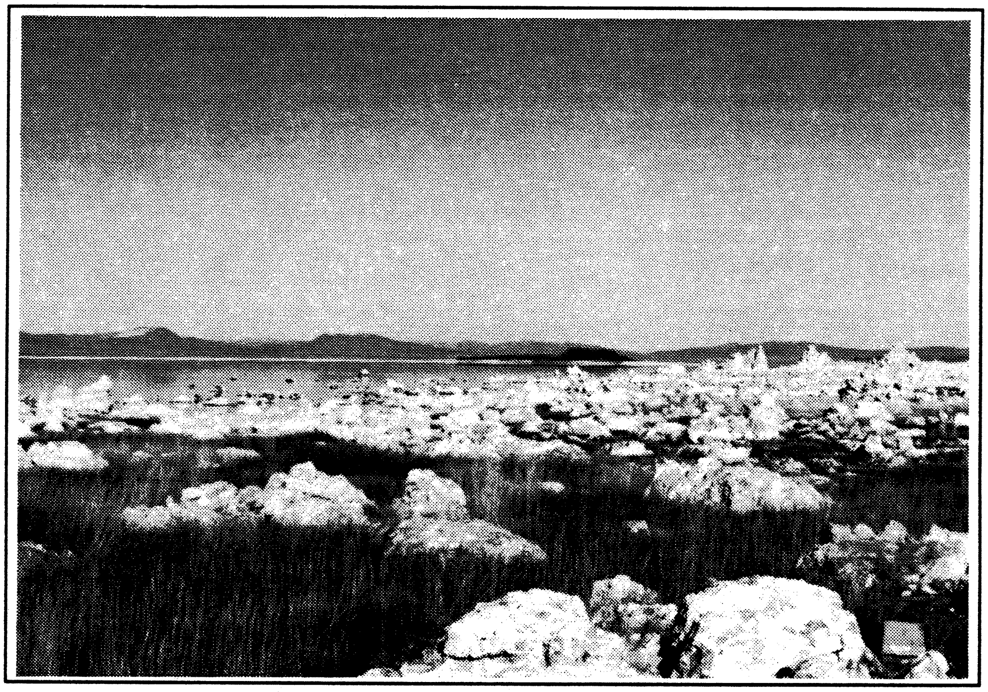


Source: Stine pers. comm.

Figure 3I-9.
Distribution of Tufa Deposits at Mono Lake



County Park Tufa and Pumice Blocks

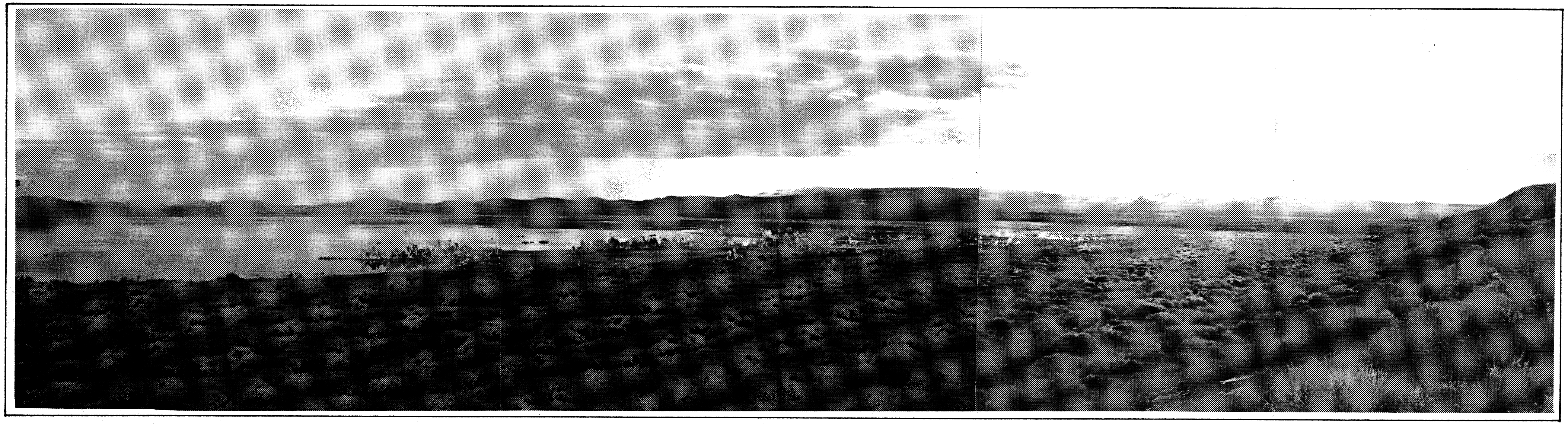


Old Marina Tufa and Pumice Blocks

Figure 3I-10.
Tufa Towers and Pumice Blocks

Figure 3I-11.
Lee Vining Tufa Groves

Figure 3I-12.
South Tufa Grove



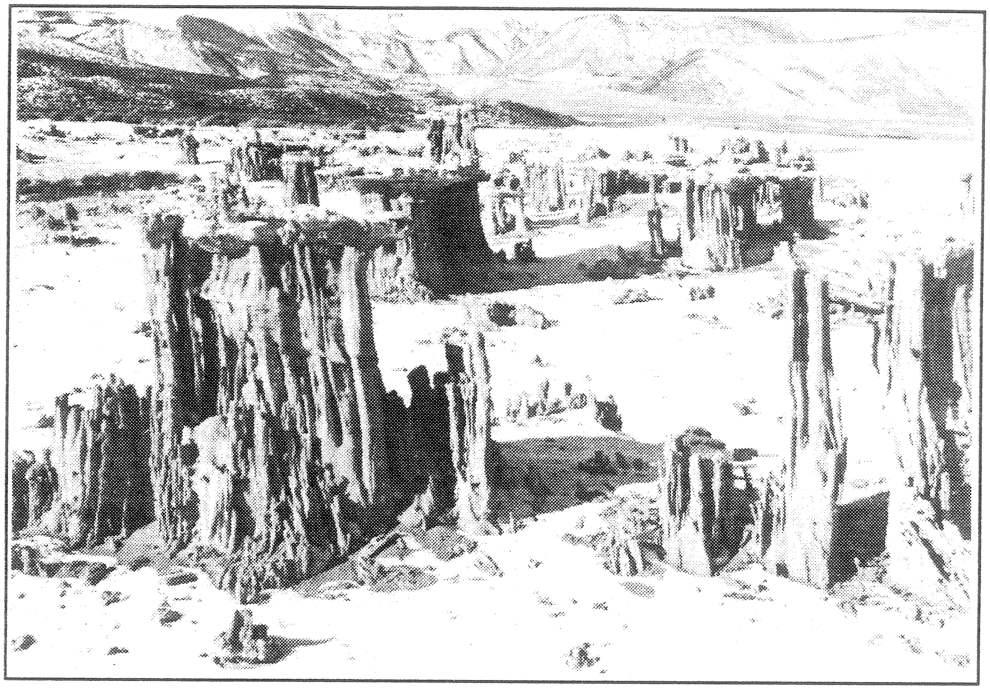
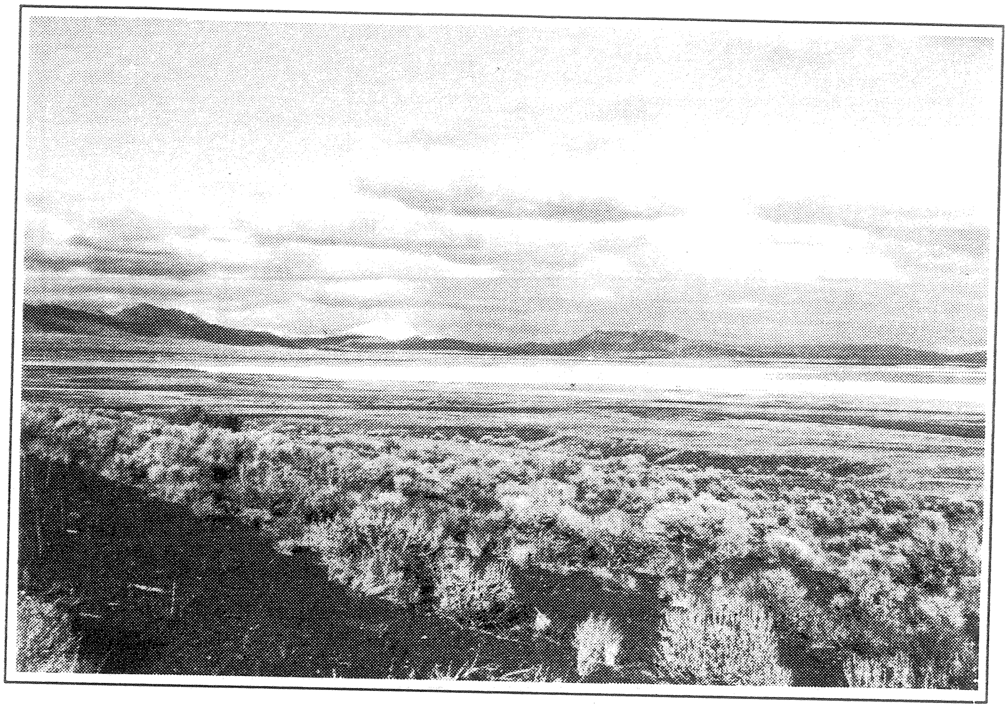
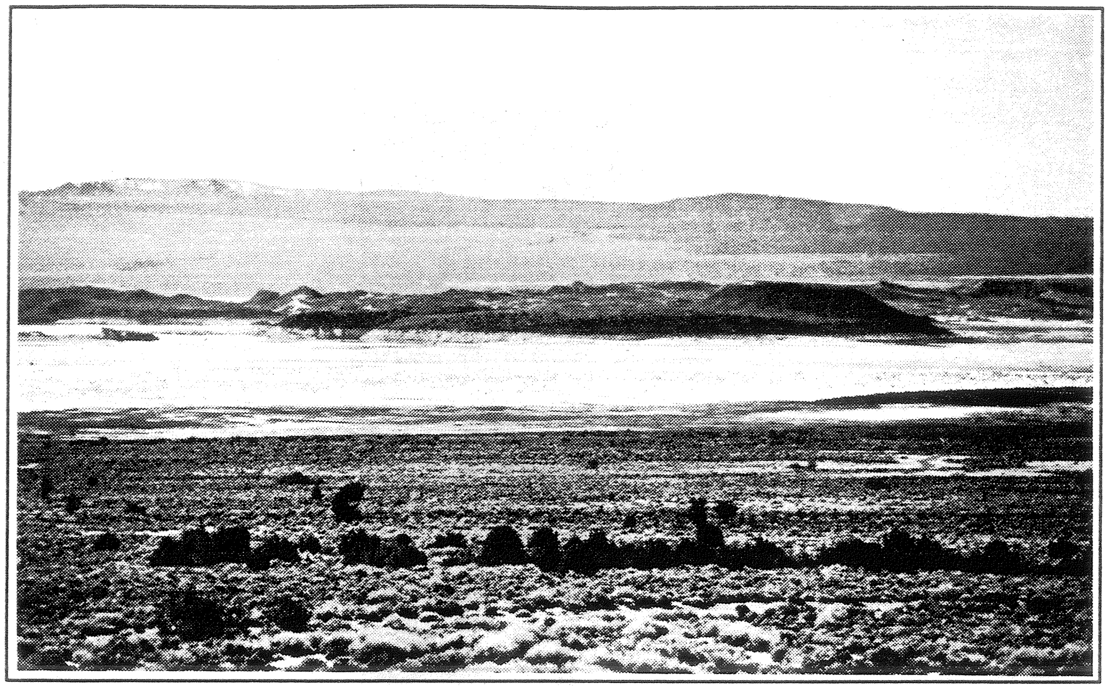


Figure 3I-13.
Sand Tufa at Navy Beach



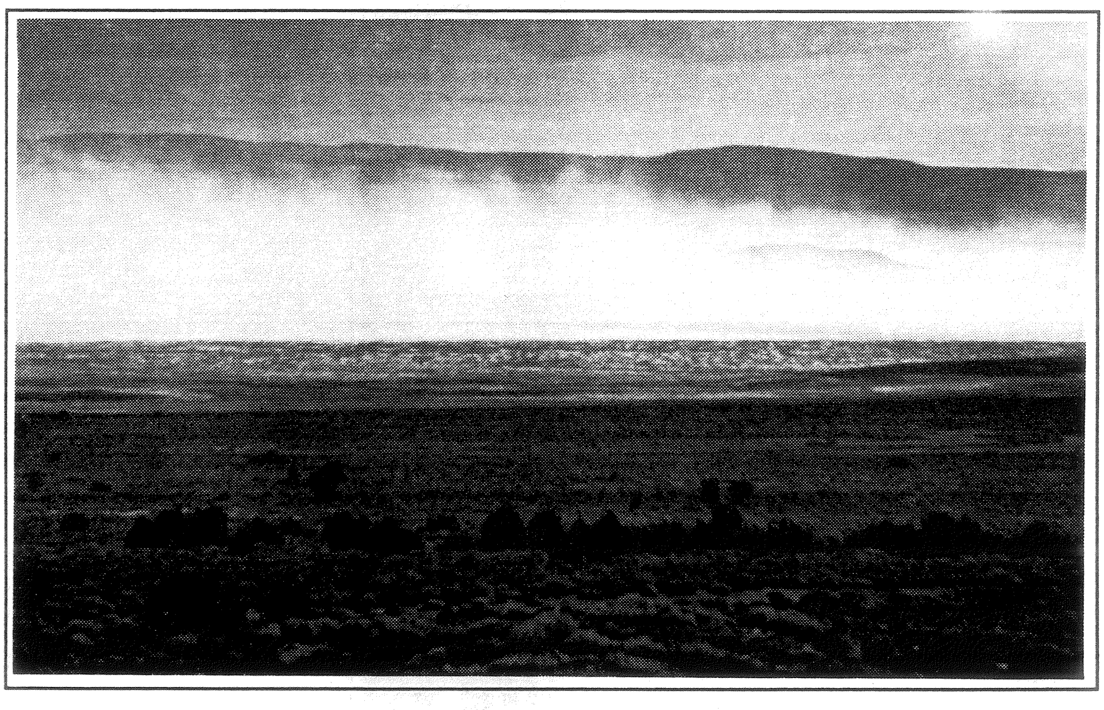
View from Black Point

Figure 3I-14.
Playa as a Visual Element



Negit Island on a Clear Day

Viki Lang photograph; Mono Lake Committee collection



Negit Island during a Dust Storm

Mono Lake Committee collection

Figure 3I-15.
Playa as a Source of Dust

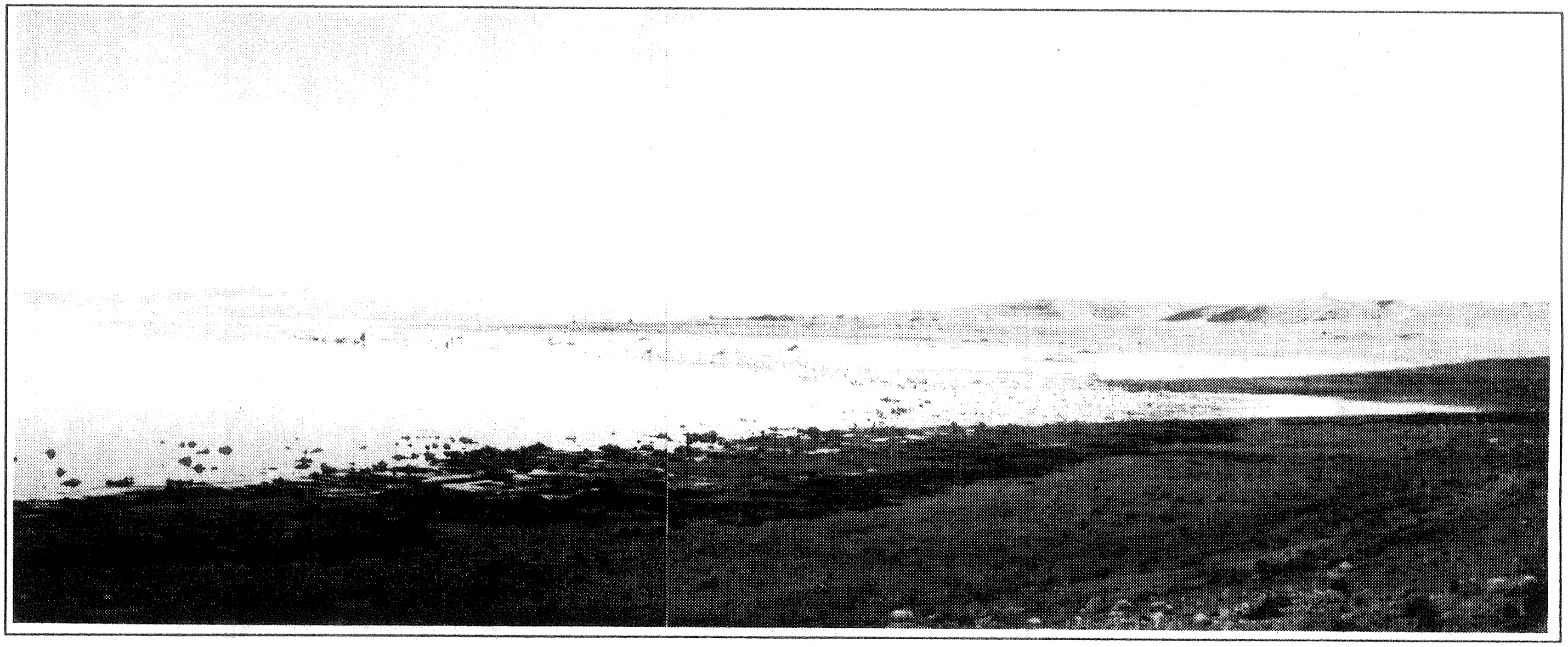
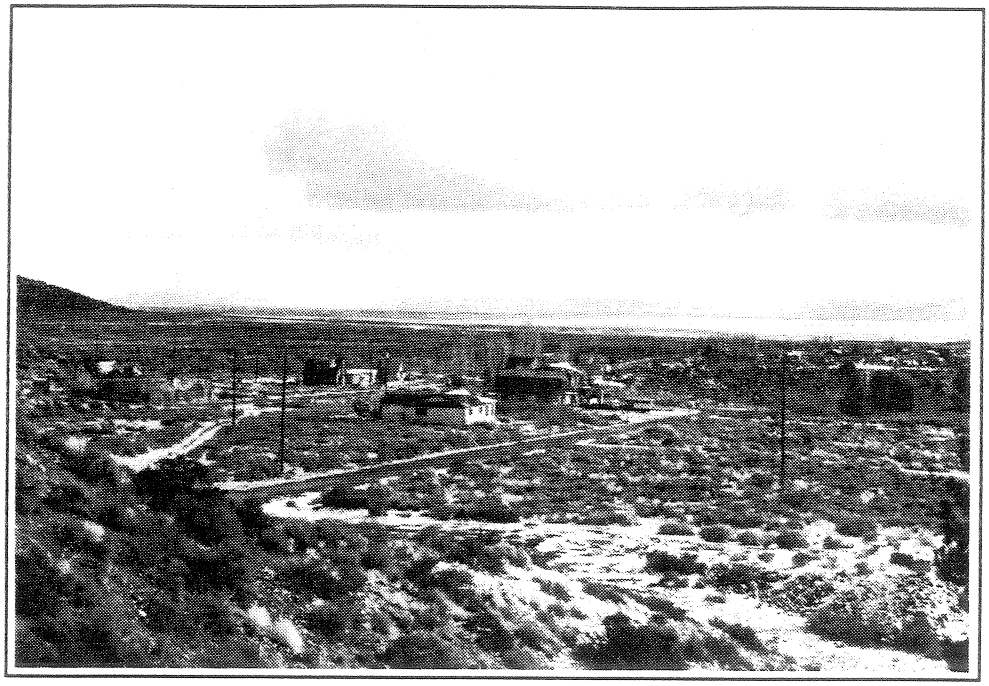
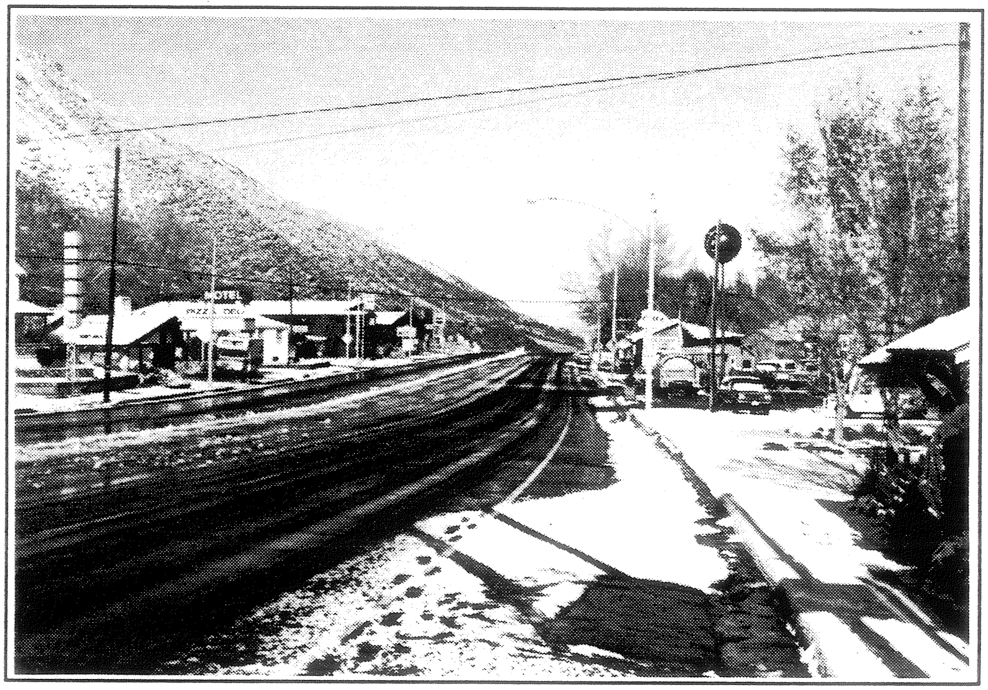


Figure 3I-16.
Pumice Blocks on Shorelands at Old Marina



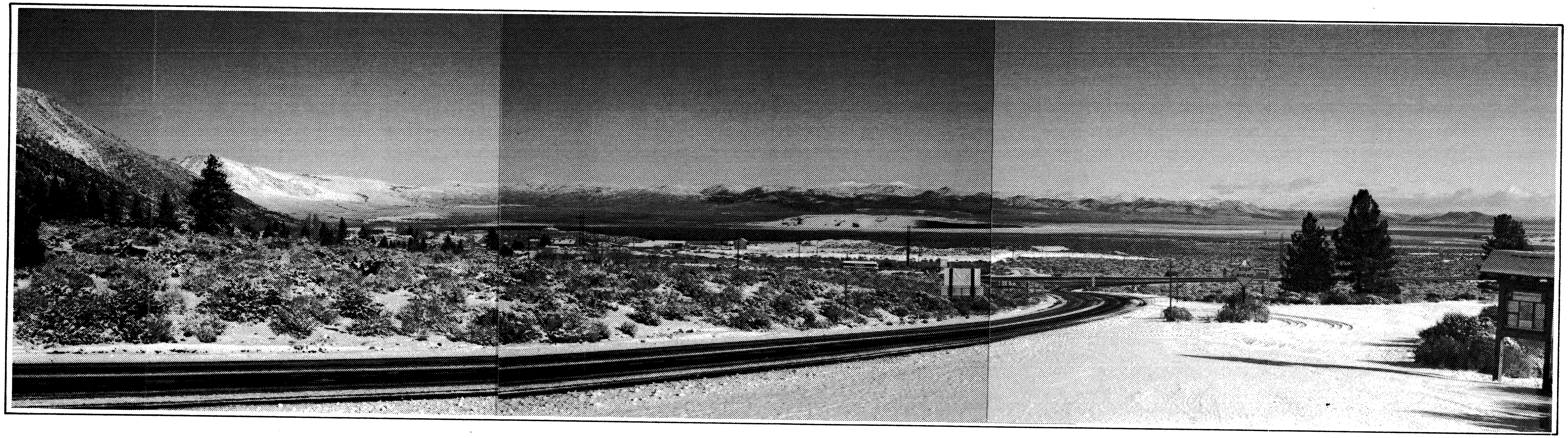
Mono City



Community of Lee Vining

Figure 3I-17.
Visual Character of Development Near Mono Lake

Figure 3I-18.
Utility Lines and Industrial Facilities at the Junction of U.S. Highway 395 and State Route 120 West



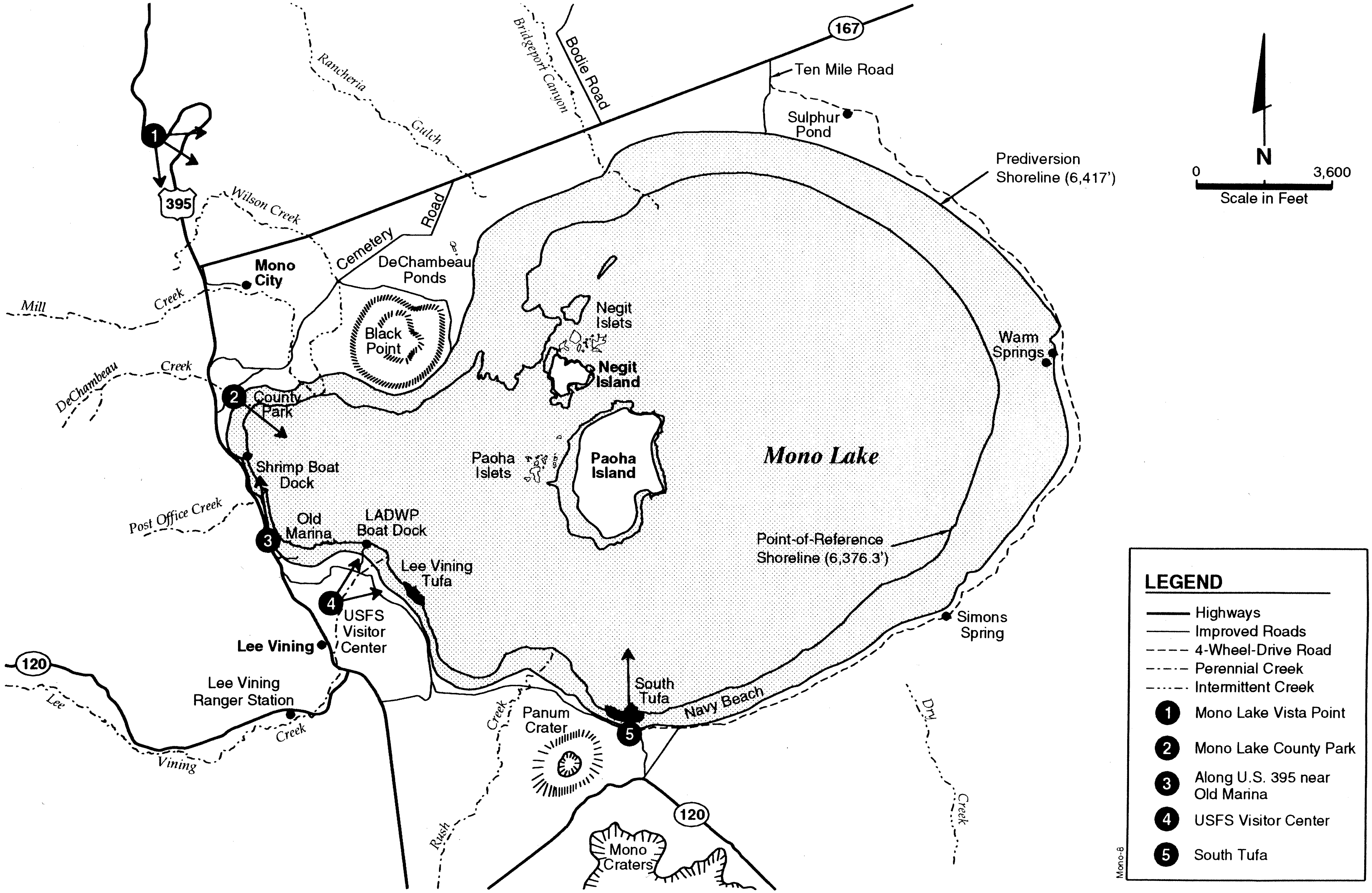
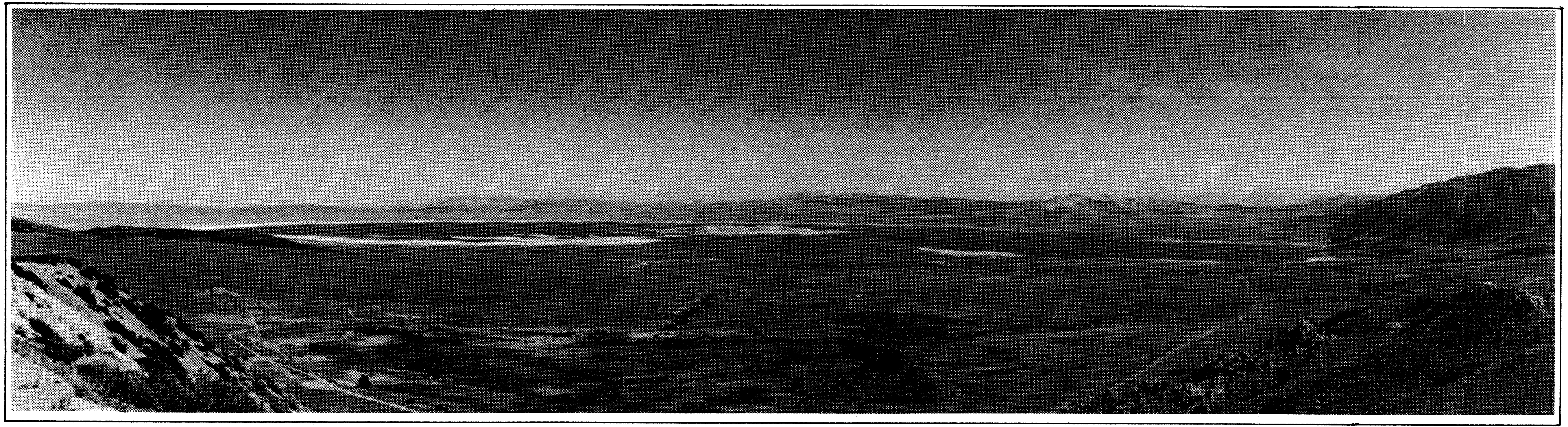


Figure 3I-19.
Viewpoints of Lake-Level Simulations

Figure 3I-20.
View of Mono Lake
from Conway Summit



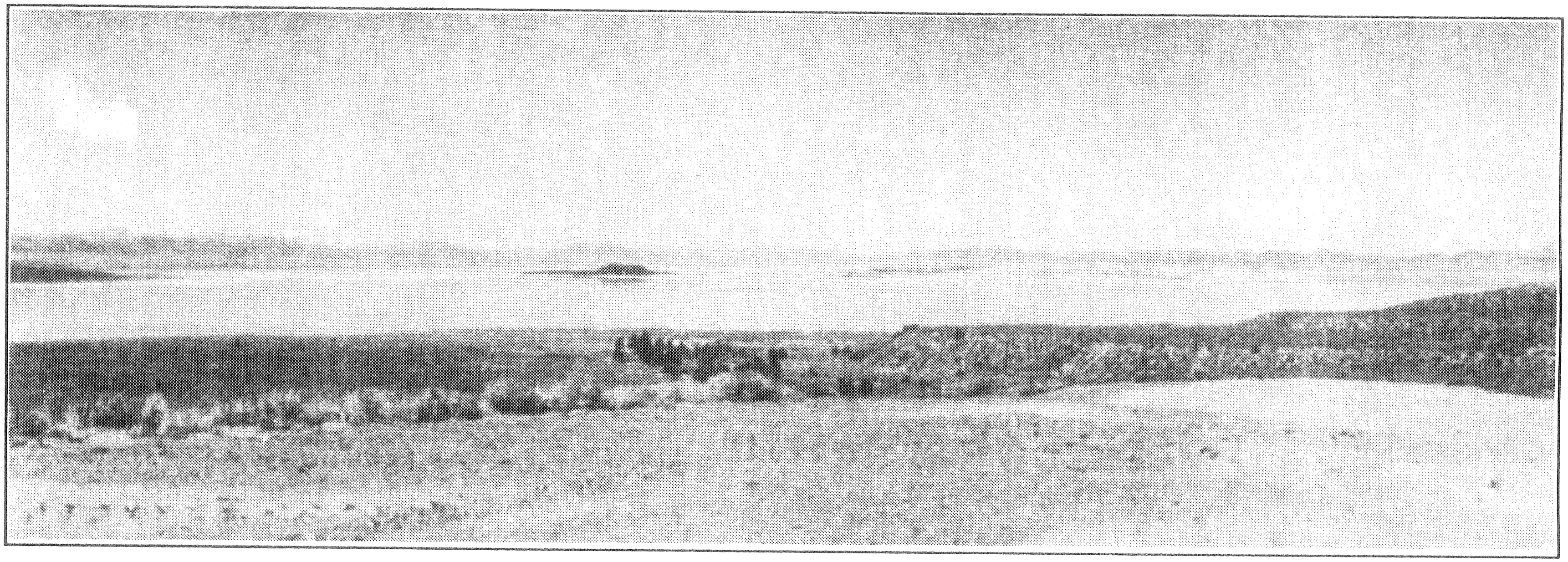
Note: Lake surface elevation is 6,375 feet.

Note: Lake surface elevation is 6,375 feet.

Figure 3I-21.
View of Mono Lake from County Park

Note: Lake surface elevation is 6,375 feet.

Figure 3I-22.
View of Mono Lake from U.S. Highway 395 at Old Marina

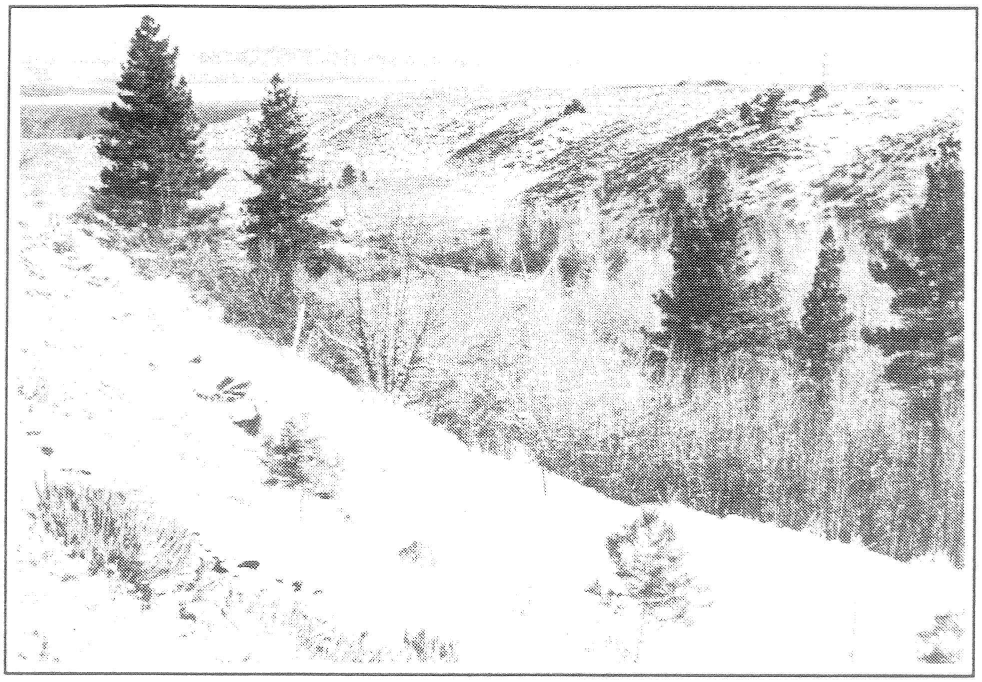


Note: Lake surface elevation is 6,375 feet.

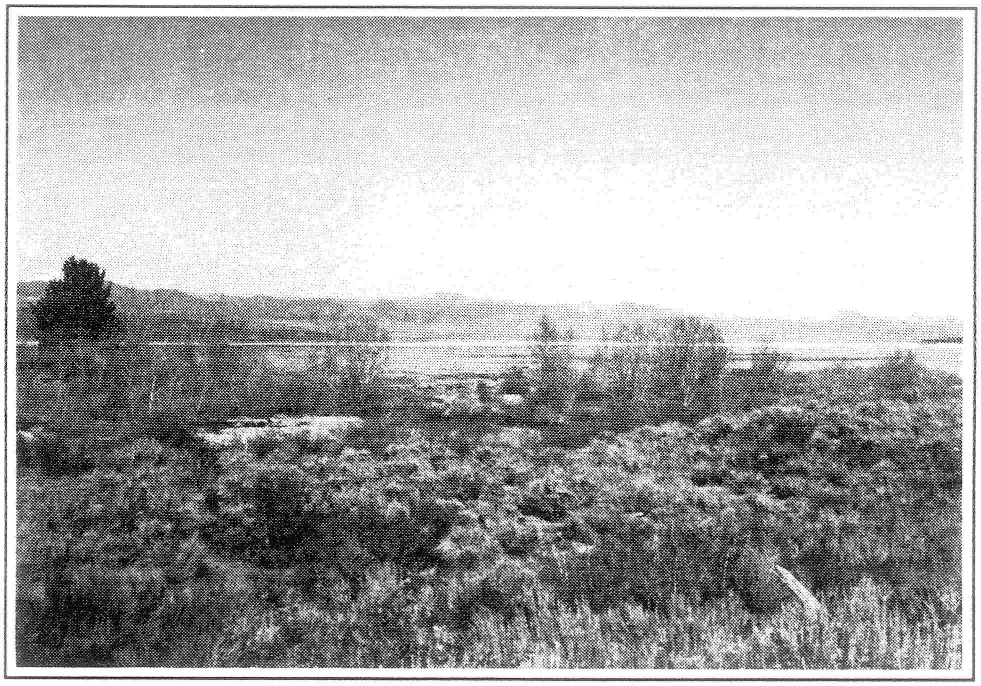
Figure 3I-23.
View of Mono Lake from Forest Service Visitor Center

Note: Lake surface elevation is 6,375 feet.

Figure 3I-24.
View of Mono Lake from South Tufa

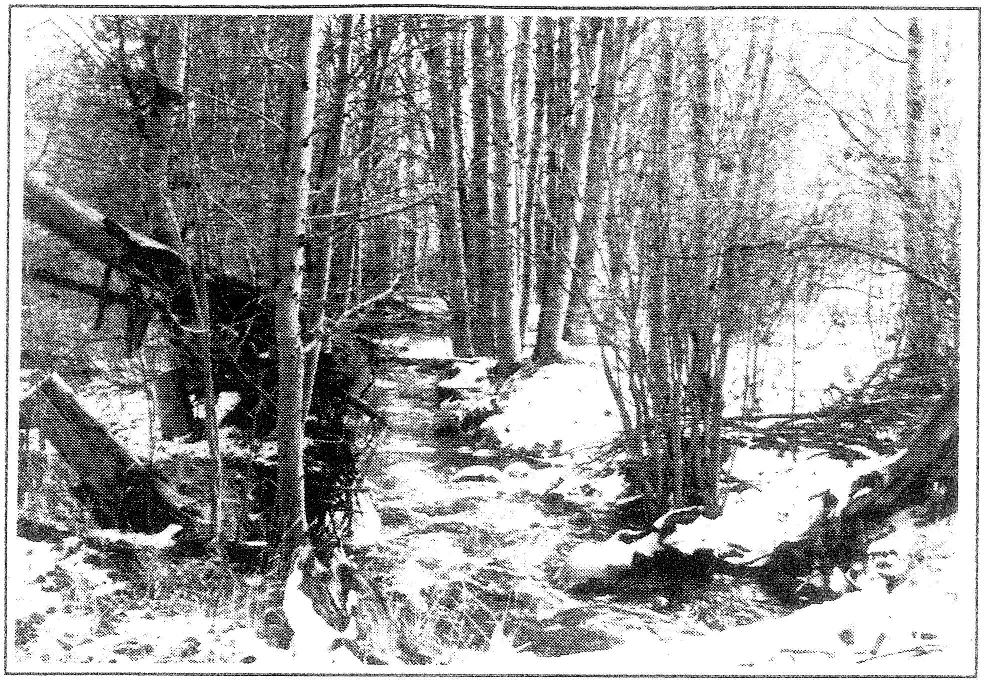


Below U.S. Highway 395



Above Delta at Mono Lake

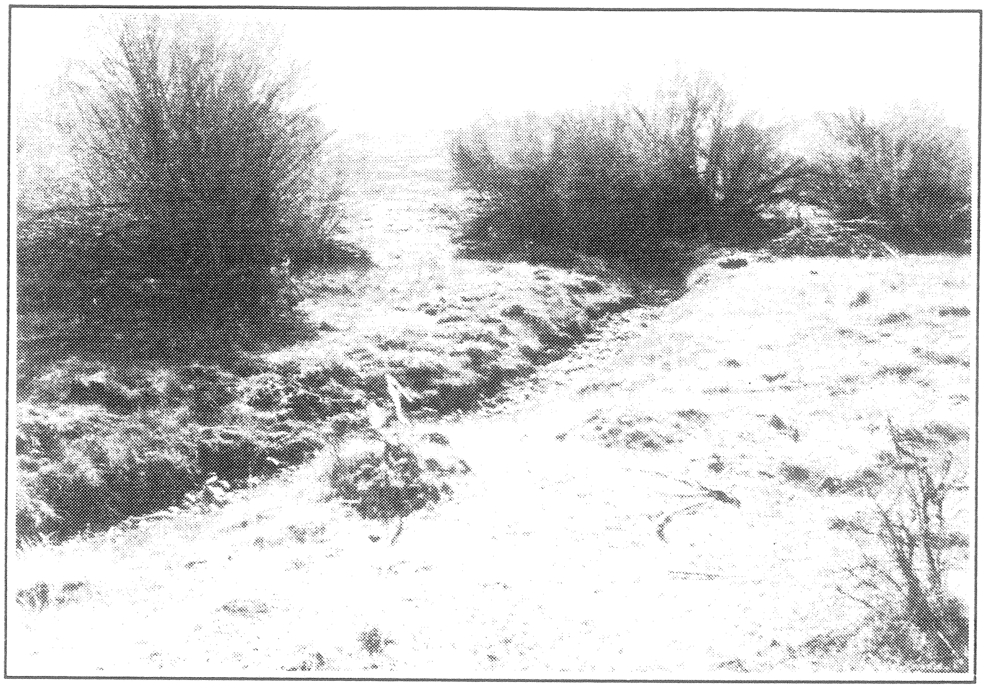
Figure 3I-25.
Lee Vining Creek



Above Diversion, Channel with Aspen

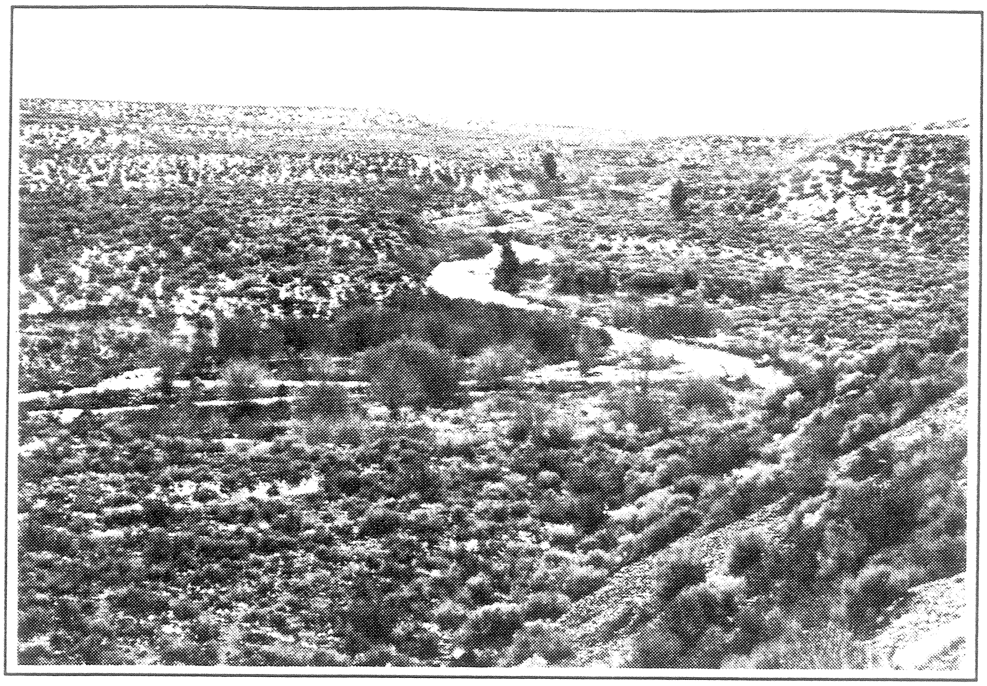
Below Diversion, Willow

Figure 3I-26.
Walker Creek

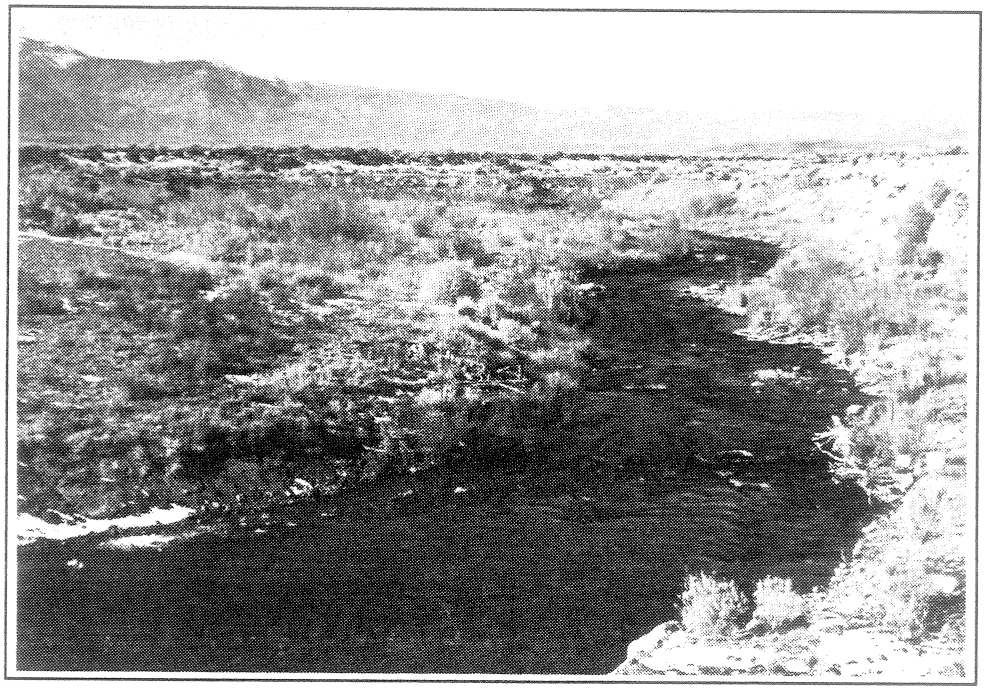


Dry Channel before Rewatering; Lack of Riparian Vegetation

Figure 3I-27.
Parker Creek



Braided Channel, Sparse Riparian Vegetation



Incised Channel at Prediversion Delta, Sparse Riparian Vegetation

Figure 3I-28.
Rush Creek

Figure 3I-29.
View of Grant Lake Reservoir from Developed Recreation Area

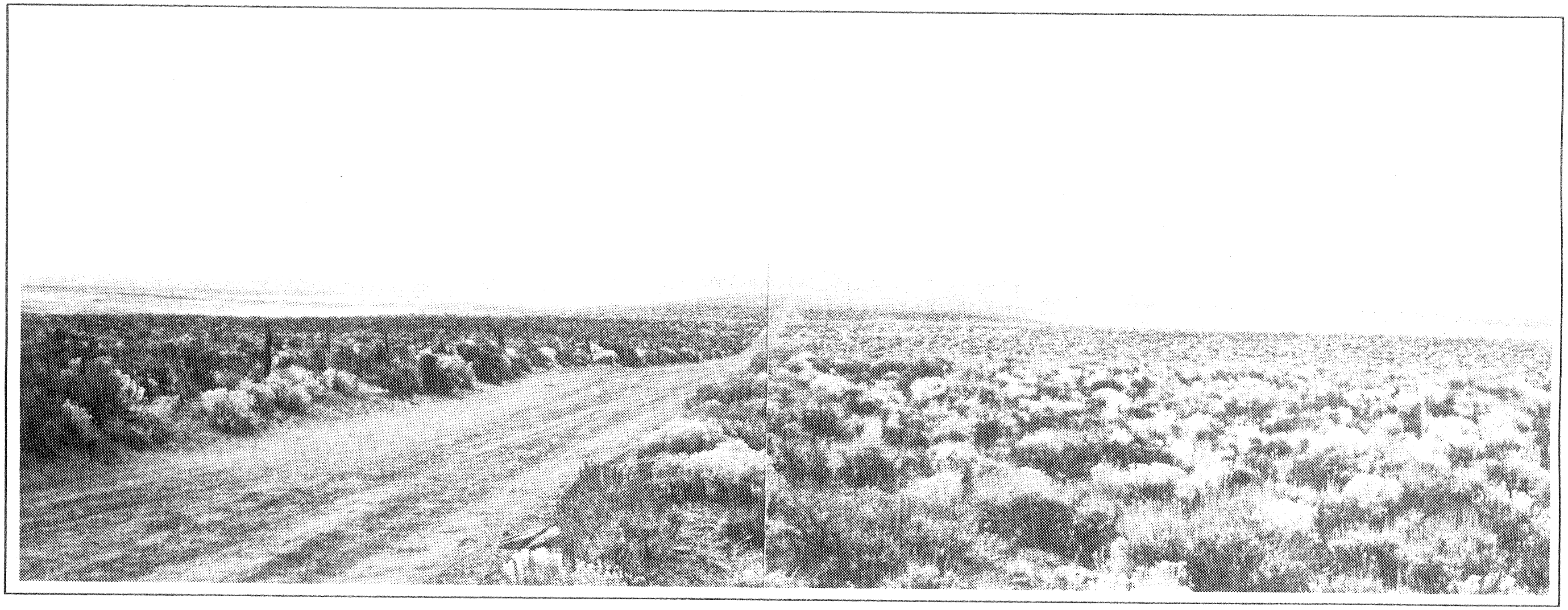


Figure 3I-30.
Upper Owens River Valley

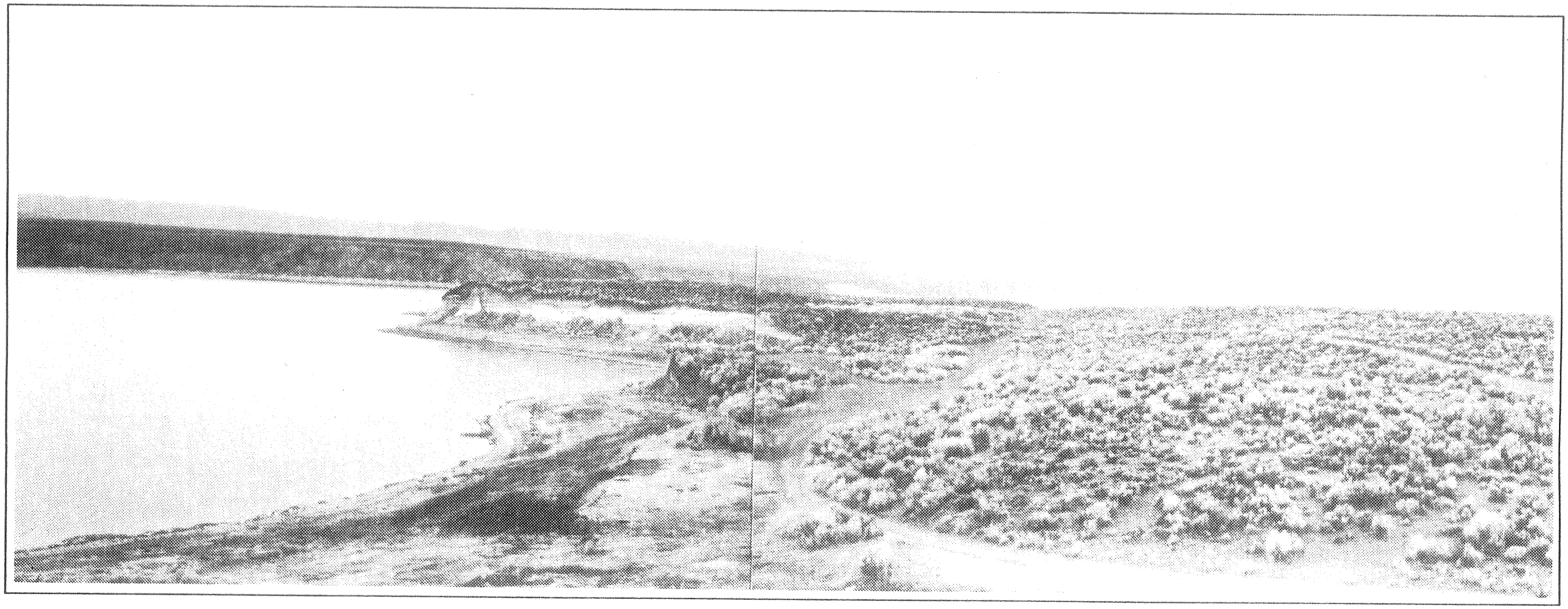
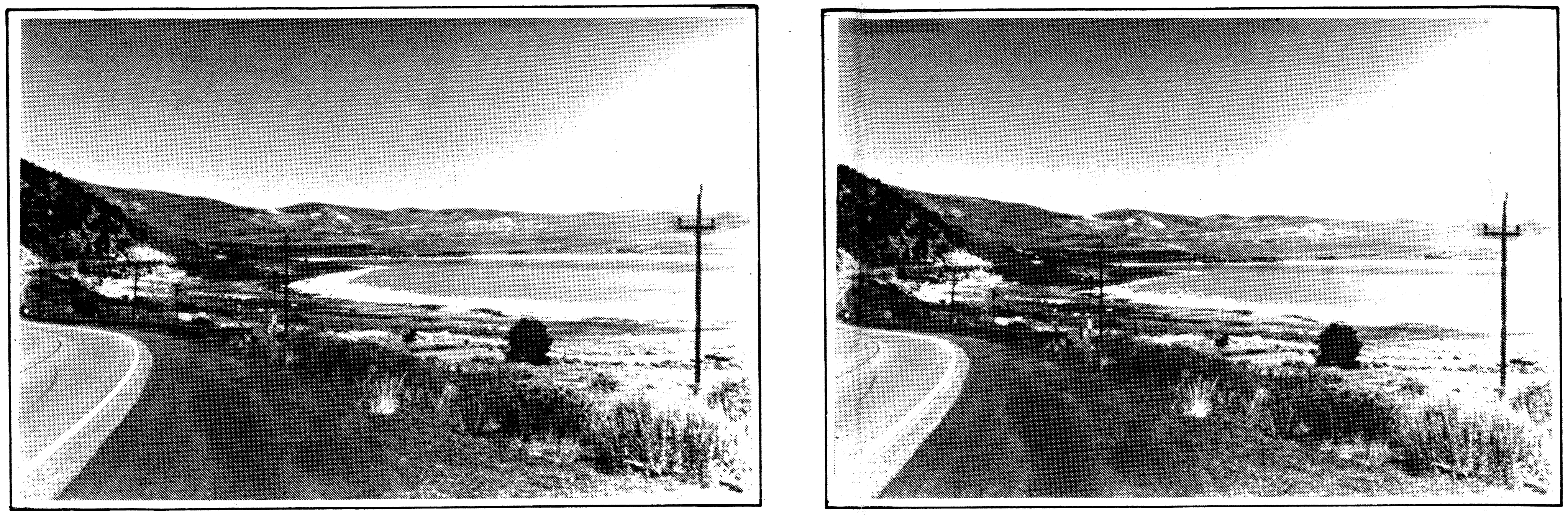


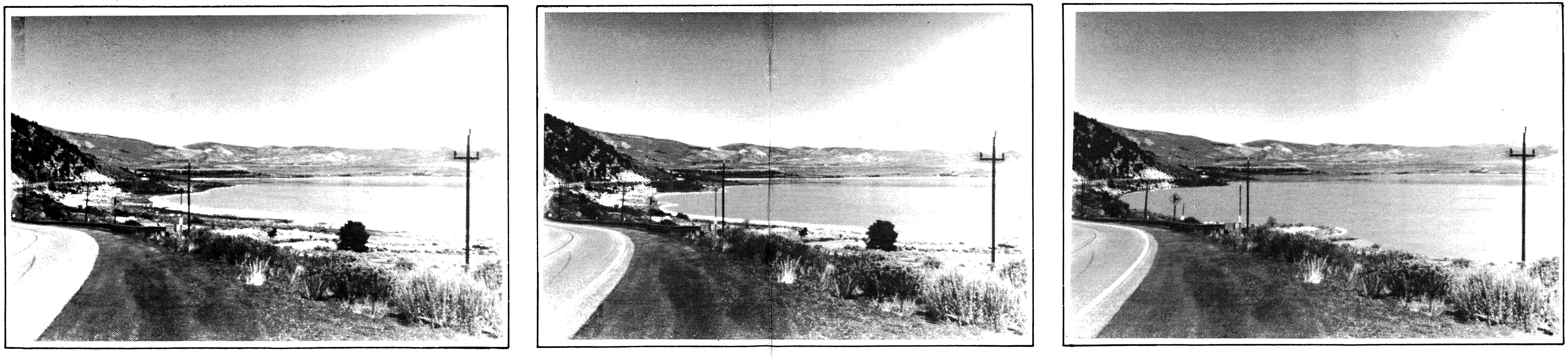
Figure 3I-31.
Lake Crowley Reservoir

Figure 3I-32.
Photograph Simulations
of Mono Lake at
U. S. 395 near
Old Marina



6,372'

6,374.5' (lake level as of August 1991)

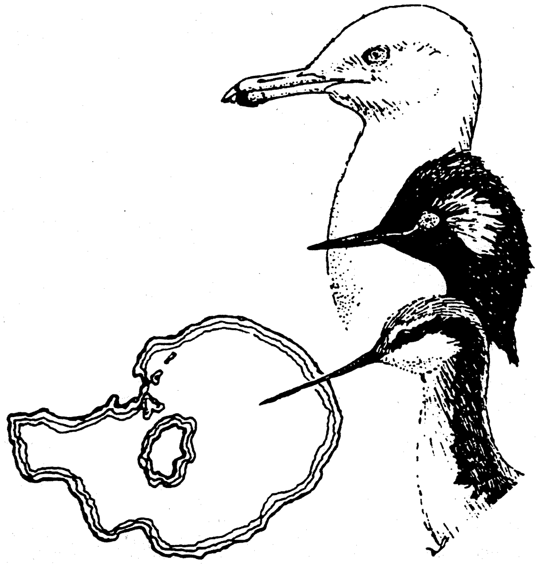


6,380'

6,390'

6,410'

Chapter 3J. Environmental Setting, Impacts, and Mitigation Measures - Recreation Resources



MONO BASIN EIR

Prepared by Jones & Stokes Associates

Chapter 3J. Environmental Setting, Impacts, and Mitigation Measures - Recreation Resources

This chapter describes the recreation resources in Mono Basin and Owens River basin that could be affected by the target lake level alternatives. In Mono Basin, these resources are located around Mono Lake, along diverted and undiverted tributary streams, around Grant Lake reservoir and the June Lake Loop, and near other lakes in the basin. In the Owens River basin, potentially affected resources are located along the Upper Owens River, around Lake Crowley reservoir, in the Owens River gorge, and around Pleasant Valley reservoir near Bishop.

Recreation resources are described as they existed prior to diversions from Mono Basin, as important changes occurred since 1941, and as they existed in recent years. Potential impacts of the project alternatives and available mitigation measures are presented in later portions of this chapter. The information in this chapter is organized by major basin (Mono Basin and Owens River basin). The visual resources of Mono Basin and Owens River basin, which greatly influence recreational activities, are described in Chapter 3I, "Visual Resources".

PREDIVERSION CONDITIONS

Sources of Information

Information on recreation resources and use in Mono Basin and Owens River basin before 1941 was obtained from published contemporary and historical accounts and interviews with individuals with first-hand knowledge of the subject. Contemporary sources include Homer Mining Index (1884) and Bergman (1938). Historical accounts include Mears (1963), Bean (1977), and Moore (1987). Personal accounts of prediversion recreation conditions in the study area were obtained from Wallis McPherson, Katherine Clover, and others.

Mono Basin

Historically, the major recreation resources in Mono Basin were Mono Lake, lakes along the June Lake Loop, and the tributary streams that supply water to Mono Lake (Figure 3J-1).

Mono Lake

Much of the early recreational activity at Mono Lake depended on use of its waters for their purported health benefits. A private health spa was in operation by 1884 where visitors soaked in lake water and rested in adjoining bedrooms (Homer Mining Index 1884). During the 1920s, a large health spa, including a sanitarium featuring hot-spring baths and a large hotel, was planned for construction on Paoha Island, but the venture eventually foundered because of inadequate financial resources. (McPherson pers. comm.)

The lake's sandy beaches were highly attractive to tourists; however, its unique water chemistry created unusual conditions for typical lake activities such as swimming and fishing. Although no fish species were known to reside permanently in Mono Lake, trout were observed historically in the brackish environment of the Rush Creek delta (McPherson pers. comm.).

Tourists began visiting Mono Lake in substantial numbers during the 1920s. A 1927 brochure promoted the "Inyo-Mono Playground" and its seven hotels and campgrounds. Early lakeshore facilities included the Mono Inn, Tioga Lodge, Farrington's Ranch, El Mono Hotel, Lee Vining Camp, and Lakeview Camp. Winter tourism increased when a rope tow for skiing was installed on Conway Summit in 1939 (McPherson pers. comm.).

Mono Lake attracted most of its visitors from southern California and, to a lesser extent, the San Francisco Bay Area. Early promoters of the area's recreational resources specifically targeted Los Angeles. Visitors pursued activities such as motor boating, water-skiing, swimming, picnicking, hunting, and camping. Sunbathing and beach games also were common on the lake's sandy beaches (McPherson pers. comm.).

Hunting for deer and waterfowl was popular historically at Mono Lake. The area was known for its abundant populations of waterfowl and other birds. Before 1940, many hunting blinds were located along the road connecting the mouths of Lee Vining and Rush Creeks (McPherson pers. comm.).

In 1938, the Mono Inn's owners initiated motorboat tours of Paoha and Negit Islands. One popular sport was aquaplaning, a precursor to waterskiing in which people standing on a large platform were towed. (McPherson pers. comm.)

Mark Twain Days, a Lee Vining festival that was initiated in 1929 to commemorate Mark Twain's 1862 visit to the basin, attracted many visitors to Mono Lake. The event occurred annually through 1941 when it was discontinued because of World War II. Mark Twain Days featured boat races, various tests of skill, and a bathing-beauty contest. By 1940, boat races held in conjunction with Mark Twain Days were sanctioned by the National Outboard Racing Commission and the American Power Boat Association, and over 50 boats participated.

June Lake Loop

The June Lake Loop road provides access to a string of lakes and reservoirs (June, Gull, Silver, and Grant) that are linked by Rush and Reversed Creeks (Figure 3J-1). The chain of lakes was created by glaciers that also left features such as Reversed Creek, which appears to flow uphill toward the Sierra Nevada, and Perched Rock, a 750-ton glacial boulder (Bean 1977).

Improvements to the June Lake Loop road and construction of water diversion and transport structures by LADWP brought many people to the June Lake area in the 1930s. Construction of Mono Craters Tunnel began in the early 1930s. The community of West Portal was founded to accommodate tunnel workers, many of whom preferred to live in the June Lake community. During construction of the tunnel, weekly rodeos and boat races were held at June Lake.

Grant Lake was originally formed by the same glacier that sculpted the other lakes of June Lake Loop. The lake was enlarged in 1915 when a dam was constructed at its outlet, and again enlarged in 1926 when the dam was raised. In 1935, construction began on a new Grant Lake reservoir dam. This project brought many workers to the northern end of June Lake Loop, further increasing the number of recreational events in the area. (Bean 1977.)

During the 1930s, June Lake Loop was a popular destination for tourists from southern California. A development at Silver Lake was known as "Little Pasadena", because most of its cabins were owned by Pasadena families. (Bean 1977.)

By 1940, the June Lake Loop had developed into a major outdoor recreation area. Warm-weather activities included camping, hiking, fishing, horseback riding, swimming, and picnicking. Deer and duck hunting, ice-skating, and skiing were popular during colder weather. Cabins and campgrounds were available at all of the loop's lakes, and horses could be rented at June Lake. Fishing was popular, and each lake had tackle shops and boat rentals. Fern Creek Fish Hatchery, established near Silver Lake in 1927, produced a yearly average of a million fingerlings for distribution to June Lake Loop lakes, Rush Creek, and other Mono Basin waters. (Bean 1977.)

Tributary Streams of Mono Lake

In the prediversion period, seven perennial streams flowed into Mono Lake. The most important of these streams were Rush and Lee Vining Creeks. The others are Parker, Walker, DeChambeau, Mill, and Wilson Creeks.

Rush Creek. Fishing was popular on Rush Creek. More than 300 species of birds, including 90 waterfowl and shorebird species, have been identified at Mono Lake. Although Mono Basin's waters did not support any native fish populations, trout fisheries were established in the creek by plantings in the late 19th century. Rush Creek provided good trout habitat and its banks supported lush riparian vegetation (Clover and Arnold pers. comms.). Streamflows were adequate to provide year-round fish cover, and periodic floodflows maintained good supplies of spawning gravels. In 1924, California Bureau of Fish and Game began stocking Rush Creek, supplementing the wild trout populations with trout weighing up to 6 pounds (McPherson pers. comm.). See Chapter 3D, "Fishery Resources" for a more complete assessment of the prediversion fishery.

Rush Creek also sustained substantial camping and picnicking use (McPherson pers. comm.). Many artists used the area as subject matter for paintings (Clover pers. comm.). Waterfowl hunting was a major use of the Rush Creek delta. Most recreationists along Rush Creek were not local residents (Arnold pers. comm.).

Lee Vining Creek. As today, the Lee Vining Creek canyon was the principal route to Mono Basin for travelers from San Francisco. Many tourists combined visits to Mono Basin with trips to Yosemite National Park. Use of the creek increased substantially after Tioga Pass Road was paved in the 1920s. Popular campgrounds were located near the confluence of Lee Vining Creek and Gibbs Canyon and near the current intersection of U.S. 395 and SR 120. The California Bureau of Fish and Game first stocked Lee Vining Creek with trout in 1924 (Arnold pers. comm.). Lee Vining Creek and the other streams of the basin did not support as many large trout as Rush Creek and were not as renowned for their fishing as Rush Creek (McPherson pers. comm.)

Owens Basin

The main recreation resource in the Owens Basin is the Owens River, which originates at Big Springs and flows through Long Valley (Upper Owens River), Owens River gorge, and Owens Valley to its historic sink at Owens Lake (Figure 3J-2). Historically, the Upper Owens River was typically less than 30 feet wide and bordered primarily by grassy, overhanging banks interspersed with willow stands upstream of John Arcularius Ranch (Bergman 1938). Upper Owens River streamflows near the present location of the East Portal averaged approximately 55 cfs, and peak flows never exceeded 180 cfs. These conditions provided excellent trout habitat. (Edmondson pers. comm.)

The Upper Owens River was renowned for the quality of its fishing. One author described it as "the most underrated brown-trout water in the West", and another claimed it was the best stream in the nation for production of large trout (Mears 1963). The owners of two ranches encompassing 7 miles of the Upper Owens River took advantage of its fishery by establishing guest fishing ranches. The first of these guest ranches to be established was Arcularius Ranch in 1919 (Moore 1987). Owens River Ranch, just upstream from Arcularius Ranch, was operated as a guest ranch by the early 1920s. By the 1930s, both ranches were attracting many loyal customers.

In the mid-1920s, LADWP began construction of an impoundment on the Upper Owens River several miles downstream of the guest fishing ranches. After construction was suspended for several years, Lake Crowley reservoir dam was completed in 1940, and water began filling the reservoir concurrent with the first water exports from Mono Basin.

The Owens River gorge, located downstream from Lake Crowley reservoir, is distinguished from other sections of the river by its high, steep rock walls. Before diversions for power production began in the early 1950s, the river flowed through the gorge to the Los Angeles Aqueduct (LA Aqueduct) intake below Tinemaha Reservoir. The gorge was well known for its production of large brown trout. Ten-pound fish were common, and the record catch was 22 pounds. (Mears 1963.)

ENVIRONMENTAL SETTING

This section describes recreation resources in the two-county Mono/Inyo area (the region) that could be adversely affected by the target lake level alternatives. Important resource changes that occurred since 1940 and recreation use in recent years are described.

Sources of Information

Principal information sources used in preparing this section include public agency reports; unpublished use records compiled by public agencies; summaries of user surveys commissioned by LADWP; summaries of creel censuses conducted by DFG; published scientific reports; and interviews with public land managers, resort operators, and public recreation facility concessionaires. Additional information on the characteristics of users of the affected areas and on their patterns of use was obtained through onsite user surveys conducted in 1991 and 1992 at Mono Lake, Rush Creek, Lee Vining Creek, Grant Lake reservoir, and Lake Crowley reservoir.

Regional Context

The region includes a large portion of the eastern Sierra Nevada, one of the premier recreation regions in the western United States. It features spectacular mountains, abundant lakes and streams, pristine forests and meadows, and fascinating historical sites. The region is heavily visited year-round, mainly for sightseeing, camping, fishing, hiking, and boating in summer and for skiing and other snow-related activities in winter. For example, Mammoth Mountain Ski Area near Mammoth Lakes is used more than any other ski area in the nation (U.S. Fish and Wildlife Service 1989).

Most of the region's recreation resources are managed by public agencies and are accessible to the public. The area's principal land management agencies are the U.S. Forest Service (USFS), U.S. Bureau of Land Management (BLM), California Department of Parks and Recreation (DPR), and LADWP. Most of the Upper Owens River flows through private land, but much of this land also is accessible to the public if they reserve cabins at guest ranches.

Most visitors to the region are residents of metropolitan southern California. The proportion of visitors from southern California ranges from 69% in summer to 76% in winter, and out-of-state residents account for 15-19% of the visitors. Almost all visitors travel by motor vehicle. (California Department of Transportation 1979.)

The importance of the region for recreation can perhaps best be described using recreation information compiled for the Inyo National Forest. The Inyo National Forest includes 1.6 million acres in Mono and Inyo Counties, nearly all of which are in Mono Basin and Owens River basin (U.S. Forest Service 1989). (About 83% of the national forest is in either Inyo or Mono County.) In 1982, recreation use in the Inyo National Forest totaled 4.8 million recreation visitor days (RVD). (One RVD equals 12 hours of recreation use by any combination of persons.) Of this total, approximately 58% of RVDs were spent in the national forest's developed recreation areas (including alpine ski areas) and 42% were spent in dispersed areas. Recreation use of the Inyo National Forest has increased rapidly since 1982, reaching a total of 8.0 million RVD in 1989 (Upham pers. comm.).

Mono Basin

Recreation areas in Mono Basin that could be directly affected by the target lake level alternatives include Mono Lake, Grant Lake reservoir, and some of the tributaries of Mono Lake. Estimates of annual visitor days at these recreation areas are shown in Table 3J-1.

Recreation at other basin lakes and streams could be indirectly affected by potential changes in regional recreation use patterns. Other lakes and streams could have increases or decreases in use in response to changes in the quality of recreation opportunities at the directly affected areas.

Mono Lake

Resources. Mono Lake and its lakeshore are part of the 116,000-acre Mono Basin National Forest Scenic Area, which is administered by the USFS (Figure 3J-1). The Scenic Area includes lands owned by the federal and state governments, the City of Los Angeles, and various private entities. Portions consist of relicted lands on the lakeward side of non-federal lands and constitute the 17,000-acre Mono Lake Tufa State Reserve, which is managed by DPR (Figure 3J-1). The entire lakeshore is open to public use.

Mono Lake's distinctive tufa towers and mounds form underwater as calcium-rich spring water mixes with carbonate-rich lake water. The lake's greatest concentrations of tufa are located near its southern and western shorelines (see Chapter 3I, "Visual Resources") and are a primary attraction for visitors to Mono Basin.

Sand tufa are tubular structures formed of beach sand and carbonates that are also uniquely characteristic of Mono Lake. The lake's greatest concentrations of sand tufa occur near Navy Beach, along its southern shoreline. The lake's sand tufa are less well known than its calcium-carbonate tufa towers and are an important recreational feature for only a small portion of the lake's visitors.

Birds are another of the lake's popular attractions. The lake and its nearshore environments support relatively large populations of nesting shorebirds, including California gulls and plovers, and also provide important resting and feeding areas for large numbers of migrating grebes and phalaropes. Waterfowl use, substantial in prediversion times, is relatively small at present, although several thousands of ducks still visit the lake (see Chapter 3F, "Wildlife").

Recreation resources at Mono Lake have been affected by declines in the lake level due to stream diversions. Seasonal waterfowl use has markedly diminished from its historic level. Opportunities for swimming, wading, and powerboating have declined as the lake's salinity has increased and as the lake has become less accessible. The increased frequency of severe dust storms on the lake's northern and eastern shores as more unvegetated lakeshore has become exposed (see Chapter 3H, "Air Quality") also has affected the recreational experience, particularly for the relatively few people who visit these areas.

Declining lake levels have affected recreation facilities originally constructed to improve lake access. For example, at Old Marina the boat ramp became unusable because of low lake levels. Boardwalks and interpretive signs at several recreation sites have functioned less effectively as the lake level has fallen. Much of the recently exposed shore is muddy and difficult to traverse on foot. As a result, the western shore, which consisted of sandy beaches and supported heavy recreation use in the prediversion period, is now less suitable for sun bathing and other beach uses.

Mono Lake produces abundant alkali flies and brine shrimp, which are the principal diet of the lake's bird populations. Fly and shrimp production may vary depending on lake elevation and salinity. Such changes in invertebrate production could affect bird abundance. Although some visitors to Mono Lake are intrigued by its abundant invertebrate populations, surveys conducted for the visual resources analysis for this EIR indicate that visitors do not consider alkali fly and brine shrimp to be important features of the visual environment.

Fluctuating lake levels also have affected the lake's tufa formations, one of its primary tourist attractions. As the lake has declined, tufa towers have become increasingly visible, land based, and accessible to the public. Mono Lake Tufa State Reserve was established in 1981 in part to control damage to tufa resulting from increased visitor pressure. During a temporary rise in the lake level during the wet years of the early 1980s, many tufa towers at South Tufa were undercut and toppled by waves (Stine 1992).

Use. Most recreation use at Mono Lake occurs along the lakeshore. The most popular recreation areas have been South Tufa, County Park, and Old Marina (Figure 3J-1). Their popularity is attributable to their relative accessibility and unique natural features. South Tufa and County Park feature the best views of tufa towers. South Tufa is the most popular site for boating because of its comparative ease of access from the lake. Picnicking is highly popular at County Park because of its picnic facilities, restrooms, and shade. Much of Old Marina's popularity results from its location immediately adjacent to heavily traveled U.S. 395; however, since the May 1992 opening of the Forest Service Visitors Center, located along U.S. 395 just north of Lee Vining, use of Old Marina has declined substantially. The Forest Service Visitors Center and the Mono Lake Committee's Visitor Center in Lee Vining provide visitors with information on Mono Lake.

The typical visitor to Mono Lake is a day user engaging primarily in relatively passive activities such as sight-seeing. A survey of 297 visitors conducted in summer 1992 for this EIR found that 23% spent more than 1 day at the lake and that the average length of a daily visit was 2.5 hours. When asked how satisfied they were with their most recent visit to Mono Lake, 73% of those surveyed indicated they were very satisfied, 23% indicated they were generally satisfied, and 4% indicated they were not satisfied. Thirty-nine percent of all those surveyed also had visited Mono Lake within the past 3 years.

The main reason for visiting Mono Lake indicated by 52% of the lake's visitors was "to see what the lake looks like"; another 25% indicated sight-seeing was their main reason for visiting. Bird watching or nature study was the next most frequently mentioned activity, accounting for 8% of visitors.

Mono Lake was the principal destination for 26% of the visitors, 52% of the visitors indicated that Mono Lake was one of several important destinations, and 23% indicated it was an incidental stop. Approximately 35% of the visitors interviewed at Mono Lake also visited Mammoth Lakes on their trip, 26% visited Yosemite National Park, and 25% visited June Lake Loop.

Use of Mono Lake peaks during summer; 67% of all visits take place during June-September (Carle pers. comm.). Most summer visitors are vacationing California families engaged primarily in casual sight-seeing; off-season visitors are more likely to be individuals participating in nature study (Carle and Upham pers. comms.).

Mono Lake is a popular destination for foreign visitors. Approximately 17% of the Scenic Area's visitors are overseas travelers, particularly from Germany, the United Kingdom, and Japan (Inyo National Forest 1989). The percentage of all visits made by foreign travelers increases during the off-season when use by California families declines.

Of the United States residents interviewed in the 1992 survey, 24% resided in the San Francisco Bay area, 20% in metropolitan southern California, 24% elsewhere in California, and 24% in other states. Only 1% of the respondents resided in Mono Basin.

Between 1986 and 1989, visitation to the lake increased while the lake level declined (Table 3J-3). The increase in use may be related to increasing public awareness and curiosity regarding Mono Lake. Estimates of Mono Lake use since 1990 compiled by DPR indicate that use may have decreased in recent years, although recent use estimates are less reliable than pre-1990 estimates. (Carle pers. comm.)

Grant Lake Reservoir

Grant Lake reservoir, along the June Lake Loop (Figure 3J-1) provides fishing from boat and shore, sailing, and powerboating activities such as waterskiing and jet skiing. Powerboating is limited at other Mono Basin lakes because of their relatively small size. Grant Lake Marina features a 70-unit campground; boat launch, moorage, and rentals; store; and cafe (Ihnen pers. comm.). Another public boat launch is located at the inlet of Parker Flume near the southeast end of the lake (Balint pers. comm.).

The spillway elevation at Grant Lake reservoir dam is 7,130 feet above sea level. The lake consists of an upper and a lower lobe (Figure 3J-1). At lake elevations above 7,125 feet, most of the lakeshore is inundated and the area available for beaching boats is limited (Ihnen pers. comm.). Vehicle access to the upper lobe and the east side of the lake also are limited at very high lake levels (Balint pers. comm.).

As lake levels decline, the upper lobe is affected first. When the lake level drops below 7,110 feet, the upper lobe becomes inaccessible to boats, and the boat launches are unusable (Balint pers. comm.). When the launches are out of use, the lake is accessible only to smaller boats. Fishing quality also declines at levels below 7,110 feet because the lake's natural fishery suffers from low reproductive success (see Chapter 3D, "Fishery Resources").

Based on a survey of 98 users of Grant Lake reservoir conducted in 1991 for this EIR, the average length of stay at the lake is 5.3 days and the average daily period spent on the lake or lakeshore is 4.3 hours. Among visitors interviewed, 66% indicated that Grant Lake reservoir was their primary destination.

The most popular activity at Grant Lake reservoir is shore fishing, which was identified as the main reason for visiting the lake by 87% of the visitors. Only 6% of the visitors identified a boating-related activity (i.e., boating, waterskiing, or trolling) as the most important reason for visiting the lake.

About 66% of Grant Lake visitors also visited other lakes in the June Lake Loop during their most recent trip to Grant Lake reservoir. About 28% of Grant Lake reservoir visitors visited Mammoth Lakes and about 16% visited the lakes near Tioga Pass.

Day and overnight use at Grant Lake reservoir and lake levels are shown for recent years in Table 3J-4. Since 1986, total annual use at Grant Lake reservoir has averaged approximately 48,000 visitor days. Approximately 20% of Grant Lake reservoir's use typically occurs in April and May; 60% occurred in June, July, and August; and 20%

occurred in September and October (Ihnen pers. comm.). Both use and lake levels were relatively low in 1990 and 1991.

As suggested by the data in Table 3J-3, Grant Lake reservoir recreation use varies with lake level fluctuations. For example, fishing and waterskiing decline when the lake level drops and the upper lake becomes dry. Although lake levels often fluctuate substantially from year to year and even from month to month, use levels typically recover slowly following sustained low lake levels. Adverse publicity regarding recreation conditions at Grant Lake in 1 year are believed to affect visitation levels for several years (Ihnen pers. comm.).

Diverted Tributary Streams

The lower reaches of Rush, Lee Vining, Walker, and Parker Creeks were largely dewatered by diversions to the LA Aqueduct beginning in 1941. Except for occasional flooding episodes, these creeks were dry after 1971, when the second pipeline of the LA Aqueduct became operational. Recreational use of these stream reaches, which had mainly consisted of trout fishing, subsequently declined to negligible levels. Continuous streamflows were resumed in these reaches by large runoff events during the early 1980s and, subsequently, by orders from the El Dorado County Superior Court in 1986 for Rush and Lee Vining Creeks and in 1991 for Walker and Parker Creeks.

Based on results of a 1991 survey of 247 tributary stream users conducted for this EIR, visitors spent an average of 9.9 days on the upper reaches of the streams in 1990 and 1.1 days on the lower reaches. In 1991, visitors' use of the tributary streams was estimated to be an average of 11.8 days on the upper reaches and 1.3 days on the lower reaches. The average period of daily use was 6.0 hours.

Visitors to the tributary streams also were asked about other destinations on their most recent trip to the area. Convict Lake was identified by 54% of the visitors, Mammoth Lakes or Twin Lakes by 33%, Lundy Lake by 32%, the Bishop area by 26%, Convict Creek by 16%, and Lake Crowley reservoir by 15%. Of the 197 visitors surveyed, 54% resided in metropolitan southern California, 6% resided in the San Francisco Bay Area, 2% were residents of Mono Basin, 36% resided elsewhere in California, and 2% resided out of state.

Rush Creek. Lands adjacent to upper Rush Creek (i.e., the reach above Grant Lake reservoir) are managed by USFS. Most of the lands along lower Rush Creek, which extends for 10 miles from the Grant Lake reservoir diversion dam to Mono Lake, are managed by LADWP. The entire creek is accessible to the public. Access to Rush Creek is provided by SR 158 (the June Lake Loop) above its intersection with U.S. 395 and by unimproved roads and trails below U.S. 395. A 17-unit USFS campground is located on Reversed Creek below Gull Lake. No facilities are provided along lower Rush Creek.

Most fishing on Rush Creek occurs on its upper reaches. Because DFG regularly stocks upper Rush Creek with catchable-sized trout, anglers generally enjoy high fishing success rates despite intense fishing pressure.

Recent El Dorado Superior Court decisions have sustained the rewatering of lower Rush Creek and the restoration of the historical conditions that supported its pre-1941 fishery. The suitability of lower Rush Creek for fishing is not yet widely recognized outside Mono Basin, however, and thus little recreation occurs there. Use of the lower reach has not yet approached levels that existed before the streams were dewatered (Vestal 1954). Between 1985 and 1990, annual fishing use on lower Rush Creek ranged from 73 to 250 fishing days (Sorensen 1990). As the restoration and recovery of Rush Creek and its fishery continue, recreation use is expected to increase substantially. (A fishing day is 12 hours of use; on Rush and Lee Vining Creeks, the average length of a visitor-day is 0.5 fishing day.)

Other popular activities along Rush Creek include camping, hiking, wildlife observation, and photography. As with fishing, very little of this use occurs along its recently rewatered reach (Sorensen 1989). These activities are also expected to increase as restoration and recovery of the stream progress.

In the 1991 survey of users of Rush Creek, 76% of those surveyed indicated the main reason they visited Rush Creek was to fish with bait or lures. Fly fishing and camping were the main reasons identified by 15% and 3% of the respondents, respectively.

After being shown photographs of Rush Creek at 20 cfs, 60 cfs, and 100 cfs, visitors to Rush and Lee Vining Creeks were asked which (if any) of the streamflow conditions was most appealing to them for their primary recreation activity. Of the visitors interviewed, 5% indicated that they preferred 20 cfs, 36% preferred 60 cfs, 43% preferred 100 cfs, and 15% had no preference.

Lee Vining Creek. Lee Vining Creek is accessible from SR 120 upstream from U.S. 395 and by dirt roads and trails below U.S. 395. Big Bend Campground, consisting of 16 camp sites, is located in Lee Vining Canyon 7 miles west of U.S. 395.

Fishing, camping, hiking, and picnicking are the primary recreation uses at Lee Vining Creek. In the 1991 survey of users of Lee Vining Creek, 58% of those surveyed indicated the main reason they visited Lee Vining Creek was to fish with bait or lures. Camping and bird watching were the main reasons identified by 30% and 7% of the respondents, respectively.

Like Rush Creek, upper Lee Vining Creek is frequently stocked with catchable-size trout and is heavily fished. Lower Lee Vining Creek consists of the 4-mile-long reach below the diversion dam. The El Dorado County Superior Court has ordered the restoration of the historical conditions that supported the pre-1941 fishery for Lee Vining Creek, as it did for Rush Creek. Continuous streamflow was resumed in lower Lee Vining Creek in 1986, but the riparian habitat has not yet recovered and its recovering fishery has not yet attracted many anglers. Annual use of lower Lee Vining Creek increased from 15 fishing days in 1987 to 74 fishing days in 1990 (Sorensen 1989, 1990).

Walker and Parker Creeks. Access to Walker and Parker Creeks is provided by unimproved roads and footpaths. No public recreation facilities are provided along these creeks. A private fishing club, however, is located on Walker Creek above the diversion points near the outlet of Walker Lake.

The upper reaches of Walker and Parker Creeks receive light use, primarily for fishing. The portions of Walker and Parker Creeks between their diversion dams and their confluences with Rush Creek were rewatered in 1991. Some stream restoration work has been completed, but these recently rewatered streams have attracted only a few anglers to date (Ford pers. comm.).

Other Potentially Affected Resources

Lakes of the June Lake Loop. Access to June, Gull, and Silver Lakes is provided by SR 158. Although the area supports year-round recreation, most activity at the lakes occurs during summer.

Facilities at June Lake include a marina, 130-unit and 27-unit campgrounds, boat launch, picnic area, and swimming beach. Gull Lake features 16-unit and 10-unit campgrounds. Facilities at Silver Lake include a 63-unit campground, a boat launch, and a backcountry pack station. Use of the five campgrounds at June, Silver, and Gull Lakes in 1991 totaled approximately 42,000 visitor-nights for an average campsite occupancy rate of 54%. (Senn pers. comm.)

Other Mono Basin Lakes. Lundy Lake is located on Mill Creek near the upper end of Lundy Canyon and features a boat launch and a 15-unit private campground. Ellery, Tioga, and Saddlebag Lakes, located near the headwaters of Lee Vining Creek at Tioga Pass, are accessible by SR 120. Each lake has a resort and camping and boating facilities. Saddlebag Lake has a 22-unit campground, and Tioga Lake and Ellery Lake have 13-unit campgrounds.

Walker Lake is located on Walker Creek about 0.5 mile downstream from the eastern boundary of the Ansel Adams Wilderness. Access to the lake is provided by a gated dirt road and trails. Although Walker Lake features no public facilities, a private resort is located just downstream from the lake's outlet to Walker Creek.

Mono Basin also features many high-elevation lakes accessible only by foot or by horse. Many of these lakes are located in the Ansel Adams and Hoover wilderness areas. Management prescriptions for these wilderness areas emphasize opportunities for solitude and primitive recreation. No developed recreation facilities are provided at these lakes.

The most popular activities at Mono Basin's freshwater lakes include fishing, boating, and camping. Campsite occupancy at the three campgrounds near Tioga Pass averaged 89% in 1991, or approximately 11,900 visitor days (Senn pers. comm.). Facilities at lakes accessible by motor vehicles are typically open May-October. High-country lakes that can be reached only by hiking are usually accessible somewhat later.

Other Tributaries to Mono Lake. Other streams tributary to Mono Lake include Mill, Wilson, and Dechambeau Creeks, the latter discharging into the lake at Mono Lake County Park. Mill Creek is accessible by a USFS road that ends at Lundy Lake. A 50-unit campground administered by Mono County is located on Mill Creek approximately 1.5 miles below Lundy Lake.

A major destination resort, Conway Ranch, has been proposed for establishment on private land along the lower portion of Wilson Creek. Mono County approved a master plan for this project in 1990, but further approvals are required for construction to proceed (see Chapter 3G, "Land Use").

Owens River Basin

Principal recreation areas in Owens River Basin that could be affected by the target lake level alternatives are the Upper Owens River and Lake Crowley reservoir. Estimates of annual visitor days at these recreation areas are shown in Table 3J-1. Other recreation areas in the basin at which use could be indirectly affected by changes in the regional pattern of use include the Owens River gorge and Pleasant Valley reservoir.

Upper Owens River

Resources. Recreation facilities along the upper Owens River include public and private campgrounds and private ranches that allow limited access to the river for fishing. USFS operates a 24-unit campground at Big Springs, a 30-unit campground at Glass Creek, and an 80-unit campground at Deadman Creek (U.S. Forest Service 1987). These campgrounds, accessible from U.S. 395 from mid-May through October, are all upstream of the East Portal of LADWP's Mono Craters tunnel. A 100-unit privately operated campground is located at Benton Crossing several miles upstream from Lake Crowley reservoir along a reach of the Owens River affected by Mono Basin exports.

The Upper Owens River offers high-quality recreation that combines good fishing opportunities, campgrounds, and attractive scenery. Fishing is seasonally available for resident trout and for trout that migrate from Lake Crowley reservoir to the Upper Owens River to spawn. Two guest ranches are operated along the Upper Owens River: Alpers' Owens River Ranch, which comprises 2 stream miles above the East Portal beginning 1 mile downstream from Big Springs, and John Arcularius Ranch, which encompasses the 5 stream miles immediately downstream from Owens River Ranch and on which the East Portal is situated. Although fishing is the primary activity at the guest ranches, at least half of the guests visit primarily to enjoy the serenity and scenic amenities. These ranches can jointly accommodate up to 120 guests. The fishing quality is maintained by restricting fishing access and streamside grazing and through catch-and-release restrictions. (Alpers and Arcularius pers. comms.)

Fishing quality on the Upper Owens River depends on the size of trout spawning runs between Lake Crowley reservoir and the river's headwaters. Low streamflows (from low runoff, low exports from Mono Basin, and large local irrigation diversions) can result in the formation of sandbars and other physical impediments to fish migration and increased water temperatures that constitute thermal barriers to migration (Scheubert pers. comm.). Flows in the Upper Owens River could be further reduced by extractions of groundwater from the aquifer supplying Big Springs proposed for municipal use by the Town of Mammoth Lake.

Use. Fishing, camping, and sightseeing are the primary recreation activities along the Upper Owens River. John Arcularius Ranch and Owens River Ranch are open during the trout fishing season, which runs from the last week in April through October. Fishing activity is greatest during the season's opening weekend. On an average day, approximately 25 anglers use the 7 miles of the Upper Owens River within these ranches, for an annual total use of about 4,600 visitor days (Alpers and Arcularius pers. comms.)

Fishing access is restricted to landowners and their guests on the 7 miles of the Upper Owens River downstream from John Arcularius Ranch owned by Inaja Land Company and Howard Arcularius. These ranches support approximately 1,000 visitor days of fishing use each year.

More fishing activity occurs along the public-access portions of the Upper Owens River, where access is unrestricted and anglers may keep up to five fish per day. A 1987 survey of fishing use on the 6.5-mile public reach between Howard Arcularius Ranch and Benton Crossing estimated total use during the 6-month season at 43,300 fishing hours. Assuming the average daily visit lasts 6 hours, this amount of fishing would equal approximately 7,200 visitor days, or 1,110 visitor days per stream mile. Bait fishing accounted for 60% of the total, fly fishing for 21%, and lure fishing for 19%. Fishing activity varies in response to periodic changes in fishing regulations and in response to fish stocking activities. (Deinstadt pers. comm.)

Remaining public portions of the Upper Owens River are the 1-mile reach between Big Springs and Owens River Ranch and the 4-mile reach between Benton Crossing and Lake Crowley reservoir. Assuming use of these reaches equals the average use rate on the 6.5-mile reach upstream from Benton Crossing, annual fishing use on the all public portions of the Upper Owens River would total approximately 13,000 visitor days.

Estimates of fishing use of the Upper Owens River in 1987 are shown by reach in Table 3J-4.

Lake Crowley Reservoir

Resources. Recreation facilities and use at Lake Crowley reservoir were managed by the City of Los Angeles until 1991. Los Angeles owns all land surrounding the lake. South Landing Marina, located at the south end of the lake, is the only developed recreation facility. The marina is open to the public from the last weekend in April through Labor Day, although its hours of use are reduced after August 1. In 1992, management of the marina and other recreation facilities was contracted to Sierra Recreation Associates, a private concern.

Recreation opportunities on the reservoir include fishing from boats, float-tubes, and shore; water skiing; sailing; and other watercraft use. Its trout fishery is highly renowned. The recreation facilities at South Landing Marina include a boat launching ramp, marina, boat storage and rentals, and parking area (Griffith pers. comm.). Camping is allowed at South Landing Marina only on the first weekend of the season. Dispersed camping is allowed along the lakeshore outside the marina throughout the year. Frequently used areas outside the marina include North Landing and Leighton Springs.

Recreation opportunities and quality vary over the season according to fluctuations in reservoir level and water temperature and quality. High water temperatures and low water levels frequently result in large algae blooms. These blooms reduce the attractiveness of the reservoir for boating, waterskiing, and fishing. In addition, the surface area and depth of the reservoir decline with water level, thus reducing the area available for waterskiing. A waterski course in a constructed cove at the south end of the reservoir is largely unusable when lake levels drop below 6,772 feet (Paranick pers. comm.).

Fishing success also is affected by lake levels. Natural production of trout and Sacramento perch decline at shallower lake levels (see Chapter 3D, "Fishery Resources"). For example, late-season fishing for perch and trophy brown trout in McGee Bay is generally possible if the reservoir is maintained at levels exceeding 6,765 feet. Lower levels cannot support extensive weed beds in the littoral zone; these weed beds are the main source of cover for fish and the substrate for the insects that provide much of their diet. (Edmondson pers. comm.)

Use. Fishing is the leading recreation activity at Lake Crowley reservoir, accounting for 91% of its total use. Approximately two-thirds of the fishing occurs from boats and one-third from shore or float-tubes. Boating, including boat fishing, waterskiing, and other boating, accounts for 67% of the lake's total recreation. (O'Donnell pers. comm.)

Early season use typically accounts for a disproportionately large share of Lake Crowley reservoir's total annual use. Between 1988 and 1991, 16% of recreation use at Lake Crowley reservoir occurred during the opening week of trout fishing season and 58% occurred during the first five weeks of the season (Table 3J-5).

Relative use levels at South Landing Marina and at undeveloped areas outside the marina vary over the season. During the first week of the season, use levels at the marina and the undeveloped areas are roughly equal. Relative use of the marina then increases, accounting for approximately 90% of the total during August. Recreation continues in the undeveloped areas after the marina closes on Labor Day. Except for the opening weekend, camping use along the lakeshore is relatively low because of the lack of facilities. (Griffith pers. comm.)

In a survey of 294 Lake Crowley reservoir users conducted in 1991 and 1992 for this EIR, respondents indicated they spent an average of 3.0 days at Lake Crowley reservoir during their trip and 6.2 hours on the reservoir each day. They spent an average of 12.7 days visiting Lake Crowley reservoir during 1991. Shore fishing or float-tubing for trout was the main reason 52% of those surveyed visited the reservoir; a boating-related activity (i.e., boating, waterskiing, or trolling) was the main reason identified by 42% of the visitors.

Among the visitors interviewed, 28% had visited Mammoth Lakes and 28% had visited June Lake Loop on their trip. Lake Crowley reservoir was identified as the principal destination for 73% of the visitors interviewed. As far as place of residence, 56% of the reservoir's users resided in metropolitan southern California, 26% were local residents (i.e., lived between Mammoth Lakes and Bishop), and less than 1% resided in the San Francisco Bay Area. Only 1% of the respondents resided outside California.

Recreation use at Lake Crowley reservoir has declined dramatically since the early 1980s, in part because of low lake levels. Fishing use was estimated at 40,839 fishing days in 1989, down 78% from 182,661 days in 1980 (Sorensen 1989). As at Grant Lake, users' negative impressions of Lake Crowley reservoir resulting from low lake levels in one year appear to affect use in subsequent years.

Total use and lake level are shown by month for four recent years in Table 3J-5. Use was relatively low in 1989 and especially low in 1990, when the lake level was relatively low throughout the recreation season.

Other Potentially Affected Recreation Areas

The key recreation areas potentially affected by displacing visitors from the Upper Owens River and Lake Crowley reservoir are the Owens River gorge and Pleasant Valley reservoir.

Owens River Gorge. The Owens River gorge connects Long Valley and Owens Valley. The gorge, which is upstream from Pleasant Valley reservoir, has been largely dewatered for almost 40 years by diversion of the Owens River into the LA Aqueduct. Seepage beneath Long Valley Dam at the outflow of Lake Crowley reservoir has maintained a sport fishery in a short reach of the river immediately downstream. In 1991, a penstock failure resulted in the temporary rewatering of the gorge. Ongoing negotiations between LADWP, DFG, and others could result in the permanent rewatering of the gorge and restoration of its formerly famous trout fishery.

The reach of the Owens River gorge just downstream from Long Valley Dam supports a moderate level of fishing. Unlike most of the Upper Owens River, the pools in this reach support fishing for warmwater species such as bass, in addition to trout. Because of the absence of streamflow and the area's steep and rugged terrain, recreation use of the remainder of the gorge has been negligible.

Pleasant Valley Reservoir. Pleasant Valley reservoir is a 4-mile-long reservoir located at the south end of the Owens River gorge. Recreation opportunities at Pleasant Valley reservoir are limited by its narrow width, water-level fluctuations resulting from LADWP water operations, and use-restrictions to maintain high water quality. In particular, boating and water-contact activities are not allowed on the reservoir. Motor vehicle access to the reservoir is prevented by a locked gate; pedestrian and bicycle access is provided by a paved service road along the reservoir's west bank. The primary recreation activity at the reservoir is shore fishing for rainbow and brown trout. The reservoir is noted for producing trophy brown trout and has a year-round fishing season.

Pleasant Valley campground is located immediately downstream from the reservoir. It has 200 campsites and is operated by Inyo County. Campers enjoy access to both the reservoir and the Owens River downstream from the reservoir.

A survey of 52 visitors to Pleasant Valley reservoir conducted in 1991 for this EIR indicated that 65% of the reservoir's visitors are residents of metropolitan southern California, 17% are local residents, and 2% are residents of the San Francisco Bay Area. Pleasant Valley reservoir was the principal destination for the trips of 50% of the visitors. Other places visited on their most recent trip included the Bishop area (73%), Owens River (21%), Convict Lake (15%), and Mammoth Lakes (15%). Approximately 63% of the respondents had visited Lake Crowley reservoir at least once, 33% had visited it in 1990, and 27% had visited it in 1989.

IMPACT ASSESSMENT METHODOLOGY

Introduction

For the Mono Basin EIR, recreation impacts consist of potential changes in the quality of recreation opportunities relative to point-of-reference conditions. They include changes in recreation conditions projected to occur at recreation areas either directly or indirectly affected by the target lake level alternatives.

The directly affected recreation areas are:

- Mono Lake;
- the lower reaches of four tributaries to Mono Lake (i.e., Rush, Lee Vining, Walker, and Parker Creeks);

- Grant Lake reservoir;
- Lake Crowley reservoir; and
- the Upper Owens River.

Target lake level alternatives could indirectly affect recreation at other areas if enough users displaced from directly affected areas because of decreasing opportunities visit alternative areas, thereby increasing congestion at the alternative areas such that the quality of recreation there declines. Such indirect impacts were analyzed by identifying recreation areas in the eastern and southern Sierra Nevada regions representing suitable substitutes for the directly affected areas, and assessing congestion levels at these substitute areas.

Point-of-reference hydrologic conditions for all directly affected areas were projected based on the point-of-reference scenario described in Chapter 2. Streamflows and lake levels were simulated for two projection periods. The first, a 20-year period, was used to analyze the near-term effects of water diversions (i.e., effects occurring as the lake moves from its 1989 level, the point of reference, toward the target levels that define the alternatives). The second, a 50-year period beginning after Mono Lake reaches the target level for a specified alternative, was used to analyze long-term (i.e., post-transition) recreation effects. Hydrologic conditions for both projection periods were assumed to replicate the historical (i.e., 1940-1989) distribution of dry, normal, and wet runoff years.

At all directly affected areas except Mono Lake, the recreation analysis focused on near-term impacts because recreation impacts expected to occur over the next 20 years are considered to be more relevant to comparison of the EIR alternatives than impacts that would not occur for more than 50 years under some alternatives. For Mono Lake, the recreation analysis focused on long-term impacts because the EIR alternatives were formulated based on long-term Mono Lake target levels. Mono Lake recreation opportunities for the alternatives were compared at their respective target lake levels for lake fluctuations.

In addition to near-term and long-term effects, the recreation impacts of a prolonged drought were analyzed based on hydrologic information describing streamflows and lake levels associated with the driest 1% of the projection period.

Impact Prediction Methodology

Direct Impacts

The objective of the analysis of direct recreation impacts is to assess changes in the quality of recreation opportunities at each directly affected area. Recreation impacts were assessed through identification of environmental features of each directly affected area that are necessary to maintain the quality of the area's recreation opportunities. Features considered in this EIR include the aesthetic quality or biological conditions of the recreation environment, the accessibility or ease of use of recreation areas or facilities, and the abundance of catchable fish. These important features were identified through review of published technical reports and discussions with resource specialists.

User surveys were conducted at Mono Lake, Grant Lake reservoir, Lake Crowley reservoir, Rush and Lee Vining Creeks, and other areas to identify the most important recreation activities at each area and to predict the impact of various hydrologic scenarios on respondents' use of these areas. (Key results of the user surveys are summarized in Appendix W.) The analysis of recreation effects then focused on identifying hydrologic thresholds (i.e., lake levels or streamflows) which, if exceeded, could substantially affect opportunities for user participation in the important recreation activities or the quality of such participation.

In most cases, the quality of recreation opportunities changes gradually with hydrologic conditions. For example, reduced tributary flows during midsummer result in higher water temperatures that increase stress on the trout population. Temperature stress, in turn, impedes feeding activity among the fish and can also cause fish injury or mortality. The eventual result of low flows is generally poorer fishing opportunities.

In developing thresholds for recreation opportunities, hydrologic conditions were identified at which recreation quality for a particular activity changed in response to a change in water availability (e.g., a streamflow of 19 cfs on lower Rush Creek during July or August). The recreation opportunity thresholds used in this analysis represent the consensus of scientific knowledge on flows and lake levels where substantial changes in environmental features affecting recreation opportunities are most likely to occur. Los Angeles Aqueduct Monthly Program (LAAMP) operations model projections were analyzed to determine whether flows and lake levels associated with each alternative would exceed any thresholds and, if so, the frequency of exceedance.

Key environmental conditions affecting important recreation opportunities are discussed next with their corresponding thresholds for each directly affected recreation area.

Mono Lake. Analysis of recreation effects at Mono Lake focused on opportunities for sightseeing, birdwatching, and nature study. Results of the Mono Lake user survey indicate that the principal reason that 76% of the lake's visitors stop at Mono Lake is to "see what the lake looks like" or to engage in sightseeing. An additional 8% of the respondents listed birdwatching or nature study as their principal reason for visiting Mono Lake. No other activity accounted for more than 5% of the responses concerning the principal reason for visiting Mono Lake.

The principal features of the Mono Lake environment that are important to sightseeing and lake-viewing opportunities and that could be affected by lake level changes are:

- the distance from parking lots to the lakeshore at popular visitor areas,
- the frequency of severe dust storms, and
- the abundance of land-based and exposed tufa towers.

Environmental features sensitive to lake level changes that could affect birdwatching and nature-study opportunities include:

- the abundance of gulls, grebes, phalaropes, and waterfowl, and
- the presence of phalaropes at areas frequented by visitors.

Snowy plovers are a species of special concern that may also be affected by lake level changes. Because these birds constitute such a small portion of Mono Lake's avian fauna, however, and because they are located along the remote northeastern lakeshore, birdwatching of this species is of relatively minor importance as a recreation activity.

The physical processes through which these environmental features are affected by lake level changes are complex and are described in detail elsewhere in this EIR. The effects of changes in these features on recreation opportunities are summarized in Table 3J-6, which identifies threshold lake elevations that, if exceeded, would substantially affect opportunities for sightseeing and lake-viewing or for birdwatching and nature study.

As shown in Table 3J-6, the elevation of 6,373.5 feet was selected as the threshold lake level for distance from parking areas to the lakeshore. Among Mono Lake's most popular viewing areas, lake level changes have their greatest effect on distance to shoreline at Mono Lake County Park on the lake's northwest shore. When the lake level declines from 6,377 feet to 6,373.5 feet, distance to the shoreline increases by approximately 67% to 2,000 feet. Subsequent declines in lake level result in proportionately smaller increases in distance. Distances to the lakeshore from South Tufa and Old Marina, two other popular lakeshore areas, are shorter and less sensitive to lake elevation changes.

Dust storms occur mainly on the lake's northeastern and eastern shores and on Paoha Island where relatively few people visit. Severe dust storms, however, can reduce visibility over a large portion of the lake and lakeshore. No large reductions in the frequency of severe dust storms are expected to occur until the lake level approaches 6,390 feet (see Chapter 3H, "Air Quality"). At elevations exceeding 6,390 feet, such storms would become infrequent and geographically restricted events.

Lake level increases above 6,390 feet elevation adversely affect the visibility and accessibility of Mono Lake's tufa groves, considered to be its most distinctive recreation resource. With lake elevation at 6,390 feet, most of the small towers at South Grove would be toppled by wave erosion or, if still standing, would be covered with water. At 6,407 feet, nearly all towers at South Grove would be toppled or inundated. (See discussion of tufa formations in Chapter 3I, "Visual Resources".) (Stine 1992.)

Each of the major bird species at Mono Lake is affected differently by changes in lake level. As shown in Table 3J-6, the numbers of grebes and phalaropes at Mono Lake would probably decline substantially if the lake declined below its prehistoric low level of 6,368 feet. Gull numbers at Mono Lake would probably be considerably lower at levels below 6,373.5 feet because prime island nesting sites would be susceptible to persistent predation by land-based carnivores. Opportunities for observing phalaropes would decline substantially at levels below 6,378 feet; at levels above 6,378 feet, many phalaropes would move from the eastern shore to the northwestern shore, which is more accessible to visitors. Unless artificial ponds were constructed near the lakeshore, numbers of migratory waterfowl using Mono Lake would not increase substantially until the lake level exceeds 6,400 feet.

Lower Reaches of Affected Mono Lake Tributaries. Tributaries to Mono Lake potentially affected by target lake level alternatives are Rush, Lee Vining, Walker, and Parker Creeks. Only the lower reaches (i.e., the portions downstream from LADWP diversions) of these streams would be directly affected.

Analysis of recreation impacts on the tributary streams focused on the effects of streamflow variations on angling opportunities, including the availability and accessibility of fishable waters and the abundance of catchable trout. Effects on fishing opportunities were emphasized because, of the 247 respondents to the tributary survey, 86% had fished at the tributaries on their current trip and 72% identified fishing as their main reason for visiting the tributaries. Camping was identified as the most important reason for visiting the tributaries by 20% of the respondents; the quality of camping opportunities is insensitive to streamflow changes.

The analysis of recreation impacts focused on lower Rush Creek, which is the largest and most popular of the four tributary streams. As shown in Table 3J-7, three streamflows were identified as thresholds for angling quality on lower Rush Creek. Flows less than 19 cfs in July and August usually result in water temperatures that are intolerably high for adult trout. Similarly, at flows of less than 40 cfs in October and November, spawning habitat characterized by stream depths exceeding 2 feet is highly limited. (Beak Consultants 1991.)

Grant Lake Reservoir. Analysis of recreation impacts at Grant Lake reservoir focused on opportunities for angling, boating, and waterskiing. In the survey of Grant Lake reservoir users, fishing was identified as the main reason for visiting by 89% of the 95 users interviewed. Only 13% of the anglers interviewed fished from boats; the remainder fished from shore. Only 2% identified boating or waterskiing as their main reason for visiting the lake. Boating and waterskiing were unusually unpopular at Grant Lake reservoir in 1991 when the survey was conducted because low lake levels made the boat ramp at Grant Lake reservoir inoperable.

One lake level threshold for fishing opportunities at Grant Lake reservoir and two thresholds for boating and waterskiing were identified (Table 3J-8). Natural trout production at Grant Lake reservoir is substantially reduced at lake levels below 7,101 feet between April and October because of limited total surface area and limited shallow water area. (See Chapter 3D, "Fishery Resources".) At levels below 7,105 feet, the upper lobe of the lake is too small and shallow to accommodate boating or waterskiing. (These conditions are discussed in detail in Chapter 3D.) A lake level of at least 7,111 feet is needed for the boat ramp to be operable, even though the ramp was extended substantially in 1992 to make it usable at lower levels (Miller pers. comm.).

Upper Owens River. Fishing constitutes almost all recreation activity along the Upper Owens River. Analysis of recreation impacts on this reach will focus on changes in fishing opportunities as a function of the abundance of catchable fish.

Only the reach of the Upper Owens River between East Portal and Lake Crowley reservoir would be directly affected by target lake level alternatives. In 1987, approximately 78% of the fishing use of the Upper Owens River occurred downstream from East Portal. Fishing opportunities on the reach above East Portal could be indirectly affected by export alternatives, however, through changes in the number of trout that live in Lake Crowley reservoir most of the year but migrate above East Portal to spawn. Spawning trout provide trophy fishing opportunities and are highly prized by Owens River anglers.

Three threshold streamflows were identified for fishing opportunities on the Upper Owens River (Table 3J-9). At flows less than 75 cfs, summer water temperatures below the Hot Creek confluence would frequently exceed 68°F, which would cause substantial stress on trout populations. Second, flows of approximately 200 cfs are considered optimal for trout production for much of the Upper Owens River; flows below 150 cfs between May and October would support less than 75% of the potential adult trout habitat available when streamflow is 200 cfs. Third, flows exceeding 200 cfs would substantially accelerate streambank erosion and related adverse geomorphic effects, especially in the reach just below East Portal. (EBASCO Environmental et al. 1993.)

Lake Crowley Reservoir. Analysis of recreation effects at Lake Crowley reservoir focused on opportunities for angling, boating, and waterskiing. In the survey of 271 Lake Crowley reservoir users, 79% indicated that fishing was their main reason for visiting Lake Crowley reservoir. Ten percent of those interviewed indicated that boating was their main reason for visiting and 8% specified waterskiing as their main reason. Boat-fishing is very popular at Lake Crowley reservoir.

Different lake level thresholds were identified for boating, fishing, and waterskiing opportunities at Lake Crowley reservoir (Table 3J-10). Below 6,760 feet elevation, some boat docks and ramps are inoperable (Griffith pers. comm.). Below 6,766 feet, production of large trout is limited by declines in the littoral ecosystem at McGee Bay (Edmundson pers. comm.). Below 6,773 feet, a waterskiing course constructed for competition use is inaccessible (Paranick pers. comm.).

Indirect Impacts

The principal indirect recreation impact considered in this EIR is potential increased congestion at eastern and southern Sierra Nevada recreation areas caused by displacement of users of directly affected recreation areas. Increased congestion could result in reduced opportunities at these areas. Offsite congestion impacts were analyzed by estimating reductions in use of directly affected areas resulting from quality declines, identifying substitute recreation areas that people displaced from directly affected areas might visit, and assessing potential congestion effects resulting from such displacement.

Cumulative Impacts

Cumulative impacts include adverse effects of past, present, and foreseeable future projects that are closely related to the proposed project. One past project and one future project were identified that are closely related to the EIR alternatives that have had, or would have, adverse effects on recreation. The relevant past project is LADWP's historical diversions of Mono Lake tributaries, which began in 1940. The relevant future project is the proposed extraction of groundwater potentially tributary to the Upper Owens River for municipal use by the town of Mammoth Lakes. The proposed pumping by the town of Mammoth Lakes could affect flows in the Upper Owens River.

Cumulative impacts of historical diversions of Mono Lake tributaries were analyzed by assessing changes in recreation opportunities and qualities at recreation areas adversely affected by the diversions (i.e., Mono Lake, the diverted tributaries, and the Upper Owens River). Cumulative recreation effects were not analyzed for Lake Crowley reservoir or Grant Lake reservoir because these were constructed or enlarged in conjunction with the LADWP's Mono Basin diversion project; consequently, the effects of historical diversions on recreation at these reservoirs were beneficial.

Criteria for Determining Impact Significance

Direct Impacts

The significance of direct recreation impacts was determined using two approaches. The first approach involved assessing the frequency with which the important recreation opportunity thresholds described above would be exceeded under an EIR alternative relative to the point-of-reference scenario. All opportunity thresholds used in this analysis are defined such that exceedance implies an adverse recreation effect. For some thresholds, exceedance occurs when water availability (as measured by median lake level or streamflow) is *below* a specified level; other thresholds are exceeded when water availability is *above* a specified level.

An adverse change in recreation opportunities under a specified alternative was considered significant if an opportunity threshold was conclusively exceeded more frequently than under the point-of-reference scenario. Based on the limitations of the model used in this recreation analysis, changes in threshold exceedance frequencies of at least 10% were considered conclusive; changes in exceedance frequencies of less than 10% were considered to represent inconclusive departures from point-of-reference conditions. Significance was not determined for beneficial changes.

The second approach involved analyzing potential effects on recreation use at the directly affected areas and comparing resulting use with that associated with the point-of-reference conditions. Use effects were predicted from data collected in on-site user surveys concerning whether and how much visitor use of a recreation area would change in relation to local hydrologic conditions (i.e., lake levels for Mono Lake, Grant Lake reservoir, and Lake Crowley reservoir, and streamflow for Rush Creek). Estimated changes in per capita use of a recreation area were used as criteria to assess the impacts. Changes in per capita use of a recreation area were considered significant impacts when the change associated with hydrologic conditions of an alternative was 10% or more. Per-capita use changes were not estimated for the Upper Owens River, however, because no survey-based information was obtained on users' responses to streamflow changes. For the Upper Owens River, the significance of recreation impacts was evaluated based on changes in available habitat and fishing opportunities. Additional details on the estimation of per capita use are provided in Appendix W.

These two approaches provide a balanced and comprehensive consideration of recreation effects. Discrete, measurable changes in the quality of the recreation environment are indicated by the threshold exceedance approach and impacts resulting from incremental changes in hydrologic conditions are analyzed by use changes.

Indirect Impacts

Displacement of visitors from directly affected areas was considered to be a significant indirect impact if it would likely result in substantial use increases at areas where congestion has been recognized as a problem in recent years or where use is currently at or near its carrying capacity.

Cumulative Impacts

A cumulative recreation impact was considered significant if, in conjunction with a proposed lake level alternative, it would result in a substantial long-term reduction in the quality of one or more recreation opportunities or activities relative to the prediversion condition.

SUMMARY COMPARISON OF IMPACTS AND BENEFITS OF THE ALTERNATIVES

As described in the "Impact Assessment Methodology" section, relative recreation effects of the alternatives are assessed in this section through several key variables related to recreation opportunities, quality, and use:

- aesthetic quality, biological conditions, and lakeshore access at Mono Lake;
- fishery habitat and stream access on the lower reaches of the Mono Lake tributaries;

- fish production and lake access at Grant Lake reservoir;
- fishery habitat on the Upper Owens River;
- fishery habitat and lake access at Lake Crowley reservoir;
- changes in visitor use rates at directly affected areas; and
- potential congestion impacts at other eastern and southern Sierra Nevada recreation areas caused by displacement of users of directly affected areas (indirect impacts).

Table 3J-11 provides a summary comparison of each alternative using the recreation opportunity and quality attributes (first five items above). Table 3J-12 provides a summary comparison of each alternative using the visitor use variable (sixth item above). For the analysis of direct and indirect impacts, values of the attributes and variables for each alternative are compared to values for the point-of-reference condition. For the analysis of cumulative impacts, projected conditions are compared with prediversion conditions.

POINT-OF-REFERENCE SCENARIO

This section describes recreation opportunities and qualities and per visitor use levels projected for the point-of-reference scenario. It describes predicted long-term (i.e., post-transition) conditions at Mono Lake and near-term conditions at all other directly affected areas. These conditions are used in subsequent sections to assess recreation impacts under the EIR alternatives and determine their significance. Estimated exceedance frequencies for each recreation opportunity threshold under the point-of-reference scenario are shown in Table 3J-11. Per visitor use levels under the point-of-reference scenario are shown in Table 3J-12.

Mono Lake

The point-of-reference elevation for Mono Lake is 6,376.3 feet, its level on August 22, 1989 (Table 3J-13). Four of the recreation opportunity thresholds previously described for Mono Lake (Table 3J-7) are at lake levels that exceed the point-of-reference level. These threshold elevations are 6,378 feet for observing phalaropes, 6,390 feet for severe dust storms and toppling of small tufas, 6,400 feet for waterfowl abundance, and 6,407 feet for toppling and inundation of all tufa.

As part of a survey conducted for this EIR, visitors to Mono Lake were asked how their use of the lake would be affected by various lake levels. As discussed in Appendix W, a 1-foot increase in the level of Mono Lake from the lake's 1991 level (6,375 feet) would result in an estimated increase in per visitor use of 0.035 days per year. Average annual per visitor use at the point of reference is estimated to be 3.3 days (Table 3J-12).

Lower Reaches of Affected Tributaries

The point-of-reference scenario for the affected reaches of Mono Lake tributaries is defined by the lower Rush Creek streamflows that would have resulted from repetition of historical runoff conditions and diversion practices under the minimum release flow requirements established in August 1989. Such flows were projected for a 20-year period that replicates the distribution of dry, normal, and wet runoff years that occurred during 1940-1989. (This definition of the point of reference for analyzing near-term effects also applies to Grant Lake reservoir, the Upper Owens River, and Lake Crowley reservoir.)

Two of the flow-related thresholds identified for Rush Creek (Table 3J-8) would be exceeded at times under the point-of-reference scenario. Streamflow would be less than 40 cfs during October and November for 80% of the projection period (Table 3J-11); this condition would impair trout spawning. In addition, flows would exceed 150 cfs for 10% of the projection period, impairing wading opportunities and access to fishable waters.

Streamflow on lower Rush Creek averaged 50 cfs in 1991 when per visitor use averaged 1.5 days. As discussed in Appendix W, each 1-cfs increase in the average streamflow of lower Rush Creek (up to 100 cfs) is estimated to result in an average use increase of approximately 0.02 day per visitor per year. Under the point-of-reference scenario, flows on lower Rush Creek would average 52 cfs over all types of runoff years (Table 3J-13), an increase of just 2 cfs over the average flow in 1991; consequently, annual use would also average an estimated 1.5 days per visitor under the point-of-reference scenario (Table 3J-12).

Grant Lake Reservoir

Point-of-reference conditions for Grant Lake reservoir represent the lake levels that would result from historical runoff conditions and diversion practices and minimum release flows for the lower tributaries. Similar to the protection levels developed for the lower tributaries, minimum lake levels (7,101 feet elevation) were developed to protect the reservoir's environmental and recreation resources. Because of these protections, recreation quality thresholds for trout production (7,101 feet) would not be exceeded under point-of-reference conditions (Table 3J-11). Recreation quality thresholds for boating and water-skiing on the upper lake (7,105 feet) would be exceeded with a frequency of 50%. The threshold for use of the marina boat ramp (7,111 feet) would be exceeded 50% of the time.

Per visitor use of Grant Lake reservoir averaged 9.6 days in 1991 when the lake's average level was 7,094 feet. As described in Appendix W, the rate of change in per visitor use for each 1-foot change in the average level of Grant Lake reservoir was estimated to be 0.1 day. Under the point-of-reference scenario, the average level at Grant Lake reservoir over the near term is 7,112 feet (Table 3J-13), which is an increase of 18 feet relative to 1991 when per-visitor use averaged 9.6 days. At this median lake level, annual use is estimated to average 11.4 days per visitor (Table 3J-12).

Upper Owens River

Point-of-reference conditions for the Upper Owens River represent historical diversion practices and minimum release flows for the lower tributaries. Under these conditions, the water temperature threshold (less than 75 cfs) would not be exceeded, the adult trout habitat threshold (less than 150 cfs) would be exceeded 60% of the time, and the excessive streambank erosion threshold (more than 200 cfs) would be exceeded 40% of the time.

Lake Crowley Reservoir

As with Grant Lake reservoir, point-of-reference conditions at Lake Crowley reservoir represent historical runoff and diversion practices and minimum release requirements for the lower tributaries. As with Grant Lake reservoir, minimum lake levels (6,768 feet elevation) were developed to protect Lake Crowley reservoir's environmental and recreation resources. Because of these protections, recreation quality thresholds for operability of boat ramps (6,760 feet) and productivity of the littoral ecosystem in McGee Bay (6,766 feet) would never be exceeded. The threshold for accessibility of a waterskiing course would be exceeded with a frequency of 20% (Table 3J-11).

Per visitor use at Lake Crowley reservoir averaged 11.0 days in 1991 when its average level was 6,767 feet. As described in Appendix W, the rate of change in per visitor use for a 1-foot change in the average level of Lake Crowley reservoir was estimated to be 0.4 day. The median level of Lake Crowley reservoir would be 6,773 feet under the point-of-reference scenario (Table 3J-13); at this level, annual use would average 13.5 days per visitor (Table 3J-12).

IMPACTS AND MITIGATION MEASURES FOR THE NO-RESTRICTION ALTERNATIVE

Changes in Resource Condition

As discussed above under "Impact Prediction Methodology", assessment of recreation impacts for this EIR focused on changes in recreation opportunities and quality as indicated by exceedances of opportunity thresholds. In this section, changes in recreation opportunities under the No-Restriction Alternative are considered relative to the point-of-reference scenario. Comparisons of recreation opportunities focus on long-term conditions for Mono Lake and for near-term conditions for the other directly affected areas. Important differences in recreation opportunities between long-term, near-term, and drought-period conditions are also noted.

Mono Lake

Under the No-Restriction Alternative, the average level of Mono Lake over the long term would be 6,354 feet. At this level, thresholds for grebe, phalarope, and gull abundance at Mono Lake would be exceeded 100% of the time, compared to 0% of the time under point-of-reference conditions (Table 3J-11). This condition would adversely affect opportunities for birdwatching and nature study at Mono Lake.

The threshold for lakeshore accessibility would also be exceeded 100% of the time under the No-Restriction Alternative, compared to 0% of the time under point-of-reference conditions. This condition would adversely affect sightseeing and lake-viewing opportunities. Visitor use of Mono Lake also is projected to decline substantially under the No-Restriction Alternative (Table 3J-12).

Exceedance frequencies for other lake level conditions that affect recreation opportunities at Mono Lake (i.e., dust storms, tufa, and waterfowl) would not change relative to point-of-reference conditions (Table 3J-11).

Per-capita use cannot be estimated for the No-Restriction Alternative because Mono Lake's average level over the long term (6,354 feet) is outside the range for which information is available. The change in use is likely to substantially exceed the 10% change estimated to result from a lake level decline to 6,372 feet, however, and thus represents a significant adverse effect on recreation.

Over the near term, the lake's average level would be 6,370 feet (Table 3J-13). Consequently, birdwatching opportunities would not be adversely affected. Recreation opportunities at Mono Lake would not be appreciably different during prolonged droughts compared to opportunities over the long term (Table 3J-13).

Affected Reaches of Lower Tributaries

Under the No-Restriction Alternative, low flows in July and August occur 80% of the time compared to 0% of the time under point-of-reference conditions (Table 3J-11). These conditions, which would result in stream temperatures that are limiting to trout production, would adversely affect fishing opportunities. Recreation use of the lower tributaries is also projected to decline substantially (20%) under the No-Restriction Alternative (Table 3J-12).

Recreation opportunities on the lower tributaries would not be appreciably different over the long term compared to the near term.

During drought periods, fishing conditions in the lower tributaries would be worsened because high stream temperatures and low-flow periods for spawning would occur more often than under the near-term conditions.

Grant Lake Reservoir

Under the No-Restriction Alternative, lake level thresholds for making upper Grant Lake reservoir unusable for boating and waterskiing and for making the boat ramp unusable would be exceeded less often than under the point-of-reference scenario (Table 3J-11). Recreation use of Grant Lake reservoir is also projected to increase by 9% under the No-Restriction Alternative (Table 3J-12).

Over the long term and under drought conditions, these thresholds for making Grant Lake reservoir inaccessible for boating and fishing activities would be exceeded more often than under near-term conditions.

Upper Owens River

Under the No-Restriction Alternative, Upper Owens River streamflows would result in no significant adverse impacts (Table 3J-12).

During drought periods, the adult trout habitat threshold would be exceeded more often than under near-term conditions.

Lake Crowley Reservoir

Under the No-Restriction Alternative, waterskiing opportunities at Lake Crowley reservoir would not differ appreciably from those under the point-of-reference scenario (Table 3J-11). Recreation use of Lake Crowley reservoir is projected to increase slightly (3%) under the No-Restriction Alternative. Consequently, this alternative would not appreciably affect recreation at Lake Crowley reservoir.

Over the long term and during severe droughts, waterskiing opportunities at the lake would be more limited than under near-term conditions.

Indirect Impacts

Mono Lake

Under the No-Restriction Alternative, Mono Lake is expected to have an average elevation of 6,354 feet over the long term. The change in use under this alternative relative to the point of reference cannot be reliably estimated because lake levels would be well below levels for which survey information was obtained. Recreation opportunities would be so limited at 6,362 feet, however, that use could decline substantially. Based on recent use levels (Table 3J-1), implementation of this alternative could result in displacement of more than 70,000 Mono Lake visitors per year.

As discussed above, recreation opportunities at Mono Lake are relatively unique; no good substitute recreation areas exist in the Sierra Nevada or western Great Basin regions. According to results of the Mono Lake visitor survey, other popular places visited on trips to Mono Lake are Mammoth Lakes, Yosemite National Park, June Lake Loop, and Bodie State Park. None of these areas provide opportunities for sightseeing or birdwatching comparable to those at Mono Lake. These other destinations are considered complimentary to visits to Mono Lake, rather than substitute destinations. Consequently, if use declines at Mono Lake, significant increases in use and congestion at these other recreation areas would not be expected.

Lower Reaches of Affected Tributaries

Under the No-Restriction Alternative, fishing opportunities on the lower tributaries would decline substantially relative to the point-of-reference scenario. In recent years, annual use of lower Rush and Lee Vining Creeks has been less than 530 visitor days (Table 3J-1). Considering that hundreds of miles of fishable streams are available in the eastern Sierra Nevada, the potential increase in congestion on any stream would be negligible even if most users of the lower tributaries were displaced to several locations.

Grant Lake and Lake Crowley Reservoirs

Under this alternative, use at Grant Lake and Lake Crowley reservoirs would increase relative to point-of-reference conditions (Table 3J-12). No displacement of users to substitute lakes or reservoirs would occur.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (No-Restriction Alternative)

- Enhances fishing opportunities on the Upper Owens River.
- Significantly reduces birdwatching and nature study opportunities at Mono Lake contributing to an estimated 12% decline in visitor days.

Mitigation Measures. Grebe and phalarope abundance and viewing opportunities would decline as a result of changes in prey abundance attributable to changes in water quality and hard substrate extent. These effects cannot be mitigated without increasing the lake level. Gull abundance and viewing opportunities would be affected by predation because of land bridges to nesting sites. This impact cannot be feasibly mitigated.

- Significantly reduces sightseeing and lake-viewing opportunities at Mono Lake, contributing to an estimated 12% decline in visitor days.

Mitigation Measures. Adverse impacts on sightseeing and lake-viewing opportunities resulting from long distances between parking lots and the lakeshore could be reduced by extending roads and constructing new parking lots closer to the lakeshore.

- Significantly reduces fishing opportunities on the lower reaches of the affected tributaries, resulting in an estimated 20% decline in recreation use.

Mitigation Measures. Under the No-Restriction Alternative, no water would flow down the lower tributaries during dry and normal runoff years. Under these circumstances, significant adverse impacts on fishing conditions cannot be effectively mitigated.

- Increases opportunities for boating and waterskiing at Grant Lake reservoir.

IMPACTS AND MITIGATION MEASURES FOR THE 6,372-FT ALTERNATIVE

Changes in Resource Condition

Mono Lake

Under the 6,372-Ft Alternative, Mono Lake's average long-term level would be 6,375 feet, 1 foot lower than the point-of-reference level. At this level, the thresholds for lakeshore inaccessibility and for low gull populations would be exceeded 64% of the time compared to 0% of the time under point-of-reference conditions. This condition would adversely affect opportunities for sightseeing and birdwatching.

Lake level thresholds for low phalarope observability would be exceeded slightly more often than under point-of-reference conditions. Visitor use of Mono Lake is projected to be unchanged.

During prolonged droughts, adverse lake level conditions for grebes, phalaropes, and gulls would occur constantly.

Lower Reaches of Affected Tributaries

Under the 6,372-Ft Alternative, low flows in October and November would occur 100% of the time compared to 80% of the time under the point-of-reference conditions. These conditions, which result in poor trout spawning habitat, would substantially affect fishing opportunities. Recreation use of the lower tributaries is projected to decline by an estimated 7%.

During drought periods, poor trout spawning habitat would occur more frequently than over the near term.

Grant Lake Reservoir

Under the 6,372-Ft Alternative, exceedance of lake level thresholds for reservoir inaccessibility would be comparable to that under point-of-reference conditions. Consequently, there would be no substantial impact on recreation opportunities. Recreation use at Grant Lake reservoir would decrease by an estimated 5%.

Over the long term and during drought conditions, the reservoir access thresholds would be exceeded more often than under near term conditions.

Upper Owens River

Under the 6,372-Ft Alternative, flows would cause excessive streambank erosion more frequently than under point-of-reference conditions, while available adult trout habitat would be restricted less often than under point-of-reference conditions (Table 3J-11). Because the adult trout habitat threshold is a more comprehensive indicator of the effect on fishing opportunities than the excessive streambank erosion threshold, and because the beneficial effect on adult habitat would occur relatively more frequently than the adverse effect on bank stability, the 6,372-Ft Alternative is considered to have a net beneficial effect on fishing on the Upper Owens River.

Over the long term and during drought conditions, thresholds associated with high stream temperatures and low habitat availability would be exceeded more often than over the near term.

Lake Crowley Reservoir

Under the 6,372-Ft Alternative, waterskiing opportunities would be substantially affected because the course would be unusable 35% of the time compared to 20% of the time under the point-of-reference scenario (Table 3J-11). Recreation use at Lake Crowley reservoir would decline by an estimated 3% compared to point-of-reference conditions.

During prolonged droughts, the waterskiing course would never be usable.

Indirect Impacts

Mono Lake

Under the 6,372-Ft Alternative, use at Mono Lake is not projected to change relative to the point of reference; consequently, impacts on other recreation areas from displacement of users would not occur.

Affected Reaches of the Lower Tributaries

The 6,372-Ft Alternative would result in an estimated 7% reduction in use of the lower tributaries relative to the point-of-reference scenario (Table 3J-12). Potential impacts on other streams resulting from displacement of use would be negligible.

Grant Lake Reservoir

The 6,372-Ft Alternative would result in an estimated use reduction of 5% (or approximately 2,300 visitor days per year) at Grant Lake reservoir relative to the point-of-reference scenario (Tables 3J-1 and 3J-12). Displaced users are most likely to use one or more of the other lakes on the June Lake Loop. Campsite occupancy at June Lake, Reverse Creek, Gull Lake, and Silver Lake campgrounds averaged 77% over the 1991 recreation season (Senn pers. comm.). If all 2,300 visitor days of displaced use at Grant Lake reservoir were accommodated at these four campgrounds, their average occupancy rate would increase to approximately 80%. The resulting increase in congestion at these areas would be less than significant.

Lake Crowley Reservoir

The 6,372-Ft Alternative would result in an estimated use reduction of 3% (or approximately 3,800 visitor days per year) at Lake Crowley reservoir relative to the point-of-reference scenario (Tables 3J-1 and 3J-12). The best substitutes for Lake Crowley reservoir are Bridgeport Lake, Lake Topaz, Big Bear Lake, Isabella Lake, Shaver Lake, and Huntington Lake. Southern California residents who visit Lake Crowley reservoir would tend to use Big Bear, Isabella, Huntington, or Shaver Lakes; all of these lakes are closer to Los Angeles than is Lake Crowley reservoir. According to survey results, 61% of Lake Crowley reservoir's users reside in metropolitan southern California. Almost all remaining visitors to Lake Crowley reservoir reside elsewhere in California.

If all use displaced from Lake Crowley reservoir were distributed evenly among the six substitute lakes identified above, average total daily use would increase by less than 4 visitor days per area. This increase in use would have a negligible effect on congestion at these areas.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,372-Ft Alternative)

- Enhances fishing opportunities on the Upper Owens River.

- Significantly reduces opportunities for sightseeing and lake viewing at Mono Lake.

Mitigation Measures. See measure described above for the No-Restriction Alternative.

- Significantly reduces opportunities for observing gulls at Mono Lake.

Mitigation Measures. See measure described above under "No-Restriction Alternative" for enhancing gull-viewing opportunities.

- Significantly reduces fishing opportunities on the lower reaches of the affected tributaries.

Mitigation Measures. Inadequate flows during spawning periods could be avoided by increasing the uniformity of flows over the year. In particular, reducing June flows could make more water available in October and November.

- Significantly reduces waterskiing opportunities at Lake Crowley reservoir, contributing to a 3% decline in visitor days.

Mitigation Measures. This effect could be mitigated by constructing a substitute waterskiing course at a different Lake Crowley reservoir location that is relatively insensitive to lake level fluctuations.

IMPACTS AND MITIGATION MEASURES FOR THE 6,377-FT ALTERNATIVE

Changes in Resource Condition

Mono Lake

Under the 6,377-Ft Alternative, lake level thresholds for low phalarope observability would be exceeded 20% of the time compared to 100% of the time under point-of-reference conditions. This condition would improve opportunities for birdwatching and nature study. A slight (3%) increase in visitor use is also projected.

In the near term, opportunities for observing phalaropes would be similar to those over the long term; during droughts, opportunities would be less frequent.

Lower Reaches of Affected Tributaries

The generally higher flows relative to point-of-reference conditions would substantially increase (33%) recreation use of the tributaries relative to point-of-reference conditions (Table 3J-12).

Over the long term, flows would be less than under near-term conditions, but would not substantially affect recreation opportunities. During droughts, flows would constantly exceed the threshold for limited spawning habitat.

Grant Lake Reservoir

Under the 6,377-Ft Alternative, lake level thresholds for upper reservoir inaccessibility and unusability of the boat ramp would be exceeded about 80% and 87% of the time, respectively, compared to 50% of the time under the point-of-reference scenario. These conditions would substantially affect opportunities for boating and waterskiing at the reservoir. Recreation use would decline by a projected 6%.

Over the long term, recreation conditions would be similar to near-term conditions. During droughts, thresholds for reservoir inaccessibility would be exceeded constantly.

Upper Owens River

Under the 6,377-Ft Alternative, the water temperature threshold on the Upper Owens River would be exceeded more frequently than under point-of-reference conditions, while adult trout habitat would be restricted less frequently than under point-of-reference conditions (Table 3J-11). The net effect of these opposing impacts on fishing opportunities is inconclusive and likely to be relatively minor.

During prolonged droughts, the stream temperature and adult trout habitat availability thresholds would be exceeded more frequently than over the near term.

Lake Crowley Reservoir

Under the 6,377-Ft Alternative, waterskiing opportunities would be substantially affected because the course would be unusable 50% of the time compared to 20% of the time under the point-of-reference conditions. Recreation use at Lake Crowley reservoir would not change compared to use under point-of-reference conditions.

Over the long term, waterskiing opportunities would decline relative to near-term conditions; during droughts, waterskiing and fishing opportunities would decline relative to near-term conditions.

Indirect Impacts

Under the 6,377-Ft Alternative, use at Mono Lake and the lower tributaries would increase relative to the point-of-reference scenario (Table 3J-12); consequently, no congestion impacts would occur at other recreation areas.

At Grant Lake reservoir, recreation use would decrease by an estimated 6% or approximately 2,800 visitor days per year. At Lake Crowley reservoir, recreation use would decrease by an estimated 6% or approximately 7,600 visitor days per year. Displacing approximately 10,000 annual visitor days to other recreation areas in the eastern and southern Sierra Nevada would not be expected to have a significant impact on congestion at such areas.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,377-Ft Alternative)

- Enhances birdwatching opportunities at Mono Lake because of increased phalarope observability.

- Enhances overall fishing opportunities on the lower tributaries because of generally higher flows, contributing to an estimated 33% increase in annual recreation use.

Mitigation Measures. Adverse effects on fishing access could be reduced by limiting flows during daylight hours and increasing them proportionately at night.

- Significantly reduces boating and waterskiing opportunities at Grant Lake reservoir.

Mitigation Measures. Reduced boating and waterskiing opportunities at Grant Lake reservoir could be compensated for by extending the boat ramp at the Grant Lake marina or by modifying water releases from Grant Lake reservoir to maintain a higher lake level through the recreation season.

- Significantly reduces waterskiing opportunities at Lake Crowley reservoir.

Mitigation Measures. This effect could be mitigated by constructing a new waterskiing course in an area not susceptible to lake level fluctuations.

IMPACTS AND MITIGATION MEASURES FOR THE 6,383.5-FT ALTERNATIVE

Changes in Resource Condition

Mono Lake

Under the 6,383.5-Ft Alternative, lake level thresholds for low phalarope observability would be exceeded, thereby improving opportunities for birdwatching and nature study. A 6% increase in visitor use is also projected.

In the near term and during droughts, opportunities for observing phalaropes would be similar to those over the long term.

Affected Reaches of Lower Tributaries

Under the 6,383.5-Ft Alternative, the generally higher flows relative to point-of-reference conditions would substantially increase recreation use of the tributaries (60% increase) (Table 3J-12).

Over the long term, flows would be less than under near-term conditions but would not substantially affect recreation opportunities. During droughts, flows would constantly exceed the threshold for limited spawning habitat.

Grant Lake Reservoir

Under the 6,383.5-Ft Alternative, lake level thresholds for upper lake inaccessibility and unusability of the boat ramp would be exceeded about 80% and 87% of the time, respectively, compared to 50% under point-of-reference conditions. These conditions would substantially affect opportunities for boating and waterskiing at the reservoir. Recreation use would decline by a projected 7%.

Over the long term, recreation opportunities would be similar to those under near-term conditions. During droughts, thresholds for reservoir inaccessibility would be exceeded constantly.

Upper Owens River

Under the 6,383.5-Ft Alternative, the thresholds for stream temperature and adult trout habitat availability would be exceeded more often than under point-of-reference conditions (Table 3J-11). These adverse effects would outweigh the beneficial effect of less frequent occurrences of excessive streambank erosion.

During prolonged droughts, the stream temperature and habitat availability thresholds would be exceeded significantly more often than over the near term.

Lake Crowley Reservoir

Under the 6,383.5-Ft Alternative, waterskiing opportunities would be substantially affected because the course would be unusable 80% of the time compared to 20% of the time under point-of-reference conditions. Recreation use at Lake Crowley reservoir would decline by a projected 9% compared to point-of-reference conditions.

Over the long term, recreation opportunities would be similar to those under near-term conditions. During droughts, the McGee Bay ecosystem would have low productivity and the waterskiing course would be unusable more often than under near-term conditions.

Indirect Impacts

Under the 6,383.5-Ft Alternative, use would increase at Mono Lake and the lower tributaries; consequently, no congestion impacts would occur at other areas. At Grant Lake reservoir, recreation use would decrease by an estimated 7%, or 3,200 visitor days per year. At Lake Crowley reservoir, recreation use would decrease by about 9%, or approximately 11,500 visitor days. If the total amount of displaced use were distributed evenly among Lake Topaz, Bridgeport Lake, Isabella Lake, Big Bear Lake, Lake Shaver, and Lake Huntington, average daily use at each of these lakes would increase by approximately 13 visitor days. This increase in use would have a less-than-significant effect on congestion at these areas.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures
(6,383.5-Ft Alternative)

- Enhances birdwatching opportunities at Mono Lake because of increased phalarope observability.

- Enhances overall fishing opportunities on the lower tributaries because of generally higher flows, contributing to an estimated 60% increase in annual recreation use.

- Significantly reduces boating and waterskiing opportunities at Grant Lake reservoir.

Mitigation Measures. Reductions in boating and waterskiing opportunities could be lessened by extending the boat ramp or by modifying water releases.

- Significantly reduces fishing opportunities on the Upper Owens River.

Mitigation Measures. The adverse effects on fishing on the Upper Owens River could be lessened by scheduling water exports from Mono Basin to increase the uniformity of flows in the Upper Owens River. The effects also could be lessened by reducing diversions from the river for irrigation. (See Chapter 3D, "Fishery Resources", for a more detailed description of this mitigation measure.)

- Significantly reduces waterskiing opportunities at Lake Crowley reservoir.

Mitigation Measures. This effect could be avoided by constructing a new waterskiing course in an area not sensitive to lake level fluctuations.

IMPACTS AND MITIGATION MEASURES OF THE 6,390-FT ALTERNATIVE

Changes in Resource Condition

Mono Lake

Under the 6,390-Ft Alternative, lake level thresholds for low phalarope observability would never be exceeded, thereby improving opportunities for birdwatching and nature study.

Lake level thresholds for severe dust storms would be exceeded substantially less often under the 6,390-Ft Alternative than under point-of-reference conditions, enhancing sightseeing and lake-viewing opportunities; however, thresholds for inundating or topping most small tufa formations at South Tufa grove and most sand tufa at Navy Beach would be exceeded almost constantly under this alternative, adversely affecting sightseeing and lake viewing.

These conflicting effects must be considered to determine the net impact on sightseeing and lake viewing. Tufa towers are a very important visual feature at Mono Lake; however, visitor use, which is based on visitor survey responses, is projected to increase by 12% under the 6,390-Ft Alternative. Based on this result, the net effect on sightseeing and lake viewing under this alternative is considered beneficial.

In the near term and during droughts, tufa inundation at South Tufa grove would be much less extensive than over the long term. However, severe dust storms would occur relatively often in the near term and during droughts.

Lower Reaches of the Affected Tributaries

Under the 6,390-Ft Alternative, high stream flows that make access to the streams difficult would occur 23% of the time compared to 10% under point-of-reference conditions. This condition would substantially affect fishing opportunities. The generally higher flows relative to point-of-reference conditions, however, would substantially increase recreation use, although no estimates of the percent change could be made (Table 3J-12).

Over the long term, flows would be less than under near-term conditions but would not substantially affect recreation opportunities. During droughts, flows would constantly exceed the threshold for limiting spawning habitat.

Grant Lake Reservoir

Under the 6,390-Ft Alternative, lake level thresholds for upper lake inaccessibility and unusability of the boat ramp would be exceeded about 90% of the time compared to 50% under the point-of-reference scenario. Recreation use at Grant Lake reservoir would decline by a projected 8% compared to use under point-of-reference conditions.

Over the long term, recreation opportunities would be similar to those under near-term conditions. During droughts, thresholds for reservoir inaccessibility would be exceeded constantly.

Upper Owens River

Under the 6,390-Ft Alternative, the stream temperature and trout habitat availability thresholds would be exceeded more frequently than at the point of reference, while streamflows exceeding 200 cfs would occur less frequently. The net effect on fishing opportunities would be adverse and significant.

During droughts, the stream temperature and habitat availability thresholds would be exceeded more often than over the near term.

Lake Crowley Reservoir

Under the 6,390-Ft Alternative, waterskiing opportunities at Lake Crowley reservoir would be substantially affected because the course would be unusable 80% of the time compared to 20% under point-of-reference conditions. Recreation use at Lake Crowley reservoir would decline by a projected 9% compared to use under point-of-reference conditions.

Over the long term, recreation opportunities would be similar to those under near-term conditions. During droughts, the thresholds for low productivity of the McGee Bay ecosystem and for inaccessibility of the waterskiing course would be exceeded more often than under near-term conditions.

Indirect Impacts

Under the 6,390-Ft Alternative, annual use relative to the point-of-reference scenario would increase at Mono Lake and on the lower tributaries, but would decrease by 8% (3,700 visitor days) at Grant Lake reservoir and by 10% (12,800 visitor days) at Lake Crowley reservoir (Tables 3J-1 and 3J-12). These levels of displaced use could be accommodated by substitute lakes and reservoirs without significantly increasing congestion at these areas.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,390-Ft Alternative)

- Enhances birdwatching opportunities at Mono Lake contributing to an estimated 12% increase in visitor use.
- Enhances overall sightseeing and lake-viewing opportunities at Mono Lake contributing to an estimated 12% increase in visitor use.
- Significantly reduces opportunities for viewing tufa towers and sand tufa.

Mitigation Measures. The effects on sightseeing from tufa tower inundation and toppling cannot be effectively mitigated.

- Enhances overall fishing opportunities on the lower tributaries because of generally higher flows, contributing to a substantial increase in recreation use.
- Significantly reduces boating and waterskiing opportunities at Grant Lake reservoir.

Mitigation Measures. This impact could be mitigated by extending the boat ramp or by modifying water releases.

- Significantly reduces waterskiing opportunities at Lake Crowley reservoir.

Mitigation Measures. This effect could be avoided by constructing a new waterskiing course in an area not sensitive to lake level fluctuations.

- Significantly reduces fishing opportunities on the Upper Owens River.

Mitigation Measures. This impact could be lessened by scheduling exports from Mono Basin to increase the uniformity of flows in the Upper Owens River and by reducing diversions from the river for irrigation.

IMPACTS AND MITIGATION MEASURES FOR THE 6,410-FT ALTERNATIVE

Changes in Resource Condition

Mono Lake

Under the 6,410-Ft Alternative, potential waterfowl habitat at Mono Lake would increase substantially, which is expected to eventually result in larger waterfowl populations at the lake. As a result, the lake level threshold for low waterfowl abundance at Mono Lake would be exceeded 29% of the time compared to 100% under point-of-reference conditions. In addition, phalaropes would be more observable compared to point-of-reference conditions. Consequently, birdwatching and nature study opportunities would be enhanced.

Dust storms would be relatively uncommon under the 6,410-Ft Alternative, but almost all tufa formations at South Tufa grove are likely to be toppled or flooded. As suggested by a predicted 3% decline in visitor use, the net effect on sightseeing and lake-viewing opportunities is considered adverse under this alternative.

In the near term, the adverse effects of high lake levels on sightseeing and lake-viewing would be less substantial than over the long term. During droughts, waterfowl habitat would be less abundant and inundation of tufa towers would be less extensive than over the long term.

Lower Reaches of the Affected Tributaries

Under the 6,410-Ft Alternative, flows that limit spawning habitat would occur only 20% of the time compared to 80% under point-of-reference conditions. These conditions would enhance fishing opportunities. Effects on average use are unpredictable under this alternative because median streamflows exceed the range for which information on use is available. Overall, the generally higher flows relative to point-of-reference conditions would improve fishing opportunities.

Over the long term, flows would be less than under near-term conditions, but would not substantially affect recreation opportunities. During droughts, flows would frequently exceed the threshold for limiting spawning habitat and would also impair fishing access less often.

Grant Lake Reservoir

Under the 6,410-Ft Alternative, lake level thresholds for upper lake inaccessibility and unusability of the boat ramp would be exceeded almost all of the time compared to

50% of the time under point-of-reference conditions. Recreation use at Grant Lake reservoir would decline by an estimated 9% compared to use under point-of-reference conditions.

Upper Owens River

Under the 6,410-Ft Alternative, high stream temperatures and low habitat availability would limit fishing opportunities more than under point-of-reference conditions, while streamflows sufficient to cause excessive bank erosion would occur relatively infrequently. This alternative would have a net adverse effect on fishing opportunities.

During drought conditions, the stream temperature threshold would be exceeded significantly more often than over the near term.

Lake Crowley Reservoir

Under the 6,410-Ft Alternative, recreation effects would be the same as under the 6,390-Ft Alternative.

Indirect Impacts

Under the 6,410-Ft Alternative, displacement of use from directly affected areas would be approximately the same as under the 6,390-Ft Alternative, except that annual use of Mono Lake would decrease by roughly 3% (8,100 visitor days). No significant increases in congestion would result at other recreation areas.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,410-Ft Alternative)

- Enhances birdwatching opportunities at Mono Lake because of greater numbers of waterfowl that are expected to eventually visit the lake because phalaropes would be more observable.
- Enhances overall fishing opportunities on the lower tributaries because of generally higher flows.
- Significantly reduces sightseeing and lake-viewing opportunities at Mono Lake because of inundation and toppling of tufa.

Mitigation Measures. The effect on sightseeing from tufa tower inundation and toppling cannot be mitigated.

- Significantly reduces boating and waterskiing opportunities at Grant Lake reservoir.

Mitigation Measures. See measure described above for the 6,377-Ft Alternative.

- Significantly reduces fishing opportunities on the Upper Owens River.

Mitigation Measures. This impact could be reduced by regulating exports from Mono Basin and by reducing diversions from the Upper Owens River for irrigation.

- Significantly reduces waterskiing opportunities at Lake Crowley reservoir contributing to an estimated 12% decline in recreation use.

Mitigation Measures. See measure described above for the 6,372-Ft Alternative.

IMPACTS AND MITIGATION MEASURES FOR THE NO-DIVERSION ALTERNATIVE

Changes in Resource Condition

Mono Lake

Under the No-Diversion Alternative, the lake level threshold for low waterfowl abundance would be exceeded 65% of the time compared to 100% under the point-of-reference conditions. The threshold for low phalarope observability would almost never be exceeded. Consequently, bird watching and nature study opportunities would be enhanced.

As under the 6,410-Ft Alternative, severe dust storms would be relatively uncommon under the No-Diversion Alternative. Thresholds for inundation and toppling of large tufa formations would be exceeded 16% of the time. The net effect on sightseeing and lake-viewing opportunities is considered adverse.

During droughts, the adverse and beneficial effects of high lake levels would be reduced relative to long-term conditions.

Lower Reaches of the Affected Tributaries

Under the No-Diversion Alternative, effects on fishing opportunities would be similar to those under the 6,410-Ft Alternative.

Grant Lake Reservoir

Under the No-Diversion Alternative, the opportunity thresholds would never be exceeded. Fishing, boating, and waterskiing opportunities would thus be enhanced relative to the point-of-reference scenario.

Upper Owens River

Under the No-Diversion Alternative, high stream temperatures and low trout habitat availability would limit fishing opportunities more than under point-of-reference conditions, while excessive streambank erosion would occur relatively infrequently. The net effect of this alternative on fishing opportunities would be adverse.

During prolonged droughts, high stream temperatures would limit fishing opportunities significantly more often than over the near term.

Lake Crowley Reservoir

Recreation impacts under the No-Diversion Alternative would be the same as under the 6,390-Ft Alternative.

Indirect Impacts

Under the No-Diversion Alternative, use would increase at all directly affected areas except Lake Crowley reservoir, where annual use would decrease by 12% (about 15,400 visitor days) relative to the point-of-reference scenario (Tables 3J-1 and 3J-12). This level of displacement of use from Lake Crowley reservoir would not be expected to increase congestion significantly at any substitute lakes or reservoirs.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures

- Enhances birdwatching opportunities at Mono Lake because of greater numbers of waterfowl and increased phalarope observability.

- Significantly reduces sightseeing and lake-viewing opportunities at Mono Lake because of toppling and inundation of large tufa formations.

Mitigation Measures. The effects on sightseeing of tufa tower and sand tufa inundation and toppling cannot be mitigated.

- Enhances overall fishing opportunities on the lower tributaries because of generally higher flows.

- Enhances fishing, boating, and waterskiing opportunities at Grant Lake reservoir.

- Significantly reduces fishing opportunities on the Upper Owens River.

Mitigation Measures. This impact could be reduced by regulating exports from Mono Basin and by restricting stream diversions for irrigation.

- Significantly reduces waterskiing opportunities at Lake Crowley reservoir, contributing to an estimated 12% decline in recreation use.

Mitigation Measures. This impact could be avoided by constructing a new waterskiing course in an area that is not sensitive to lake level fluctuations.

CUMULATIVE IMPACTS OF THE ALTERNATIVES

As discussed in the "Impact Assessment Methodology" section, the analysis of cumulative impacts focuses on effects at Mono Lake, the lower tributaries, and the Upper Owens River.

Related Impacts of Earlier Stream Diversions by LADWP

Cumulative recreation effects of LADWP diversions were not analyzed for Grant Lake or Lake Crowley reservoirs or the Upper Owens River because their recreation resources were beneficially affected by implementation of LADWP's Mono Basin diversion project.

Mono Lake

Historical diversions of the Mono Lake tributaries by LADWP resulted in a decline in lake level from 6,417 feet in 1940 to the 1992 level of 6,375 feet. As discussed above under "Prediversion Conditions" and "Environmental Setting", historical reductions in lake level have substantially reduced opportunities for motorboating, sunbathing and beach uses, waterfowl hunting, and swimming and wading at Mono Lake.

Motorboating and waterskiing are limited primarily by the high salinity of Mono Lake's water, which increased from 51.3 grams per liter (g/l) of total dissolved solids in 1940 to 93.4 g/l in 1991 (NAS 1987). Boating and waterskiing were also adversely affected as the declining lake level made the boat ramp at Old Marina unusable. Swimming and wading may have declined because of water-quality changes resulting from diversions. Sunbathing and beach uses have declined as the lake's western shore changed from a sandy surface to a muddy surface. Hunting for ducks and geese, which was an important autumn recreational activity at Mono Lake in the prediversion period, declined substantially with reductions in seasonal waterfowl abundance.

Recession of Mono Lake during the postdiversion period has exposed and made accessible formerly submerged groves of tufa and sand tufa, some of which are currently land based and some of which stand in shallow water. Over recent decades, the tufa formations have become popular tourist attractions and the most recognizable feature of the Mono Lake environment. (See discussion of tufa as a visual resource in Chapter 3I, "Visual Resources".) The increased recreational importance of the Mono Lake tufa resulting from historical diversions represents a beneficial cumulative recreation impact of historical diversions.

At lake levels exceeding approximately 6,400 feet, water quality, beaches, and waterfowl habitat at Mono Lake would resemble their prediversion conditions. At levels exceeding 6,400 feet, the lake's tufa formations would similarly resemble their prediversion condition (i.e., they would largely be inundated and relatively inaccessible and invisible). Over the long term, the net cumulative recreation impact for the 6,410-Ft and No-Diversion Alternatives would be less than significant. All other alternatives would have significant cumulative impacts on recreation opportunities at Mono Lake.

Lower Reaches of Affected Tributaries

The lower reaches of the affected tributaries supported recreationally important fisheries in the prediversion period. In particular, Rush Creek was recognized as a trophy trout fishery. Restored flows for these reaches will improve their fisheries relative to recent decades when streamflows were intermittent and no fisheries existed there. As discussed in Chapter 3D, "Fishery Resources", however, the diversions resulted in geomorphic changes to portions of the Rush and Lee Vining Creek channels east of U.S. 395 that will have long-term adverse impacts on these streams' fisheries. Restoration work currently being implemented will reduce these impacts and accelerate the recovery of the fisheries and other riparian features enjoyed by recreationists.

Related Impacts of Other Past, Present, or Anticipated Projects or Events

Proposed Groundwater Extraction from the Aquifer Supplying Big Springs and the Upper Owens River

Groundwater extraction from the aquifer that supplies Big Springs could reduce flows in the Upper Owens River and impair trout spawning and production. Such reductions in trout production would adversely affect fishing on the Upper Owens River, particularly upstream from East Portal where Big Springs accounts for the river's entire flow. Because the headwaters of the Upper Owens River provide spawning habitat for fish that reside downstream from East Portal, fishing on the Upper Owens River could be adversely affected by reduced discharge from Big Springs. To date, however, no hydrologic studies have been conducted of the effects of groundwater extraction on discharge from Big Springs.

Significant Cumulative Adverse Impacts

No-Restriction Alternative

- Reduces opportunities for motorboating, waterskiing, sunbathing and beach uses, waterfowl hunting, and swimming and wading at Mono Lake.
- Reduces or eliminates fishing opportunities on the lower reaches of Rush and Lee Vining Creeks.
- Possibly reduces fishing opportunities on the Upper Owens River.

6,372-Ft Alternative

Significant cumulative adverse impacts would be the same under this alternative as under the No-Restriction Alternative, except that fishing opportunities on the tributary streams would be reduced but not eliminated.

6,377-Ft Alternative

Significant cumulative adverse impacts would be the same under this alternative as under the 6,372-Ft Alternative.

6,383.5-Ft Alternative

Significant cumulative adverse impacts would be the same under this alternative as under the 6,372-Ft Alternative.

6,390-Ft Alternative

Significant cumulative adverse impacts would be the same under this alternative as under the 6,372-Ft Alternative.

6,410-Ft Alternative

- Reduces fishing opportunities on the lower reaches of Rush and Lee Vining Creeks.
- Possibly reduces fishing opportunities on the Upper Owens River.

No-Diversion Alternative

Significant cumulative adverse impacts would be the same under this alternative as under the 6,410-Ft Alternative.

Mitigation Measures for Significant Cumulative Impacts

Mono Lake

Reduced recreation opportunities resulting from changes in water quality at Mono Lake due to historical diversions cannot be fully mitigated. Impacts on sunbathing and beach uses and on waterfowl hunting could be lessened by creation of appropriate facilities. For example, sandy beaches could be created at selected sites on the western lakeshore. Similarly, waterfowl abundance and hunting could be enhanced by creation of freshwater or brackish lagoons and other habitat improvements adjacent to Mono Lake.

Lower Reaches of Rush and Lee Vining Creeks

The adverse effects on fishing of permanent changes in channel morphology on lower Rush and Lee Vining Creeks could be compensated for by construction of in-stream trout habitat improvements such as pools and overhanging banks. Reduction or elimination of livestock grazing along the lower tributaries would also hasten habitat recovery. A detailed discussion of supplementary mitigation projects for the lower tributaries is presented in Chapter 3D, "Fishery Resources".

Upper Owens River

Hydrologic studies are needed to assess the effects on Big Springs of groundwater extraction by the Town of Mammoth Lakes. Any adverse effects on fishing on the Upper Owens River resulting from reduced discharge from Big Springs could be lessened by restricting pumping for municipal use, particularly during drought events, and by reducing diversions from the river for irrigation.

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Paranick, Dan. Supervisor. Mono County, Mammoth Lakes, CA. July 16, 1992 - telephone conversation.

Scheubert, Dean. Director of West Coast Fishing Schools. Orvis Company, San Francisco, CA. August 22, 1991 - meeting.

Senn, Charlie. Administrative assistant. Sierra Recreation Associates, Mammoth Lakes, CA. October 11, 1991 - telephone conversation regarding campground use.

Upham, Nancy. Manager, Mono Basin National Forest Scenic Area. Inyo National Forest, Lee Vining, CA. July 17, 1990 - letter regarding Scenic Area use data; July 19, 1990 - letter regarding use information for scenic area.

Table 3J-1. Annual Visitor Days at Directly Affected Recreation Areas in Mono Basin and Owens River Basin, 1985-1991

Year	Mono Basin			Owens Basin	
	Mono Lake Tufa State Reserve[a]	Grant Lake[b]	Lower Rush and Lee Vining Creeks[c]	Upper Owens River[d]	Lake Crowley Reservoir[e]
1985	153,000	--	500[f]	--	--
1986	136,000	57,000	320[f]	--	--
1987	156,000	53,000	250	18,300	--
1988	184,000	57,000	530	--	149,000
1989	191,000	--	265	--	133,000
1990	178,000[g]	25,000	350	--	87,000
1991	175,000[g]	39,000	--	--	142,000

Note: -- = no estimates available.

[a] Based on Carle pers. comm.
[b] Based on Balint pers. comm.
[c] Based on Sorensen 1989, 1990.
[d] Based on Alpers, Arcularius, and Deinstadt pers. comms.
[e] Based on O'Donnell pers. comm.
[f] Lower Rush Creek only.
[g] Estimate is considered relatively unreliable by DPR (Carle pers. comm.).

Table 3J-2. Visitor Use and Lake Levels at Mono Lake Tufa State Reserve, 1983-1989

Year	Visitor Day[a]	Lake Surface Elevation (feet above mean sea level)
1983	108,000	6,376
1984	142,000	6,381
1985	153,000	6,380
1986	136,000	6,380
1987	156,000	6,380
1988	184,000	6,379
1989	191,000	6,377
1990	178,000[b]	6,376
1991	175,000[b]	6,375
1992	162,000[b]	6,374

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[a] Use reported for fiscal years beginning July 1.

[b] Use estimate is considered relatively unreliable by DPR.

Source: Carle pers. comm.

Table 3J-3. Annual Visitor Days and Water Surface Elevations at Grant Lake Reservoir

Year	Day Use	Overnight Use	Total Use	Elevation (feet above mean sea level)	
				Minimum[a]	Maximum[a]
1986	29,000	28,000	57,000	7,106	7,128
1987	27,000	26,000	53,000	7,096	7,104
1988	30,000	27,000	57,000	7,092	7,098
1989	N/A	N/A	N/A	7,095	7,115
1990	19,000	16,000	35,000	7,089	7,100
1991	16,000	23,000	39,000	7,089	7,098

N/A = use data were not available.

[a] Minimum or maximum between May 1 and October 1.

Source: Balint pers. comm.

Table 3J-4. Estimated Fishing Use of the Upper Owens River in 1987

Reach	Visitor Days
Big Springs - Alpers' Owens River Ranch	1,100
Owens River Ranch and John Arcularius Ranch	4,600
Inaja Land Company and Howard Arcularius Ranch	1,000
Howard Arcularius Ranch - Benton Crossing	7,200
Benton Crossing - Lake Crowley reservoir	4,400
Total	18,300

Sources: Alpert, Arcularius, and Deinstadt pers. comms.

Table 3J-5. Visitor Days and Water Surface Elevation at Lake Crowley Reservoir

	May		June		July		August		Total	
Year	Use[a]	Elevation[e]	Use	Elevation[e]	Use	Elevation[e]	Use[b]	Elevation[e]	Use	Elevation[d,e]
1988	111,000	6,766	13,200	6,767	14,300	6,768	10,200	6,765	148,700	6,766
1989	70,400	6,762	30,100	6,764	21,300	6,766	10,800	6,759	132,600	6,763
1990	46,100	6,762	15,600	6,760	14,600	6,760	11,100	6,758	87,400	6,760
1991	66,000	6,765	21,200	6,765	48,800	6,766	6,500[c]	6,767	142,500	6,766

[a] Includes portion of last week in April.
[b] Includes days in September through Labor Day.
[c] August only.
[d] Average elevation over season, rounded to nearest foot.
[e] Feet above mean sea level.

Source: Use estimates provided by Los Angeles Department of Parks and Recreation (O'Donnell pers. comm.).

Table 3J-6. Threshold Elevations and Effect on Major Recreation Activities at Mono Lake

	Activity and Effect	
Threshold Elevation (feet above sea level)	Sightseeing and Lake Viewing	Birdwatching and Nature Study
Less than 6,368	N/A	Low grebe and phalarope abundance
Less than 6,373.5	Distance to lakeshore at Mono Lake County Park exceeds 2,000 feet	Low gull abundance
Less than 6,378	N/A	Low phalarope observability
Less than 6,390	High dust storm frequency and severity	N/A
More than 6,390	Most small South Grove tufa towers and most sand tufa at Navy Beach toppled or inundated	N/A
Less than 6,400	N/A	Low waterfowl abundance
More than 6,407	Nearly all South Grove tufa towers and Navy Beach sand tufa toppled or inundated	N/A

Notes: Information on tufas provided by Stine (1992).

All other information developed by SWRCB consultants.

N/A = no substantial change in quality for the activity at this level.

Table 3J-7. Threshold Streamflows and Effect on Recreational Fishing on Lower Rush Creek

Threshold Streamflow (cubic feet per second)	Applicable Period of Year	Effect
Less than 19	July-August	Water temperature excessive for adult trout
Less than 40	October-November	Trout spawning habitat limited

Source: Beak Consultants 1991.

Table 3J-8. Threshold Elevations and Effect on Major Recreation Activities at Grant Lake Reservoir

Threshold Elevation (feet above sea level)	Applicable Period of Year	Activity and Effect	
		Fishing	Boating and Waterskiing
Less than 7,101	April-October	Trout production is low	N/A
Less than 7,105	May-October	N/A	Upper lake is inaccessible
Less than 7,111	May-October	N/A	Boat ramp is unusable

N/A = no substantial change in quality for the activity at this level.

Sources: Balint and Miller pers. comms.

Table 3J-9. Threshold Streamflows and Effects on Recreational Fishing on the Upper Owens River

Threshold Streamflow (cfs)	Applicable Period of Year	Effect
Less than 75	July-August	Water temperature excessive for adult trout below Hot Creek confluence
Less than 150	May-October	Available adult trout habitat less than 75% of potential
More than 200	All year	Accelerated streambank erosion

Source: EBASCO Environmental et al. 1993.

Table 3J-10. Threshold Elevations and Effect on Major Recreation Activities at Lake Crowley Reservoir

Threshold Elevation (feet above sea level)	Applicable Period of Year	Activity and Effect		
		Fishing	Boating	Waterskiing
Less than 6,760	May-October	N/A	Some boat ramps are inoperable	N/A
Less than 6,766	April-October	McGee Bay ecosystem is unproductive	N/A	N/A
Less than 6,773	June-September	N/A	N/A	Competition waterskiing course is inaccessible

N/A = no substantial change in quality for the activity at this level.

Sources: Griffith, Edmondson, and Paranick pers. comms.

Table 3J-11. Summary Comparison of Effects: Recreation Resources (Exceedance Frequencies)

	Point of Reference (POR)	No Restriction		6,372 Ft		6,377 Ft		6,383.5 Ft		6,390 Ft		6,410 Ft		No Diversion		Prediversion
	Exceedance Frequency (%)	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)
Mono Lake																
Low grebe/phalarope abundance (<6,368 ft)	0	100	100*	0	0	0	0	0	0	0	0	0	0	0	0	0
Low gull abundance (<6,373.5 ft)	0	100	100*	64	64*	0	0	0	0	0	0	0	0	0	0	0
Lakeshore inaccessible (<6,373.5)	0	100	100*	64	64*	0	0	0	0	0	0	0	0	0	0	0
Low phalarope observability (<6,378 ft)	100	100	0	95	-5	20	-80	0	-100	0	-100	0	-100	2	-98	0
High dust storm frequency (<6,390 ft)	100	100	0	100	0	100	0	100	0	6	-94	0	-100	30	-70	0
Most small tufa inundated (>6,390 ft)	0	0	0	0	0	0	0	0	0	94	94*	100	100*	70	70*	100
Low waterfowl abundance (<6,400 ft)	100	100	0	100	0	100	0	100	0	100	0	29	-71	65	-35	0
Nearly all large tufa inundated (>6,407 ft)	0	0	0	0	0	0	0	0	0	0	0	81	81*	16	16*	100
Lower Tributaries																
High stream temperatures (<19 cfs, July-August)	0	80	80*	0	0	0	0	0	0	0	0	0	0	0	0	[a]
Limited spawning habitat (<40 cfs, October-November)	80	80	0	100	20*	80	0	80	0	80	0	20	-60	20	-60	[a]
Grant Lake reservoir																
Low trout production (<7,101 ft, April-October)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
Upper Lake inaccessible (<7,105 ft, May-October)	50	30	-20	50	0	80	30*	80	30*	87	37*	97	47*	0	-50	N/A
Boat ramp unusable (<7,111 ft, May-October)	50	50	0	50	0	87	37*	87	37*	90	40*	100	50*	0	-50	N/A

Table 3J-11. Continued

	Point of Reference (POR)	No Restriction		6,372 Ft		6,377 Ft		6,383.5 Ft		6,390 Ft		6,410 Ft		No Diversion		Prediversion
	Exceedance Frequency (%)	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)	Change Relative to POR	Exceedance Frequency (%)
pper Owens River																
Excessive water temperature (<75 cfs)	0	0	0	3	3	17	17*	20	20*	30	30*	50	50*	50	50*	50
Reduced available adult trout habitat (<150 cfs)	60	10	-50	40	-20	60	0	80	20*	87	27*	100	40*	100	40*	100
Excessive streambank erosion (>200 cfs)	40	40	0	50	10*	30	-10	20	-20	10	-30	0	-40	0	-40	0
ke Crowley reservoir																
Boat ramp unusable (<6,760 ft, May-October)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
McGee Bay ecosystem unproductive (<6,766 ft, May-October)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
Waterski course inaccessible (<6,773 ft, June-September)	20	20	0	35	15*	50	30*	80	60*	80	60*	80	60*	80	60*	N/A

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te: Significant adverse cumulative impacts include: a) reduced opportunities for motor boating, waterskiing, sunbathing and beach uses, waterfowl hunting, and swimming and wading for all alternatives except the 6,410-Ft and No-Diversion Alternatives and b) reduced fishing opportunities along the diverted tributary streams under all alternatives.

ignificant adverse project impact.

A = not applicable

o quantitative information available. See Chapter 3A for discussion of prediversion flows.

Table 3J-12. Summary Comparison of Effects: Recreation Use
(Annual Visitor Days per Visitor)

Alternative or Condition	Mono Lake	Lower Tributaries	Grant Lake Reservoir	Lake Crowley Reservoir
Point of Reference (POR)				
Per visitor use	3.3	1.5	11.4	13.5
No Restriction				
Per visitor use	--[b]	1.2	12.1	13.9
% change, relative to POR	--[b]*	-20*	9	3
6,372 Ft				
Per visitor use	3.3	1.4	10.8	13.1
% change, relative to POR	0	-7	-5	-3
6,377 Ft				
Per visitor use	3.4	2.0	10.7	13.5
% change, relative to POR	3	33	-6	0
6,383.5 Ft				
Per visitor use	3.5	2.4	10.6	12.3
% change, relative to POR	6	60	-7	-9
6,390 Ft				
Per visitor use	3.7	--[b]	10.5	12.3
% change, relative to POR	12	--[b]	-8	-9
6,410 Ft				
Per visitor use	3.2	--[b]	10.4	11.9
% change, relative to POR	-3	--[b]	-9	-12*
No Diversion				
Per visitor use	N/A	2.4	--[b]	11.9
% change, relative to POR	N/A	60	--[b]	-12*
Prediversion	N/A	N/A	N/A	N/A

Note: No significant adverse cumulative impacts have been identified because the prediversion use levels are unknown.

[a] Change in use was not analyzed for the Upper Owens River recreation impact assessment.

[b] Outside predictable range.

* = significant adverse project impact.

N/A = no information available.

Table 3J-13. Average Hydrologic Conditions at Directly Affected Recreation Areas, by Alternative

	Point of Reference	No Restriction	6,372 Ft	6,377 Ft	6,383.5 Ft	6,390 Ft	6,410 Ft	No Diversion
Mono Lake[a]								
Long term[d]	6,376	6,354	6,375	6,379	6,386	6,392	6,411	6,427
Near term[e]	6,376	6,370	6,375	6,379	6,384	6,384	6,385	6,387
Drought[f]	6,376	6,351	6,372	6,376	6,383	6,389	6,408	6,416
Lower Tributaries[b]								
Long term	52	33	46	61	76	97	104	104
Near term	52	36	49	76	95	115	126	110
Drought	19	0	32	32	32	32	32	32
Grant Lake[a]								
Long term	7,114	7,114	7,105	7,104	7,104	7,103	7,101	7,132
Near term	7,112	7,119	7,106	7,105	7,104	7,103	7,102	7,132
Drought	7,101	7,101	7,100	7,101	7,097	7,097	7,097	7,124
Upper Owens River[c]								
Long term	185	186	195	157	130	117	81	78
Near term	190	204	200	164	125	110	82	81
Drought	76	77	49	37	37	34	32	32
Lake Crowley[a]								
Long term	6,772	6,773	6,771	6,770	6,770	6,770	6,769	6,769
Near term	6,773	6,774	6,772	6,773	6,770	6,770	6,769	6,769
Drought	6,766	6,767	6,767	6,767	6,766	6,766	6,766	6,766

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[a] Hydrologic conditions refer to lake levels in feet above sea level.
[b] Hydrologic conditions refer to lower Rush Creek streamflow in cubic feet per second.
[c] Hydrologic conditions refer to streamflow in cubic feet per second.
[d] Near term refers to the 20-year projection period beginning in 1989.
[e] Long term refers to the projection period beginning after Mono Lake achieves its target level.
[f] Drought refers to a drought event with a 100-year recurrence interval.

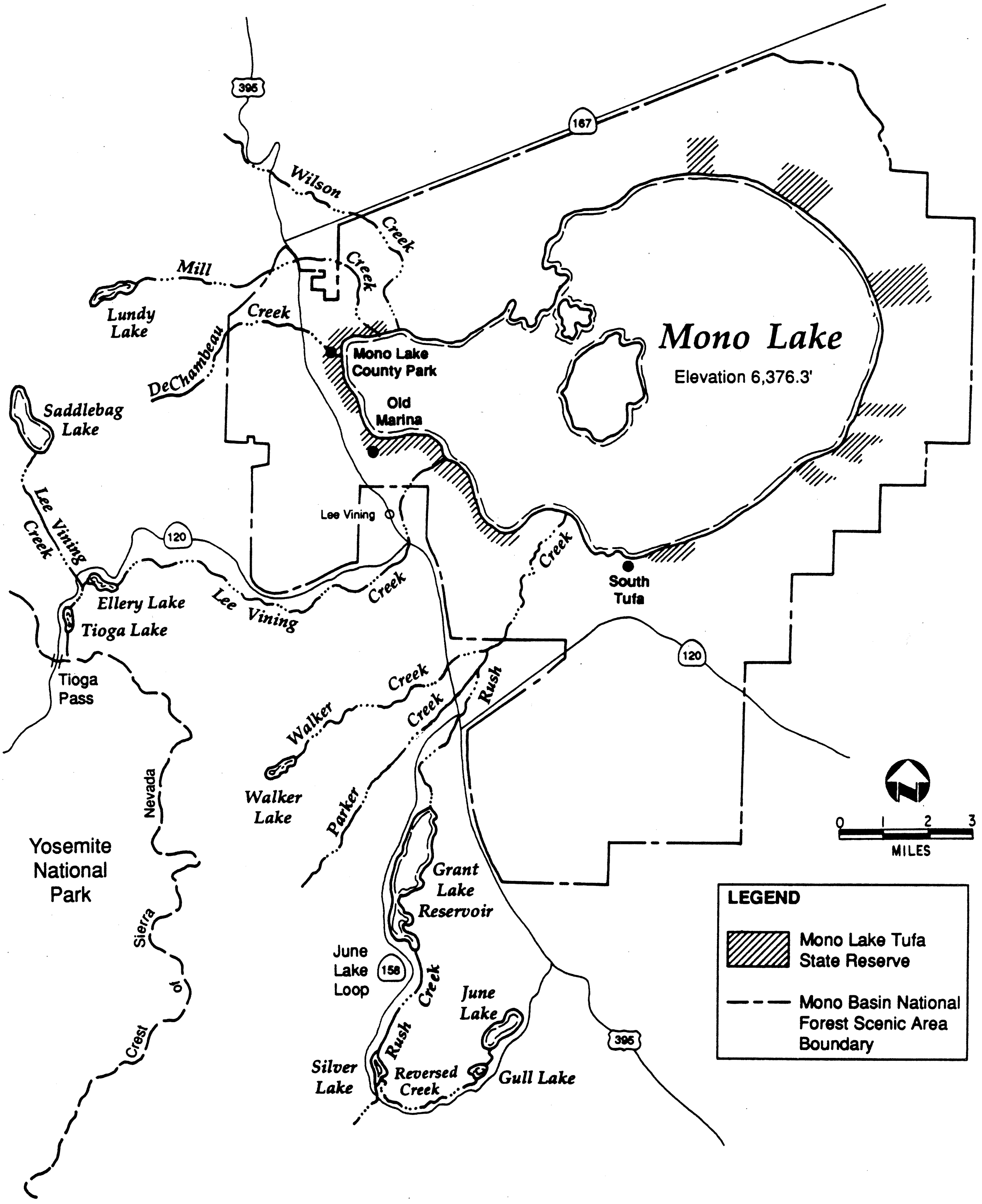


Figure 3J-1.
Principal Recreation Areas in Mono Basin

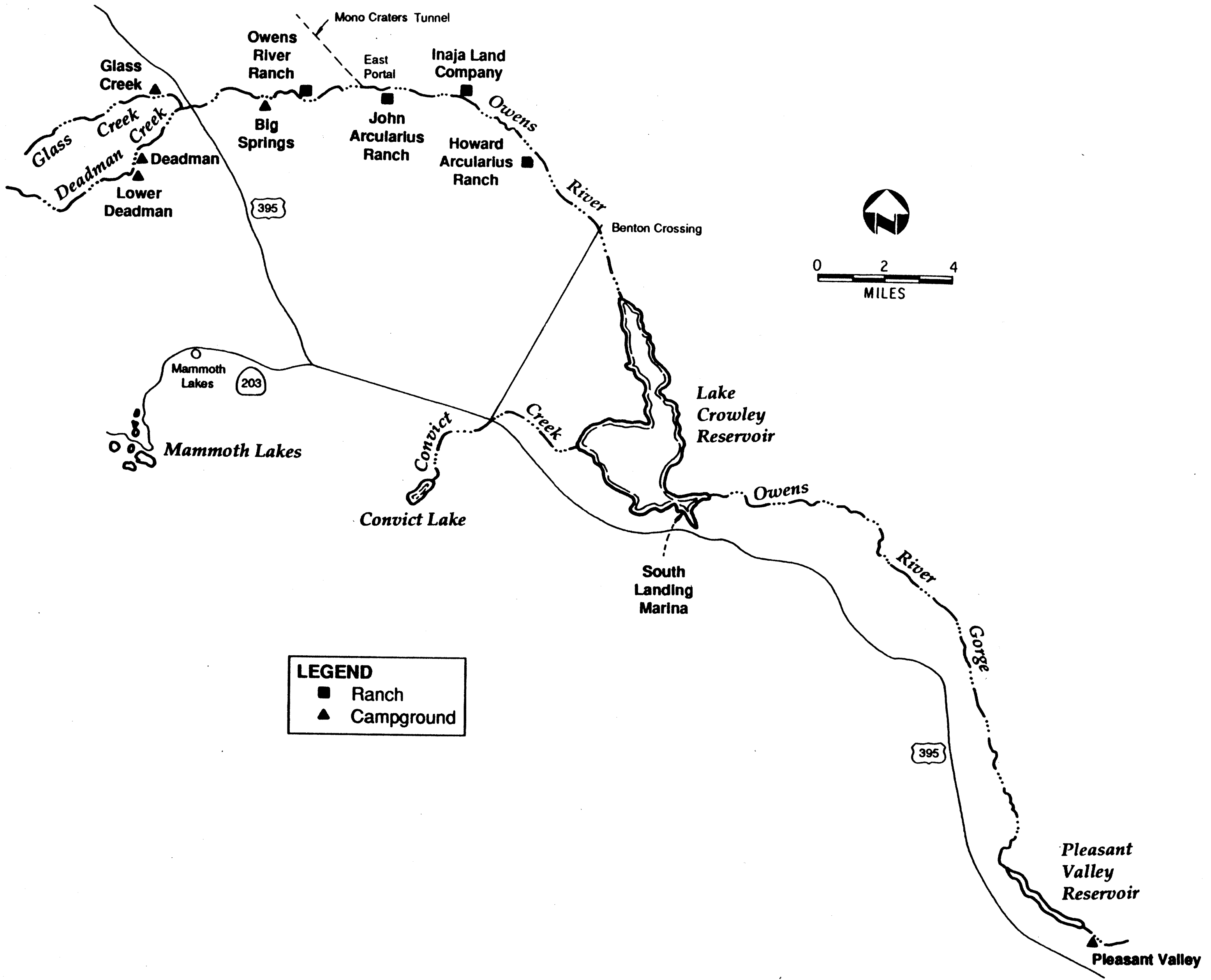
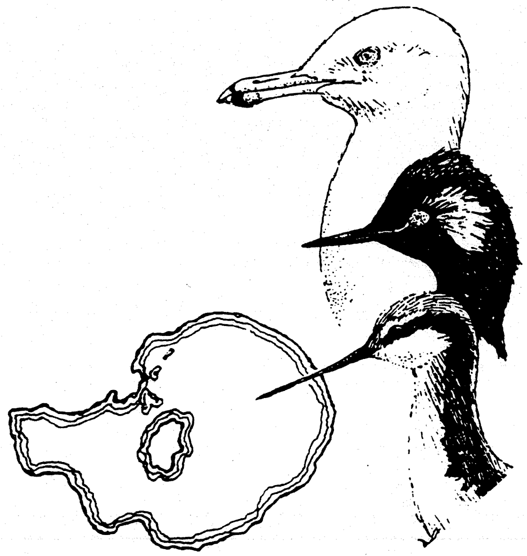


Figure 3J-2.
Principal Recreation Areas in Owens River Basin

Chapter 3K. Environmental Setting, Impacts, and Mitigation Measures - Cultural Resources



Chapter 3K. Environmental Setting, Impacts, and Mitigation Measures - Cultural Resources

This chapter addresses potential impacts of the alternatives on cultural resources in Mono Basin and Upper Owens River basin. Impacts are generally in the realm of potential disturbance to cultural resource sites from channel erosion, recreational activity, and restoration activities along the diverted streams and Owens River. Few effects would result from establishing higher or lower lake levels because no sites are expected to be present on the relicted lands.

As described below, some diminishment in the use of the lake's food resources by Native Americans may have occurred during the diversion period, but choice of an alternative would little affect future resource utilization as long as resources of Native American importance are avoided during restoration activities.

SOURCES OF INFORMATION

Background Research

A record search was conducted at the Eastern Information Center of the California Archaeological Inventory, University of California, Riverside, to determine the types and locations of known cultural resources within the areas of concern. Primary and secondary archeological, ethnographic, and historical sources were consulted for information pertaining to the areas of concern, including:

- the National Register of Historic Places,
- California Historical Landmarks, and
- California Inventory of Historical Resources.

Literature considered in this process is cited in the following discussions. Information on the Mono Lake Paiute is presented by Davis (1959, 1961, 1965, 1962, 1963, 1964), Curtis (1926), Kroeber (1925), and Merriam (1955, 1966:Part 1). Primary accounts of the Owens Valley Paiute are contained in Steward (1929, 1933, 1934, 1936, 1938a, 1938b). Additional information can be found in Davis (1961), Driver (1937), Kroeber (1925, 1939, 1959), and Merriam (1955).

Contacts with Knowledgeable Individuals

Several individuals possessing knowledge about the areas of concern were contacted by SWRCB consultants for information about cultural resources within the areas of concern. These individuals include Scott Stine, who has extensive geological field experience in Mono Basin; Wally Woolfenden, USFS district archeologist currently working in the area; and Nancy Upham, former coordinator for the USFS Mono Basin Scenic Area. Interviews with Native Americans on file with the Mono Lake Committee were also reviewed for pertinent information.

Field Methods

Based on site types and locational information obtained from the record search, several sites were selected for field visits by SWRCB consultants. Sites were selected based on their location, type, potential for impact, and accessibility. During the limited field reconnaissance, 15 previously recorded sites were revisited. This reconnaissance was designed to:

- ascertain what types of resources have been recorded in the different physiographic regions within the area,
- generally assess the accuracy of existing resource data,
- evaluate the general condition of selected recorded resources,
- determine the potential for impacts on cultural resources from the project alternatives, and
- assess sensitivity for unknown resources within unsurveyed portions of the areas of concern.

LAWS, REGULATIONS, AND TERMINOLOGY

Applicable Laws and Regulations

Applicable laws and regulations for dealing with historical properties are outlined in Appendix K of CEQA. An impact is considered significant if a project may cause damage to an important cultural resource. A cultural resource is considered important if it:

- is associated with an event or person of recognized significance in California or American history or recognized scientific importance in prehistory;
- can provide information that is both of demonstrable public interest and useful in addressing scientifically consequential and reasonable or archeological research questions;
- has a special or particular quality such as oldest, best example, largest, or last surviving example;
- is at least 100 years old and possesses substantial stratigraphic integrity; or
- involves important research questions that historical research has shown can be answered only with archeological methods.

Under CEQA, public agencies should seek to avoid or mitigate impacts on significant cultural resources.

Also applicable are Section 7052 of the Health and Safety Code and Section 5097 of the Public Resources Code, which provide for the protection of Native American remains and identify special procedures to be followed when Native American burials are found. When remains are found, the Native American Heritage Commission (NAHC) and the county coroner must be notified. The NAHC provides guidance concerning the most likely Native American descendant and treatment of human remains and associated artifacts.

Definition of Key Terms

Cultural resources is a term used here to include prehistorical, historical, and architectural resources. Archeological sites are locations where past activities occurred and are marked by surface and subsurface cultural remains. Historical archeological sites date from the advent of written records. Historical sites in California generally date from the late 1700s to the first part of the 20th century and are primarily the result of Euroamerican activities. In California, prehistorical sites date from several thousand years ago to the late 1700s and are the result of Native American activities. Ethnohistorical sites date from the period of contact between the Native Americans and Euroamericans and usually date from the late 1700s to the late 1900s or early 20th century.

Architectural properties are defined as standing structures or buildings. In the areas of concern, most standing structures are the result of Euroamerican occupation of the area, but some historical aboriginal wickiups (historical winter houses) may also be present.

PREDIVERSION CONDITIONS

Overview

During prehistorical times, streams and springs in Mono Basin provided an ample supply of fresh water; riparian corridors, meadows, and marshes contained diverse species of vegetal foods; and game and fowl were plentiful. Sources of obsidian, an important resource for hunting, could be found at Mono Craters and in the Bodie area. At certain times of the year, the shores of Mono Lake produced abundant accumulations of alkali fly larvae (*Ephydra hians*), rich in protein and prized by the native people. Together, these factors made Mono Basin an attractive location for Native American settlement and use.

The Owens River basin, like Mono Basin, supported a wide range of flora and fauna that could be exploited by Native Americans. Stands of Jeffrey pine provided nuts and Pandora moth larvae (*Coloradia pandora lindseyi*), both important food sources. Wetlands and marsh areas contributed vegetal resources and supported many important species of game and fowl, and the Owens River contained four species of native fish. Obsidian could be found less than 10 miles away from the Upper Owens River at Mono Glass Mountain and Casa Diablo obsidian quarries.

During the latter half of the 19th century, Native American use of Mono Basin was largely replaced by ranching, agriculture, mining, logging and milling, and homesteading. By the turn of the century, Native American lifeways had largely been supplanted by Euroamerican culture.

During the 1930s, LADWP constructed the water export system on Mono Basin, possibly disturbing archeological sites or inundating them at Grant Lake and Lake Crowley reservoirs as the diversions began in 1940.

Because of its lack of mineral resources and remote location, the Upper Owens River area experienced less intensive Euroamerican settlement than did Mono Basin. As a result, traditional Native American activities, such as pine nut harvesting and Pandora moth larvae collection, persisted well into the 20th century. As prime land to the north and south was appropriated, the Upper Owens River area became more attractive and several ranches were established.

Ethnographic Background

Native American Groups

Before Euroamerican settlement, the Mono Lake Paiute occupied the Mono Basin area, and the Owens River Paiute lived primarily in the Lower Owens River area. To the west of the areas of concern lived the central and southern Sierra Miwok and the Sierra Monache. Both the Owens Valley Paiute and the Mono Lake Paiute are classed as subgroups of the larger linguistic family of Numic-speaking Northern Paiute. The boundary between the two groups has traditionally been drawn near the headwaters of the Owens River, although territorial margins for the Northern Paiute were quite fluid (Hall 1983). The lands between the Owens Valley Paiute and Mono Lake Paiute have been considered a shared-use area (Liljeblad and Fowler 1986). Intermarriage was common among the different Paiute groups and between the Paiute and other groups living nearby.

Paiute Lifestyles

Although the Owens Valley and Mono Lake Paiute shared linguistic similarities, Bettinger (1982a, 1982b, as cited in Hall 1983) has outlined differences between their adaptive strategies, settlement patterns, and organizational structure. The Mono Lake Paiute practiced what has been termed a "desert culture strategy", which depended on flexibility of movement for most of the season, with groups congregating only during winter. The family is the primary settlement unit associated with this type of economic strategy.

The Owens Valley Paiute differed from the Mono Lake Paiute in that they practiced a desert village strategy, with several extended families occupying villages year round. These villages operated as bases from which subsistence activities were undertaken. Small special-use camps were often set up at the location of hunting and gathering activities (Bettinger 1982a, 1982b, as cited in Hall 1983). In addition, large plots of land on the floor of Owens Valley were irrigated and two wild crops, hyacinth corms and yellow nut-grass, were cultivated (Hall 1983, Steward 1933).

During spring and early summer, the Mono Lake Paiute lived along streams draining the Sierra Nevada. There they gathered seeds, berries, bulbs, and grasses, and hunted for game. The Mono Lake and Owens Valley Paiute hunted antelope, as indicated by the remains of extensive game-drive fences in Mono Basin and to the south (Steward 1933).

When summer came, their attention turned to the collection of insects. Alkali fly larvae dislodged by wind-driven waves frequently formed extensive windrows around portions of the shore of Mono Lake (see Chapter 3E, "Aquatic Productivity"), providing a rich source of protein to the Mono Lake Paiute. These insect resources were so important to the Mono Lake Paiute that they called themselves Kuzedika, or "fly larvae eaters".

Another major food source for both groups was Pandora moth larvae, which were available every other summer and collected from stands of Jeffrey pine (Davis 1965, Fletcher 1987, Liljeblad and Fowler 1986, Steward 1933, Weaver and Basgall 1986). In midsummer, both groups traveled from their core occupation areas to an area they shared in Long Valley to collect the moth larvae. Both groups also had access to fishing, seeds, and game present in the Upper Owens River area. In fall, both groups collected pine nuts.

External Relationships

Both the Mono Lake and Owens Valley Paiutes had extensive interaction with other ethnographic groups. Specifically, the Monache, Sierra Miwok, Washo, and Tubutulabal often ventured into the area on trading expeditions or for social gatherings (d'Azevedo 1986, Fletcher 1987, Hall 1983, Spier 1978). Travel was also an integral part of Paiute life. They ventured frequently over the crest of the Sierra to trade for acorns, manzanita berries, shell beads, bear skins, arrows, baskets, and black and yellow paints. In return, they brought pine nuts, dried caterpillars, kutsavi (brine fly larvae), salt, obsidian, pumice, rabbit-skin blankets, and sinew-backed bows (d'Azevedo 1986, Fletcher 1987, Spier 1978). So friendly were these trade relations that when the pine nut crop on the eastern side of the Sierra was poor, the Mono Lake Paiute wintered with the Sierra Miwok in Yosemite Valley (Davis 1965, Steward 1933).

The main route over the Sierra for the Mono Lake Paiute was the Mono Trail. This trail led from the east up Bloody Canyon, over Mono Pass, and along the Dana Fork of the Tuolumne River to Tuolumne Meadows. From there, it forked to the north and south (Davis 1965, Fletcher 1987). Another frequently used trail was the Parker Pass trail just south of Mono Pass. To the south, the Mammoth Pass was used to reach the San Joaquin drainage and the western slope of the Sierra (Davis 1965).

Although many trade items were carried back and forth over these trails, none were as important to the region's economic and social structure as obsidian. Several obsidian sources are located near Mono Lake and within Owens Valley, and recent archeological research has focused on questions concerning the control of these sources and the possible relationship between the control of obsidian sources and different subsistence strategies practiced by the Owens Valley and Mono Lake Paiute and groups to the west.

Effects of Contact

When Euroamerican settlers began entering Mono Basin, the Mono Lake Paiute tried to avoid them, abandoning the west and north shores of the lake. Eventually, the settlers became too numerous and resources too scarce for the Paiute to isolate themselves, and they were forced to become participants in the local Euroamerican economy. During the late 1800s and early 1900 the Mono Lake Paiute traded goods with the settlers and worked as seasonal laborers on ranches and farms, on the Mono Mills-to-Bodie railroad, and at the Mono Mill (Fletcher 1987).

Evidence exists that despite Euroamerican influences, traditional cultural practices prevailed well into the 20th century. For example, on the east side of the lake, three wickiups have been found with artifact assemblages dating from the 1880s to possibly as late as 1920 (Arkush 1987). Arkush suggested that the historical wickiup sites evidenced a trend toward isolation from the Euroamerican population during fall and winter months. During this time, they engaged in traditional subsistence activities and craft production little affected by modern technology. This practice of seasonal isolation and traditional subsistence activities may have helped the Paiutes preserve their native lifeways to a greater degree than Native Americans elsewhere in California.

Native American Life near the Beginning of Diversions

Important Areas. Native American occupation of Mono Basin continued into the 20th century. Many Native Americans lived along Rush Creek, especially along the bottomlands (to near the prediversion shoreline, just below the current County Road crossing). When LADWP purchased these lands in the 1930s, about 20 families established a large settlement nearby (which was abandoned a few years later) (Blaver pers. comm.). Not as many people lived on Lee Vining Creek, perhaps due to the more difficult access to uplands (Hess and Andrews pers. comms.).

Some of the people still wintered in Warm Springs on the east side of Mono Lake well into the 1920s and 1930s (McPherson pers. comm.).

All families in the basin used Mono Lake for swimming, bathing, and washing clothes. Mono Lake water was an excellent detergent. The elders believed that Mono Lake water was a good panacean medicine. People usually swam near Rush Creek where fresh water was available for rinsing (Durant pers. comm.).

Rush Creek. The Rush Creek area was considered valuable by Native Americans because of its lush vegetation and natural meadows, abundant water, and, after trout were introduced by Euroamericans, good fishing. The children could be allowed to roam all over the hills and meadows near the creek. At the confluence of Rush and Walker Creeks above The Narrows, a waterfall was followed by a pool considered to be the habitat of "waterbabies", spirits who at times were said to be heard crying.

Some people lived at The Narrows, but the pine nut grinding rocks and natural garden there were maintained by the community (Blaver pers. comm.). A large bedrock area with several communal mortars existed near the top of The Narrows where women pounded and ground acorns, pine nuts, and other seeds.

Downstream from The Narrows, on a plateau above Rush Creek, was an Indian camp with three or four buildings. potatoes were grown on a big flat area below, but irrigation was unknown.

Wildlife Food Resources. Deer and jackrabbits were hunted in upland habitats, and geese and ducks were hunted around the lake in marshy areas. Duck or goose feathers were made into down pillows, rabbit skins were made into blankets, and the meat was eaten (Hess and Andrews pers. comms.). Venison was made into jerky, and fish from Grant Lake reservoir was dried. Older Euroamericans recall seeing some of people haul water from the lake to the meadows where it was poured down ground squirrel holes to drive out ground squirrels, another food source.

During the late spring, men made willow rafts and sailed to the Mono Lake islands for seagull eggs, which were a source of food used by the elders (Durant pers. comm.). Captain John, the last Mono Basin Paiute chief, used to travel to Bodie to sell gull eggs (Hess and Andrews pers. comms.).

Fishery Resources. Rush Creek had good pools for fishing, and introduced trout were very plentiful, ranging in length from 6 to 8 inches. Willows were used for poles, string for line, and pins for hooks. Insects, worms, and grasshoppers were used for bait. (Durant pers. comm.)

Fly Larvae. The earlier extensive use of the alkali fly larvae must have diminished substantially from the time of contact to the onset of diversions. By this time, some Paiute people were still screening sand for fly larvae near the mouth of Lee Vining Creek and making sandwiches with the larvae (Wood pers. comm.).

Plant Resources. The people used digging sticks to gather edible plants, usually roots and bulbs, such as the Mariposa lily. Other edible plants gathered were lambsquarter, clovers, wild rhubarb, cattail roots, sunflower stalks, wild garlic, and mint along the creek. Acorns and pine nuts were gathered in neighboring areas and brought home to be made into a soup or gruel. (Durant pers. comm.)

The Mono Lake Paiutes used the willows that grew nearby along Rush Creek as the natural source of material for basket making. Some of their woven baskets were the finest made by Native Americans. The women were creative and artistic, and many of the baskets were prize winners at the Yosemite Indian Field Days. (Durant pers. comm.).

Historical Background

Early Explorations

The first Euroamericans to venture into the areas of concern were probably fur trappers and explorers, such as Jedediah S. Smith and Peter Ogdan, who came to the area in the 1820s. In the 1830s and 1840s, Joseph Reddeford Walker made several trips through the area, and in 1852, the first systematic survey of the area was undertaken by the U.S. Army, led by Lieutenant Tredwell Moore. During their exploration, they discovered gold on Lee Vining Creek. One of Moore's group, Leroy Vining, returned and became the area's first settler (Fletcher 1987; U.S. Bureau of Land Management 1979).

Mining

The area was only sparsely inhabited until gold was discovered in Mono Basin and to the north during the late 1850s. These discoveries caused "rushes" at several locations, such as Aurora, Bodie, Dogtown, and Monoville, resulting in the almost immediate establishment of communities with considerable populations. Later, mines were developed west of Mono Lake on the eastern flank of the Sierra Nevada.

The development of mining was accompanied by the growth of the lumber industry because Bodie and other mines in the area required large amounts of timber for their mines and fuel wood for heating buildings. In the early mining years, several mills on the west side of the lake provided wood to the mines. In 1880, the Bodie Railway and Lumber Company secured rights to 12,000 acres of Jeffrey pine forest east of Mono Craters. A railroad was built along the east shore of the lake, which extended 32 miles from Bodie to a sawmill built near the timber. Both Chinese and Mono Lake Paiute worked on constructing and operating the railroad and the lumber mill.

When the population of the mining communities swelled, farmers realized the profitability of catering to the miners. The result was an agricultural boom in Mono Basin. As the market for agricultural products developed, irrigated acreages grew. Irrigation ditch systems were constructed, and by the 1880s and 1890s, about 4,000 acres within Mono Basin was under irrigation (Fletcher 1987).

Ranching

During the latter half of the 1800s, grazing also became an important economic pursuit in Mono Basin (Chapter 3G, "Land Use"). In addition to the area resident's grazing activities, thousands of sheep and cattle grazed in the area every year on their way to summer pasture in the Sierra. By the 1880s, the effects of overgrazing were apparent, but grazing in the area was reduced with the passage of the Taylor Grazing Act in 1934 (Fletcher 1987).

As roads from the Los Angeles area and over Tioga Pass were constructed, improved, and paved, the area was gradually opened to recreation. Recreational use of the area has so increased that today it is the region's primary economic base (Chapter 3J, "Recreation Resources").

ENVIRONMENTAL SETTING

Archeological Resources

Little of the Mono Basin and Upper Owens River areas has been systematically surveyed for cultural resources. Many of the prehistorical sites that have been recorded were found during unsystematic surveys conducted many years ago. Most sites records contain only minimal data, and few of the sites have been revisited or rerecorded.

A generalized archeological sequence for the project vicinity, originally defined by Bettinger (1982a), has been refined by several subsequent surveys and excavations in Mono Basin and Owens Valley. Evidence of Native American occupancy from before 5500 B.P. is indicated by projectile point assemblages of the Mohave Complex (pre-5500 B.P.). Artifacts of the Little Lake Period (5500-3200 B.P.), Newberry Period (3200-1400 B.P.), Haiwee Period (1400-700 B.P.), and Marana Period (700 B.P) can be distinguished. Evidence exists of earlier occupation in Mono County, as indicated by fluted points found at the Komodo Site (CA-MNO-617/679). It has been suggested that this site could push back occupation in the region to 11,300 years B.P. (Infotech 1990).

Mono Basin

Archeological data for Mono Basin are limited. Davis conducted a general survey of the Mono Basin area and excavated two rock shelters at Hot Creek (Davis 1964). Other survey and evaluation work has been conducted for highway improvement projects (Biorn 1983, Grantham and Jones 1990), hydroelectric projects (Clay and Hall 1988; Crist 1982; White 1985, 1988; York 1990), telephone transmission lines (Macko 1988), private development (Burton 1984) and USFS projects (Faust 1986; Reynolds 1985a, 1987; Sawyer 1988).

As a result of these surveys, approximately 50 sites have been recorded within areas of concern in Mono Basin. Sites of Native American origin include lithic scatters, limited-use temporary camps, rockshelters, large habitation sites with middens, bedrock mortars, cremation sites, remains of historical aboriginal wickiups, obsidian quarries and lithic workshop sites, and fly-larvae collection sites.

Historical sites include the remains of residential structures and ranching facilities, refuse deposits, sheep camps, and the remains of recreational facilities. Additional historical sites are probably also present in the area, such as the remains of mining operations; milling activities; ranches, farms, domiciles, and sheep and cattle grazing camps; components of the LADWP Mono Basin water export system and earlier water diversion systems; features and refuse deposits associated with the Bodie-Mono Mills Railroad; and refuse deposits, features, and structures associated with early 20th-century hydroelectric development.

The former sites of Mono Mills and the Bodie-Mono Mills Railroad are listed on the California Inventory of Historic Resources, and triplex cottage No. 102, associated with a hydroelectric facility in the town of Lee Vining, has been determined eligible for listing in the National Register of Historic Places.

Upper Owens River

Systematic survey work along the Upper Owens River has been limited, with most restricted to land owned by USFS. Meighan (1955) conducted some of the earliest systematic surveys in the area and recorded many sites in the upper Long Valley area. Other work has been conducted primarily for USFS projects (Burton 1980; Faust 1984, 1986, 1988; Jackson and Bettinger 1985; Self 1977, 1980; Lipp 1981; Reynolds 1985b, 1985c).

Sites recorded during this work include habitation sites with large middens and bedrock mortars, lithic workshop sites and scatters, temporary camps and resource processing sites, rock rings, and stone hunting blinds. Numerous moth larvae collection sites have been found to the west, north, and south of the area (Weaver and Basgall 1987) and may also be present in areas forested with Jeffrey pine near the Upper Owens River.

Historical sites recorded in the Upper Owens River area include historical refuse deposits associated with an aboriginal resource collection site, isolated refuse deposits resulting from the construction of the LA Aqueduct, and features and artifacts associated with the East Portal of the Mono Craters segment of Mono Basin extension of the LA Aqueduct.

Current Archeological Sensitivity

Mono Lake Margin

Although little of the area around Mono Lake has been systematically surveyed, unsystematic investigations have not identified any resources near the present lake margin. A few isolated artifacts, such as projectile points and Chinese coins, have been reported near the present water line (Stine pers. comm.) where they could have been transported by natural forces from sites at higher elevations.

All recorded resources are located at elevations above 6,440 feet, which is well above the historical highstand and prediversion lake levels. One exception, marked by a few projectile points found in "dry pond beds", is located at 6,430 feet, which is also above these levels. Recorders speculated that the site was used for hunting waterfowl when the previous lake level supported fresh or brackish water in lake-fringing wetlands (Chapter 3C, "Vegetation").

Indirect impacts could occur from:

- streamflows eroding streambanks and damaging or destroying buried or surface historical or archeological resources and
- recreation use changes possibly resulting in vandalism and unauthorized collection or inadvertent destruction of these resources.

Direct Impacts

Rising Lake Levels. As described in the "Environmental Setting" section, only one cultural resource site is known to exist within the relicted lands: the foundation of an egg collector's cabin on the north side of Negit Island, at about 6,406-foot elevation (Stine pers. comm.). The cabin was apparently constructed and used around 1861 when the lake was slightly below this elevation. The two higher lake level alternatives would result in inundation of this resource.

As described in the "Environmental Setting" section, one other recorded historical or archeological site lies at an elevation of 6,430 feet, above the relicted lands; all other sites lie above 6,440-feet elevation. Under the No-Diversion Alternative, the lake may reach an elevation of 6,436 feet in wet periods, a higher level than under prediversion conditions. Thus, there exists the possibility of erosion or inundation of the noted site and other undiscovered sites.

These facts are used to assess the potential for lake erosion or inundation of cultural resources among the alternatives.

Restoration Activities. Restoration of aquatic and terrestrial habitats could continue or be initiated to mitigate cumulative losses of these resources attributable to stream diversions. These efforts could result in ground disturbance during site reconfiguration and installation of habitat elements, as well as during activities related to access, staging, borrowing, and stockpiling of construction materials. Archeological, historical, and Native American resources could be degraded or destroyed by these activities. In addition, because Native American gathering practices may conflict with revegetation or restoration goals, they may be difficult or impossible to continue.

Indirect Impacts

Stream Erosion. Lake levels and streamflows of the alternatives create various potentials for stream channel erosion, as described in Chapter 3C, "Vegetation". Low lake levels can induce the tributary streams to incise, and high streamflows spilled over the diversion structures can provide the erosive power for both bank erosion and incision. Flow augmentation in the Upper Owens River can continue the process of bank erosion. The potentials for channel erosion associated with the different alternatives are used to rank the relative threats to known or undiscovered cultural resources along the diverted tributary streams and the Upper Owens River.

Recreation Activity. The alternatives would result in various levels of recreational activity around Mono Lake, along the tributary streams, and along the Upper Owens River, as described in Chapter 3J, "Recreation". Recreational use represents a potential for vandalism, unauthorized collection, or inadvertent destruction of cultural resources. Prediction of changes in recreational activity under the alternatives is used to rank the relative threats to known or undiscovered cultural resources.

Criteria for Determining Impact Significance

According to the California State CEQA Guidelines, a project would have a significant impact on cultural resources if it would disrupt or adversely affect an archeological site or a property of historical or cultural significance to a community or to an ethnic or social group. For the purposes of this impact analysis, it is assumed that cultural resources in the study area are potentially significant.

SUMMARY COMPARISON OF IMPACTS AND BENEFITS OF THE ALTERNATIVES

As described in the preceding section, relative cultural resource effects of the alternatives are assessed in this chapter through four key variables:

- potential for inundation of known or potential sites,
- potential for damage to known or potential sites from restoration activities,
- potential for damage to known or potential sites through stream channel erosion, and
- potential for site disturbance from recreational activities.

Table 3K-1 provides a comparison of the alternatives using these variables. Values of the variables for each alternative are compared to values for the prediversion and point-of-reference conditions. Those values representing significant adverse changes from the point of reference are indicated. Further discussion of these impacts on an alternative-by-alternative basis is not warranted because, as the table shows, all of the alternatives have the potential to have an impact on potentially significant cultural resources.

MITIGATION MEASURES FOR SIGNIFICANT IMPACTS

As shown in Table 3K-1, all the alternatives have potential to have an impact on archeological, historical, and Native American resources; therefore, mitigation for these impacts would be similar for all alternatives. Site- or location-specific mitigation cannot be developed until cultural resources surveys are performed, an alternative is selected, and alternative-specific habitat restoration is designed. Therefore, a general mitigation strategy for cultural resources impacts is provided below that could be directed by the SWRCB, Chief of the Division of Water Rights, and implemented by LADWP after an alternative is selected.

First, areas that could be directly or indirectly affected by project-related activities should be identified and cultural resources surveys should be conducted in these areas. Consultation with the local Native American community should be undertaken to determine where traditional use areas and resources of concern are located. If impacts may occur on USFS land as a result of the project, surveys of the affected areas should be the responsibility of USFS.

Based on the surveys and Native American coordination, a cultural resources treatment plan (CRTP) should be developed. Selection of treatment options should depend on resource type, nature of potential impacts (direct or indirect), and the ability to reconfigure restoration activities to avoid important resources. Treatment options included in the CRTP should include, but not be limited to, avoidance of resources; monitoring by an archeologist during ground-disturbing activities; archeological test excavation and, if necessary, data recovery excavations; relocation or closure of public access roads; and protection measures such as capping and fencing of sites.

The CRTP should also include protection of resources of importance to Native Americans and, if requested, provisions for access to resources and areas for traditional uses. The CRTP should include provisions for unanticipated discoveries, such as human remains and other archeological materials that could be discovered during project-related activities. The CRTP should outline the requirements for archeological excavations and should call for the preparation of research designs to guide all excavations and data recovery plans to direct data recovery efforts.

To ensure that the treatment options are effective, the CRTP should outline a monitoring program. Minimally, the monitoring program should define locations that require monitoring and provide guidance on frequency for field visits and reporting methods. The CRTP should require that other treatment options, such as protection measures or data recovery, be implemented if monitoring indicates that impacts are occurring as a result of project-related activities.

CUMULATIVE IMPACTS OF THE ALTERNATIVES

As described in Chapter 3C, "Vegetation", a substantial erosion of the Rush and Lee Vining Creek corridors occurred during the diversion period. This erosion probably damaged or destroyed cultural resources along the stream margins. All alternatives could contribute to the cumulative loss, but would do so to varying degrees, as shown in Table 3K-1 and discussed in Chapter 3C, "Vegetation".

Stream dewatering, erosion, and fire may have caused loss of plants and animals important to the maintenance of Native American cultural practices during the diversion period. Changes in the use of Mono Lake by migrating ducks and in the productivity of the alkali fly population may also have affected such practices. The project alternatives might contribute to a cumulative effect on the maintenance of such practices.

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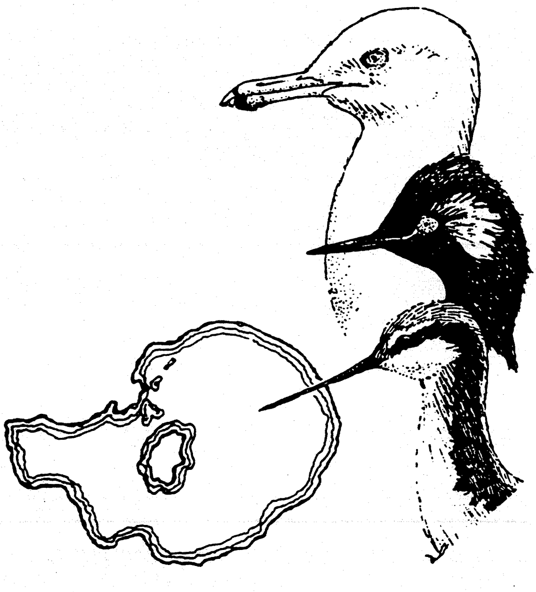
Table 3K-1. Summary Comparison of Effects: Cultural Resources

Alternative or Condition	Potential for Resource Inundation	Potential for Erosion (Tributary Streams and Upper Owens River)	Potential for Recreation Disturbance (Mono Lake Vicinity and Tributary Streams)	Potential for Restoration Disturbance (Mono Lake Vicinity and Tributary Streams)
Point of reference	Unlikely	Likely	Likely	None
No restriction	Unlikely	Likely	Unlikely	None
6,372 Ft	Unlikely	Likely	Likely	Likely
6,377 Ft	Unlikely	Likely	Likely	Likely
6,383.5 Ft	Unlikely	Likely	Likely	Likely
6,390 Ft	Unlikely	Likely	Likely	Likely
6,410 Ft	Definite	Likely	Likely	Likely
No diversion	Definite	Likely	Likely	Likely
Prediversion	Likely	Unlikely	Likely	None

Chapter 3L. Environmental Setting, Impacts, and Mitigation Measures - Water Supply



MONO BASIN EIR

Prepared by Jones & Stokes Associates

Chapter 3L. Environmental Setting, Impacts, and Mitigation Measures - Water Supply

This chapter describes the early history of the LADWP water system, recent water supply and demand conditions in the Los Angeles basin, and projected supply and demand conditions over the next 20 years. Later portions of this chapter discuss water supply and demand conditions as they exist under the point-of-reference scenario for the impact and analysis in this EIR, potential impacts of the project alternatives, and suggested mitigation measures.

PREDIVERSION CONDITIONS

This section describes the development of the public water supply in Los Angeles, from the incorporation of the city in 1850 to the diversion of water from Mono Basin in 1941.

Sources of Information

SWRCB consultants reviewed historic records maintained by LADWP on the Los Angeles water supply system and summary publications such as Facts & Figures (LADWP 1988) and the current Urban Water Management Plan (UWMP) (LADWP 1991a). SWRCB consultants also reviewed the transcript of court testimony from the Mono Lake hearings (Sonora County Court of Tuolomne County), commonly referred to as the Aitken case. Recent publications and correspondence by LADWP and others were also reviewed to evaluate alternative supply options.

Development of the LADWP Water Supply System

In 1850, Los Angeles was incorporated under the laws of the United States. Four years later, the city created a department to oversee the water system. The city authorized the first pipeline system for domestic water distribution in 1857 and by 1861 had adopted an ordinance to establish rates for domestic water. From 1865 to 1898, municipal domestic water works were leased to private parties to provide service to the public. In 1899, the citizens of Los Angeles approved a $2 million bond measure to purchase the private water service companies. (LADWP 1988.)

The public completed purchase of the water system in 1902. Although less than 2% of the customers were metered for consumption at the time of purchase, by 1927 the system was 100% metered (LADWP 1988.)

Between 1902 and 1903, Los Angeles began adding to its water supplies to meet increasing demand. In 1903, the U.S. Supreme Court affirmed Los Angeles' paramount rights to surface flow of the Los Angeles River. Two years later, the citizens approved a $1.5 million bond measure to purchase lands, rights-of-way, and water rights in the Owens River basin. The initial proposal was to divert 1,000 cubic feet per second (cfs) for municipal purposes on the Owens River at Charlies Butte near the present Los Angeles Aqueduct (LA Aqueduct) intake. (LADWP 1988.)

U.S. census data indicate that the population of Los Angeles doubled approximately every 10 years from 1910 to 1930. During the same period, Los Angeles' water consumption increased 50% faster than the city's population.

To keep up with its rapidly growing demand, Los Angeles pursued two major sources of water supply between 1910 and 1941: the Colorado River and the waters in Mono Basin and Owens River basin. In 1913, the LA Aqueduct was completed and storage of Owens River water began at Haiwee Reservoir. In 1915, Los Angeles residents received their first deliveries of LA Aqueduct water. Also in 1915, Los Angeles first began to study the potential for appropriating waters in Mono Basin (LADWP 1988).

In 1923, Los Angeles began performing surveys to determine the feasibility of constructing an aqueduct from the Colorado River to Los Angeles. The following year, Los Angeles filed an application with the State Division of Water Resources to appropriate water from the Colorado River at a rate of 1 billion gallons per day (LADWP 1988).

In 1927, the Metropolitan Water District Act was enacted by the California legislature, which allowed for the formation of the Metropolitan Water District (MWD). The next year, the electorate of 13 cities voted to form the MWD. LADWP was one of the 13 founding members of MWD. Initially, MWD was formed to build the Colorado River Aqueduct to import water from the Colorado River. This water was to supplement the local water supplies of the 13 original southern California member cities. (Planning and Management Consultants 1990.)

In 1934, the city applied to the State Water Rights Board for permission to divert water from four Mono Lake tributary streams. Mono Craters Tunnel construction also began that year. The Mono Basin project was finished, and the State Water Rights Board issued the permit to operate the project in 1940. The permits authorized the city to divert water from Lee Vining, Walker, Parker, and Rush Creeks at a combined rate of 189 cfs and to collect 89,200 af per annum by storage in Grant Lake and Long Valley, Tinemaha, and Haiwee Reservoirs. When Mono Basin exports began, the city's population had reached 1.5 million and total water demand had reached 245 thousand acre-feet per year (TAF/yr).

The Colorado River Aqueduct was completed to Lake Mathews in 1940, and Colorado River water was first delivered to Los Angeles in 1941. (LADWP 1988.)

ENVIRONMENTAL SETTING

This section describes changes in water supply and demand conditions from 1941 to 1990. It summarizes historical water demand in the City of Los Angeles, including efforts to reduce demand through conservation, and LADWP historical water supplies. The predicted supply and demand conditions from 1990 to 2010 also are described. Opportunities to increase supplies by reclamation/recycling and conjunctive use of local groundwater basins are also discussed.

Sources of Information

SWRCB consultants reviewed the 1991 LADWP UWMP in preparing this section. The UWMP synthesizes census data on the population served by LADWP, discloses records of LADWP water use, identifies LADWP operations policies, and describes projected water demand and supply conditions for the LADWP service area.

To identify potential sources of water available to LADWP, SWRCB consultants reviewed numerous other studies, including The Regional Urban Water Management Plan for the Metropolitan Water District of Southern California (Planning and Management Consultants 1990), Water Reclamation in the Past, Opportunities and Plans for the Future (Los Angeles Office of Water Reclamation 1990), the Mayor's Blue Ribbon Committee on Water Rates, and Municipal and Industrial Water Use in the Metropolitan Water District Service Area: Interim Report No. 4 (Planning and Management Consultants 1991).

Population Growth and Water Use in the City of Los Angeles

Population growth in the City of Los Angeles between 1940 and 1990 has been uneven (Figure 3L-1). Population served by LADWP increased 10% during the 1940s, 34% during the 1950s, 15% in the 1960s, 5% during the 1970s, and 16% in the 1980s. The 1990 population in the LADWP service area was about 3.46 million.

Total water consumption increased substantially from 1940 to 1990 (Figure 3L-2). Agricultural water use, nonexistent in 1914, peaked at 92,000 af in 1949 and gradually declined thereafter. Current agricultural use is approximately 1,200 af per year. In contrast, total urban water consumption in the LADWP service area has increased markedly since the early 1900s, once exceeding 700,000 af/yr in the 1980s. Urban consumption temporarily declined in the late 1970s and early 1980s, however.

Between 1976 and 1990, single-family and multifamily water use was approximately 66% of total water demand, with the commercial sector using approximately 21% of the supply (Figure 3L-3). Industry, government, and miscellaneous sales (which includes agriculture) accounted for the remaining 13% of demand.

Water use varies on a month-to-month and year-to-year basis in response to climatological conditions. Demand for water is higher in summer and during hot, dry years and lower in winter and during cooler, rainier years. Indoor water use remains fairly constant, with outdoor water use accounting for most of the variation.

Monthly demand peaks in summer when outdoor irrigation is at a maximum and subsides in winter when outdoor irrigation is at minimum (Figure 3L-4). In the 1989-1990 fiscal year (July 1, 1989 to June 30, 1990), water use in the LADWP area ranged from 44,512 af in February to 72,624 af in July, a 63% fluctuation in seasonal demand.

Per capita water use, as measured by gallons consumed per capita per day (gcpd), has shown an increasing trend between 1945 and 1990 (Figure 3L-5). Over the past 20 years, per capita use has leveled off, however, and a major reduction occurred during the 1976-1977 drought.

Current per capita water use is about 179 gcpd. Per capita annual water use rarely fluctuates more than 5% above or below consumption during an average weather year. During exceptionally hot years, however, water use may increase as much as 8-10% above average water year consumption levels.

The City of Los Angeles' rate of water use is moderately low in comparison to samples of cities nationwide (Table 3L-1). Per capita use in the 11 cities ranged from 149 to 300 gallons per day (gpd).

Conservation Efforts in the City of Los Angeles

Two droughts (1976-1977 and 1986-1992) have intensified the need to accommodate water shortages. Consequently, LADWP has made water conservation a priority.

LADWP's UWMP contains estimates of the savings from water conservation during the past decade. These estimates of conservation savings are reviewed in the "Impact Assessment Methodology" section of this chapter.

LADWP's water conservation programs can be grouped into five categories:

- restrictive mandates,
- pricing policies,
- public education programs,
- water-conserving fixtures, and
- system maintenance measures.

These five programs are discussed separately below.

Restrictive Mandates

Restrictive mandates are regulations that limit the ways in which water may be used. Violation of these mandates may result in financial or other types of penalties.

In response to the 1976-1977 drought, LADWP implemented the Emergency Water Conservation Ordinance (LADWP 1991a). The 1977 ordinance, amended in 1978 and reimposed and amended in 1990, contains measures that can be implemented quickly in the event of a water supply shortage.

The ordinance includes basic use requirements that are always in effect, and five increasingly stringent requirements that may be imposed according to the severity of a shortage. Phase 1A (always in effect) prohibits watering lawns between 10:00 a.m. and 5:00 p.m., hosing paved surfaces, offering water unrequested in restaurants, allowing excess water to run off onto sidewalks or into gutters, and operating nonrecycling decorative fountains. Phase 1B requires a 10% reduction in water use but has no monetary penalties. Phases 2, 3, 4, and 5 require 10, 15, 20, and 25% reductions in water use, with increasingly large surcharges with each violation.

The 1988 Water Conservation/Sewer Flow Reduction Ordinance established goals of reducing overall water consumption by 10% in 5 years and 15% in 2000. The ordinance mandates a 10% reduction in water used for irrigation of turf areas in excess of 3 acres and imposes a surcharge that increases over time on customers who violate the 10% reduction. The ordinance also states that no building permit shall be issued to construct any industrial, commercial, or multifamily structure unless the Los Angeles Department of Planning certifies that drought-resistant landscaping will be installed.

Pricing Policies

Pricing policies can be designed to reduce water demand by increasing the cost of water to consumers. Until recently, LADWP's pricing policies were not designed to promote conservation. Meters were installed to allow each customer to be billed for actual usage, but the declining block rate structure of charges that was used until 1977 resulted in little incentive to conserve.

A uniform rate structure was introduced in 1977 on the recommendation of a Blue Ribbon Committee appointed by the Mayor. In 1985, this rate structure was modified to incorporate a higher rate during the summer season (April-September). Initially, the summer rate was made 12.6% higher than the winter rate; by 1990, the summer surcharge had been raised to 25%.

In summer 1991, the Mayor appointed a new Blue Ribbon Committee to review water rates and recommend any needed changes. The committee proposed a new rate structure keyed more to promoting conservation via increasing block pricing. With a few modifications, this rate structure was adopted by the city council and went into effect at the beginning of 1993. For customers in single-family residences, median use is about 350 gallons/account/day. Under the new rate structure, those who use more than 550 gallons/day in winter, or more than 700 gallons/account/day in summer, will pay a higher rate for consumption in excess of these benchmarks. For other customers (multifamily residential, commercial, and industrial), there is a single rate for consumption in winter; in summer, this same rate would apply for consumption up to 125% of winter consumption, but there is a higher rate for consumption beyond this level. The second block rate is the same for all classes of users; it is based on an estimate of LADWP's marginal cost of supplying water and is different in summer and winter, reflecting seasonal differences in marginal cost. The rate for the first block varies among customer classes and is based on the need to meet revenue requirements. For residential users, the first block rate is $753/af, and in summer the second block rate is $1,298/af. In drought years, the same type of structure will still be applied, but the consumption levels at which the second block begins is reduced, depending on the severity of the shortfall. Also, the rate charged in the second block is raised to be equal to the estimated rationing price that equilibrates demand to supply, given the shortfall.

Public Education Programs

Public education programs provide information on the need to conserve, suggest ways to conserve, and describe any incentives that may be offered. In addition to direct financial incentives (or punitive measures) to conserve water, LADWP promotes public awareness of the need to conserve and means for doing so. Programs include general information targeted at the public and school populations, specific information about individual residential customers' consumption levels, and programs targeted to assist commercial, industrial, and governmental users to implement their conservation options.

Water-Conserving Fixtures

Water-conserving fixtures include plumbing hardware that requires less water to perform a particular task than conventional hardware. Since 1977, LADWP has provided retrofit kits to its customers, including door-to-door distribution to homes in the city. Each retrofit kit contains one toilet displacement bag, low-flow shower heads, dye tablets to identify leaks, installation instructions, and conservation information.

The Water Conservation/Sewer Flow Reduction Ordinance enacted in 1988 requires that low-flow shower heads and toilet displacement devices be installed for all LADWP customers. LADWP offers low-interest loans (since 1980) to residential customers for the financing of conservation measures and $100 rebates (since 1990) for replacement of non-ultra-low-flush toilets with ultra-low-flush toilets.

The National Energy Policy Act (PL 102-486), signed into law on October 24, 1992, by former President Bush, establishes standards for the manufacture and labeling of showerheads, toilets, urinals, and faucets. The new plumbing standards are intended to conserve water, while saving energy and money.

Incorporated into the bill were provisions for standards for showerheads and lavatory and kitchen faucets and faucet aerators manufactured after January 1, 1994, at 2.5 gallons per minute at operating pressures of 80 pounds per square inch. Performance standards for noncommercial tank-type toilets, as of January 1, 1994, are 1.6 gallons per flush, and for urinals, 1.0 gallons per flush. Most toilets that are manufactured after January 1, 1997, must meet the 1.6-gallon standard.

LADWP, by offering rebates to those who replace old units with the new ultra-low-flow models, estimates that as of June 1992, 10,000 af/yr have been conserved at a cost of only $300/af (LADWP 1993). LADWP also estimates that the free distribution of low-flow showerheads, toilet displacement bags, and leak-detecting dye has saved a similar amount. According to LADWP, these types of conservation programs offer the best and cheapest way to reduce consumption (LADWP 1993).

System Maintenance Measures

System maintenance measures are actions taken by LADWP to reduce the amount of water that escapes from the system (e.g., leaks) without serving a beneficial use. LADWP preventive measures include lining existing pipelines, instituting a city plumbing code that requires the installation of pressure regulators in new construction, establishing a corrosion protection program, and periodically replacing existing pipelines and meters.

Leak detection alone is estimated to save approximately 1,000 af/yr. No estimates of the savings associated with other system maintenance are available.

Best Management Practices

In addition to the five water conservation programs described above, a statewide California Best Management Practices (BMPs) work group and MWD have identified the effectiveness of different conservation measures. The concept behind BMPs is the creation of an industry standard for the management and use of water resources (Wilkinson 1991). LADWP has signed the memorandum of understanding to implement the BMPs and has begun implementing all the programs identified by the BMP work group. Those BMPs include:

- interior and exterior water audits and incentive programs for single-family residential, multifamily residential, institutional, and governmental customers;
- new and retrofit plumbing (enforcement of requirement for ultra-low-flush toilets in all new construction beginning January 1, 1993, and plumbing retrofit programs for existing homes);
- ultra-low-flush toilet replacement programs;
- distribution system water audits, leak detection, and repair;
- metering with commodity rates for all new connections and retrofit of existing connections;
- large landscape water audits and incentives;
- landscape water conservation requirements for new and existing commercial, industrial, institutional, governmental, and multifamily developments;
- public information;
- school education;
- commercial and industrial water use review;
- elimination of declining block rate pricing structures within customer classifications;
- landscape water conservation for new and existing single-family homes;
- water waste ordinances;
- water conservation coordination; and
- economic incentives.

Water Supply

Supply Sources

The major historical sources of LADWP water supply are groundwater wells in the Los Angeles Basin, imported water from the LA Aqueduct, and MWD. Supplies from each source for 1941 through 1990 are shown in Figure 3L-6. (Reclamation is not included in Figure 3L-6 because it was a small portion of Los Angeles' historical water supply.)

The amount of water obtained from local groundwater has been a relatively stable source of supply during the past 50 years. Water supplies from the LA Aqueduct and MWD have been more variable, depending on the type of water year. During dry years, reductions from Mono Basin and the Owens River basin usually were replaced by water from MWD. During wet years, LADWP typically has limited purchases from MWD because MWD has historically been LADWP's most expensive source of supply.

Groundwater. LADWP currently obtains an average of 112,000 af/yr from local groundwater basins, including the San Fernando Basin (92,300 af/yr), the Sylmar Basin (3,100 af/yr), the Central Basin (15,000 af/yr), and the West Coast Basin (1,500 af/yr). In the last 20 years, groundwater extraction has ranged from 68,600 af/yr to 136,300 af/yr (LADWP 1991a). In wet years, surplus imported water may be spread to recharge groundwater basins. Groundwater consumption increases during drought years when other sources are more limited. In a drought year, LADWP can extract its annual rights, any stored water credits it has accrued, and any additional pumping it requires from stored native waters on an emergency basis. This native water must be paid back in future years.

Los Angeles Aqueduct. LADWP imports water from the Owens River basin and Mono Basin through the LA Aqueduct. Historically, four times as much water comes from the Owens River basin as from Mono Basin (Figure 3L-7). The 1970 expansion of the aqueduct allowed for an average export of 450,000 af of water to Los Angeles annually. Recent legal challenges have led LADWP to project that future average long-term extraction rates will not exceed 380,000 af/yr.

Owens River basin surface waters are the first to be exported through the aqueduct because of their high quality and lower costs compared to Mono Basin waters (LADWP 1991a). Mono Basin water is exported on a second priority basis; Owens River basin surface waters are sufficient to fill the aqueduct to capacity only in very wet years.

Owens River basin groundwater extraction for export has been the source of substantial controversy. During dry years, Owens River basin groundwater is extracted when necessary to fill the aqueduct. In wet years, surplus surface waters are spread to recharge Owens River basin groundwater. The recently completed Inyo/Owens groundwater pumping agreement prevents additional water from being diverted from current irrigation practices in the Owens River basin in Inyo County. The agreement limits long-term average groundwater pumping to 110,000 af/yr and the annual maximum pumping to approximately 200,000 af/yr.

Metropolitan Water District. LADWP supplements its own local and imported water supplies with water purchases from MWD, which presently serves 27 member agencies. Between 1970 and 1990, LADWP relied on MWD for an average of 78,550 af/yr, or 13% of LADWP's total water supply. LADWP has purchased greater amounts of water from MWD during periods of drought than in normal water years, including a fourfold increase from 25,215 af in fiscal year 1975-1976 to 104,798 af in fiscal year 1976-1977. The fourth consecutive year of drought and the court-imposed halt to LADWP diversions from Mono Basin necessitated purchase by LADWP of approximately 385,000 af of water, or 55% of the city's total water supply, from MWD in fiscal year 1989-1990 (Figure 3L-6). LADWP has continued its high levels of demand from MWD in 1990-1991 and 1991-1992.

Preferential rights to MWD water are allocated to each member agency based on the ratio of the taxes each pays to MWD divided by the total cumulative taxes paid to MWD by all 27 member agencies (LADWP 1991a, Gleason pers. comm.). LADWP's current entitlement to MWD is 26% of the total supply, which represents a decline from 35% in 1970. However, the total amount of water available annually from MWD has increased over the same period from 1,145,000 af to 2,456,250 because of MWD's increased supplies. Thus, LADWP's preferential right has actually increased nearly 60% between 1970 and 1985. There may be practical and political constraints on the extent to which LADWP could take its full entitlement from MWD. LADWP may not want to become more dependent on MWD or to arouse hostility from other MWD members who have access to fewer alternative sources of water than LADWP and believe that their own access to MWD supply is in jeopardy.

MWD's primary sources of water include the Colorado River and the State Water Project (SWP) (Figure 3L-8). In 1964, the U.S. Supreme Court reduced MWD's firm apportionment of Colorado River water to 550,000 af. However, for several years, MWD has been receiving approximately 1.3 million af/yr of Colorado River water, including surplus water, unused California agricultural water, and unused Arizona and Nevada water.

SWP is funded by and serves 30 separate water agencies. MWD's annual contracted entitlement is for 2.01 million af of water, or nearly 50% of the 4.23 million af/yr total project commitments. Presently, the firm yield of the project is about 2.4 million af/yr. Firm yield is the minimum amount of water expected to be available during a repeat of the 7-year dry period that occurred from 1928 to 1934 in California. In most years, the project can deliver about 3-3.5 million af/yr; entitlement requests are now more than 3.7 million af/yr. Unless new SWP facilities are constructed, firm yield will decline over time because of upstream depletions and changes in instream use requirements and water quality standards.

Between 1971 and 1990, SWP delivered an average of 467,000 af/yr of water to MWD, or 31.3% of MWD's water supply, with the balance supplied by the Colorado River.

In the 1989-1990 fiscal year, SWP supply to MWD reached a peak of 1,300,000 af, or 52% of MWD's supply.

Reclamation. Water reclamation consists of the treatment of municipal wastewater and its reuse for irrigation, industrial, and other nonpotable uses. Water reclamation represents the largest, most secure source of new water available to LADWP.

LADWP currently obtains 1,000 af/yr through reuse of reclaimed wastewater for irrigation of parks, golf courses, and other greenbelts. The City of Los Angeles' water reclamation goal has been set at 255,000 af by 2010, which would require treatment of 39% of LADWP's estimated total effluent.

Water System Operations

Operation of the LADWP system is designed to minimize the amount of water purchased from MWD because MWD water is more costly than the city's own sources. LADWP generally utilizes maximum amounts of water from the LA Aqueduct and wells as its primary supplies and purchases MWD water only to supplement these supplies.

LADWP purchases most of the water supplied by MWD during winter, when rates are most favorable. Typically, some MWD water is spread to recharge the San Fernando Basin. LADWP attempts to pump its maximum allocation of groundwater and import the maximum amount of aqueduct water during the 5 summer months when MWD water is most expensive. Pumping capacity limitations in the Central and West Basins require that some pumping occur in winter (Adams pers. comm.).

Use of the San Fernando Basin is affected by pumping capacity, which varies as new wells are drilled and older wells are retired because of contamination or low productivity. Maximum storage levels in the basin are limited by the need to keep the water table below a level at which it could adversely affect surface facilities or become contaminated. A minimum water level is required for effective pumping and to prevent seawater intrusion and other problems. Natural recharge and other parties' use of the basin for storage also affect groundwater levels in the basin (Adams pers. comm.).

Projected Supply and Demand

This section summarizes the City of Los Angeles' projected water demand and supply conditions from 1990 through 2010 as reported in LADWP's UWMP (LADWP 1991a). The UWMP projections are used as the starting point for the water supply impact analysis. In the "Impact Assessment Methods" section that follows, revisions to the UWMP supply and demand projections are identified to reflect new information available since the UWMP was published.

Projected Water Demand

The city's water demand is projected to increase 9% from 1990 to 2010 (Figure 3L-9). Total forecasted demand in each year is based on an estimate of future per capita water use multiplied by future population. The estimates of per capita water use incorporate the effects of water conservation, increasing population density; commercial, industrial, governmental growth; and pricing. The estimates do not include the effects of new conservation programs not yet implemented.

The demand estimates shown in Figure 3L-9 are based on normal weather conditions. The actual water use in any one year may vary from the projected use due to the effects of weather.

Projected Water Supply

As described previously, LADWP historically has had three main supplies of water: local groundwater; Mono and Owens Basin water delivered via the LA Aqueduct; and MWD water, which primarily comes from the Colorado River Aqueduct and the SWP. Two additional sources, reclaimed water and savings from conservation and demand management programs, will become increasingly important to LADWP over the next 20 years. (Conservation and demand management programs are usually included as reductions in LADWP's demand rather than increases in supply.)

Table 3L-2 shows the historical yield from 1971 to 1990 of each of LADWP's water supply sources. Figure 3L-10 illustrates the quantity of water from each source that LADWP expects to use to meet future demand. Both projections are based on average-year weather conditions.

Groundwater Pumping

LADWP estimates that it can increase its average groundwater yield from existing levels of 112,000 af/yr up to 132,000 af/yr by 2010. LADWP's average groundwater yield will increase by 20,000 af/yr between 1990 and 2010 because of credit given for imported water used in the San Fernando Valley and returned by natural percolation to the San Fernando Basin.

As of October 1, 1991, LADWP had a credit of 185,239 af stored in the San Fernando basin. The Cities of Burbank and Glendale had credits of 48,859 af and 32,569 af, respectively (Upper Los Angeles River Area Watermaster 1992). Currently, the San Fernando basin has approximately 250,000 af of available storage space. LADWP may also be able to use the San Fernando Valley basin to recycle reclaimed water provided that the state and federal approvals are received.

Water extractions from the San Fernando Basin are managed on a safe-yield basis in which the long-term average extractions equal the average amount of water that enters the basin each year through three sources: percolation of natural precipitation and runoff, percolation of imported waters used for irrigation, and spreading of native and imported waters. The additional 20,000 af/yr available to LADWP by 2010 will result from percolation of increased amounts of imported water used for irrigation in the San Fernando Valley.

In drought years, the Upper Los Angeles River Area Watermaster may declare an emergency and allow additional pumping up to 170,000 af from stored native waters, which must be paid back in future years. The San Fernando Valley basin adds great flexibility to LADWP's operations.

MWD supports projects that offset a demand for imported water by way of a rebate program. MWD provides a rebate of $250/af for projects that increase or restore groundwater production under this program (Los Angeles Office of Water Reclamation 1992a).

Los Angeles Aqueduct

LADWP (1991a) projects that the aqueduct will continue to supply 380,000 af/yr from 1990 through 2010, assuming average weather conditions. This consists of 326,000 af of surface and groundwater from the Owens River Valley and 54,000 af from Mono Basin. The estimate from Mono Basin is based on current streamflow releases required by the court order in February 1990. The actual amount of Mono Basin surface water available to LADWP may be higher or lower, depending on the SWRCB's final decision on streamflows (LADWP 1991a).

Metropolitan Water District

LADWP (1991a) predicts that MWD will be the primary source of future additional supplies for Los Angeles. LADWP plans to use approximately one-third of its total MWD entitlement during the next 20 years. LADWP has estimated that its request for MWD water will increase from 196,900 af in 1990 to 211,700 af by 2010, assuming normal weather conditions. (LADWP's actual 1990 demand for MWD equaled 385,000 af due to the drought.) LADWP's demand for MWD water is considerably less than its entitlement to MWD water, which was over 639,000 af in 1990 but is projected to drop to about 601,500 af by 2010.

Although MWD is attempting to expand its water supplies, LADWP has indicated that it does not plan to rely solely on MWD to balance supply with demand. Assuming average rainfall, MWD projects a shortage in supplying all its members of 80,000 af/yr in 1995 (2.0%), increasing to 740,000 af/yr by 2010 (15.9%). Under above-average demand and/or lower than normal rainfall conditions, MWD's supply shortfall would be even larger (LADWP 1991a).

Although MWD water currently represents one of LADWP's least expensive sources of new water, LADWP has decided to develop its own presently more expensive resources because of MWD's supply uncertainty.

Reclamation/Recycling

Treated wastewater is a secure future supply. According to an LADWP report, "As long as people live and shower and eat in Los Angeles, there will be sewage" (LADWP 1993). Recycled water can be used for all types of greenbelt irrigation and other nonpotable and potable uses.

Many southern California water agencies are concerned about the future of imported water supplies and are pursuing recycled water projects because of its dependable supply. Los Angeles County recycles 12% of the effluent at the county-operated wastewater treatment plants. At the end of 1991, Los Angeles County recycled 68,645 af/yr and is planning new projects that may double that figure within the next few years. Los Angeles County uses most of its reclaimed water (69%) for groundwater recharge, 15% for landscaping, 7% for agriculture, and 6% for industrial uses. (Los Angeles Office of Water Reclamation 1991.)

Some examples of new projects in various stages of planning are the following (Los Angeles Office of Water Reclamation 1991):

- **Century Reclamation Project.** The Central Basin Municipal Water District is the lead agency in developing a 5,500-af/yr regional reclaimed water distribution system to serve the Cities of Bellflower, Compton, Downey, Lynwood, Norwalk, Paramount, Santa Fe Springs, and South Gate.

- **Upper San Gabriel Valley Municipal Water District.** This water agency is planning a 4- to 5-mile-long pipeline to deliver 25,000-40,000 af/yr of reclaimed water for both groundwater recharge and direct reuse.

- **Rio Hondo Reclamation Project.** A regional distribution system to deliver 5,000-10,000 af/yr of reclaimed water to the Cities of Montebello, Pico Rivera, Commerce, Vernon, and Whittier.

- **Central and West Basin Water Replenishment District.** This agency is evaluating the feasibility of constructing a reverse osmosis facility to allow for an additional 25,000-50,000 af/yr of reclaimed water to be used for groundwater recharge.

MWD has supported water reclamation through its "Local Projects Program" (LPP). MWD provides a rebate of $154/af of reclaimed water produced under the LPP. MWD determines financial need by comparing a facility's projected costs to its projected water rates for a noninterruptible supply of treated water. A program will receive the LPP rebate until its projected unit costs are less than MWD water rates, up to a maximum of 25 years

(Los Angeles Office of Water Reclamation 1992a). This program is similar to MWD's rebate program for groundwater supplies.

Several reclamation projects are included in LADWP's 20-year water supply forecast. Several other reclamation projects have been identified that are not part of LADWP's projected 20-year supply. These include projects that would not be operational until after 2010 and additional projects identified by the Los Angeles Office of Water Reclamation (1990). The individual reclamation projects included in LADWP's 20-year forecast are listed in the "Impact Assessment Methodology" section that follows.

The use of reclaimed water is constrained by public acceptability and government regulation. California Department of Health Services has stated that proposals for new reclaimed water spreading projects would have to be evaluated on a case-by-case basis (LADWP 1991a).

IMPACT ASSESSMENT METHODOLOGY

Changes in water exports from Mono Basin to Los Angeles will affect how LADWP meets the future demands of its customers. The water supply impact analysis focuses on predicting possible effects of the diversion alternatives on LADWP, its customers, and others in the region.

This section describes the methods used to predict impacts of the alternatives and to assess the significance of these impacts. Direct, indirect, and cumulative impacts of the diversion alternatives are considered.

Impact Prediction Methodology

For this analysis, direct impacts are defined as predicted changes in the supply of water delivered to LADWP via the LA Aqueduct. Indirect impacts are defined as effects on other water users potentially affected by changes in LADWP's use of Mono Basin water supplies. These impacts focus on potential changes in LADWP's demand for regional water supplies provided by the MWD.

Direct and indirect impacts were examined under three scenarios: a near-term (20-year) analysis, a drought analysis, and a long-term analysis. For the near-term analysis, predicted changes in water deliveries were estimated from results of the LA Aqueduct Monthly Program (LAAMP) over a 20-year projection period (1992-2011). This projection period was constructed by randomly selecting 20 years out of the 50-year historical hydrological record; the number of dry, normal, and wet years was selected proportionate to their percentage of occurrences in the 50-year period. Monthly projections of water delivered from Haiwee Reservoir to the LA Aqueduct were used to construct annual projections over the 20-year period for point-of-reference conditions and the seven EIR alternatives.

The drought analysis was used as a sensitivity analysis of the near-term effects. For each alternative, adjustments were made to the supply assumptions. The effects of having twice as many dry years in the 20-year period were evaluated. The results of the drought analysis are evaluated relative to the near-term impacts of each alternative.

In addition to the near-term and drought analysis, long-term impacts also were analyzed. For three alternatives (6,383.5-ft, 6,390-ft, and 6,410-ft), projected Mono Lake levels do not reach their targets in the first 20 years. For each of these three alternatives, the average exports to LADWP during the period in which equilibrium lake level is reached are compared to the average exports in the near-term analysis.

Cumulative water supply impacts also were analyzed. The cumulative analysis examined the potential loss of Mono Basin supplies with other projects and regulatory changes that could affect LADWP and MWD water supplies.

Criteria for Determining Impact Significance

This section describes the criteria and the thresholds that were used to assess the significance of direct, indirect, and cumulative impacts predicted for the alternatives.

Direct Impacts

The criteria used to assess the significance of predicted changes in water deliveries to LADWP from the LA Aqueduct (direct impacts) include predicted changes in the water supply costs to meet projected demands and predicted occurrences of substantial supply shortfalls (shortages).

A water supply simulation model that balances annual supply and demand conditions was developed to provide the data needed to apply the criteria related to costs and water shortages. This simulation model was used for both the near-term and drought analyses. Figure 3L-11 illustrates the concept behind the water supply model. It shows water demand in the LADWP service area for the next 20 years and hypothetical supply sources representing point-of-reference conditions. Water supply sources are brought online as needed to meet increasing demand.

For each of the seven EIR alternatives, the amount of water available to LADWP from the LA Aqueduct will differ from that available under point-of-reference conditions. In Figure 3L-11, arrows show this shift in the current supply sources. A downward shift may indicate a shortage if enough resources are not available to meet demand. If LADWP does not have enough of its own resources to meet demand in any year, purchases of more expensive resources may be necessary. Conversely, an upward shift in the current supply sources may indicate a water surplus, reducing LADWP's demand for purchases from third parties. The simulation model estimates the cost of LADWP's water supplies for each alternative, including point-of-reference conditions.

The primary components of the model are demand projections, available supplies and associated costs, and the procedures for balancing annual supply with demand. These three model components are described below.

Demand Projections. Two different forecasts of future LADWP water demand are LADWP's projections, which are included in its UWMP (LADWP 1990); and MWD projections of the entire MWD service area (Planning and Management Consultants 1990). The MWD forecast breaks out the LADWP service area as one of its geographical subareas. These two forecasts are shown in Figure 3L-12.

An extensive analysis was performed of the assumptions that underlie both forecasts (Hanemann 1992). Based on this analysis, the LADWP UWMP forecast is considered to represent the best estimate of LADWP's future demand.

In the LADWP forecast, water use is projected to grow from 697,000 af in 1992 to 759,000 af in 2011, an increase of 9%. During the same period, the population served by LADWP is expected to rise by 30%.? The demand projections are based on historical average temperatures and incorporate the effects of water conservation, population density, commercial and industrial growth, pricing, and other miscellaneous factors that affect water use (LADWP 1991a). These demand projections remain constant for all near-term modeling scenarios, including point-of-reference conditions.

Supply Projections. Supply sources in the model include LADWP's three major historical sources and a fourth source, water reclamation, that will become increasingly important in the future. The historical sources are Mono Basin and Owens River basin water delivered through the LA Aqueduct; local wells that draw from the San Fernando, Sylmar, Central, and West Coast basins; and MWD water, which primarily comes from the Colorado River Aqueduct and the SWP. In the analysis that follows, resource costs refer to the total cost from these sources.

Mono Basin and Owens River Basin. The amount of water that would be available to LADWP from Mono Basin and the Owens River basin for each EIR alternative and the point-of-reference conditions was determined using the LAAMP. The 20 years of aqueduct water supply projected for each alternative were based on a random selection of years from the 50-year historical hydrological record (1940-1989). The near-term 20-year analysis contains 12 average water years, 4 dry years, and 4 wet years.

The drought analysis was performed by using 4 additional dry water years to replace 2 average and 2 wet years. For each alternative, the water available in the 4 additional dry years was based on the average amount available from the existing 4 dry years included in the near-term analysis. Consequently, the drought analysis assumes 8 dry years, 4 wet years, and 8 average water years. Also, the 8 dry years are assumed to occur during the first 8 years of the analysis.

The costs associated with obtaining water from the LA Aqueduct were obtained from LADWP's UWMP. Water costs from the aqueduct consist primarily of fixed costs ($48 million/year) associated with debt payments and maintenance activities. A variable cost of $20/af also is included in the analysis to account for filtration costs (LADWP 1991a). The average annual cost of aqueduct water delivered fluctuates in part because of the large percentage of fixed costs associated with the aqueduct.

Groundwater. Groundwater availability to LADWP is based on information included in LADWP's UWMP and data supplied by the City of Los Angeles' Watermaster for the Upper Los Angeles Water Basin (Blevins pers. comm.).

Figure 3L-13 shows the maximum amount of groundwater available to LADWP between 1992 and 2011. Groundwater availability is estimated to increase from 112,000 af in 1992 to as much as 134,000 af by 2011. This increase in groundwater availability over the next 20 years is due to expected increases in the amount of water delivered to the San Fernando Valley for municipal uses and eventually returned by natural percolation to the San Fernando Basin (LADWP 1991a). LADWP currently has 185,000 af of stored water credits available for use in the future (Blevins pers. comm.). This credit is assumed to remain constant for each alternative.

Based on information in the UWMP, groundwater is assumed to cost $90/af without treatment (LADWP 1991a); this cost includes the rebate obtained from participating in MWD's groundwater program. Treatment costs are expected to add $53/af in 1992, increasing to $246/af by 2011 (Porter pers. comm.). Treatment costs for intermediate years were derived by interpolation.

Metropolitan Water District. The availability and cost of water from MWD are based on information included in LADWP's UWMP, data supplied by the City of Los Angeles' Watermaster for the Upper Los Angeles Water Basin (Blevins pers. comm.), newsletters published by the Los Angeles Office of Water Reclamation, and personal contacts with MWD.

Figure 3L-14 shows, for 1992 through 2011, the maximum amount of MWD water that LADWP would use, assuming maximum demand associated with drought conditions. LADWP's demand for MWD water would range from 280,000 to 300,000 af during the 20-year period. These estimates represent the upper limit of MWD water assumed to be available to LADWP, although LADWP's preferential rights to MWD water exceed this amount (see page 3L-9). The maximum amount of MWD water available to LADWP shown in Figure 3L-14 is assumed to remain the same for each alternative.

Costs for treated MWD water are expected to increase from $322/af in 1992 to $680/af in 2000 and reach $800/af by 2010 (Porter pers. comm.).

Reclamation Water. The expected amount of water available from different reclamation projects was identified from several sources (including the UWMP), documents published by the Los Angeles Office of Water Reclamation (such as WR News, the newsletter of the Los Angeles Office of Water Reclamation), and feasibility reports and environmental impact reports published for individual reclamation projects.

Figure 3L-15 shows the reclamation water available to LADWP between 1992 and 2011, based on a review of the sources cited above. Water available from reclamation projects will increase from 4,900 af in 1992 to 119,000 af by 2011. These estimates are much lower than the City of Los Angeles' 2010 water reclamation goal of 255,000 af. The cumulative predicted reclamation yield depicted in Figure 3L-16 is based on the projects identified in Table 3L-3. They consist of 21 separate projects ranging in size from 100 af to 35,000 af/yr. The costs of these projects, which range from $346 to $620/af (1992 dollars), were used in the analysis.

Balancing Procedures. Figure 3L-16 illustrates the procedures followed to estimate the costs to replace water supplies from Mono Lake. The model sequentially steps through each year of the 20-year analysis period. For each year, the model attempts to equate supply and demand.

The model uses a three-step procedure to equate supply and demand. The first step focuses on determining the availability of base resources, which include resources owned by LADWP and those that LADWP proposes to acquire over the next 20 years. These include LA Aqueduct water, groundwater, and reclamation projects. Nonbase resources are either not owned by LADWP or are not included in LADWP's 1991-2010 supply projections (primarily MWD water).

Base resources are selected in the order of least cost. After each resource is selected, cumulative resource costs are calculated and total resource supply is compared to demand. If the total supply equals or exceeds demand, the model adds any surplus from the marginal supply source to the future-year groundwater credit before it moves to the next year. After all years have been completed, total costs are summed and the modeling results are calculated.

The model moves to step two if total annual supply is less than total demand after all base resources have been selected. In step two, the model examines whether any groundwater credits are available. (These credits differ from LADWP's annual right to a specific amount of groundwater because LADWP is allowed to store surplus water in the ground as credits that can be extracted in future years.) If groundwater credit is available for pumping, then groundwater is pumped until supply equals demand or until the credit limit is reached. The model does not allow a negative credit; that is, LADWP is not allowed to pump more than the credit amount. Once the groundwater credit is used up, no additional groundwater can be pumped. After groundwater is pumped, the credit amount is adjusted and the costs of groundwater pumping are estimated.

If supply equals demand after pumping, total costs are estimated, the credit limit is adjusted to account for the credit usage, and the model moves to the next year. If a supply shortfall still exists, the model moves to step three.

In the third step, nonbase resources are selected in the order of least cost until supply equals demand. Also, the model assumes that nonbase resources are not used to increase the groundwater credit. Nonbase resources are primarily supplied from MWD but also include up to 6,000 af/yr of water that is currently diverted for irrigation from the Upper Owens River and its tributaries under LADWP leases. (The 6,000 af/yr of irrigation water from the Upper Owens River was included for modeling purposes; LADWP must decide on a year-to-year basis how to use this supply.) After each nonbase resource is selected, total supply costs are estimated.

If a supply shortfall still exists after all nonbase resources are selected, the model estimates the costs of that shortfall, using the shortage costs of LADWP water developed by the Mayor's Blue Ribbon Committee on Water Rates. These costs, which were approved by the committee and its technical panel, are shown in Table 3L-4.

Total shortage costs were calculated by multiplying the marginal cost (in dollars/af) associated with a given percent shortage by the shortage amount (in af/yr). This calculation is repeated for each year in which a shortage occurs. Shortage costs in each year are then summed to give total shortage costs.

For a predicted change in the supply of water delivered to LADWP via the LA Aqueduct (direct impact) to be considered significant, implementation of an alternative must:

- result in a 12% or greater average annual increase in LADWP's resource and shortage costs compared to the point-of-reference condition (the 12% significance threshold was based on LADWP's average increase in operating expenses [including depreciation] between 1981 and 1990) (LADWP 1991b.)
- cause a supply shortfall to occur more often (greater number of years) than under the point-of-reference condition and have LADWP demand exceed supply by more than 10% in any of those years (the 10% shortage is based on the level at which shortage costs would be implemented by LADWP under the recommendation by the Mayor's Blue Ribbon Committee on Water Rates).

Indirect Impacts

Indirect impacts are potential effects on other water users resulting from changes in diversions from Mono Basin. The change in LADWP's demand on projected MWD supplies is used as an indicator for evaluating these effects.

The criteria used to assess the significance of predicted increases in demand on MWD supplies are predicted percent changes in the amount of MWD water used by LADWP. Results of the water supply simulations for assessing direct impacts were used in conjunction with data from MWD's UWMP to estimate these changes. MWD's projections in the UWMP incorporate anticipated reductions associated with reduced deliveries of Colorado River water resulting from completion of the Central Arizona Project.

For a predicted effect on MWD and its member agencies in the region (indirect impact) to be considered significant, implementation of an alternative must cause:

- an increase in demand for MWD water that exceeds LADWP's 19-year (1971-1989) weighted average share of MWD supplies (5.1%).

Cumulative Impacts

Both direct and indirect cumulative impacts were evaluated. Direct cumulative impacts are those that would result from all potential changes in LADWP's supplies. For direct cumulative impacts of an alternative to be considered significant, implementation of the alternative must cause:

- LADWP's cumulative water supply to be lower than the total supply predicted for that Mono Basin diversion alternative.

Indirect cumulative impacts are those that would result from cumulative effects on MWD caused by changes in LADWP's Mono Basin supplies combined with changes in MWD water supplies from other sources. The combined changes in LADWP's demand on projected MWD supplies, plus potential changes in MWD's sources of supply, are used as an indicator for evaluating indirect cumulative impacts. For indirect cumulative impacts of an alternative to be considered significant, implementation of the alternative must cause:

- an increase in LADWP's demand for MWD water, when combined with reductions in MWD's supply to exceed LADWP's historical 19-year (1971-1989) weighted share of MWD supplies (5.1%).

The criteria used to assess the cumulative significance of predicted increases in LADWP's demand on MWD supplies are predicted percent changes in the amount of MWD water used by LADWP after adjustments were made to account for cumulative changes in MWD supplies. For a predicted effect on MWD and its member agencies in the region (cumulative impact) to be considered significant, implementation of an alternative must cause:

- an increase in LADWP's demand for MWD water and/or a decrease in MWD's supply that resulted in LADWP's average annual demand (1992-2011) for MWD water to exceed LADWP's historical 19-year (1971-1989) weighted share of MWD supplies (5.1%).

SUMMARY COMPARISON OF IMPACTS AND BENEFITS OF THE ALTERNATIVES

As described in the "Impact Assessment Methodology" section, relative water supply effects of the alternatives are assessed in this chapter through several key variables:

- average annual availability of LA Aqueduct water,
- percentage increases in resource acquisition and shortage costs,
- occurrence of water supply shortages, and
- percentage change in demand for MWD supplies.

Table 3L-5 provides a summary comparison of each alternative using these variables. Values of the variables for each alternative are compared to values for the point-of-reference condition. Those values representing significant adverse changes from the point-of-reference condition are indicated with an asterisk. A discussion of these variables for each alternative is provided in the following sections of this chapter.

CHARACTERIZATION OF POINT-OF-REFERENCE CONDITIONS

The point of reference is the base condition to which all seven water supply alternatives are compared. The point-of-reference condition differs from conditions under the seven alternatives in the amount of water that flows through the LA Aqueduct for use by LADWP.

Figure 3L-17 shows the average annual amount of water available to LADWP from the LA Aqueduct under point-of-reference conditions. Dry water years represented by low levels of water deliveries from the aqueduct occur in 2000 and during the last 3 years of the 20-year scenario.

Point-of-reference results show that 442,000 af/yr would be available from the LA Aqueduct, averaged over the 20-year period (Table 3L-5). Average annual resource costs would equal $174.8 million per year in 1992 dollars. These costs include expenditures for LA Aqueduct water, groundwater pumping, reclamation projects, and MWD water purchases. No supply shortages are predicted to occur under point-of-reference conditions.

The following analysis examines the water supply impacts of each alternative compared to point-of-reference conditions.

IMPACTS AND MITIGATION MEASURES FOR THE NO-RESTRICTION ALTERNATIVE

Changes in Water Supply Conditions

Near-Term Effects

Direct Impacts. Under the No-Restriction Alternative, LADWP would continue to divert water based on its historical record of diversions. The amount of aqueduct water that would be available under the No-Restriction Alternative varies from year to year, both in absolute terms and compared to point-of-reference conditions (Figure 3L-18). The No-Restriction Alternative would provide LADWP with an average increase of 7,700 af/yr compared to point-of-reference conditions (Table 3L-5). This increase in water deliveries from the LA Aqueduct would result in a reduced demand on other sources of water, primarily water purchased from MWD.

The No-Restriction Alternative would reduce resource costs over the 20-year period by 3% per year and would not result in any supply shortages (Table 3L-5). The No-Restriction Alternative would have a beneficial water supply impact on LADWP compared to point-of-reference conditions.

Indirect Impacts. Under the No-Restriction Alternative, LADWP would require 2.3% of projected MWD supplies compared to 2.6% under point-of-reference conditions. This alternative would have a beneficial impact on MWD and member agencies.

Long-Term Effects

No change from short-term conditions would occur.

Drought Effects

The drought scenario, which consists of 8 dry hydrologic years over the 20-year projection period instead of 4 years, would reduce LA Aqueduct water deliveries by an average of 34,000 af/yr compared to representative conditions (Table 3L-5).

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (No-Restriction Alternative)

- Provides an additional 7,700 af of water per year to LADWP, resulting in 3% lower total cost (direct benefit to LADWP).
- Reduces LADWP's share of projected MWD supplies from 2.6% to 2.3% (indirect benefit to MWD and its member agencies).

IMPACTS AND MITIGATION MEASURES FOR THE 6,372-FT ALTERNATIVE

Changes in Water Supply Conditions

Near-Term Effects

Direct Impacts. Figure 3L-18 shows the amount of aqueduct water available to LADWP under the 6,372-Ft Alternative. The 6,372-Ft Alternative would decrease water available to LADWP by an average of 16,900 af/yr compared to point-of-reference conditions (Table 3L-5). This decrease in water deliveries from the LA Aqueduct would result in a supply increase primarily from additional MWD purchases (90% of replacement supplies would be from MWD).

The decreased availability of LA Aqueduct supplies would increase resource costs by 6% compared to point-of-reference conditions (Table 3L-5) but would not result in water supply shortages. Based on the significance criteria, the 6,372-Ft Alternative would not have a significant adverse impact on LADWP or its customers.

Indirect Impacts. Under the 6,372-Ft Alternative, LADWP would require an average of 3.1% per year of projected MWD supplies over the 20-year period compared to 2.6% under point-of-reference conditions. Because this share is less than its historical share of 5.1%, this impact is considered less than significant.

Long-Term Effects

No change from short-term conditions would occur.

Drought Effects

The drought scenario would reduce LA Aqueduct water deliveries by an average of 32,900 af compared to representative conditions (Table 3L-5).

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures
(6,372-Ft Alternative)

No benefits or significant impacts would result from implementation of this alternative.

IMPACTS AND MITIGATION MEASURES FOR THE 6,377-FT ALTERNATIVE

Changes in Water Supply Conditions

Near-Term Effects

Direct Impacts. Figure 3L-18 shows the amount of aqueduct water available under the 6,377-Ft Alternative. The 6,377-Ft Alternative would reduce deliveries to LADWP by an average of 28,100 af/yr compared to point-of-reference conditions (Table 3L-5). This decrease in water deliveries from the LA Aqueduct would result in a supply increase primarily from MWD purchases (94% of replacement supplies would be from MWD).

This additional decrease in water availability of LA Aqueduct supplies would increase resource costs by 9% but would not result in water supply shortages (Table 3L-5). Based on the significance criteria, the 6,377-Ft Alternative would not have a significant adverse impact on LADWP or its customers.

Indirect Impacts. Under the 6,377-Ft Alternative, LADWP would require an average of 3.4% of MWD supplies over the next 20 years compared to point-of-reference conditions. Because this share is less than its historical share of 5.1%, this impact is considered less than significant.

Long-Term Effects

No change from short-term effects would occur.

Drought Effects

The drought scenario would reduce LA Aqueduct water deliveries by an average of 38,000 af/yr compared to representative conditions (Table 3L-5).

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures
(6,377-Ft Alternative)

No benefits or significant impacts would result from implementation of this alternative.

IMPACTS AND MITIGATION MEASURES FOR THE 6,383.5-FT ALTERNATIVE

Changes in Water Supply Conditions

Near-Term Effects

Direct Impacts. Figure 3L-18 shows the amount of aqueduct water available under the 6,383.5-Ft Alternative compared to point-of-reference conditions. The 6,383.5-Ft Alternative would reduce deliveries to LADWP by an average of 42,000 af/yr (Table 3L-5). This decrease in water deliveries from the LA Aqueduct would result in a supply increase primarily from additional MWD purchases (95% of replacement supplies would be from MWD).

This decrease in availability of LA Aqueduct supplies would increase resource costs by an estimated 14% (Table 3L-5). This alternative would also result in a water supply shortage of 4% during 1 year of the 20-year period. Total resource and shortage costs of this alternative are 15% higher than for the point-of-reference condition (Table 3L-5). Based on the significance criteria, the 6,383.5-Ft Alternative would have a significant adverse impact on LADWP and its customers.

Indirect Impacts. Under the 6,383.5-Ft Alternative, LADWP would require an average of 3.8% of MWD's projected supplies over the 20-year period. Because this share is less than LADWP's historical share of 5.1%, this impact is considered less than significant.

Long-Term Effects

Average LA Aqueduct exports equal 408,000 af/yr compared to 400,000 af/yr over the near term (Table 3L-5).

Drought Effects

The drought scenarios would reduce LA Aqueduct water deliveries by 39,100 af/yr compared to representative conditions (Table 3L-5).

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (6,383.5-Ft Alternative)

- Reduces LADWP supplies by 42,000 af/yr, increasing LADWP's resource and shortage costs by 15% (a significant adverse impact on LADWP and its customers).

Mitigation Measures

The following mitigation measures could be implemented for the 6,383.5-Ft Alternative and all higher lake level alternatives.

- LADWP and the MLC should jointly apply for the remaining $48 million in Assembly Bill 444 funds that are available for developing Mono Lake replacement supplies. This funding could be used to offset the costs that LADWP would incur to develop additional water reclamation projects.
- HR 429 (Bradley & Miller), which was signed in fall 1992 by former President Bush, authorizes two elements that would assist LADWP in offsetting Mono Basin water reductions. Those elements are:
    - developing 120,000 af/yr of reclaimed water in southern California specifically designated to replace water diverted from Mono Basin (projects have been authorized, but monies have not yet been appropriated) and
    - authorizing water transfers from agricultural users to urban water districts, such as LADWP.
- LADWP should participate to the maximum degree possible in the MWD rebate programs (LPP and groundwater recovery).

- LADWP could pursue other state and federal funding sources to assist in its efforts to gain the capital financing necessary for developing water reclamation projects to meet its water reuse goals of:
  - 250,000 af/yr in 2010,
  - 600,000 af/yr in 2050, and
  - 800,000 af/yr in 2090.
- LADWP should continue to develop demand-side reductions from its water conservation program and implement and monitor compliance with all BMPs identified in the UWMP.
- LADWP could assess the feasibility of future projects that conserve additional amounts of local stormwater runoff.

If LADWP fully participates in the programs described above, it is likely that the water supply impacts could be reduced to a less-than-significant level.

IMPACTS AND MITIGATION MEASURES FOR THE 6,390-FT ALTERNATIVE

Changes in Water Supply Conditions

Near-Term Effects

Direct Impacts. Figure 3L-18 shows the amount of aqueduct water available under the 6,390-Ft Alternative compared to point-of-reference conditions. The 6,390-Ft Alternative would reduce deliveries to LADWP by an average of 47,300 af/yr (Table 3L-5). This decrease in water deliveries from the LA Aqueduct would result in a supply increase primarily from additional MWD purchases (92% of replacement supplies would be from MWD).

This decrease in availability of LA Aqueduct supplies would increase resource costs by an estimated 16% compared to point-of-reference conditions (Table 3L-5). This alternative also would result in a water supply shortage of 4% during 1 year of the 20-year period. Total resource and shortage costs of this alternative are 17% higher than costs under point-of-reference conditions (Table 3L-5). Based on the significance criteria, the 6,390-Ft Alternative would have a significant adverse impact on LADWP and its customers.

Indirect Impacts. Under the 6,390-Ft Alternative, LADWP would require an average of 3.9% of MWD's projected supplies over the 20-year period. Because this share is less than LADWP's historical average share of 5.1%, this impact is considered less than significant.

Long-Term Effects

Average LA Aqueduct exports equal 404,300 af/yr compared to 394,700 af/yr over the near term (Table 3L-5).

Drought Effects

The drought scenario would reduce LA Aqueduct water deliveries by 38,300 af/yr compared to representative conditions (Table 3L-5).

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures
(6,390-Ft Alternative)

- Reduces LADWP's supplies by 47,300 af/yr, increasing LADWP's resource and shortage costs by 17% (a significant adverse impact on LADWP and its customers).

Mitigation Measures

The mitigation measures for direct impacts of the 6,390-Ft Alternative are identical to those described for the 6,383.5-Ft Alternative. If LADWP fully participates in these mitigation programs, it is likely that the water supply impacts associated with the 6,390-Ft Alternative could be reduced to a less-than-significant level.

IMPACTS AND MITIGATION MEASURES FOR THE 6,410-FT ALTERNATIVE

Changes in Water Supply Conditions

Near-Term Effects

Direct Impacts. Figure 3L-18 shows the amount of aqueduct water available under the 6,410-Ft Alternative compared to point-of-reference conditions. The 6,410-Ft Alternative would reduce deliveries to LADWP by an average of 57,600 af/yr (Table 3L-5). This decrease in water deliveries from the LA Aqueduct would result in a supply increase primarily from MWD (90% of replacement supplies would come from MWD).

This decrease in availability of LA Aqueduct supplies would increase resource costs by an estimated 20% compared to point-of-reference conditions (Table 3L-5). This alternative also would result in a water supply shortage of 5% during 1 year of the 20-year scenario. Total resource and shortage costs of this alternative are 22% higher than costs under point-of-reference conditions (Table 3L-5). Based on the significance criteria, the 6,410-Ft Alternative would have a significant adverse impact on LADWP and its customers.

Indirect Impacts. Under the 6,410-Ft Alternative, LADWP would require an average of 4.2% of MWD's projected supplies over the 20-year period. Because this share is less than LADWP's historical share of 5.1%, this impact is considered less than significant.

Long-Term Effects

For the 6,410-foot lake level, average LA Aqueduct exports equal 393,300 af/yr compared to 384,400 af/yr over the near term (Table 3L-5).

Drought Effects

The drought scenario would reduce LA Aqueduct water deliveries by 37,700 af/yr compared to representative conditions.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures
(6,410-Ft Alternative)

- Reduces LADWP's supplies by 57,600 af/yr, increasing LADWP's resource and shortage costs by 22% (a significant adverse impact on LADWP and its customers).

Mitigation Measures

The mitigation measures for the direct impacts of 6,410-Ft Alternative are identical to those described for the 6,383.5-Ft Alternative. If LADWP fully participates in those mitigation programs, it is likely that the water supply impacts associated with the 6,410-Ft Alternative could be reduced to a less-than-significant level.

IMPACTS AND MITIGATION MEASURES FOR THE NO-DIVERSION ALTERNATIVE

Changes in Water Supply Conditions

Near-Term Effects

Direct Impacts. Figure 3L-18 shows the amount of aqueduct water available under the No-Diversion Alternative compared to point-of-reference conditions. The No-Diversion Alternative would reduce deliveries to LADWP by an average of 66,800 af/yr (Table 3L-5). This decrease in water deliveries from the LA Aqueduct would result in a supply increase primarily from MWD purchases (90% of the replacement supplies would be from MWD).

This decrease in availability of LA Aqueduct supplies would increase resource costs by an estimated 20% compared to point-of-reference conditions (Table 3L-5). This alternative also would result in a water supply shortage of 4% during 1 year of the 20-year scenario. Total resource and shortage costs of this alternative are 25% higher than costs under point-of-reference conditions (Table 3L-5). Based on the significance criteria, the No-Diversion Alternative would have a significant adverse impact on LADWP and its customers.

Indirect Effects. Under the No-Diversion Alternative, LADWP would require an average of 4.5% of MWD's projected supplies over the 20-year period. Because this share is less than LADWP's historical average share of 5.1%, this impact is considered less than significant.

Drought Effects

The drought scenario would reduce LA Aqueduct water deliveries by 34,400 af/yr compared to representative conditions.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures (No-Diversion Alternative)

- Reduces LADWP's supplies by 66,800 af/yr, increasing LADWP's resource and shortage costs by 25% (a significant adverse impact on LADWP and its customers).

Mitigation Measures

The mitigation measures for direct impacts of the No-Diversion Alternative are identical to those described for the 6,383.5-Ft Alternative. If LADWP fully participates in those mitigation programs, it is likely that the water supply impacts associated with the No-Diversion Alternative could be reduced to a less-than-significant level.

CUMULATIVE IMPACTS OF THE ALTERNATIVES

Related Impacts of Earlier Stream Diversions by LADWP

Diversion of Mono Basin and Owens River basin waters to the Los Angeles basin have been ongoing since 1941. Between 1941 and 1970, the LA Aqueduct's limited capacity prevented full appropriation of Mono Basin waters. Completion of the second barrel of the LA Aqueduct in 1970 allowed LADWP to fully divert Mono Basin waters during periods of average runoff. Diversion of Mono Basin and Owens River basin waters has had a beneficial economic effect on LADWP and its ratepayers because it has provided a relatively large, inexpensive source of water.

Related Impacts of Other Past, Present, or Anticipated Projects or Events

Several past, present, and future events may cause direct or indirect cumulative impacts on water supply. These events include:

- the Inyo-Owens Grounding Pumping Agreement;
- future demands for in-basin Mono Basin waters, including development of the Conway Ranch Resort Community, USFS, City of Lee Vining, and the June Lake Public Utility District;
- enactment of the Western Water Bill (HR 429);
- potential changes in exports from the San Joaquin/Sacramento River Delta as a result of modified Bay-Delta water quality standards;
- SWP facilities and programs downstream of the delta; and
- changes in the availability of Colorado River supplies.

The first three items listed above have the potential to directly affect supply sources controlled by LADWP. The Inyo-Owens Pumping Agreement set limits on the amount of groundwater that LADWP can pump from the Owens River groundwater basin. The limits imposed by this agreement have been incorporated into the LAAMP model and are reflected in the above discussion of alternative impacts.

Development projects in Mono Basin and the Owens River basin have the potential to reduce the amount of water available to LADWP. The Conway Ranch Resort Community, currently in the planning stages, has been proposed for Mono Basin. This project could result in diversions from Mono Lake tributaries. Increasing diversions from Lee Vining Creek by the City of Lee Vining and/or the USFS for future needs could reduce water supplies available. Also, the Town of Mammoth Lakes is investigating diverting waters tributary to the Upper Owens River for municipal water supply purposes.

The Western Water Bill (HR 429) allows for restructuring California's Central Valley Project (CVP). Under this bill, farmers will be able to voluntarily sell their water to municipalities. Consequently, urban shortages could be overcome by the purchase of irrigation supplies. Also, the old price structure for Central Valley customers will be replaced with a structure that encourages conservation.

The activities described, combined with the Mono Basin water supply alternatives, have the potential to directly affect LADWP's supply of water. On balance, these projects are expected to have a beneficial impact on LADWP's water supply; decreases from Mono Basin alternatives and Mono Basin/Owens River basin development projects would be outweighed by increased water availability associated with the Western Water Bill. Consequently, no significant direct cumulative impacts would be associated with the project alternatives.

Several projects have the potential to affect MWD's water supply.

The existing water quality standards for the Sacramento-San Joaquin River Delta set minimum water quality requirements to protect fisheries and related natural resources. Proposed revision to these minimum standards (April 22, 1993 draft of Water Rights Decision 1630) is expected to lead to decreases in the amount of water available to the SWP and CVP.

Future shortfalls in Delta water exports that could result from adoption of proposed Decision 1630 would be divided between the SWP and CVP. In addition, any decreased deliveries to the SWP could be divided between agricultural and municipal uses. At this time, any estimates of the effect of revised Delta water quality standards on MWD would be speculative.

Potential SWP projects and programs downstream of the Delta could, if implemented, supply additional water to southern California. These include the Los Banos Grandes Reservoir, the Kern water bank, and the CVP Water Purchase. These projects and programs, together with the Delta management programs, have the potential to add 450,000 af/yr of reliable supply to the SWP. (Planning and Management Consultants 1990.)

MWD's dependable supply of Colorado River water was reduced with the commencement of Colorado River deliveries to the Central Arizona Project in Arizona. MWD has entered into a water conservation agreement with Imperial Irrigation District that will augment MWD reliable supplies from the Colorado River by approximately 100 TAF/yr. Several other programs may be available to offset reductions in supplies from the Colorado River. These include land fallowing programs, Colorado River banking, canal lining, and the use of currently unused agricultural water and unused Arizona and Nevada water. The losses to MWD associated with the Central Arizona Project have already been incorporated into estimates of MWD supplies used in the analysis.

For impacts on MWD and its customers, projects that could affect MWD's future water supply include potential changes in exports from the Bay-Delta as a result of proposed Decision 1630, potential increases in yield from SWP facilities and programs, changes in the availability of Colorado River supplies, and water transfers under HR 429. On balance, these projects, in conjunction with the adverse impacts associated with each of the project alternatives, would probably lower MWD's total supplies.

The indirect cumulative impacts of the alternatives addressed in this report are considered to be less than significant because LADWP's increased demand for MWD water would be less than LADWP's historical 19-year (1971-1989) weighted share of MWD supplies (5.1%).

Significant Cumulative Impacts

Several past, present, and future activities have the potential to reduce water deliveries to the City of Los Angeles. Impacts of these projects, when considered in conjunction with impacts of the project alternatives, are not expected, however, to result in significant cumulative impacts.

CITATIONS

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Table 3L-1. Comparison of Water Use among 11 Cities Nationwide

City	Water Use (gpcpd)
Goleta	149
Tucson	160
New York	160
East Bay Municipal Utility District[a]	175
Los Angeles	179
San Diego	195
Denver	225
Anaheim	245
Phoenix	250
Chicago	255
Sacramento	300

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[a] Includes Oakland, Berkeley, and vicinity.

Source: LADWP 1991a.

Table 3L-2. Average Historical Use of the City of Los Angeles' Water Supply Sources

Source	Historical Average (1971-1990) (af/yr)
Los Angeles Aqueduct	450,000
Groundwater	97,000
MWD	79,000
Reclaimed water	500
Conservation and demand management	Unknown

Source: LADWP 1991a.

Table 3L-3. Reclamation Projects Included in the Impacts Analysis

Project Name	In-Service Date	In-Service Amount (af/yr)	Annualized Cost ($ 1992/af)
Los Angeles Greenbelt	Pre-1992	1,600 – 1,200 1,000 currently, then will expand.	346
Sepulveda I	1992	2,300 ✓	500 – cheaper than 500. ≈200
Griffith Park Golf	1992	900 ✓	500 – cheaper
cA Trans Freeway 134 & 5	1992	100 ✓	500 ~~[illegible]~~ cheaper
Sepulveda II	1993	1,200 soon	500 ✓
Braemer/El Caballero	1994 – probably too soon	900	500 – lower
East Valley – pre design, then go.	realistic – 1995	10,000 ~~[illegible]~~ initially ↓ 35,000 – 15,000 – gw recharge	500
Elysian Park I	1995	1,500	500
West Basin	1995	4,000	446
San Fernando Recharge I	1997	35,000	600
West Valley	2000	1,000	500
Mountaingate	2000	450	500
Hansen Recreation	2000	2,750	500
Griffith Park	2000	9,000	500
West Los Angeles	2000	5,000	500
Elysian Park II	2000	1,400	500
San Fernando Recharge 2	2001	10,000	600
Eastside Greenbelt	2010	800	500
Eastside Industrial	2010	680	620
Elysian Park III	2010	1,200	500

Notes: East Valley yield assumed to increased from 15,000 af/yr in 1995 to 36,500 af/yr by 2011.

West Basin yield assumed to increased from 4,000 af/yr in 1995 to 10,000 af/yr by 2010.

Costs for water are annualized to 1992 dollars. Los Angeles Greenbelt and West Basin projects are assumed to receive MWD's discount of $146 per af.

Sources: LADWP 1991a, WR News 1992, Gewe pers. comm., West Basin Municipal Water District 1991.

subsidy for rec = cost of pumping over mtns
⇒ will rise w/ time.

Table 3L-4. Estimates of Shortage Costs based on LADWP's Marginal Water Supply Costs

Water Availability	1992 Dollars per Billing Unit*	1992 Dollars per af
100% of normal	2.92	1,272
10% shortage	3.70	1,612
15% shortage	4.44	1,934
20% shortage	5.18	2,256
25% shortage	6.05	2,635

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* One billing unit equals 100 cubic feet or 748 gallons.

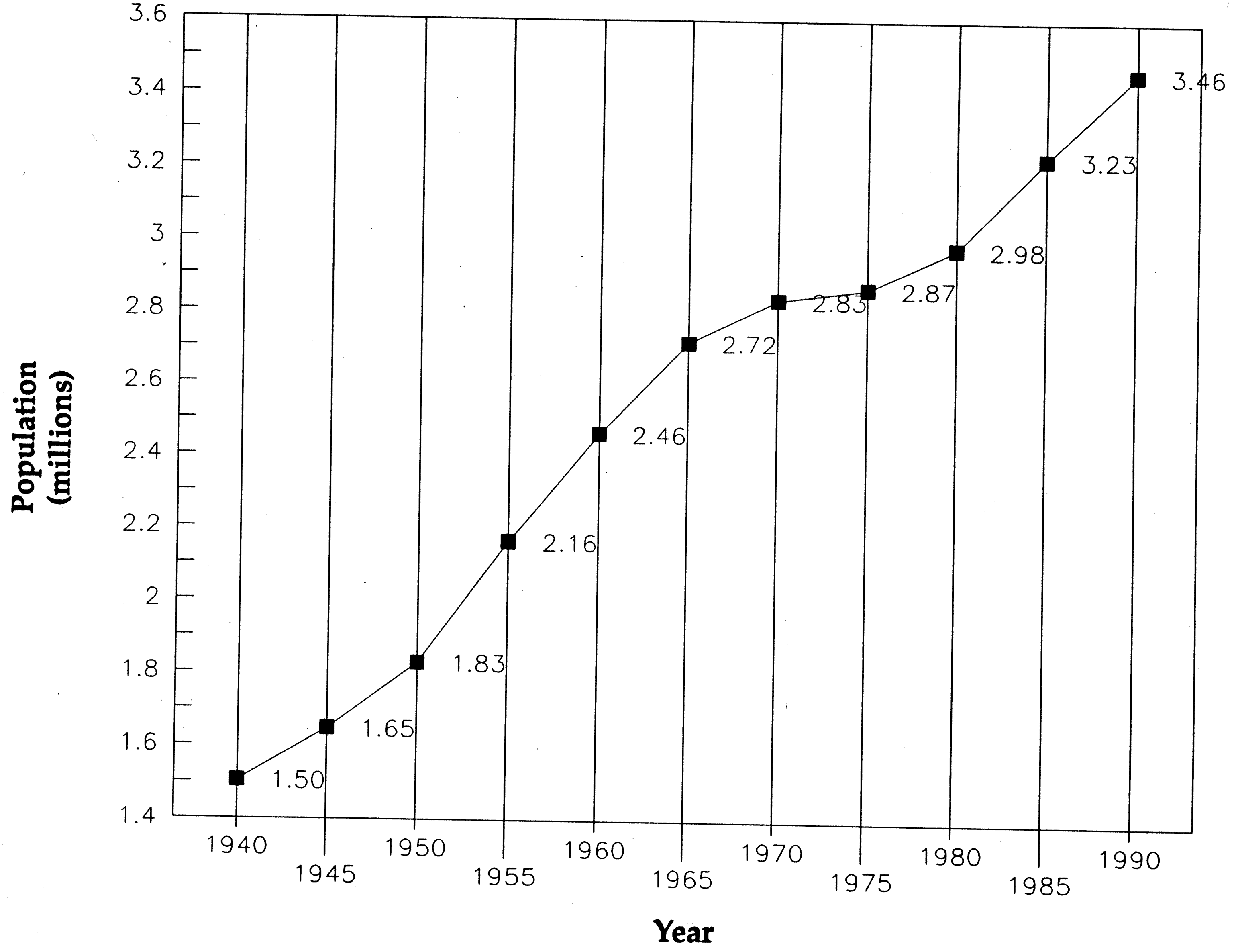
Source: Mayor's Blue Ribbon Committee on Water Rates 1992.

Table 3L-5. Summary Comparison of Water Supply Impacts

Alternative or Condition	Average Annual LA Aqueduct Water Availability (af)	Average Annual Resource Costs (1992 Dollars)	Average Annual Shortage Costs (1992 Dollars)	Average Annual Resource + Shortage (1992 Dollars)	Total Cost Increase (%)	Resource Cost Increase Compared to Point of Reference (%)	Number of Years of Shortage (out of 20)	Percent Shortage	Average LADWP Share of MWD Supply (%)
Point of reference	442,000	174,858,841	0	174,858,841			0	N/A	2.6
No restriction	449,700	169,764,455	0	169,764,455	-3	-3	0	N/A	2.3
Drought	415,500								
Long-term	NC								
6,372 Ft	425,100	185,673,369	0	185,673,369	6	6	0	N/A	3.1
Drought	392,200								
Long-term	NC								
6,377 Ft	413,900	191,399,568	0	191,399,568	9	9	0	N/A	3.4
Drought	375,900								
Long-term	NC								
6,383.5 Ft	400,000	199,529,926	1,776,414	201,306,340	15*	14	1	4	3.8
Drought	360,900								
Long-term	408,000								
6,390 Ft	394,700	203,512,848	1,776,414	205,289,262	17*	16	1	4	3.9
Drought	360,900								
Long-term	408,000								
6,410 Ft	384,400	210,290,180	2,458,887	212,749,067	22*	20	1	5	4.2
Drought	346,700								
Long-term	393,300								
No diversion	375,200	216,037,334	2,043,009	218,080,342	25*	24	1	4	4.5
Drought	340,800								
Long-term	NC								
Prediversion	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

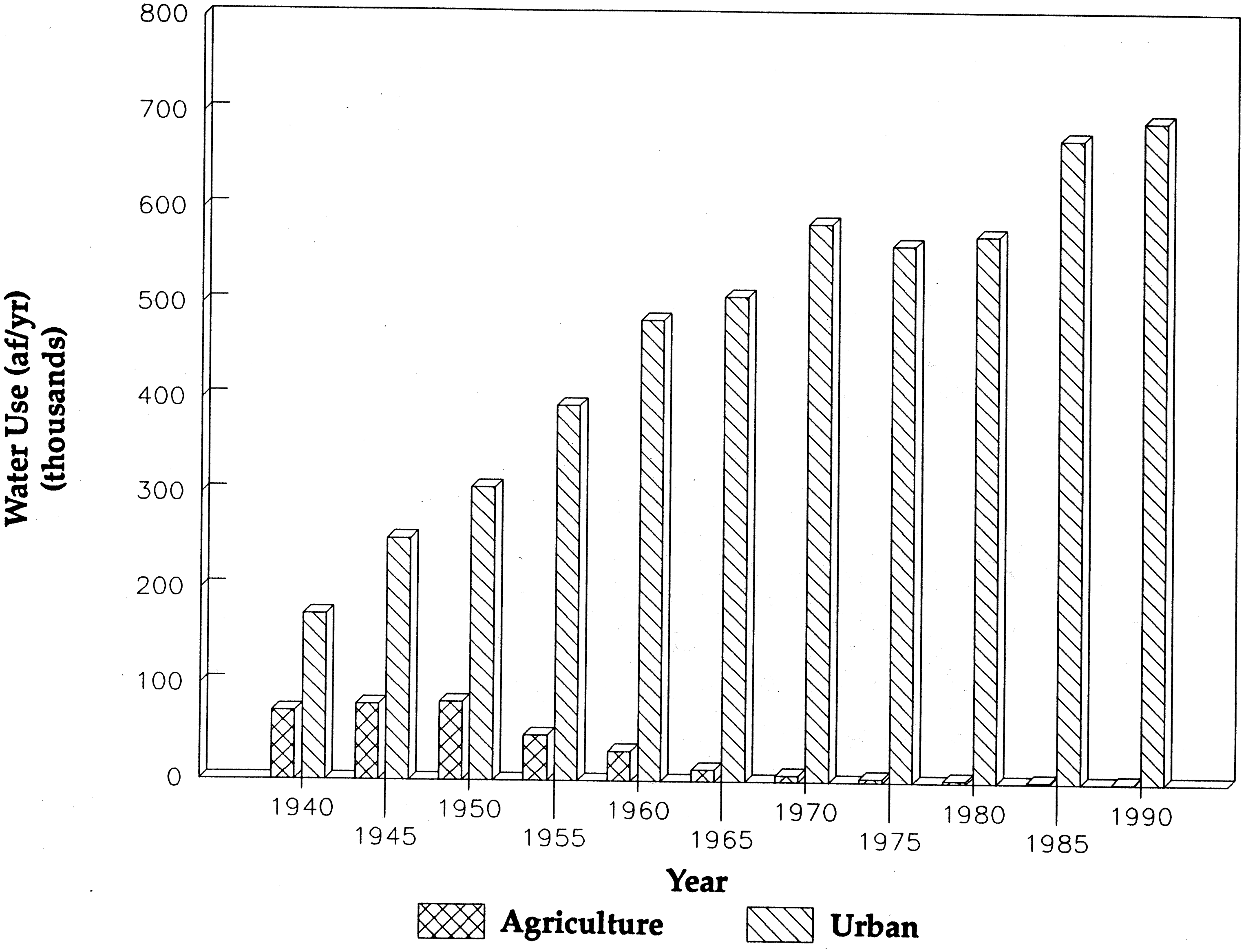
Note: Total resource acquisition costs include the costs for the 20-year period from 1992 through 2011. The methodology for estimating water supply shortages is described in the water supply impact assessment methods section. Shortage costs are based on the marginal costs shown in Table 3L-4.

NC = no change from short-term conditions.
N/A = not applicable.
* = significant adverse change from point-of-reference condition.



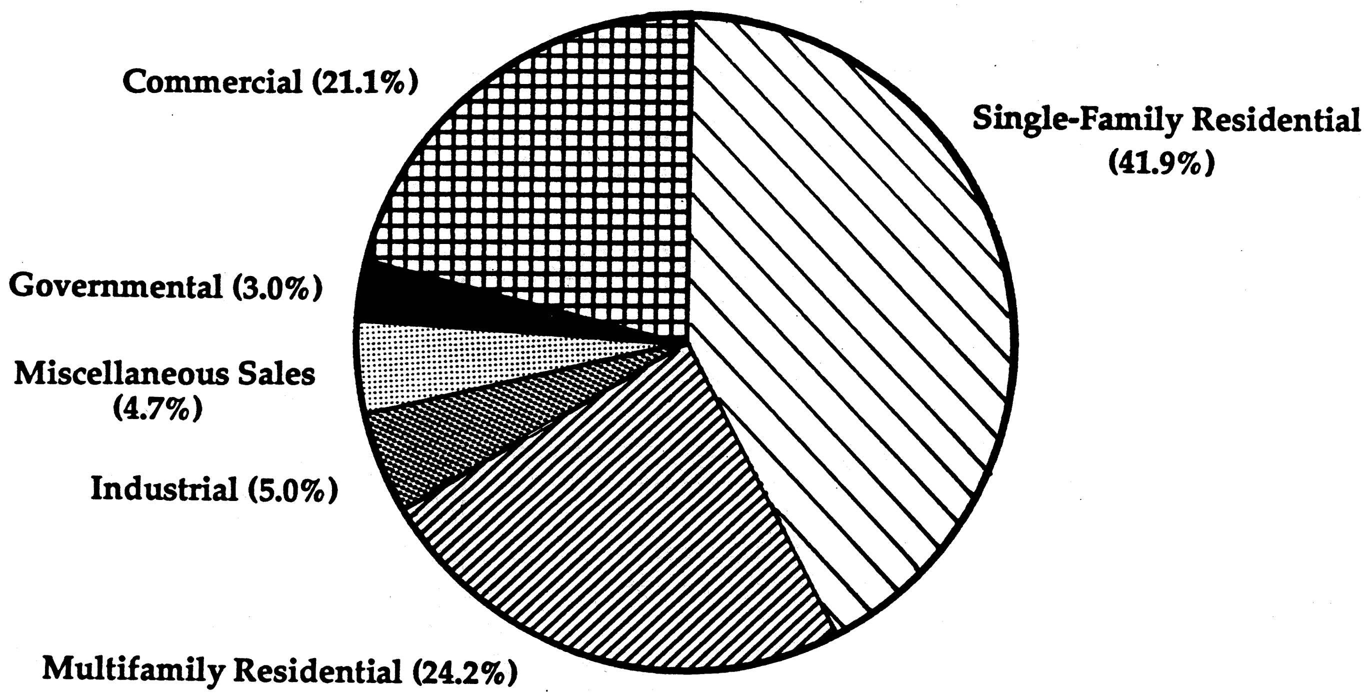
Source: LADWP 1991a

Figure 3L-1.
City of Los Angeles Population, 1940-1990



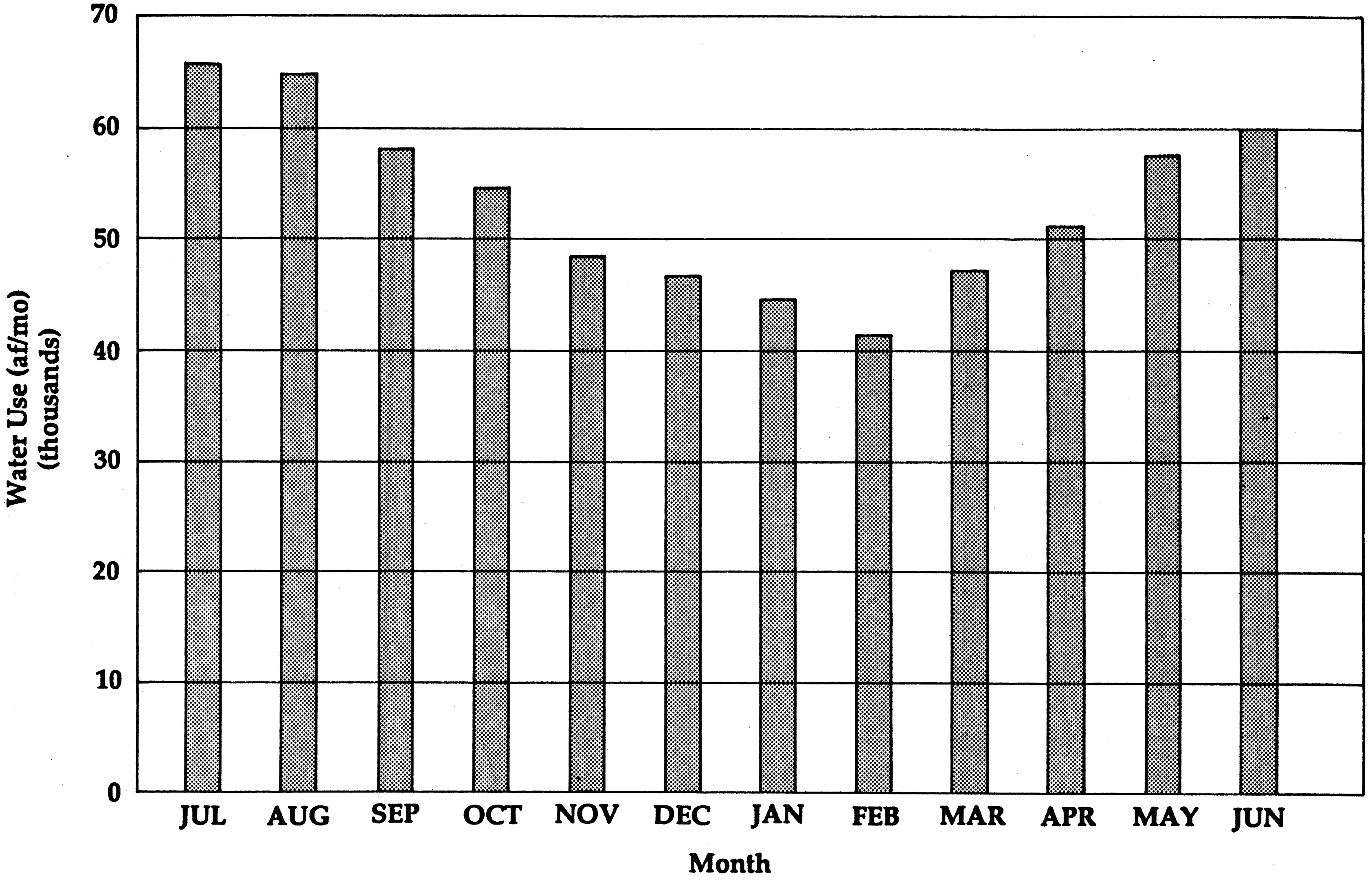
Source: LADWP 1991a

Figure 3L-2.
City of Los Angeles Urban and Agricultural Water Use, 1940-1990



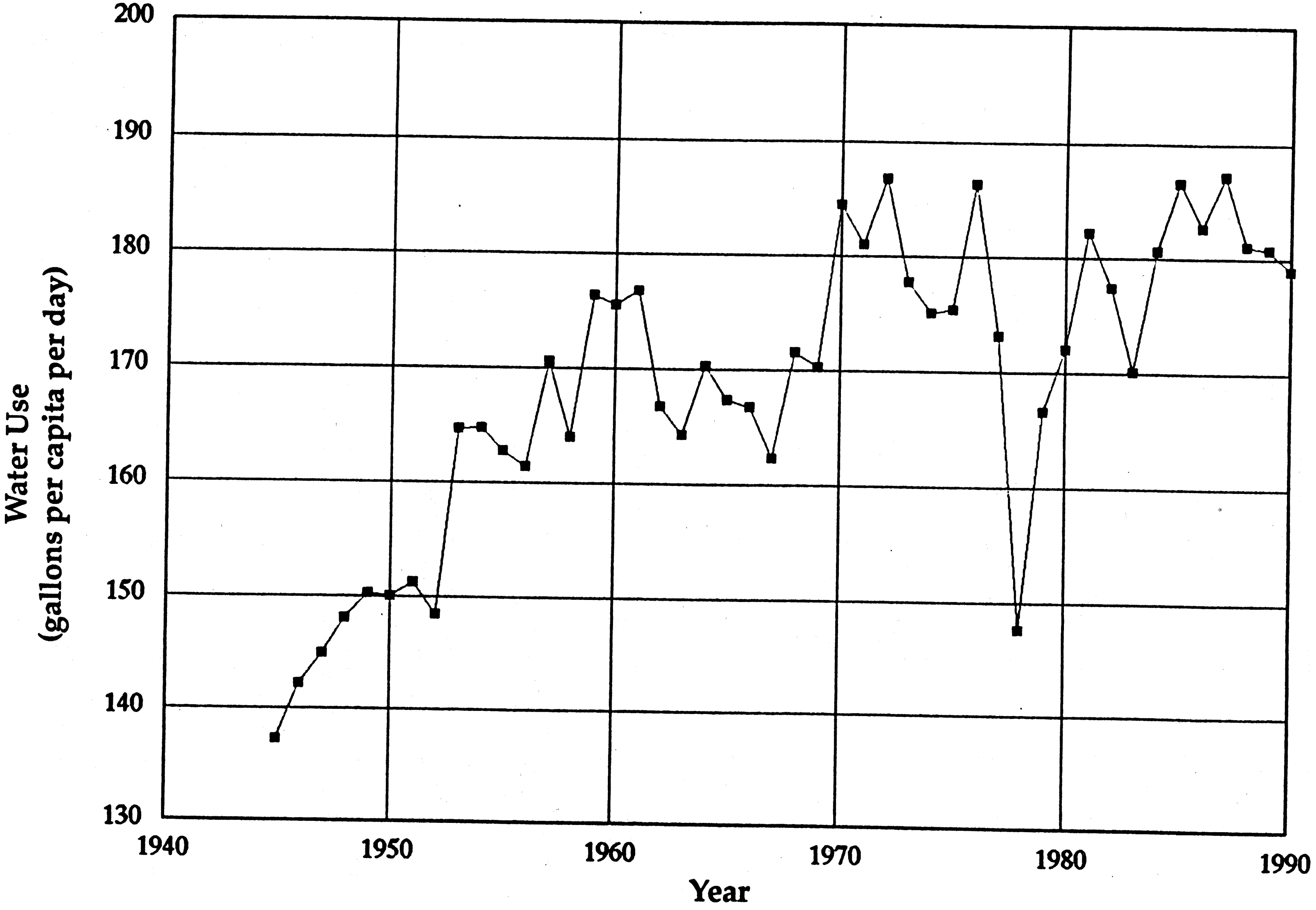
Source: LADWP 1991a

Figure 3L-3.
Relative Water Consumption by User Type, 1976-1990 Average



Source: Based on data provided by the LADWP Aqueduct Division

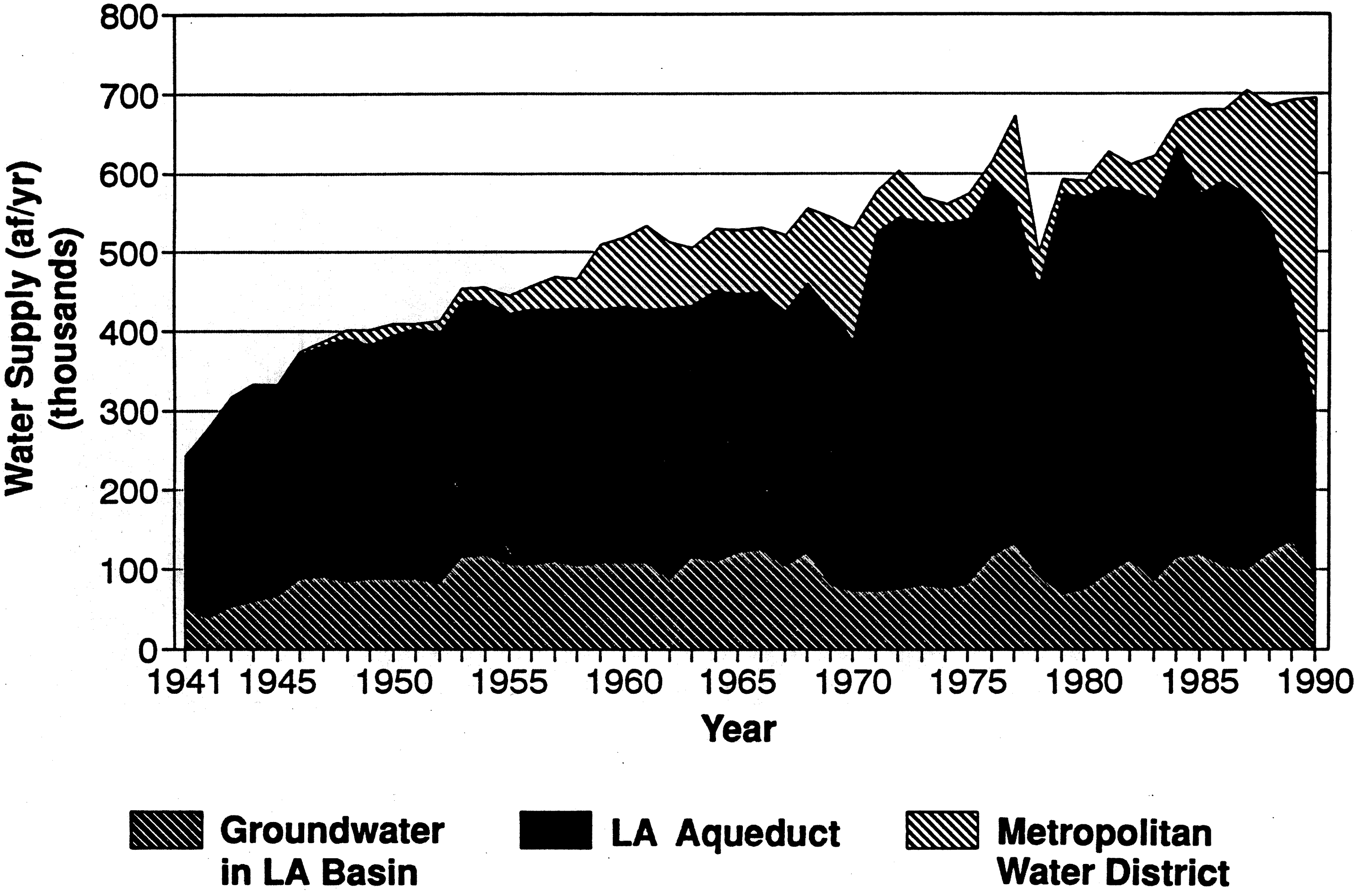
Figure 3L-4.
City of Los Angeles Monthly Water Use, 1971-1990 Average



Note: Excludes water consumed by agriculture

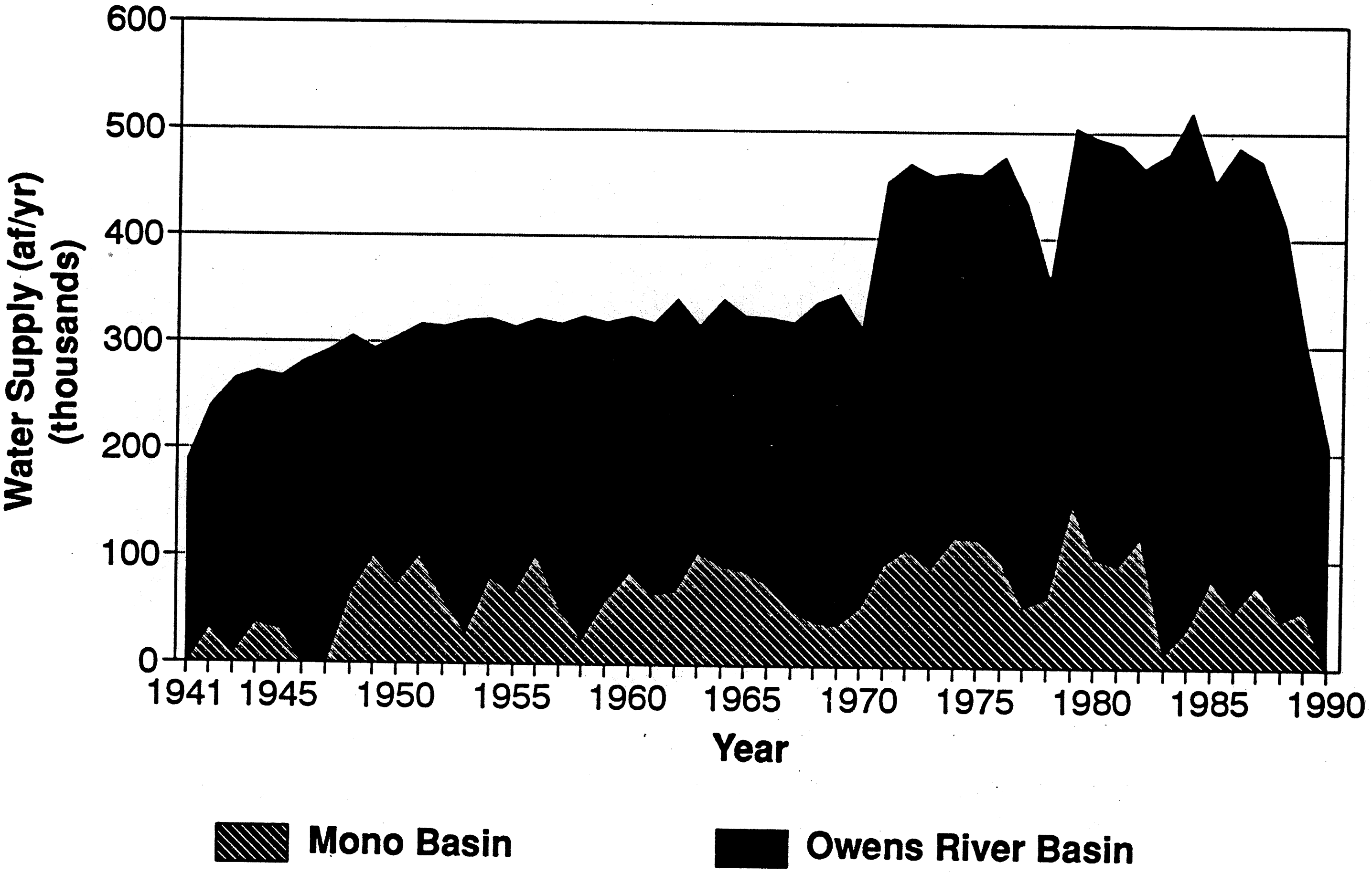
Source: LADWP 1991a

Figure 3L-5.
City of Los Angeles Per Capita Water Use



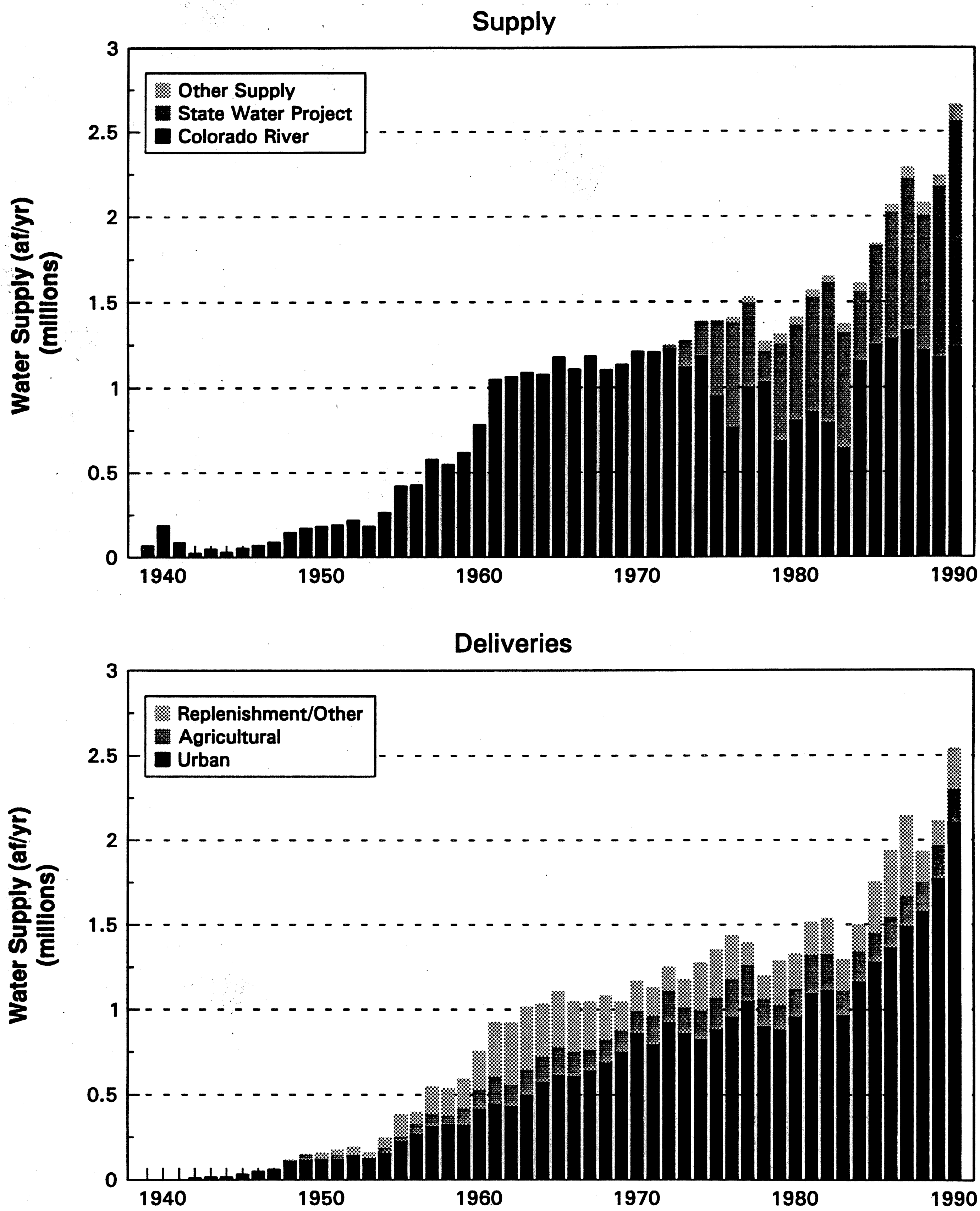
Source: Based on data provided by the LADWP Aqueduct Division

Figure 3L-6.
Los Angeles Water Supply Sources, 1941-1990



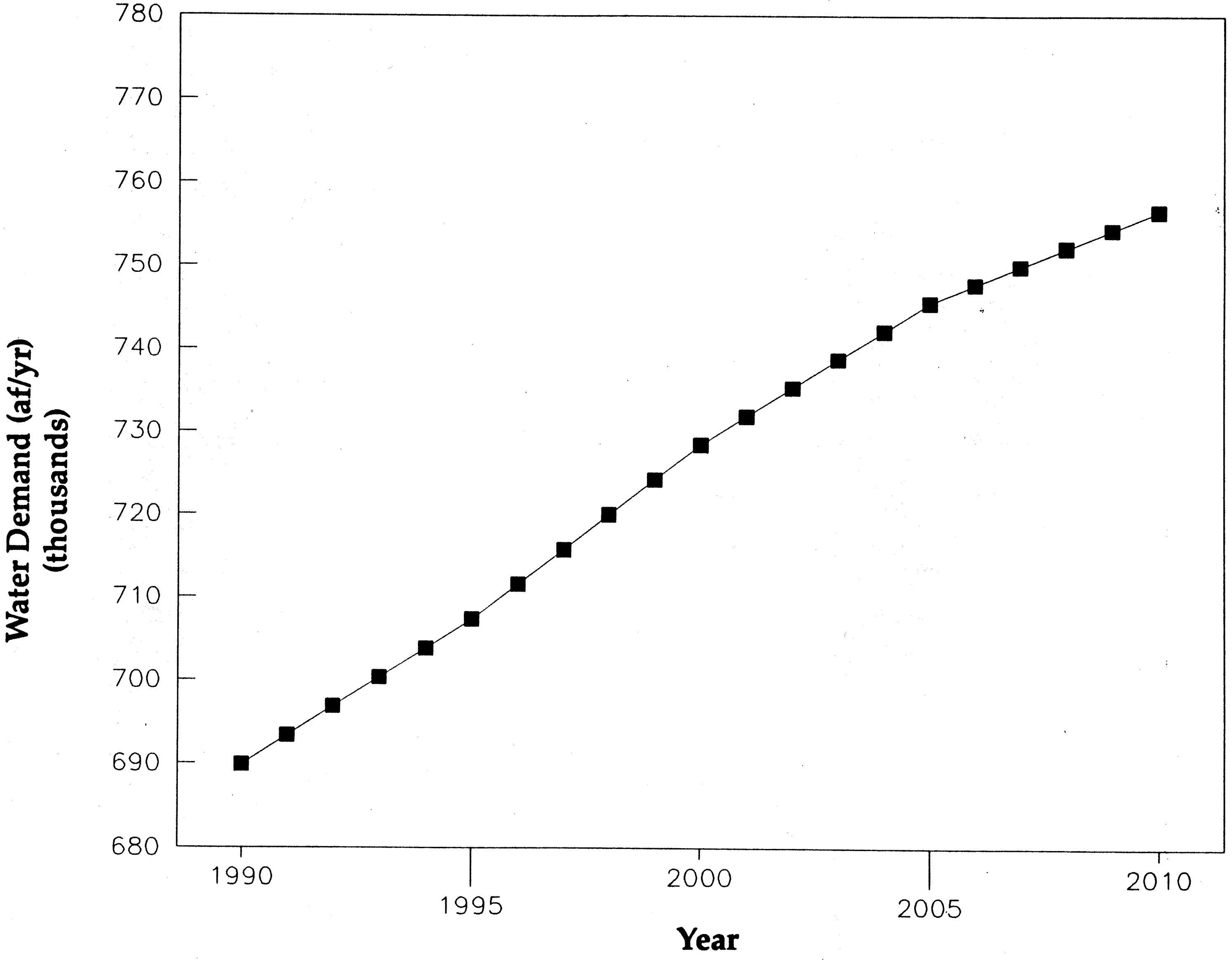
Source: Based on data provided by the LADWP Aqueduct Division

Figure 3L-7.
Los Angeles Aqueduct Deliveries, 1941-1990



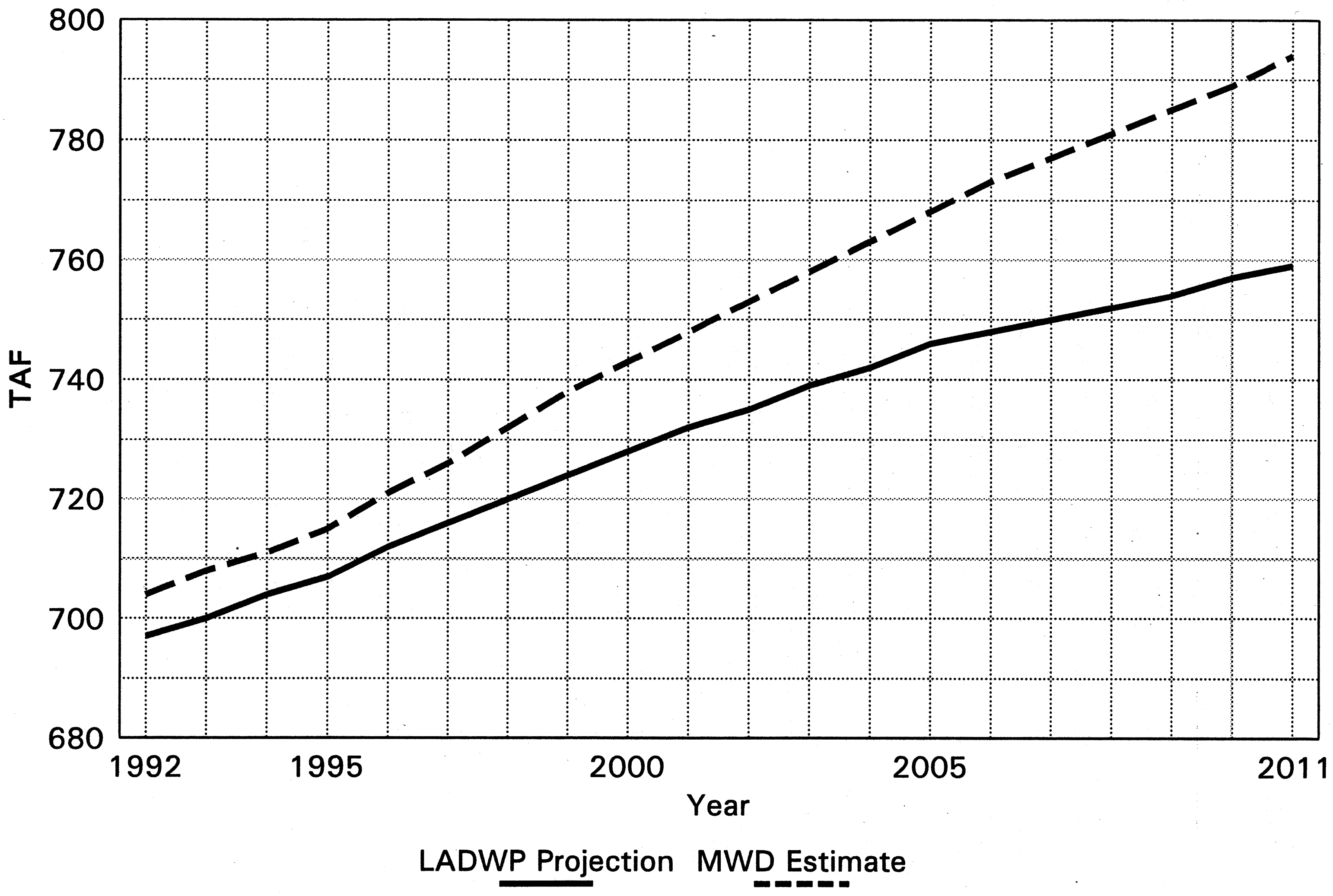
Source: Based on data provided by the Metropolitan Water District

Figure 3L-8.
Metropolitan Water District Annual
Water Supply and Deliveries



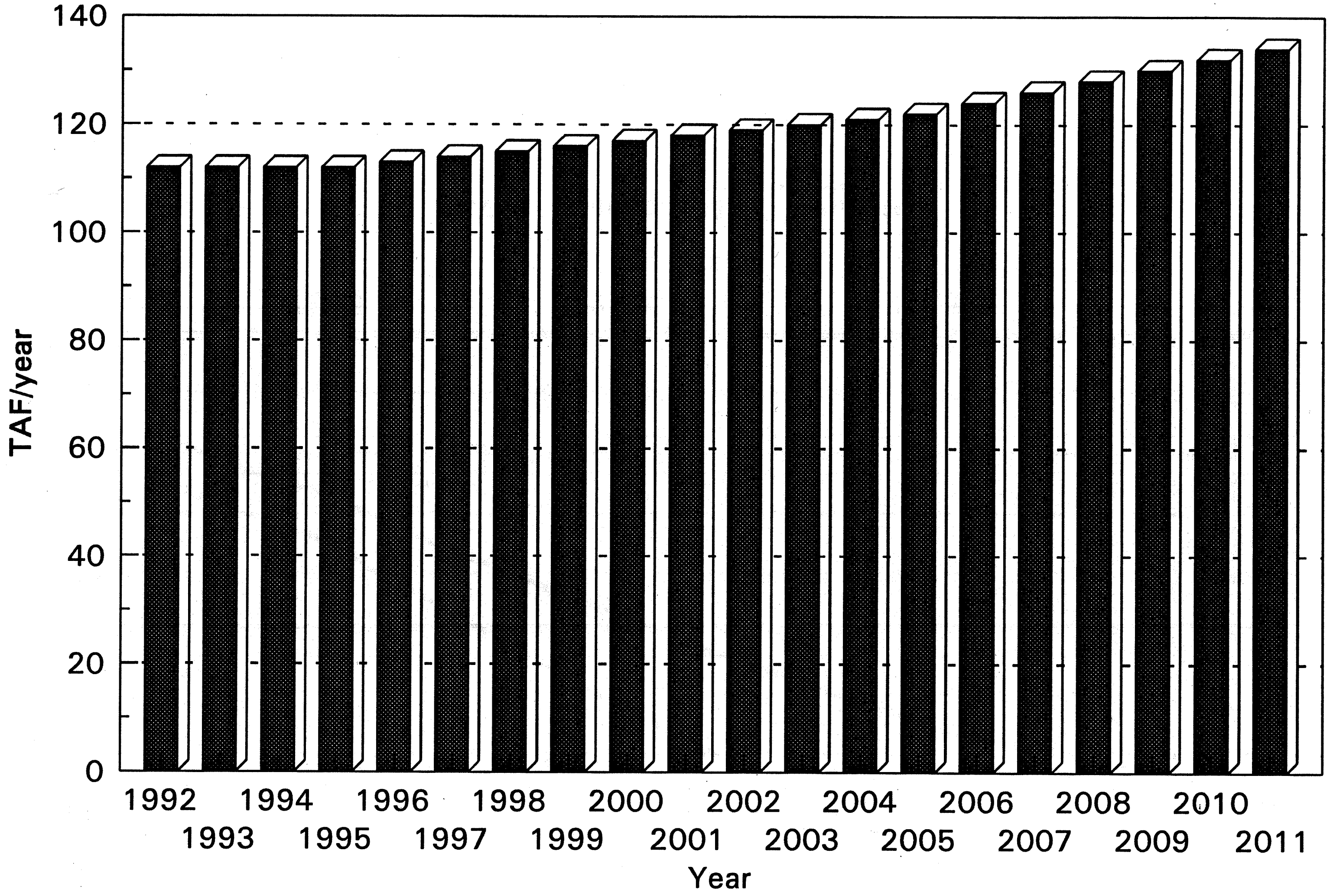
Source: LADWP 1991a

Figure 3L-9.
LADWP Projected 20-Year Water Demand



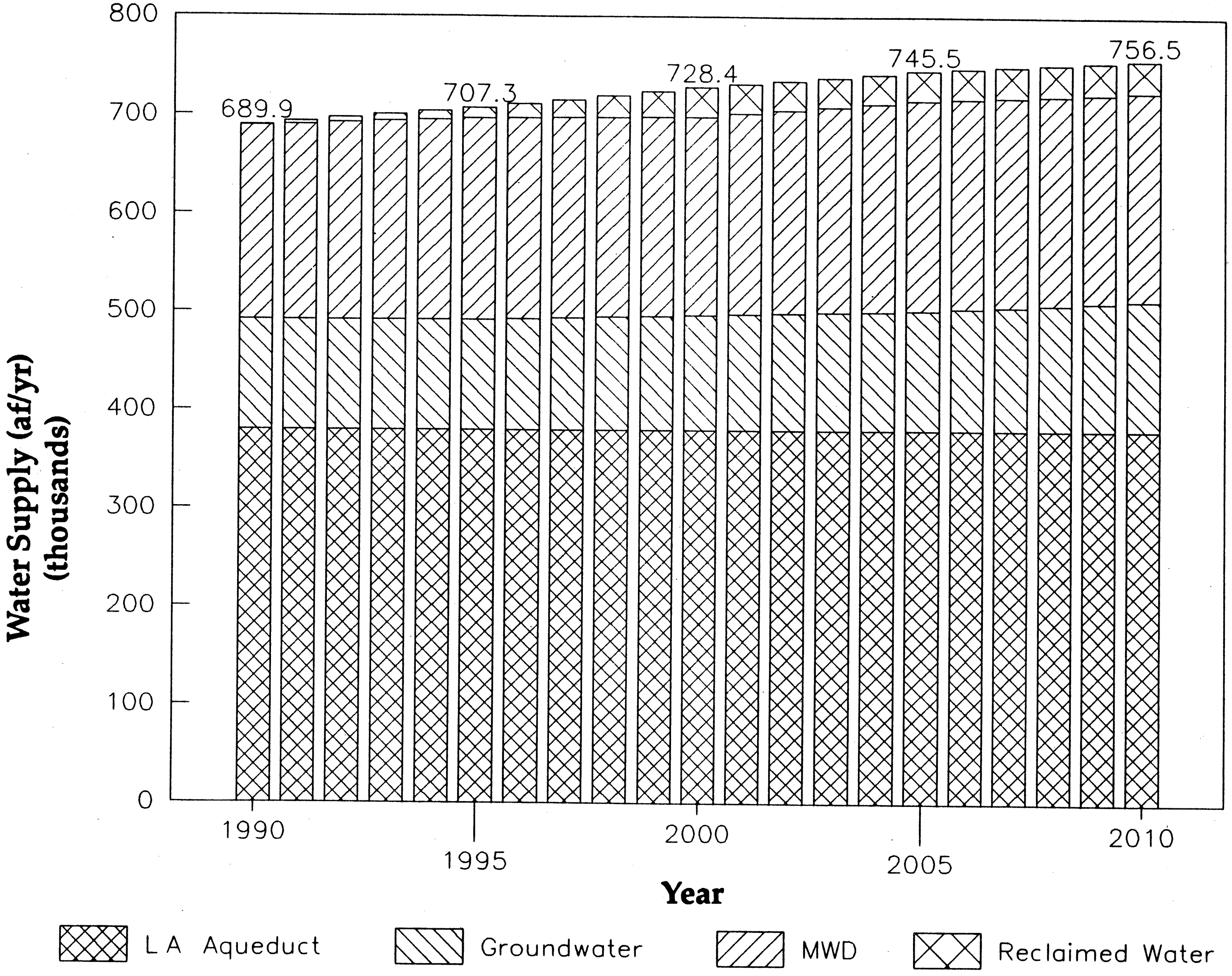
Sources: LADWP 1991a; Planning and Management Consultants, Ltd 1990

Figure 3L-12.
Comparison of Projections of City of Los Angeles 20-Year Water Demand



Source: LADWP 1991a

Figure 3L-13.
Groundwater Available to LADWP



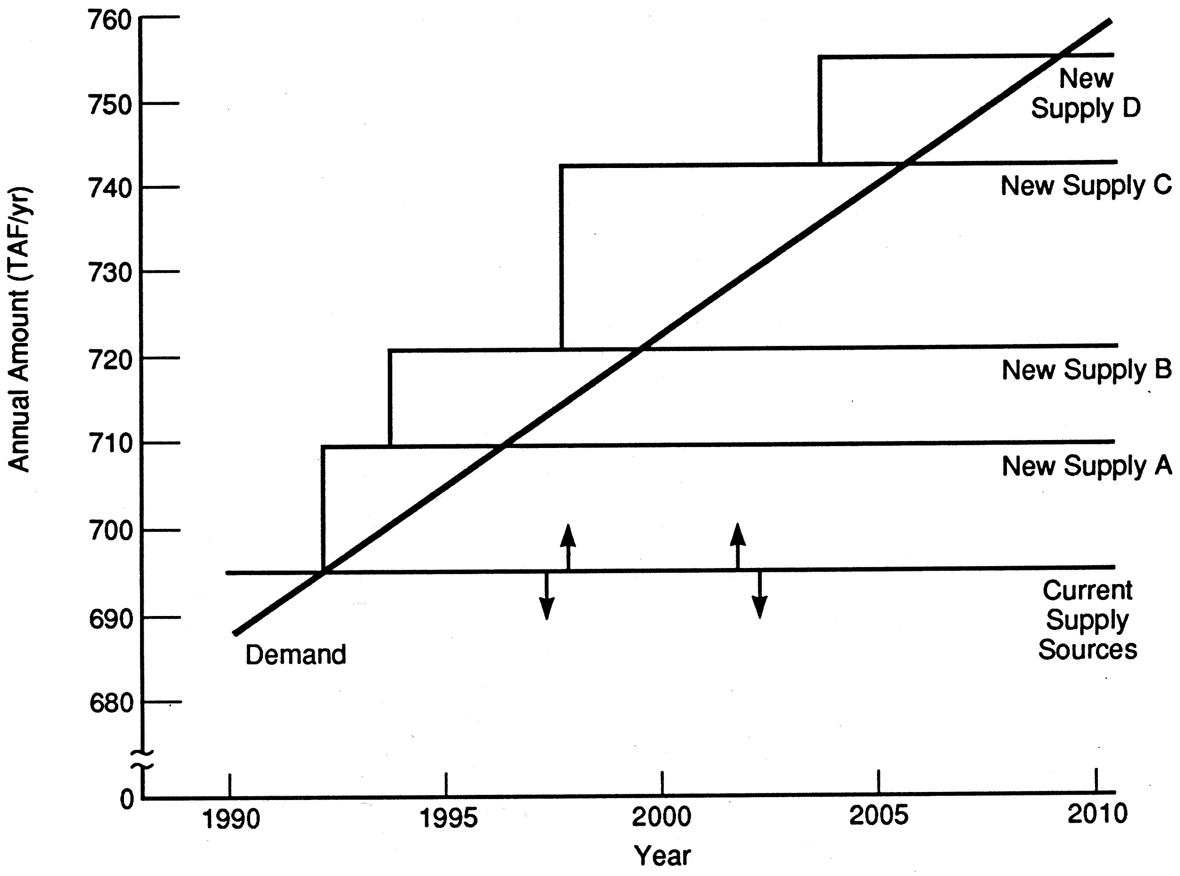
Note: Projections assume average runoff in every year.

Source: LADWP 1991a

Figure 3L-10.
LADWP Projected 20-Year Water Supply

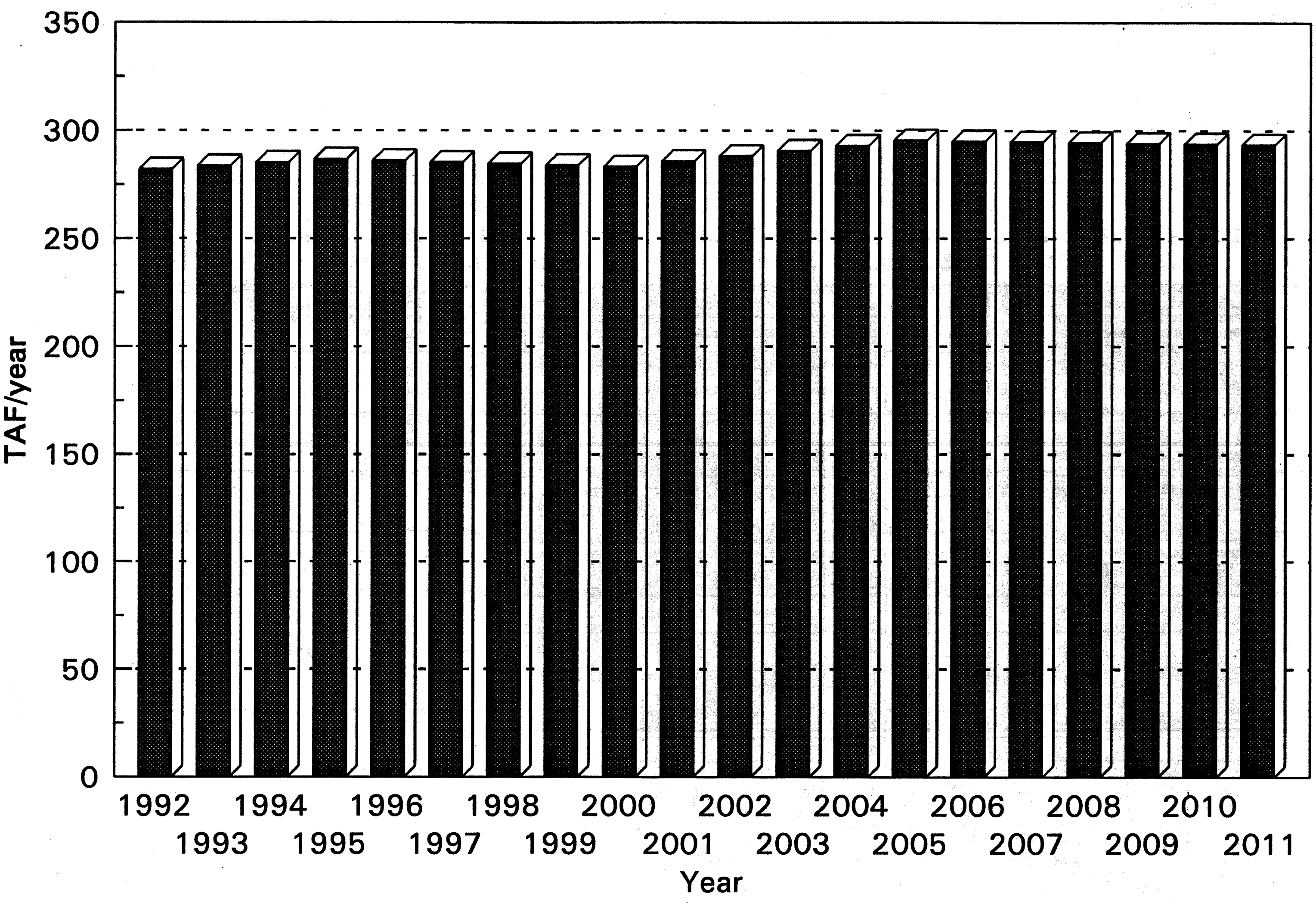
MONO BASIN EIR

Prepared by Jones & Stokes Associates



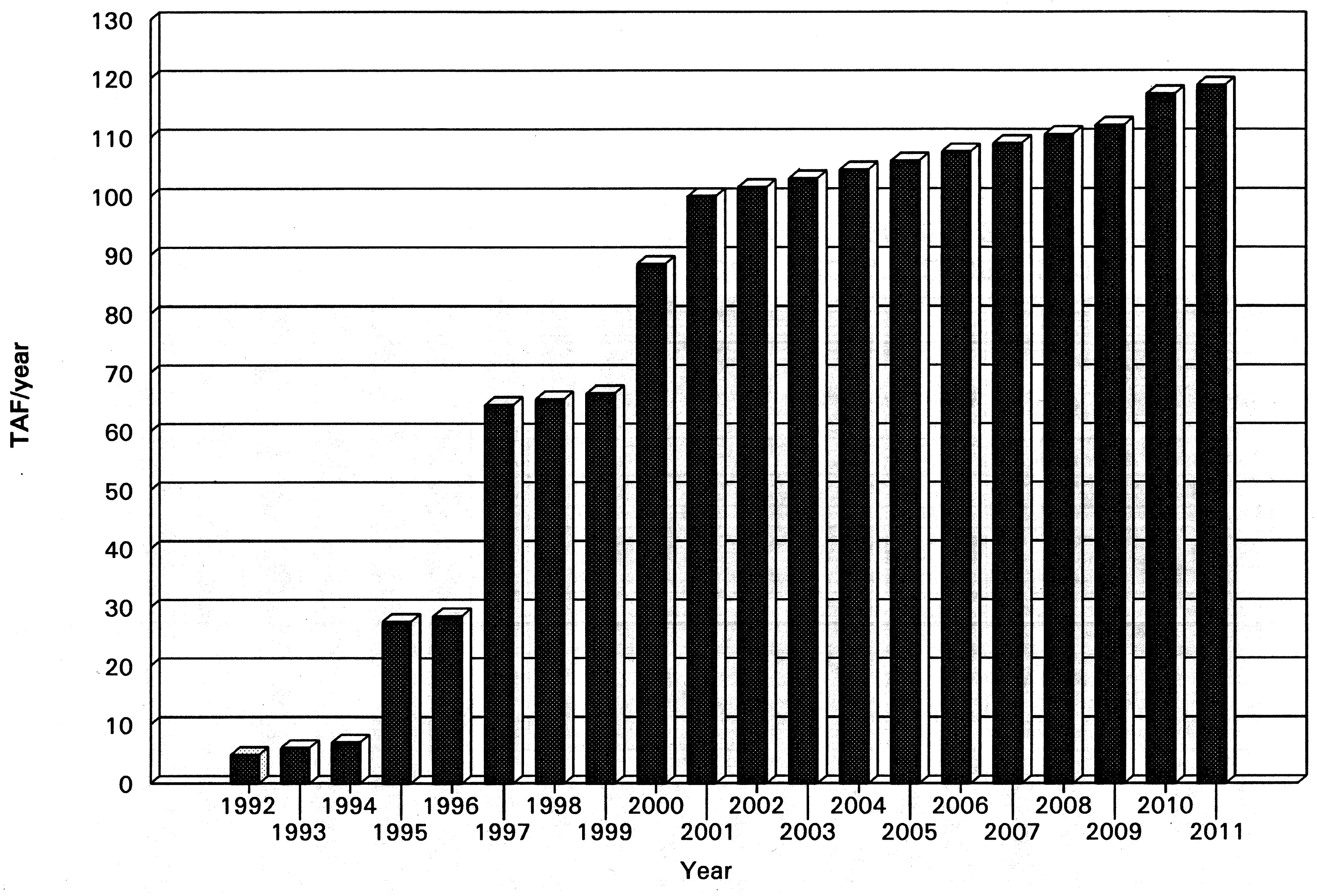
NOTE:
Arrows indicate a shift in the current supply sources associated with changes in Mono Basin diversions. An upward shift indicates increased diversions from Mono Basin while a downward shift indicates reduced diversions.

Figure 3L-11.
Conceptual Water Supply and Demand Relationships



Source: LADWP 1991a

Figure 3L-14.
LADWP Projected Demand for MWD Supplies



Sources: LADWP 1991a; Los Angeles Office of Water Reclamation, 1990 and 1992b;
Gewe pers. comm.; West Basin Municipal Water District 1991; City of Los Angeles 1992

Figure 3L-15.
Cumulative Yield of LADWP Reclamation Projects

MONO BASIN EIR
Prepared by Jones & Stokes Associates

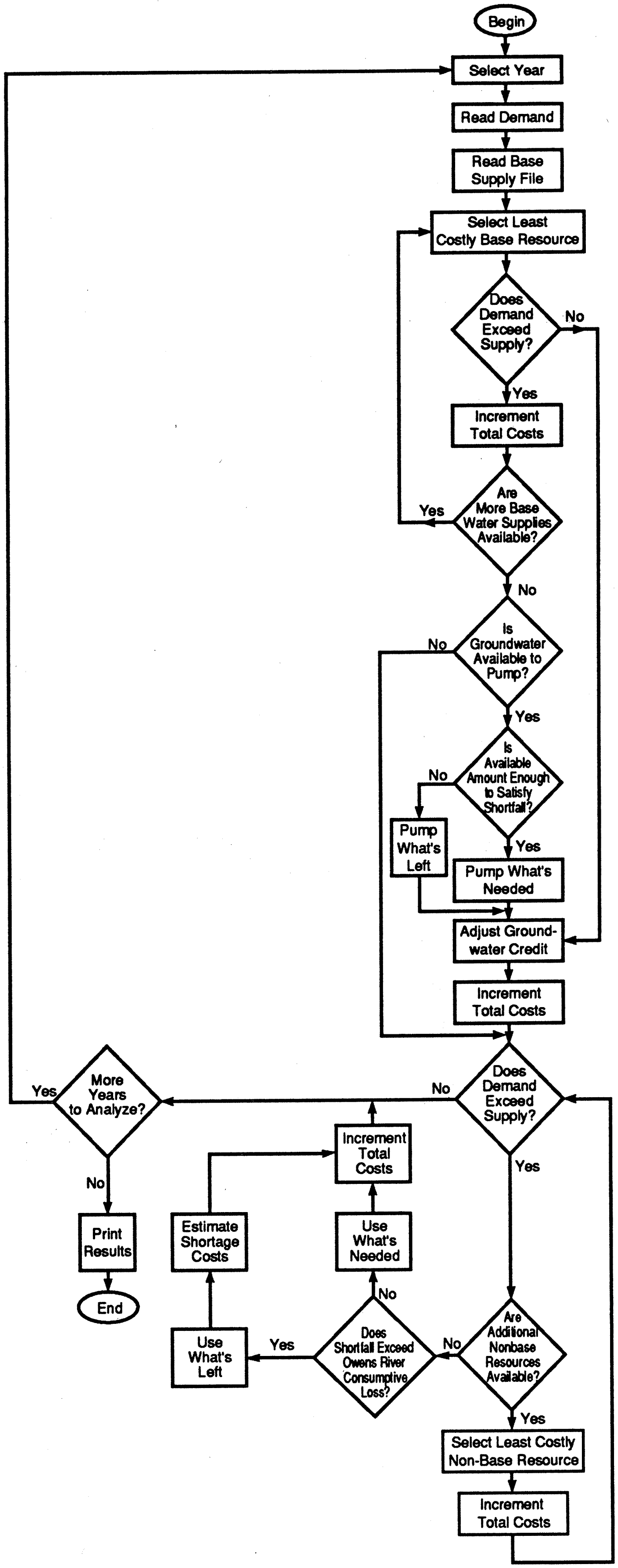


Figure 3L-16.
LADWP Water Supply Model

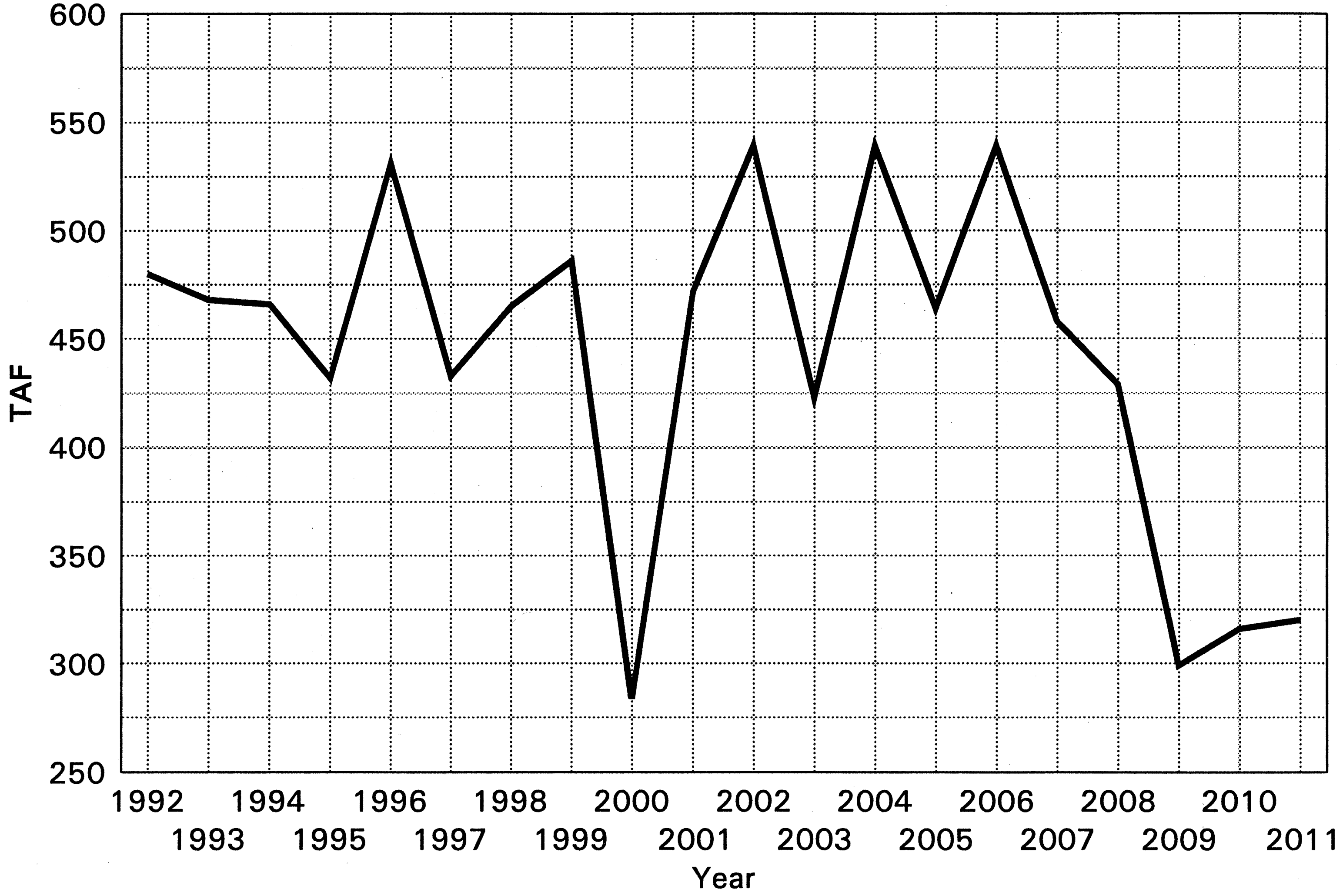
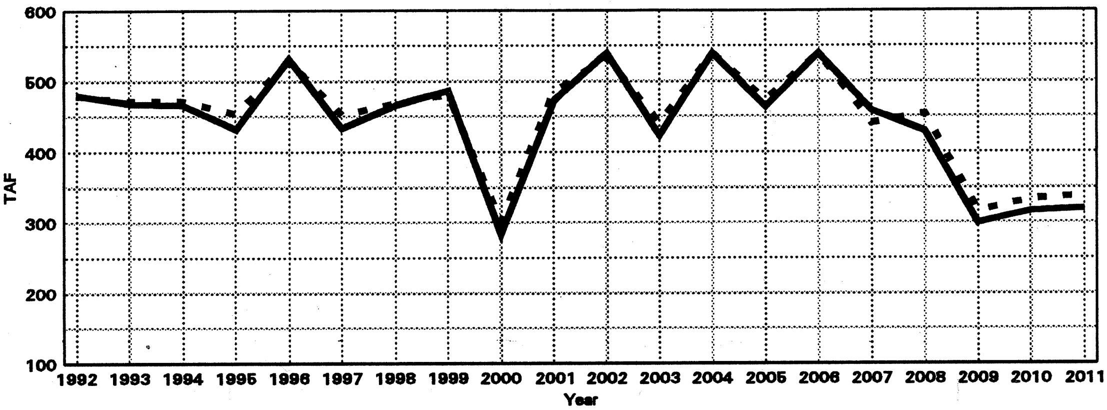
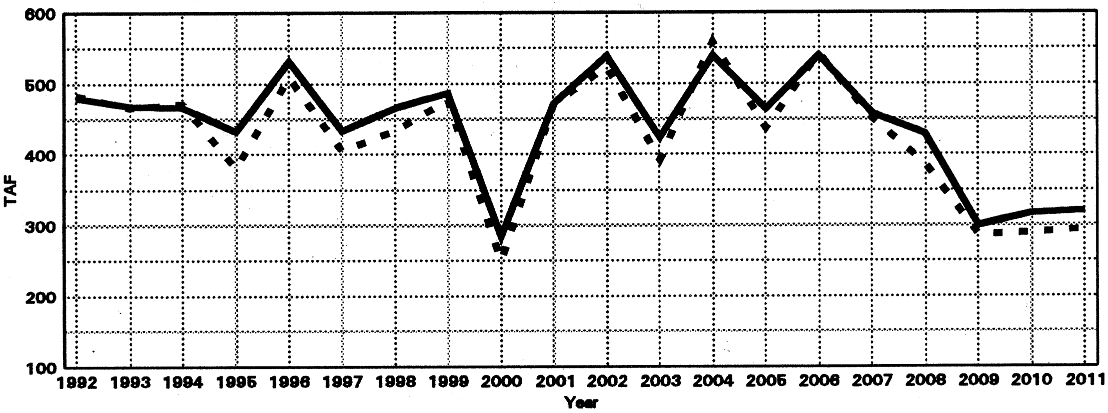


Figure 3L-17.
LA Aqueduct Water Deliveries for the Point-of-Reference Scenario

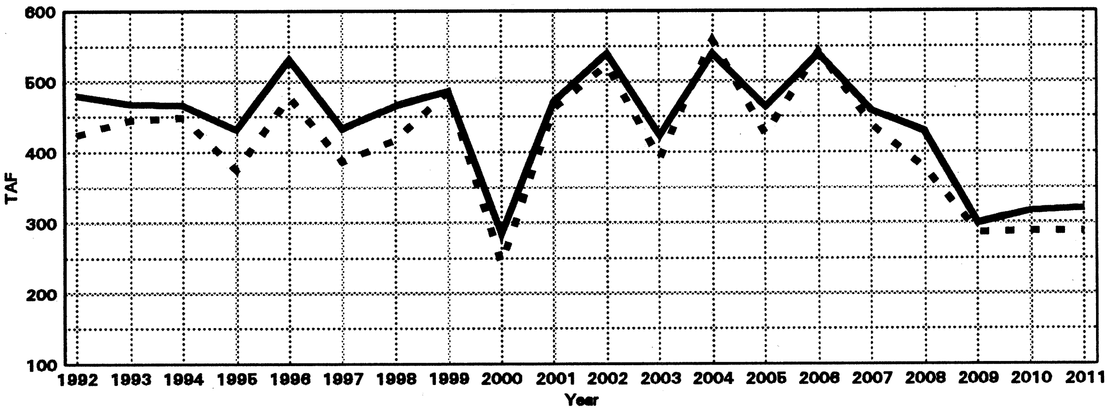
No-Restriction Alternative



6,372-Ft. Alternative



6,377-Ft. Alternative



6,383.5-Ft. Alternative

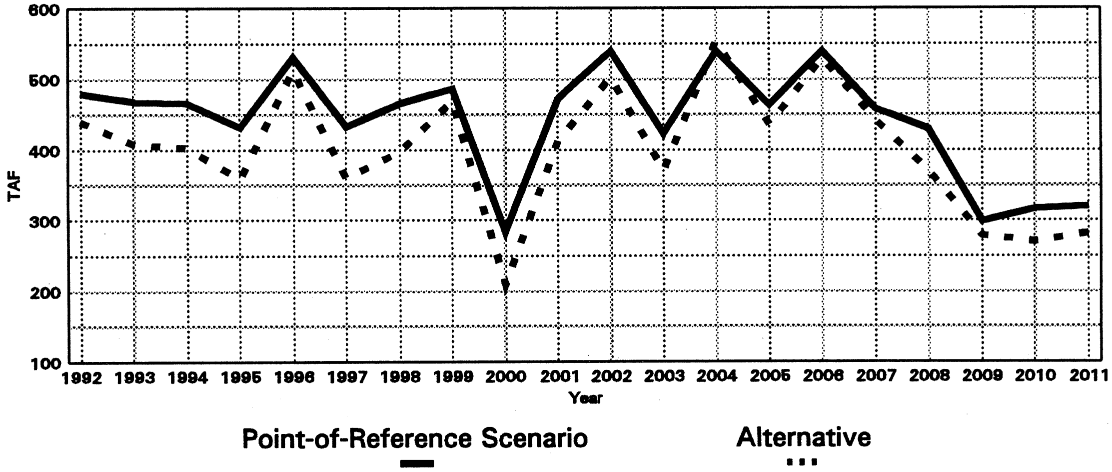


Figure 3L-18.
Comparison of Los Angeles Aqueduct Water Deliveries by Alternative

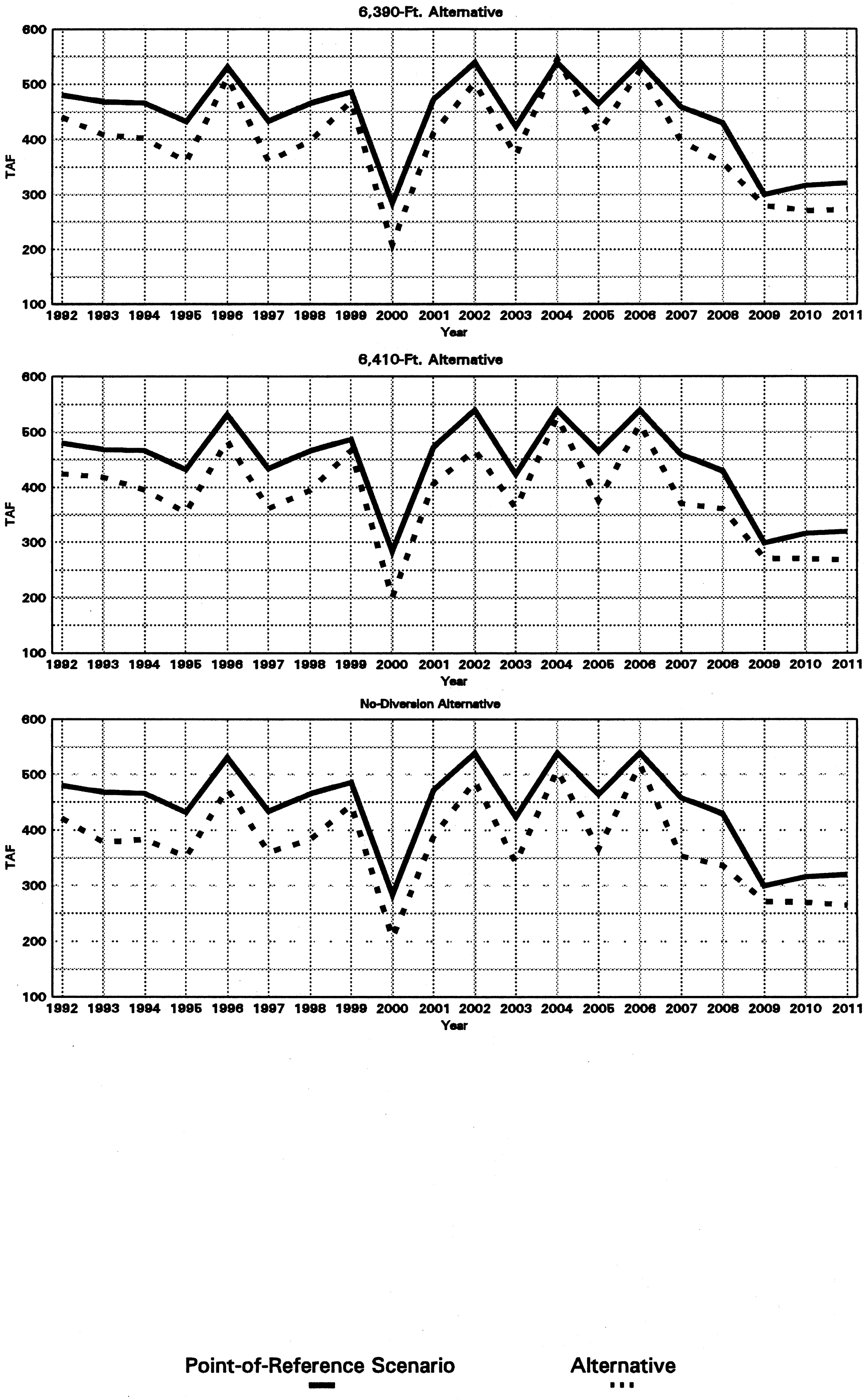
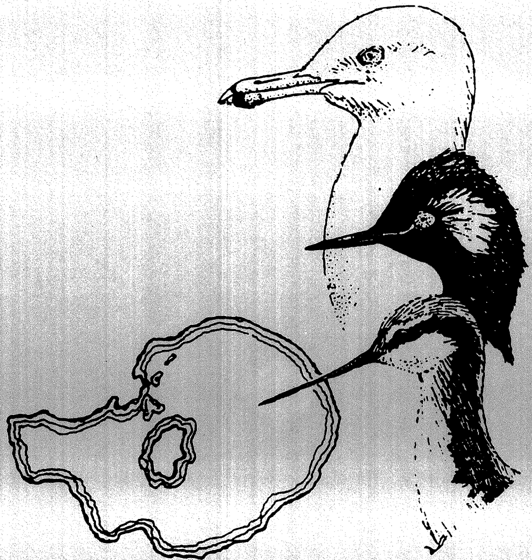


Figure 3L-18.
Continued

Chapter 3M. Environmental Setting, Impacts, and Mitigation Measures - Power Generation



MONO BASIN EIR

Prepared by Jones & Stokes Associates

Chapter 3M. Environmental Setting, Impacts, and Mitigation Measures - Power Generation

This chapter describes the power generation resources that could be affected by the water diversion alternatives. These resources include those owned and operated by LADWP both inside and outside California, and those operated by other utilities from which LADWP purchases power. LADWP power resources are described as they existed prior to diversions from Mono Basin, during the 1986-1990 period, and as they are projected to occur over the next 20 years.

PREDIVERSION CONDITIONS

Sources of Information

Information on power supply resources and energy production before 1941 was obtained from LADWP documents, including "Common Forecasting Methodology VIII Supply Plan for Los Angeles" (LADWP 1989a) and "The Power System and Los Angeles - Energy for Today and Tomorrow" (LADWP 1989b).

Development of the LADWP Power Supply System

Diversions of water from Owens Valley to the City of Los Angeles began in the early 1900s. Approximately 2.6 megawatts (MW) of hydroelectric capacity was installed at the Division Creek and Cottonwood facilities (Figure 3M-1) in 1908 and 1909. LADWP's electric power system, constructed under authorization of an amendment to the city charter in 1911, began distributing electric energy in 1916 and generating its own power in 1917. LADWP did not own or operate an electric power system before these diversions from Owens Valley began.

In 1917, San Francisquito No. 1, LADWP's first commercial hydroelectric generating plant, was placed in service (Figure 3M-1). The 28-MW capacity of this plant was increased to approximately 75 MW during the 1920s. Additionally, during the 1920s, LADWP installed hydroelectric generating facilities with a capacity of approximately 46 MW at the Big Pine, Haiwee, San Francisquito No. 2, San Fernando, and Franklin plants (Figure 3M-1). The capacity of the San Francisquito No. 2 plant was enlarged by 10 MW in 1932.

Significant additions to the system occurred in 1922, when LADWP purchased the Southern California Edison (SCE) distribution facilities in Los Angeles, and in 1937, when LADWP acquired the generation and distribution properties of the Los Angeles Gas and Electric Corporation. With these acquisitions, LADWP became the sole distributor of electric power in Los Angeles.

In the early 1930s, LADWP was instrumental in developing the hydroelectric facilities at Hoover Dam. In 1936, LADWP began using energy generated at Hoover Dam. This energy was transmitted by 287-kilovolt (kV) lines to Los Angeles. In 1941, the installed capacity of the LADWP power supply system was 440 MW, most of which was located at Hoover Dam. By 1942, approximately 75% of the energy requirements for LADWP were fulfilled by power from Hoover Dam.

ENVIRONMENTAL SETTING

This section describes power demand and supply conditions affecting LADWP from 1986 to 1990. Projected power demand and supply conditions between 1992 and 2009 also are described.

Sources of Information

Information on historical (1986-1990) and projected power supply resources and energy requirements was obtained from public documents prepared by LADWP (1989a, 1989b). Information on historical generation and water diversions affecting generating facilities along the Los Angeles Aqueduct (Aqueduct) system were obtained from LADWP personnel, including Randall Neudeck and Glenn Singley. Information on projected energy requirements and resources were obtained from the California Energy Commission (CEC). These data, which are submitted to the CEC by California utilities, are used to simulate the ELFIN power production model.

Energy Demand in the Service Area

LADWP provides electrical service to more than 1.3 million households in a service area that includes portions of three counties (Figure 3M-2). The population served was approximately 3.4 million in 1990.

Between 1986 and 1990, peak demand, which is the maximum amount of power required during any 1-hour period, increased from 4,744 MW to 5,312 MW. The time of peak demand varies depending on factors such as weather. Peak demand usually does not occur at the same time, on the same day of the week, and during the same month from year to year. Similarly, the duration of the peak period, which is the length of time during which the electrical load approaches the magnitude of the peak demand, varies daily.

The total amount of energy consumed by customers in the LADWP service area increased from 20,300 gigawatt-hours (GWh) in 1986 to 23,100 GWh in 1990, an increase of 2,800 GWh or 3.3% per year. In 1990, energy consumed by sector was as follows: residential - 6,800 GWh; commercial - 10,400 GWh; transportation, communications, utilities, and national defense - 1,500 GWh (which includes 200 GWh used by LADWP); street lighting - 300 GWh; and industrial - 4,100 GWh.

Average energy use per residential meter in the LADWP service area was 5,236 kilowatt-hours (KWh) in 1990. This consumption compares with average energy use per residential meter of 5,580 KWh in the San Diego Gas & Electric service area, 6,346 KWh in the Southern California Edison service area, and 4,712 KWh in the Glendale service area.

LADWP has implemented several conservation programs to reduce the demand for electric energy by both residential and commercial/industrial customers. The residential efforts include using more efficient lighting fixtures and heat pumps and rebates for such units. The commercial/industrial sector efforts include using more efficient lighting and lighting fixtures and using thermal storage equipment. Rebates and rate incentives are offered to increase the use of these more efficient devices. In addition, LADWP has a program that pays a portion of the costs of more energy-efficient construction and provides technical assistance to customers who desire to become more energy-efficient.

LADWP's Electrical Supply System

Generation and Purchased Power Resources

LADWP is the nation's largest municipal electric utility with a resource capability of 7,459 MW in 1990 (Table 3M-1). During 1990, approximately 75% of the system electric generating capacity was available from fossil fuels (i.e., oil, natural gas, and coal) and nuclear facilities, whereas 25% came from hydroelectric resources. Because only 5% of the total energy used by LADWP was produced by hydroelectric generation, the hydroelectric facilities were predominantly used to generate "peak" power, which is generally the most valuable type of power.

Resources within California. LADWP's largest generating facility is the 1,570-MW Haynes Generating Station in the City of Long Beach (Figure 3M-3). Three additional fossil-fueled steam plants located in the Los Angeles Basin generate 1,467 MW: the 517-MW Valley Generating Station in the San Fernando Valley, the 234-MW Harbor Generating Station in Wilmington, and the 716-MW Scattergood Generating Station near El Segundo. An additional 76 MW of combustion turbine capacity is available at the Harbor Generating Station. Natural gas supplied by the Southern California Gas Company is used as fuel for the Los Angeles Basin steam plants whenever economical gas is available; low-sulfur, low-ash residual oil is burned when economical gas is unavailable. The amount of energy produced by LADWP generating units from 1986 to 1990 is presented in Table 3M-2.

LADWP's major source of hydroelectric capacity in the Los Angeles Basin is the Castaic Pumped Storage Power Plant located near Sylmar. The Castaic plant provides 1,247 MW of peaking capacity; from 1986 to 1990 the plant produced between 162-330 GWh of energy per year. Detailed generation information on the Aqueduct hydroelectric power system is presented in a following section.

LADWP also transfers power to other utilities or entities, such as SCE, the California Department of Water Resources (DWR), and the City of Vernon. Transfers of capacity and energy to SCE, DWR, and the City of Vernon represent firm commitments; energy sales to other entities do not represent a firm commitment to deliver energy. Information on power transfers from 1986 to 1990 is presented in Table 3M-3.

Resources outside California. LADWP co-owns two coal-fired generating plants: Mojave in southern Nevada and Navajo in northern Arizona. LADWP's share of Mojave is 20%, which represents 316 MW of capacity. LADWP's share of Navajo is 21.2%, which represents 477 MW of capacity. During 1986, LADWP had access to an additional 73 MW of capacity from Navajo through an agreement with the Western Area Power Administration (WAPA). During 1986 and 1987, LADWP also had access to 70 MW of capacity from the Coronado power plant, a coal-fired facility in eastern Arizona.

LADWP has a generation entitlement of 1,004 MW of power from the Intermountain Power Project in Utah. During 1986, only one unit was in service at Intermountain Power Project, so the capacity available to LADWP was half that presently available.

LADWP has a 5.7% (217-MW) interest in the Palo Verde Nuclear Generating Station Units 1, 2, and 3 in Arizona. Unit 1 began operating in January 1986, Unit 2 began operating in September 1986, and Unit 3 in January 1988. LADWP also has a 3.96% (151-MW) generation entitlement share of power produced at the Palo Verde plant through the Southern California Public Power Authority's ownership interest of 5.91%. LADWP's major source of out-of-basin hydroelectric capacity is the Hoover Dam power plant in southern Nevada, which provides approximately 491 MW. Energy obtained by LADWP from out-of-state resources from 1986 to 1990 is presented in Table 3M-4.

In addition to the out-of-basin resources described above, LADWP purchased capacity and energy from the Bonneville Power Administration, Pacific Power & Light, Montana Power Company, Utah Power & Light, WAPA, Deseret Generation and Transmission Cooperative, and others between 1986 and 1990. Purchasing capacity from other utilities involves reserving the opportunity to buy energy in the future. These purchases are presented in Table 3M-5.

Transmission System

In-Basin Transmission System. LADWP's transmission system in the Los Angeles Basin (in-basin) is a network of overhead and underground transmission lines operating at 500 kV, 230 kV, 138 kV, and 115 kV. These transmission lines and the associated substations collect power generated inside and outside the basin for distribution to LADWP's customers.

The Adelanto and Victorville switchyards transfer power from outside the basin to 500-kV transmission lines for distribution in the basin. After power reaches LADWP's numerous in-basin receiving stations and substations, such as the Rinaldi Substation, it is distributed over a 500-kV transmission network that reaches around the periphery of the basin and then into the in-basin network of lower voltage transmission and distribution lines. An overview of the system is provided in Figure 3M-3.

Out-of-Basin Transmission System. Several transmission interconnections, including the Pacific Direct Current (DC) Intertie, the Intermountain-Adelanto DC line, and the Victorville-McCullough lines, are used to provide access to remote generating sources. LADWP's out-of-basin transmission system (Figure 3M-4) provides for access to its external resources and for the purchase, sale, and exchange of electric energy with member utilities of the Western Systems Coordinating Council (WSCC). WSCC is one of the regional reliability councils that reports to the National Electric Reliability Council. The WSCC area includes the 11 contiguous westernmost states, plus portions of Canada and Mexico. Energy from the Bonneville Power Administration and other Pacific Northwest utilities is delivered over the ±500-kV Pacific DC Intertie.

The Intermountain-Adelanto 1,000-kV DC transmission line, the Navajo-McCullough 500-kV transmission line, and the McCullough-Victorville 500-kV and 287-kV transmission lines provide access to LADWP's out-of-basin resources, including its shares in the Intermountain Power Project, the Palo Verde station, Hoover Dam, and the Navajo Generating Station. These lines also allow for the purchase of economy energy (i.e., low-cost energy) from utilities in Nevada, Arizona, New Mexico, and Colorado. Information on the transmission system for the Aqueduct hydroelectric power system is presented in the following section.

Los Angeles Aqueduct Hydroelectric Power System

The Aqueduct hydroelectric power system provides about 2.7% of LADWP's dependable capacity (Table 3M-1). From 1986 through 1990, the Aqueduct hydroelectric power system generated between 1.2% and 5.6% of the energy demands met by LADWP.

The Aqueduct hydroelectric power system comprises three subsystems: the Owens River gorge subsystem, the Owens Valley subsystem, and the Aqueduct subsystem. The generating plants in each of these subsystems rely on water that either flows into the

Aqueduct directly from mountain tributaries, or water that is diverted from Mono Basin and flows through the Aqueduct's system of reservoirs and canals.

Owens River Gorge Subsystem

Located at the northernmost reach of Owens Valley along the Owens River gorge are LADWP's Upper, Middle, and Control Gorge power plants (Figure 3M-1). These plants were constructed in conjunction with the extension of the Aqueduct in the 1950s. The largest amount of water provided to these plants comes from tributary streams in the Upper Owens River watershed; a smaller amount comes from the diversion of four tributaries of Mono Lake. The water collected in Mono Basin flows through the Mono Craters Tunnel into Lake Crowley reservoir in the upper reaches of the Owens River 20 miles north of Bishop. Water destined for the Aqueduct follows the Owens River through the Owens River gorge, passing through the Upper Gorge, Middle Gorge, and Control Gorge power plants and then into Pleasant Valley Reservoir. The total installed capacity of the Owens River gorge plants is 112.5 MW (37.5 MW each); however, LADWP estimates that 110 MW is the dependable capacity of the Owens River gorge plants.

Power from the Owens River gorge power plants is transmitted to the Los Angeles basin via a 244-mile-long 230-kV transmission line extending to LADWP's Rinaldi Substation located near San Fernando (Figure 3M-1).

Owens Valley Subsystem

The Owens Valley plants are the oldest elements of the Aqueduct power system; most of the facilities were constructed before 1930. The present Owens Valley subsystem includes the generating plants listed in Table 3M-6 and the transmission facilities required to connect them.

The Pleasant Valley and Haiwee power plants are located on the main channel of the Aqueduct. Water flowing in the Aqueduct passes through these power plants and generates electricity. The Big Pine, Division Creek, and Cottonwood power plants generate power using water collected for the Aqueduct from eastern slope Sierra tributaries of the Owens River. Water from the tributaries passes through the penstocks of each power plant, generating electricity before it reaches the Aqueduct.

The installed capacity of the Owens Valley plants is 13.9 MW; however, LADWP assumes a dependable capacity value of 1.5 MW for the Big Pine plant and 0.5 MW for the Cottonwood plant. Because of the size of the first Los Angeles aqueduct downstream of the plant, the output of the Haiwee plant is limited to 3.5 MW. These three reductions result in a total dependable capacity for the Owens Valley plants of 9 MW.

Power generated by the Owens Valley power plants is delivered to LADWP's in-basin system on the Rinaldi Substation-Control Gorge 230-kV transmission line. LADWP's

34.5-kV subtransmission line connects the Owens Valley plants to the Rinaldi Substation-Control Gorge 230-kV transmission line at the Inyo and Cottonwood Substations.

The Owens Valley is also a corridor for the Pacific DC Intertie and two SCE 115-kV transmission lines (Figure 3M-1). LADWP and SCE are connected at two locations in the Owens Valley: a 115-kV/230-kV transformer connects LADWP's 230-kV Inyo Substation and SCE's 115-kV Control Substation, and a 115-kV tie-line connects LADWP and SCE at the Haiwee Substation.

The Aqueduct Subsystem

Between the South Haiwee Reservoir and the Fairmont No. 2 Reservoir, which is upstream of the San Francisquito No. 1 plant, the Aqueduct consists of two elements. In this portion of the Aqueduct system, the first element, a pipeline, has a capacity of 470 cfs, and the capacity of the second element, an open ditch, is 300 cfs. The capacity of the Fairmont No. 2 reservoir is 500 af. Between the Fairmont No. 2 Reservoir and the upstream side of the San Francisquito No. 1 plant, all diversions flow through a single pipeline with a maximum capacity of 1,000 cfs. Water can be diverted from this pipeline into either the San Francisquito No. 1 plant or into the Bouquet Reservoir via an element with a capacity of between 600 and 700 cfs. Immediately downstream of the San Francisquito No. 1 plant, the pipeline, which has a maximum capacity of 1,000 cfs, splits. One segment enters the San Francisquito No. 2 plant, a second segment becomes the Saugus Pipeline, and the third segment connects with the Drinkwater Reservoir. The pipeline downstream of the San Francisquito No. 2 plant has a capacity of approximately 470 cfs, whereas the Saugus Pipeline has a capacity of approximately 300 cfs. The capacity of the Drinkwater Reservoir is 90 af.

The units at the plants located along the Aqueduct Subsystem are shown in Table 3M-7. The total installed capacity for these units is 133.5 MW; however, total dependable capacity is only 78 MW because of the following factors:

- The output of the San Francisquito No. 1 plant (Units 1-1A, 1-3, 1-4, and 1-5) is limited to 46 MW (rather than 95.5 MW) because of the size of the Aqueduct downstream of the plant.
- The output of the San Francisquito No. 2 plant (Units 2-1, 2-2, and 2-3) is limited to 16 MW (rather than 39 MW) because of the size of the first Aqueduct pipeline downstream of the plant.
- The total output of the two San Fernando plants (Units 1 and 2) is limited to 3 MW (rather than 6.3 MW) because of the flow-through capacity of the plant.

Output from the seven units of the San Francisquito No. 1 and No. 2 plants is delivered to the Olive Substation near San Fernando, via the San Francisquito-Olive 115-kV transmission lines. Output from the two San Francisquito plants, and the Foothill, Sawtelle, and Franklin plants is delivered to various locations on LADWP's 34.5-kV distribution system.

Relationship between Water Diversions and Operations of the Aqueduct Hydroelectric Power System Plants

From 1986 through 1990, the amount of energy generated at the Owens River gorge plants, the Owens Valley plants, and the Aqueduct plants declined sharply. These declines reflect the effects of diminished flows because of drought-related reductions in water availability. In addition, diversions from Mono Basin were reduced in 1989 and then eliminated in 1990.

As expected for a hydroelectric system, a strong correlation exists between the amount of water diverted through the Aqueduct and the amount of energy generated by the hydroelectric plants along the Aqueduct. The amount of energy available from the Aqueduct hydroelectric facilities declined from approximately 1,250 GWh in 1986 to approximately 720 GWh in 1989, an average annual decrease of approximately 14% (Table 3M-8 and Figure 3M-5). The amount of water diverted through Pleasant Valley Reservoir, which provides storage for water transferred in the Aqueduct, declined from approximately 360 TAF in 1986 to approximately 200 TAF in 1989, an average annual decrease of approximately 15%. The total energy generated in 1990 was approximately 290 GWh, a 60% decrease from the level of 1989.

The decrease in water availability also changed the way in which the hydroelectric facilities along the Aqueduct were operated and used. During 1986, the Owens River gorge plants were operated at full output over 50% of the time and, even during June and July, were operated at full output over 30% of the time (Table 3M-9). However, in 1990, the Owens River gorge plants were operated in a peaking mode with an average output of 12-20% of their maximum output.

During 1986, the Owens Valley plants were operated in a base-load fashion; that is, they generated energy essentially 100% of the time (Table 3M-9). However, in 1990, the decrease in water availability resulted in reduced energy production, and the average output of the Owens Valley plants dropped to about 34% of their maximum output. Consistent with these plants' run-of-the-river operation, LADWP operated these plants at less than full capacity essentially around the clock.

During 1986, the Aqueduct plants were also operated as base-load plants; that is, they generated energy approximately 90% of the time (Table 3M-9). However, in 1990, the decrease in water availability resulted in reduced energy production, and the average output of the Aqueduct plants dropped to about 20% of their maximum output. LADWP generally operated these plants at less than full capacity output for most of the day.

Projected Demand and Supply

The following section describes projected annual power demand and supply conditions from 1992 to 2009. This information was compiled from data used by the CEC (Griffin and Merritt 1990) in the ELFIN simulation model to forecast future energy conditions.

Projected Demand and Energy Requirements

LADWP's projected capacity requirements (i.e., peak demand) for 1992 through 2009 are shown in Table 3M-10. Capacity requirements are expected to increase from 5,456 MW in 1992 to 7,421 MW in 2009, an average annual increase of approximately 2.0%.

LADWP's projected energy requirements for 1992 through 2009 are expected to increase from 23,212 GWh in 1992 to 30,815 GWh in 2009, an average annual increase of approximately 1.8%.

Projected Supply

This section describes projected capacity, energy resources, and transmission capabilities of the LADWP power supply system from 1992 to 2009.

Capacity Resources. In 1992, LADWP's in-state capacity resources are estimated to be approximately 4,900 MW (Table 3M-11). These resources are projected to increase by approximately 480 MW between 1992 and 2009. This net increase reflects:

- the Harbor repowering project, which increases the output of the Harbor facilities by 6 MW;
- the increase in capacity at Scattergood Unit 3, which increases the output of the Scattergood facility by 89 MW;
- the addition of 150 MW of cogeneration resources, primarily in the Coso Geothermal Area; and
- the addition of 196 MW of load management and conservation resources.

Out-of-state capacity resources available to LADWP in 1992 are estimated to be approximately 2,900 MW. The resources are projected to decrease by approximately 220 MW from 1992 to 2009 because of a decrease in the amount of capacity from the Palo Verde plant. In addition, the amount of nonfirm capacity available from the Pacific Northwest and the Southwest is anticipated to decrease by approximately 180 MW from 1992 to 2009.

The amount of total capacity (both inside and outside California) available to LADWP from existing and planned resources is projected to be greater than LADWP's capacity requirements under all water diversion alternatives. Consequently, additional capacity resources are not expected to be required under any of the water diversion alternatives.

Energy Resources. Table 3M-12 presents data on the projected amounts of energy to be produced by LADWP between 1992 and 2009. Total energy produced by LADWP at its in-state resources is projected to increase from 6,653 GWh in 1992 to 15,217 GWh in 2009.

Total energy generated by LADWP at out-of-state facilities is projected to decrease from 19,228 GWh in 1992 to 19,142 GWh in 2009. Energy available to LADWP from other sources in the Pacific Northwest and Southwest is projected to increase from 3,440 GWh in 1992 to 3,859 GWh in 2009.

Transmission Resources. LADWP has indicated no short-term or long-range plans to add to or increase the transmission capability in the Owens Valley area. It is, however, considering proposals from respondents to the 1990 request for proposals to develop the Coso Known Geothermal Resource Area (KGRA). One or more of these proposals may include modifications to the Rinaldi-Gorge 230-kV transmission line to accommodate the KGRA development.

As part of its annual planning process, LADWP identifies transmission projects that serve to ensure the reliable delivery of energy to its customers. A list of these projects is presented in Table 3M-13.

To provide additional access to energy resources in the Southwest, LADWP and several other entities are pursuing several transmission projects. The projects, some of which are shown in Figure 3M-4, are intended to increase the flexibility and reliability of LADWP's power system and provide access to low-cost energy and capacity. These projects include the Mead-Adelanto transmission project, the Mead-Phoenix transmission project, the second Devers-Palo Verde 500-kV transmission line, and the Utah-Nevada transmission project.

IMPACT ASSESSMENT METHODS

LADWP's need for electricity is served by a combination of resources, including the hydroelectric generating facilities located along the Los Angeles Aqueduct (LA Aqueduct). The amount of water diverted through these hydroelectric facilities directly affects the amount of capacity and energy available to LADWP. Consequently, LADWP's other resources must vary their output to adjust for changes in the capacity and energy available from the LA Aqueduct hydroelectric generating facilities. This power generation impact analysis focuses on predicting possible effects of the alternatives on LADWP and its customers and, to a lesser degree, on other areas where LADWP's out-of-state resources are located.

This section describes the methods used to predict impacts of the alternatives and to assess the significance of these impacts. Direct, indirect, and cumulative impacts of the diversion alternatives are considered.

Impact Prediction Methodology

For this analysis, impacts are predicted changes in the amount of electrical energy that would be generated by the LA Aqueduct hydroelectric facilities. These changes in hydroelectric energy result in changes in the production of electricity by LADWP's other resources and to changes in fuel costs associated with these resources. Changes in the production of electricity by LADWP's other resources result in changes in the amount of emissions at plants located within the Los Angeles basin and outside of the basin (predominately outside of California). The changes in emissions for the out-of-basin resources primarily occur at the Navajo, Mohave, and Intermountain coal-fired power plants.

Impacts were examined under near-term, drought, and long-term analyses. The near-term analysis focused on changes in energy production over a 20-year analysis period (1992-2011) using water export information predicted by the Los Angeles Aqueduct Monthly Program (LAAMP) operations model. The methods used for estimating the amount of water diverted through the LA Aqueduct facilities are described in detail in Chapter 2, "Project Alternatives and Points of Reference", and in the methods section of Chapter 3L, "Water Supply". The drought analysis evaluated the effects on hydroelectric generation from having 8 dry years in the 20-year analysis period compared to 4 dry years included in the representative scenario. Long-term impacts were analyzed for two alternatives (6,390-Ft and 6,410-Ft) in which the amount of average annual energy generated from the LA Aqueduct facilities would differ from that produced over the near term (i.e., first 20 years). For these two alternatives, average hydroelectric energy output during the period in which equilibrium lake levels are reached is compared to average output in the near-term analysis.

The cumulative analysis examined the potential impact of losses of energy generated from LA Aqueduct facilities combined with other projects and events that could affect LADWP's energy supply.

Criteria for Determining Impact Significance

The criteria used to assess the significance of predicted changes in LA Aqueduct hydroelectric energy generation are predicted changes in fuel supply costs and predicted changes in emissions from LADWP's in-basin and out-of-basin generating facilities.

The ELFIN model, an energy production simulation model developed by the Environmental Defense Fund, was used to develop the data needed to assess fuel supply costs and emissions levels. The ELFIN model, which allows the calculation of energy production, costs, and emissions associated with serving a given level of electrical load, was utilized as follows. First, the amount of energy and capacity available from the LA Aqueduct hydroelectric generating facilities for a given level of assumed water diversions was determined using relationships between water flow, energy, and capacity availability; these relationships were developed from historical information provided by LADWP. This LA Aqueduct generation information was then used to develop input data representing the LA Aqueduct facilities for the ELFIN model. Finally, a series of ELFIN simulations were performed. Each simulation represented a different level of LA Aqueduct energy production and capacity availability and, as a result, differing levels of energy production by and capacity used from LADWP's non-LA Aqueduct resources.

The major inputs to the ELFIN model are the overall level and pattern of energy demands and the operating cost and performance characteristics of generating units (including thermal, hydroelectric, and pumped storage facilities). The model determines the least cost manner of operating the generating units within any given month, season, or year to maximize overall system reliability. Generating resources are dispatched to serve load in order of increasing incremental operating cost; however, generating units with non-economic constraints (such as run-of-river hydroelectric generation or unit-minimum generation requirements) are dispatched first.

The level and pattern of energy demands for LADWP, and the operating costs and performance characteristics of LADWP's generating units for 1992-2009, were obtained from data files developed by the California Energy Commission for the 1990 Electricity Report (ER-90). Data for 2010 and 2011 were estimated using escalation trends for the 5-year period of 2005-2009.

Because the LA Aqueduct hydroelectric facilities supply a relatively small portion of LADWP's total energy requirements (Table 3M-1), changes in diversions through the LA Aqueduct are not expected to affect LADWP's ability to meet its electrical demands. Also, the relatively small increase in energy production by other facilities to replace LA Aqueduct energy would have little impact on LADWP's ability to transmit energy over its transmission system. Therefore, potential impacts on electrical supply shortages or on transmission capabilities are not addressed further.

For a predicted change in the supply of energy produced by LADWP from the LA Aqueduct hydroelectric facilities to be considered significant, an alternative must:

- cause a 2% or greater increase in LADWP's average annual fuel costs compared to the point-of-reference condition,
- cause the NO_x emissions from LADWP's in-basin resources to exceed 960 tons per year,

- cause the change in SO_x emissions from LADWP's in-basin resources to exceed 27 tons per year,

- cause the CO emissions from LADWP's in-basin resources to exceed 100 tons per year, or

- cause the out-of-basin emissions monitored to exceed the levels in the point-of-reference condition by 1%.

The threshold for assessing the significance of cost impacts is based on historical increases in costs to residential and commercial customers and the effect these cost increases had on electricity sales. Between 1980 and 1989, the average cost of energy to LADWP's residential and commercial customers increased at an annual rate of about 3.1%, of which about 2% was attributable to increases in fuel and operations/maintenance expenses. During the same period, sales of electricity to residential and commercial customers increased at an annual rate of about 3.2%. Based on this information, cost increases apparently did not limit sales to residential and commercial customers during this period. Consequently, a 2% increase in fuel costs above the point-of-reference conditions would not be expected to significantly affect electricity customers and therefore is used as the significance threshold.

The NO_x threshold is based on amendments to South Coast Air Quality Management District (SCAQMD) Regulation XI, Rule 1135, that were in effect when the ER-90 data file was prepared. This rule established that LADWP will be subject to a NO_x emission rate ceiling of 0.15 pounds per megawatts per hour (MWh). The rule establishes an annual emissions cap of 960 tons of NO_x per year for LADWP. This annual cap was used as the threshold in the analysis.

The thresholds for SO_x and CO are based on a significance threshold developed by the South Coast Air Quality Management District (1992) for evaluating the emissions of new projects in the basin. Daily emission thresholds were converted to annual emission rates and applied to changes in emissions of the alternatives, relative to point-of-reference conditions, to assess the significance of impacts.

The 1% significance threshold for evaluating out-of-basin emissions was selected as the level of detectability for changes in emissions. Changes in emissions that are less than 1% are considered not significantly different from point-of-reference conditions.

Cumulative impacts are those impacts that would result from all potential changes in LADWP's energy supplies. To be considered significant, a cumulative impact must:

- result in a potential reduction in annual energy supplies that exceeds 5%, which reflects the approximate average annual change in LADWP energy supplies between 1986 and 1990 (this threshold is considered a relevant indicator of LADWP's ability to respond to variability in supplies from available power sources).

SUMMARY COMPARISON OF IMPACTS AND BENEFITS OF THE ALTERNATIVES

As described in the impact assessment methodology, relative power generation effects of the alternatives are assessed in this chapter through the following key variables:

- average annual energy produced by the hydroelectric facilities along the LA Aqueduct,
- percentage increases in average annual fuel costs associated with LADWP's in-basin and out-of-basin generating facilities, and
- percentage increases in emissions (on an average annual basis and for 2011) associated with LADWP's in-basin and out-of-basin generating facilities.

Tables 3M-14 and 3M-15 provide a summary comparison of each alternative based on these variables. Values of the variables for each alternative are compared to values for the point-of-reference condition. All impacts identified in Tables 3M-14 and 3M-15 are considered less than significant. A discussion of the variables for each alternative is provided in the following sections of this chapter.

CHARACTERIZATION OF POINT-OF-REFERENCE CONDITIONS

The point-of-reference scenario represents the base condition to which all seven water supply alternatives are compared. The point-of-reference condition differs from the seven alternatives by the amount of water that flows through the LA Aqueduct for use by LADWP, which results in varying amounts of electrical energy being produced by hydroelectric generating facilities along the LA Aqueduct and at other LADWP resources.

Figure 3M-6 shows the annual amount of energy generated by hydroelectric facilities along the LA Aqueduct under point-of-reference conditions. Low levels of energy production in 2000 and during the last 3 years of the 20-year scenario represent dry water years in which flows of water through the aqueduct are lower.

Point-of-reference results show that 1,038,000 MWh of energy per year would be available from the LA Aqueduct, averaged over the 20-year period (Table 3M-14). Average annual fuel costs (in 1992 dollars) associated with all of LADWP's resources are $676.6 million: $371.7 million are incurred by LADWP's in-basin generating facilities and the balance of $303.9 million are incurred by LADWP out-of-basin resources. These costs are for natural gas burned in the in-basin units and for coal and nuclear fuel burned in units outside the basin. The amount of energy produced by region under point-of-reference conditions is shown in Figure 3M-7.

The following analysis examines the energy generation impacts of each alternative relative to the point-of-reference scenario.

IMPACTS AND MITIGATION MEASURES FOR THE NO-RESTRICTION ALTERNATIVE

Changes in Energy Supply Conditions

Near-Term Effects

The amount of energy available from the LA Aqueduct for the No-Restriction Alternative varies substantially from year to year, both in absolute terms and compared to point-of-reference conditions (Figure 3M-8a). On an average annual basis, the No-Restriction Alternative would result in approximately 34,000 MWh of additional energy generated at LA Aqueduct hydroelectric facilities (Table 3M-14). This increase in output from LA Aqueduct facilities would result in a reduction in energy generation primarily from in-basin resources (59% of the total reduction in energy generation).

The No-Restriction Alternative would reduce total fuel costs over the 20-year period by about 0.2% per year (Table 3M-14). In-basin emissions of all pollutants would be slightly reduced or remain unchanged. The No-Restriction Alternative would have a beneficial power supply impact on LADWP, compared to the point-of-reference conditions.

Under the No-Restriction Alternative, out-of-basin emissions would be reduced or remain unchanged for all pollutants (Table 3M-15); consequently, this alternative would have a slight beneficial impact on out-of-basin air resources.

Drought Effects

The drought scenario would reduce energy production from LA Aqueduct hydroelectric facilities by an average of 84,000 MWh per year, compared to energy production under the point-of-reference scenario (Table 3M-14).

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures

- Provides, on average, an additional 34,000 MWh of energy per year, resulting in a slightly lower (approximately 0.2%) total cost of fuel and a slight decrease in emissions from LADWP's in-basin generating facilities.

- Slightly reduces emission levels at LADWP's out-of-basin facilities.

IMPACTS AND MITIGATION MEASURES FOR THE 6,372-FT ALTERNATIVE

Changes in Energy Supply Conditions

Near-Term Effects

Figure 3M-8a compares the amount of energy generated from LA Aqueduct facilities under the 6,372-Ft Alternative to that under the point-of-reference scenario. On average, the 6,372-Ft Alternative would decrease energy generated at LA Aqueduct hydroelectric facilities by approximately 33,000 MWh per year (Table 3M-14). This decrease in output from LA Aqueduct facilities would result in an increase in energy generation entirely from in-basin resources.

The decreased energy availability from LA Aqueduct hydroelectric facilities would slightly increase (0.3%) total system fuel costs. Emissions from in-basin generation would increase slightly; however, based on the significance criteria, the 6,372-Ft Alternative would not have a significant adverse impact on LADWP or its customers.

Under the 6,372-Ft Alternative, out-of-basin emissions would be reduced or remain unchanged for all pollutants; consequently, this alternative would have a slight beneficial impact on out-of-basin air resources.

Drought Effects

The drought scenario would result in an average annual reduction of 107,000 MWh per year from LA Aqueduct hydroelectric facilities, compared to energy production under the point-of-reference scenario.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures

There are no benefits, significant impacts, or mitigation measures for this alternative.

IMPACTS AND MITIGATION MEASURES FOR THE 6,377-FT ALTERNATIVE

Changes in Energy Supply Conditions

Near-Term Effects

Figure 3M-8a compares the amount of energy generated from LA Aqueduct facilities under the 6,377-Ft Alternative to that under the point-of-reference scenario. On average, the 6,377-Ft Alternative would decrease energy generated from LA Aqueduct hydroelectric facilities by approximately 54,000 MWh per year (Table 3M-14). This decrease in output from LA Aqueduct facilities would result in an increase in energy generation primarily from in-basin resources (84% of the total increase in energy generation).

The decreased energy availability from LA Aqueduct hydroelectric facilities would slightly increase (0.4%) total system fuel costs. Emissions from in-basin generation would increase slightly; however, based on the significance criteria, the 6,377-Ft Alternative would not have a significant adverse impact on LADWP or its customers.

Under the 6,377-Ft Alternative, out-of-basin emissions would remain unchanged or slightly increase. Based on the significance criteria, this impact is not considered significant.

Drought Effects

The drought scenario would result in an average annual reduction of 165,000 MWh per year from LA Aqueduct hydroelectric facilities, compared to energy production under the point-of-reference scenario.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures

There are no benefits, significant impacts, or mitigation measures for this alternative.

IMPACTS AND MITIGATION MEASURES FOR THE 6,383.5-FT ALTERNATIVE

Changes in Energy Supply Conditions

Near-Term Effects

Figure 3M-8a compares the amount of energy generated from LA Aqueduct facilities under the 6,383.5-Ft Alternative to that under the point-of-reference scenario. On average, the 6,383.5-Ft Alternative would decrease energy generated from LA Aqueduct hydroelectric facilities by approximately 54,000 MWh per year (Table 3M-14). This decrease in output from LA Aqueduct facilities would result in an increase in energy generation primarily from in-basin resources (67% of the total increase in energy generation).

The decreased energy availability from LA Aqueduct hydroelectric facilities would slightly increase (0.6%) total system fuel costs. Emissions from in-basin generation would increase slightly; however, based on the significance criteria, the 6,383.5-Ft Alternative would not have a significant adverse impact on LADWP or its customers.

Under the 6,383.5-Ft Alternative, out-of-basin emissions would slightly increase, with a maximum increase of about 0.13% for SO_x on an average annual basis. Based on the significance criteria, this impact is not considered significant.

Drought Effects

The drought scenario would result in an average annual reduction of 158,000 MWh per year from LA Aqueduct hydroelectric facilities, compared to energy production under the point-of-reference scenario.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures

There are no benefits, significant impacts, or mitigation measures for this alternative.

IMPACTS AND MITIGATION MEASURES FOR THE 6,390-FT ALTERNATIVE

Changes in Energy Supply Conditions

Near-Term Effects

Figure 3M-8b compares the amount of energy generated from LA Aqueduct facilities under the 6,390-Ft Alternative to that under the point-of-reference scenario. On average, the 6,390-Ft Alternative would decrease energy generated from LA Aqueduct hydroelectric facilities by approximately 134,000 MWh per year (Table 3M-14). This decrease in output from LA Aqueduct facilities would result in an increase in energy generation primarily from in-basin resources (67% of the total increase in energy generation).

The decreased energy from LA Aqueduct hydroelectric facilities availability would slightly increase (0.7%) total system fuel costs. Emissions from in-basin generation would increase slightly; however, based on the significance criteria, the 6,390-Ft Alternative would not have a significant adverse impact on LADWP or its customers.

Under the 6,390-Ft Alternative, out-of-basin emissions would remain unchanged or slightly increase. Based on the significance criteria, this impact is not considered significant.

Drought Effects

The drought scenario would result in an average annual reduction of 141,000 MWh per year from LA Aqueduct hydroelectric facilities, compared to energy production under the point-of-reference scenario.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures

There are no benefits, significant impacts, or mitigation measures for this alternative.

IMPACTS AND MITIGATION MEASURES FOR THE 6,410-FT ALTERNATIVE

Changes in Energy Supply Conditions

Near-Term Effects

Figure 3M-8b compares the amount of energy generated from LA Aqueduct facilities under the 6,410-Ft Alternative to that under the point-of-reference scenario. On average, the 6,410-Ft Alternative would decrease energy generated from LA Aqueduct hydroelectric facilities by approximately 184,000 MWh per year (Table 3M-14). This decrease in output from LA Aqueduct facilities would result in an increase in energy generation primarily from in-basin resources (68% of the total increase in energy generation).

The decreased energy availability from LA Aqueduct hydroelectric facilities would slightly increase (about 1%) total system fuel costs. Emissions from in-basin generation would increase slightly; however, based on the significance criteria, the 6,410-Ft Alternative would not have a significant adverse impact on LADWP or its customers.

Under the 6,410-Ft Alternative, out-of-basin emissions would remain unchanged or slightly increase. Based on the significance criteria, this impact is not considered significant.

Drought Effects

The drought scenario would result in an average annual reduction of 119,000 MWh per year from LA Aqueduct hydroelectric facilities, compared to energy production under the point-of-reference scenario.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures

There are no benefits, significant impacts, or mitigation measures for this alternative.

IMPACTS AND MITIGATION MEASURES FOR THE NO-DIVERSION ALTERNATIVE

Changes in Energy Supply Conditions

Near-Term Effects

Figure 3M-8b compares the amount of energy generated from LA Aqueduct facilities under the No-Diversion Alternative to that under the point-of-reference scenario. On average, the No-Diversion Alternative would decrease energy generated from LA Aqueduct hydroelectric facilities by approximately 221,000 MWh. This decrease in output from LA Aqueduct hydroelectric facilities would result in an increase in energy generation primarily from in-basin resources (71% of the total increase in energy generation).

The decreased energy availability from LA Aqueduct hydroelectric facilities would slightly increase (about 1.2%) total system fuel costs. Emissions from in-basin generation would increase slightly; however, based on the significance criteria, the No-Diversion Alternative would not have a significant adverse impact on LADWP or its customers.

Under the No-Diversion Alternative, out-of-basin emissions would slightly increase, with a maximum increase of 0.22% for SO_x on an average annual basis. Based on the significance criteria, this impact is not considered significant.

Drought Effects

The drought scenario would result in an average annual reduction of 101,000 MWh per year from LA Aqueduct hydroelectric facilities, compared to energy production under the point-of-reference scenario.

Summary of Benefits and Significant Impacts and Identification of Mitigation Measures

There are no benefits, significant impacts, or mitigation measures for this alternative.

CUMULATIVE IMPACTS OF THE ALTERNATIVES

Related Impacts of Earlier Stream Diversions by LADWP

The production of energy from hydroelectric facilities along the LA Aqueduct has been ongoing since 1941. This production has had a beneficial economic impact on LADWP and its ratepayers because it has reduced the need for generation by other more costly facilities.

Related Impacts of Other Past, Present, or Anticipated Projects or Events

Several past, present, and future events, when combined with future limits on Mono Basin diversions and the resulting impact on energy production, may cause additional impacts on LADWP. These events include:

- changes in operations at the Hoover power plant due to limitations on downstream water releases,
- the Inyo-Owens Groundwater Pumping Agreement, and
- other future demands for Mono Basin waters, as discussed in the "Water Supply Impacts" section.

In January and February 1993, water releases from the Hoover power plant were limited to reduce the amount of water flowing into Mexico because of the large amounts of water entering the Colorado River from rivers downstream of the plant. Consequently, power production was also reduced. Although such events are not planned, they can affect the hydroelectric capacity and energy available from Hoover, which supplied approximately 3% of LADWP's energy requirements during 1988-1990.

The Inyo-Owens Pumping Agreement limits the amount of groundwater that LADWP can pump from the Owens River groundwater basin. Because the limits imposed by this agreement have been reflected in the alternatives, no additional impacts are expected.

Future development in Mono Basin and Owens River basin may limit the amount of water that can be delivered through the LA Aqueduct, which could affect the amount of energy generated by hydroelectric facilities along the aqueduct (refer to Chapter 3L, "Los Angeles Water Supply").

Other potential events include possible changes in air quality regulations that could affect LADWP's coal-fired generating facilities and changes in regulatory policies affecting nuclear generating facilities, such as Palo Verde. Because these events are considered speculative at present, their effects on future energy supplies are not considered in this analysis.

Significant Cumulative Impacts

Several past, present, and future activities have the potential to reduce water deliveries from Mono Basin and Owens River basin to LADWP, which, in turn, would reduce the amount of energy generated along the LA Aqueduct. In addition, limits on future water releases at the Hoover power plant could reduce the energy available to LADWP.

These impacts, when considered in conjunction with impacts of the project alternatives, are not expected to result in annual energy supplies being reduced by more than 5%; therefore, they are considered less than significant.

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Table 3M-1. City of Los Angeles Department of Water and Power Capacity and Energy Loads and Resources, 1986-1990

	1986	1987	1988	1989	1990
Capacity (MW)					
Peak demand	4,744	4,922	4,991	4,774	5,312
Capacity resources					
Gas- and oil-fired plant	3,252	3,252	3,113	3,113	3,113
Coal-fired plant	1,438	1,867	1,797	1,797	1,797
Hydroelectric plant					
Aqueduct	196	200	200	200	200
Other	1,748	1,738	1,738	1,738	1,738
Subtotal	1,944	1,938	1,938	1,938	1,938
Nuclear plant	236	236	368	368	368
Purchased power	500	300	64	443	243
Transferred power	(47)	(50)	(254)	(294)	(318)
Total	7,323	7,543	7,026	7,365	7,141
Energy (GWh)					
Net energy for load	22,498	23,299	23,821	24,218	24,964
Energy resources					
Gas- and oil-fired plant	4,577	6,187	5,662	6,747	4,262
Coal-fired plant	8,211	11,081	12,331	12,439	12,996
Hydroelectric plant					
Aqueduct	1,253	1,034	862	721	295
Other	2,863	1,318	862	962	964
Subtotal	4,116	2,352	1,724	1,683	1,259
Nuclear plant	928	1,306	2,261	735	1,977
Cogeneration plant	243	247	309	474	588
Purchased power	4,853	2,716	2,289	3,117	4,642
Transferred power	(622)	(674)	(844)	(1,258)	(1,247)
Net interchange	192	84	89	281	487
Total	22,498	23,299	23,821	24,218	24,964

Note: LADWP considers cogeneration resources as a nonfirm resource; therefore, no capacity credit is shown for cogeneration.

Source: Neudeck pers. comm.

Table 3M-2. Energy Produced at LADWP's Gas- and Oil-Fired Generating Plants in California, 1986-1990 (in GWh)

Generating Plant	1986	1987	1988	1989	1990
Harbor	198	275	151	56	49
Harbor (combustion turbine)	0	0	1	0	0
Valley	160	587	437	515	154
Scattergood	1,515	1,662	1,042	1,839	1,518
Haynes	2,704	3,663	4,031	4,337	2,541
Total	4,577	6,187	5,662	6,747	4,262

Source: Neudeck pers. comm.

Table 3M-3. Capacity and Energy Transfers Made by Los Angeles Department of Water and Power, 1986-1990

	1986	1987	1988	1989	1990
Capacity (MW)					
SCE	0	0	200	200	200
DWR	47	50	54	64	88
City of Vernon	0	0	0	30	30
Total	47	50	254	294	318
Energy (GWh)					
SCE	4	11	118	186	156
DWR	416	440	477	561	776
City of Vernon	0	0	0	240	263
Other	202	223	249	271	52
Total	622	674	844	1,258	1,247

Source: Neudeck pers. comm.

Table 3M-4. Energy from Out-of-State Resources Partially Owned by Los Angeles Department of Water and Power, 1986-1990 (in GWh)

Plant	1986	1987	1988	1989	1990
Coal fired					
Mojave	2,029	1,754	2,018	1,712	1,780
Navajo	3,565	3,283	3,336	3,448	3,438
Coronado	432	149	4	0	0
Intermountain Power Project	2,185	5,895	6,973	7,279	7,778
Subtotal	8,211	11,081	12,331	12,439	12,996
Nuclear					
Palo Verde	928	1,306	2,261	735	1,977
Hydroelectric					
Hoover	2,656	1,084	700	690	634
Total	11,795	13,471	15,292	13,864	15,607

Source: Neudeck pers. comm.

Table 3M-5. Capacity and Energy Purchases Made by Los Angeles Department of Water and Power, 1986-1990

	1986	1987	1988	1989	1990
Capacity (MW)					
Bonneville Power Administration	200	300	0	0	0
Pacific Power and Light	300	0	0	0	0
Montana Power Company	0	0	0	105	105
Utah Power and Light	0	0	64	64	64
Western Area Power Administration	0	0	0	200	0
Deseret Generation and Transmission Cooperative	0	0	0	74	74
Total	500	300	64	443	243
Energy (GWh)					
Bonneville Power Administration	2,516	1,359	27	798	1,511
Pacific Power and Light	1,210	11	289	22	16
Montana Power Company	23	11	5	394	988
Utah Power and Light	0	117	363	399	395
Western Area Power Administration	0	0	310	220	0
Deseret Generation and Transmision Cooperative	274	424	876	626	539
Other	830	794	419	658	1,193
Total	4,853	2,716	2,289	3,117	4,642

Source: Neudeck pers. comm.

Table 3M-6. Capacities and In-Service Dates of LADWP's Owens Valley Generating Units

Generating Unit[a]	Installed Capacity (MW)	In-Service Date
Pleasant Valley	2.7	February 1958
Big Pine	3.2	July 1925
Division Creek	0.6	March 1909
Cottonwood 1	1.0	July 1908
Cottonwood 2	1.0	July 1908
Haiwee 1	2.7	July 1927
Haiwee 2	2.7	July 1927

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[a] Plant locations are identified in Figure 3M-1.

Source: Los Angeles Department of Water and Power 1989a.

Table 3M-7. Capacities and In-Service Dates of LADWP's Aqueduct Generating Units

Generating Unit[a]	Installed Capacity (MW)	In-Service Date
San Francisquito No. 1-1A	26	December 1903
San Francisquito No. 1-3	11	April 1917
San Francisquito No. 1-4	12.5	May 1923
San Francisquito No. 1-5	26	December 1928
San Francisquito No. 2-1	14.5	July 1920
San Francisquito No. 2-2	14.5	August 1920
San Francisquito No. 2-3	10	September 1932
San Fernando Unit 1	3.2	October 1922
San Fernando Unit 2	3.2	October 1922
Foothill	10	October 1971
Franklin	2	June 1921
Sawtelle	0.6	June 1986

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[a] Plant locations are identified in Figure 3M-1.

Source: Los Angeles Department of Water and Power 1989a.

Table 3M-8. Monthly Capacity, Energy Production, and Capacity Factor of Combined Aqueduct Generating Facilities, 1986-1990

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Capacity (MW)													
1986	196.0	196.0	196.0	196.0	196.0	196.0	196.0	196.0	196.0	196.0	196.0	196.0	196.0
1987-1990	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
Energy (GWh)													
1986	89.1	78.7	109.4	129.9	111.8	86.7	94.0	108.8	132.7	110.2	98.6	98.6	1,248.5
1987	77.5	94.6	81.6	69.5	65.5	111.0	133.7	140.5	91.9	46.3	45.5	72.2	1,029.8
1988	73.7	77.2	95.3	71.9	63.4	74.0	97.7	112.5	41.6	33.1	49.2	71.8	861.4
1989	98.6	63.5	59.4	39.2	49.9	62.4	115.9	83.6	64.2	25.7	23.6	31.2	717.2
1990	34.2	25.5	27.2	31.4	33.2	30.4	28.8	23.4	12.3	20.9	13.1	12.5	292.9
Capacity Factor (%)													
1986	61.1	59.8	75.0	92.0	76.7	61.4	64.5	74.6	94.0	75.6	69.9	67.6	72.7
1987	52.1	70.4	54.8	48.3	44.0	77.1	89.9	94.4	63.8	31.1	31.6	48.5	58.8
1988	49.5	57.4	64.0	49.9	42.6	51.4	65.7	75.6	28.9	22.2	34.2	48.3	49.2
1989	66.3	47.2	39.9	27.2	33.5	43.3	77.9	56.2	44.6	17.3	16.4	21.0	40.9
1990	23.0	19.0	18.3	21.8	22.3	21.1	19.4	15.7	8.5	14.0	9.1	8.4	16.7

Sources: Singley and Neudeck pers. comms.

Table 3M-9. Annual Capacity, Energy Production, and Capacity Factor of Los Angeles Aqueduct Generating Facilities, by Subsystem, 1986-1990

	Owens River Gorge Subsystem	Owens Valley Subsystem	Aqueduct Subsystem
Capacity (MW)	110.0	9.0	81.0[a]
Energy (GWh)			
1986	542.0	91.7	614.8
1987	409.1	59.6	561.1
1988	322.1	48.9	490.4
1989	288.4	46.6	382.2
1990	121.5	26.8	144.6
Capacity factor (%)			
1986	56.2	116.3	91.1
1987	42.5	75.6	79.6
1988	33.4	62.0	69.1
1989	29.9	59.1	53.9
1990	12.6	34.0	20.4

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[a] In 1986, capacity was 77.0 MW.

Source: Singley and Neudeck pers. comms.

Table 3M-10. Los Angeles Department of Water and Power's Projected Capacity and Energy Requirements, 1992-2009

Year	Capacity[a] (MW)	Annual Energy (GWh)
1992	5,456	23,212
1993	5,584	23,700
1994	5,697	24,134
1995	5,792	24,560
1996	5,909	25,061
1997	6,006	25,477
1998	6,108	25,897
1999	6,215	26,345
2000	6,339	26,797
2001	6,468	27,285
2002	6,590	27,756
2003	6,712	28,219
2004	6,835	28,675
2005	6,969	29,163
2006	7,077	29,580
2007	7,157	29,872
2008	7,292	30,340
2009	7,421	30,815

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[a] Equivalent to peak demand.

Source: Griffin and Merritt 1990.

Table 3M-11. Projected Capacity of LADWP Power Resources, 1992-2009 (in MW)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Inside California																		
Gas- or oil-fired generation																		
Harbor	234	234	234	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240
Harbor CTs	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76
Valley	517	517	517	517	517	517	517	517	517	517	517	517	517	517	517	517	517	517
Scattergood	716	716	716	805	805	805	805	805	805	805	805	805	805	805	805	805	805	805
Haynes	1,570	1,570	1,570	1,348	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570
Subtotal	3,113	3,113	3,113	3,208	2,986	3,208	3,208	3,208	3,208	3,208	3,208	3,208	3,208	3,208	3,208	3,208	3,208	3,208
Hydroelectric generation																		
Castaic	1,247	1,247	1,247	1,247	1,247	1,247	1,247	1,247	1,247	1,247	1,247	1,247	1,247	1,247	1,247	1,247	1,247	1,247
Aqueduct	199	199	199	199	199	199	199	199	199	199	199	199	199	199	199	199	199	199
Subtotal	1,446	1,446	1,446	1,446	1,446	1,446	1,446	1,446	1,446	1,446	1,446	1,446	1,446	1,446	1,446	1,446	1,446	1,446
Exchanges/transfers (net)																		
With DWR	(65)	(65)	(65)	(65)	(65)	(65)	(60)	(60)	(60)	(60)	(60)	(66)	(66)	(66)	(66)	(66)	(66)	(66)
With SCE	(39)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	(104)	(65)	(65)	(65)	(65)	(65)	(60)	(60)	(60)	(60)	(60)	(66)	(66)	(66)	(66)	(66)	(66)	(66)
Load management/ conservation	93	138	181	217	245	265	279	289	289	289	289	289	289	289	289	289	289	289
Cogeneration	282	282	282	332	332	382	382	432	432	432	432	432	432	432	432	432	432	432
Total inside California	4,830	4,914	4,957	5,138	4,944	5,236	5,255	5,315	5,315	5,315	5,315	5,309	5,309	5,309	5,309	5,309	5,309	5,309
Outside California																		
Purchases																		
Montana	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105
Deseret	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74
NW/SW firm and nonfirm	1,135	1,153	1,200	1,050	1,038	1,063	1,068	1,073	1,083	1,061	1,025	1,043	1,048	1,123	1,130	1,045	980	951
Subtotal	1,314	1,332	1,379	1,229	1,217	1,242	1,247	1,252	1,262	1,240	1,204	1,222	1,227	1,302	1,309	1,224	1,159	1,130
Coal-fired generation																		
Intermountain	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004
Mojave	316	316	316	316	316	316	316	316	316	316	316	316	316	316	316	316	316	316
Navajo	477	477	477	477	477	477	477	477	477	477	477	477	477	477	477	477	477	477
Subtotal	1,797	1,797	1,797	1,797	1,797	1,797	1,797	1,797	1,797	1,797	1,797	1,797	1,797	1,797	1,797	1,797	1,797	1,797
Nuclear (Palo Verde)	354	354	354	354	354	354	354	354	354	226	210	138	138	138	138	138	138	138
Hydroelectric (Hoover)	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491	491
Total outside California	3,956	3,974	4,021	3,871	3,859	3,884	3,889	3,894	3,904	3,754	3,702	3,648	3,653	3,728	3,735	3,650	3,585	3,556
Total capacity resources	8,786	8,888	8,978	9,009	8,803	9,120	9,144	9,209	9,219	9,069	9,017	8,957	8,962	9,037	9,044	8,959	8,894	8,865

Source: ELFIN data file.

Table 3M-12. Projected Energy Resources of LADWP, 1992-2009 (in GWh)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Inside California																		
Gas- or oil-fired generation																		
Harbor	0	0	0	273	470	199	426	521	640	687	706	738	783	812	844	869	874	903
Harbor CTs	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	4
Valley	19	56	56	0	56	0	38	19	74	100	132	162	185	226	303	417	538	627
Scattergood	1,317	1,554	1,643	1,537	1,422	1,690	1,745	1,657	1,800	2,014	2,220	2,440	2,498	2,667	2,742	2,884	2,978	3,152
Haynes	2,317	2,359	2,200	2,552	2,699	2,659	2,742	2,542	2,868	3,018	3,451	4,005	4,255	4,527	4,613	4,819	4,987	5,250
Subtotal	3,653	3,969	3,899	4,362	4,647	4,548	4,951	4,739	5,382	5,819	6,509	7,345	7,722	8,233	8,503	8,990	9,378	9,936
Hydroelectric generation																		
Castaic	(225)	(259)	(231)	(247)	(208)	(222)	(197)	(198)	(215)	(170)	(148)	(115)	(129)	(121)	(124)	(107)	(107)	(85)
Aqueduct	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176	1,176
Subtotal	951	917	945	929	968	954	979	978	961	1,006	1,028	1,061	1,047	1,055	1,052	1,069	1,069	1,091
Exchanges/transfers (net)																		
With DWR	(577)	(577)	(577)	(577)	(577)	(577)	(538)	(538)	(538)	(538)	(538)	(588)	(588)	(588)	(588)	(588)	(588)	(588)
With SCE	(76)	(77)	(59)	(73)	(48)	(54)	(36)	(41)	(35)	(34)	(28)	(34)	(45)	(125)	(116)	(95)	(85)	(63)
Subtotal	(653)	(654)	(636)	(650)	(625)	(631)	(574)	(579)	(573)	(572)	(566)	(622)	(633)	(713)	(704)	(683)	(673)	(651)
Load management/ conservation	482	753	1,007	1,204	1,333	1,404	1,436	1,446	1,431	1,423	1,420	1,418	1,414	1,411	1,408	1,404	1,400	1,397
Cogeneration	2,220	2,226	2,226	2,632	2,638	3,038	3,038	3,444	3,452	3,444	3,444	3,444	3,452	3,444	3,444	3,444	3,452	3,444
Total inside California	6,653	7,211	7,441	8,477	8,961	9,313	9,830	10,028	10,653	11,120	11,835	12,646	13,002	13,430	13,703	14,224	14,626	15,217
Outside California																		
Purchases																		
Montana	731	729	729	729	731	729	729	729	731	729	729	729	731	729	729	729	731	729
Deseret	144	256	343	256	344	255	343	343	344	343	343	343	344	343	343	343	344	343
NW/SW firm and nonfirm	3,440	3,271	3,260	2,817	2,759	2,838	2,964	2,881	2,992	3,250	3,429	3,546	3,610	3,833	3,938	3,875	3,801	3,859
Subtotal	4,315	4,256	4,332	3,802	3,834	3,822	4,036	3,953	4,067	4,322	4,501	4,618	4,685	4,095	5,010	4,947	4,876	4,931
Coal-fired generation																		
Intermountain	7,513	7,563	7,548	7,555	7,558	7,513	7,455	7,351	7,512	7,474	7,519	7,571	7,593	7,581	7,584	7,594	7,615	7,600
Mojave	1,555	1,799	1,799	1,711	1,803	1,799	1,799	1,799	1,803	1,799	1,799	1,799	1,803	1,799	1,799	1,799	1,803	1,799
Navajo	2,896	2,994	3,023	3,060	3,126	3,069	3,292	3,263	3,316	3,347	3,348	3,348	3,357	3,348	3,348	3,348	3,357	3,348
Subtotal	11,964	12,356	12,370	12,326	12,487	12,381	12,546	12,413	12,631	12,620	12,666	12,718	12,753	12,728	12,731	12,741	12,775	12,747
Nuclear (Palo Verde)	2,251	1,905	2,068	2,081	1,963	2,193	1,765	2,283	1,830	1,663	1,248	784	835	756	840	697	854	766
Hydroelectric (Hoover)	698	698	698	698	698	698	698	698	698	698	698	698	698	698	698	698	698	698
Total outside California	19,228	19,215	19,468	18,907	18,982	19,094	19,045	19,347	19,226	19,303	19,113	18,818	18,971	19,087	19,279	19,083	19,203	19,142
Total energy resources	25,881	26,426	26,909	27,384	27,943	28,407	28,875	29,375	29,879	30,423	30,948	31,464	31,973	32,517	32,982	33,307	33,829	34,359

Source: ELFIN data file.

Table 3M-13. Planned Improvements to In-Basin Transmission Facilities

Project Description	Planned In-Service Date
Castaic-Northridge 230-kV	June 1992
Castaic-Rinaldi 230-kV	June 1992
Gramercy-Imperial 138-kV	June 1993
Tarzana-Olympic No. 1 230-kV	June 1994
Tarzana-Olympic No. 2 230-kV	June 1994
Atwater-Westlake 230-kV	June 1997
Northridge-Chatsworth 230-kV	June 1997
Toluca-Hollywood 230-kV	June 1998
Rinaldi-Northridge 230-kV	June 1998

Source: Los Angeles Department of Water and Power 1989a.

Table 3M-14. Summary Comparison of In-Basin Energy Generation Impacts[a]

Alternatives	Average Annual Aqueduct Energy (MWh)	Average Annual Fuel Cost for Entire LADWP System (1992) ($1,000s)	Change in Total System Fuel Costs Compared to Point-of-Reference Conditions (1992 dollars)		NO$_x$ Emissions				SO$_x$ Emissions				CO Emissions			
			($1,000s)	(%)	2011 (Tons)	Change (%)	Average Annual (Tons)	Change (%)	2011 (Tons)	Change (%)	Average Annual (Tons)	Change (%)	2011 (Tons)	Change (%)	Average Annual (Tons)	Change (%)
Point-of-reference	1,038,000	675,580	–	–	888	–	813	–	36.0	–	22.5	–	1,247	–	761	–
No-Restriction Alternative																
Near-term	1,072,000	674,350	(1,230)	(0.18)	886	(0.23)	812	(0.12)	36.0	0.00	22.4	(0.44)	1,243	(0.32)	759	(0.26)
Drought	988,000															
Long-term	NC															
6,372-Ft Alternative																
Near-term	1,005,000	677,480	1,900	0.28	895	0.79	815	0.36	36.0	0.00	22.7	0.89	1,255	0.64	764	0.39
Drought	898,000															
Long-term	NC															
6,377-Ft Alternative																
Near-term	984,000	678,250	2,670	0.39	899	1.24	817	0.54	36.0	0.00	22.7	0.89	1,256	0.72	766	0.66
Drought	819,000															
Long-term	NC															
6,383.5-Ft Alternative																
Near-term	930,000	679,750	4,170	0.61	899	1.24	820	0.92	36.0	0.00	22.8	1.33	1,256	0.72	768	0.92
Drought	772,000															
Long-term	930,000															
6,390-Ft Alternative																
Near-term	904,000	680,610	5,030	0.74	900	1.35	821	0.98	36.00	0.00	22.8	1.33	1,257	0.80	770	1.18
Drought	763,000															
Long-term	938,000															
6,410-Ft Alternative																
Near-term	8454,000	682,230	6,650	0.97	901	1.46	824	1.39	36.0	0.00	22.9	1.78	1,263	1.28	773	1.58
Drought	735,000															
Long-term	901,000															
No-Diversion Alternative																
Near-term	817,000	683,760	8,180	1.20	902	1.58	827	1.81	36.0	0.00	23.2	3.11	1,263	1.28	776	1.97
Drought	716,000															
Long-term	NC															

NC = no change.

[a] The significance of in-basin energy generation impacts are evaluated in terms of changes in total system fuel costs and pollutant emissions from in-basin power plants.

Table 3M-15. Summary Comparison of Out-of-Basin Energy Generation Impacts[a]

Alternative	Average Annual Aqueduct Energy (MWh)	NO_x Emissions				SO_x Emissions				CO Emissions				CX Emissions			
		Year 2011 (Tons)	Change (%)	Average Annual (Tons)	Change (%)	Year 2011 (Tons)	Change (%)	Average Annual (Tons)	Change (%)	Year 2011 (Tons)	Change (%)	Average Annual (Tons)	Change (%)	Year 2011 (1,000s of Tons)	Change (%)	Average Annual (1,000s of tons)	Change (%)
Point-of-reference	1,038,000	45,022	–	44,119	–	35,139	–	34,216	–	1,668	–	1,635	–	4,248	–	4,167	–
No-Restriction Alternative																	
Near-term	1,072,000	45,021	(0.00)	44,102	(0.04)	35,139	0.00	34,201	(0.04)	1,668	0.00	1,634	(0.06)	4,248	0.00	4,165	(0.05)
6,372-Ft Alternative																	
Near-term	1,005,000	45,022	0.00	44,102	(0.04)	35,141	0.01	34,211	(0.01)	1,668	0.00	1,634	(0.06)	4,248	0.00	4,165	(0.05)
6,377-Ft Alternative																	
Near-term	984,000	45,022	0.00	44,122	0.01	35,141	0.01	34,224	0.02	1,668	0.00	1,635	0.00	4,248	0.00	4,167	0.00
6,383.5-Ft Alternative																	
Near-term	930,000	45,022	0.00	44,122	0.01	35,141	0.01	34,262	0.13	1,668	0.00	1,636	0.06	4,248	0.00	4,171	0.10
6,390-Ft Alternative																	
Near-term	904,000	45,022	0.00	44,175	0.13	35,141	0.01	34,270	0.16	1,668	0.00	1,636	0.06	4,248	0.00	4,172	0.12
6,410-Ft Alternative																	
Near-term	854,000	45,026	0.01	44,201	0.19	35,143	0.01	34,288	0.21	1,669	0.06	1,637	0.12	4,248	0.00	4,174	0.17
No-Diversion Alternative																	
Near-term	817,000	45,026	0.01	44,203	0.19	35,143	0.01	34,290	0.22	1,669	0.06	1,637	0.12	4,248	0.00	4,174	0.17

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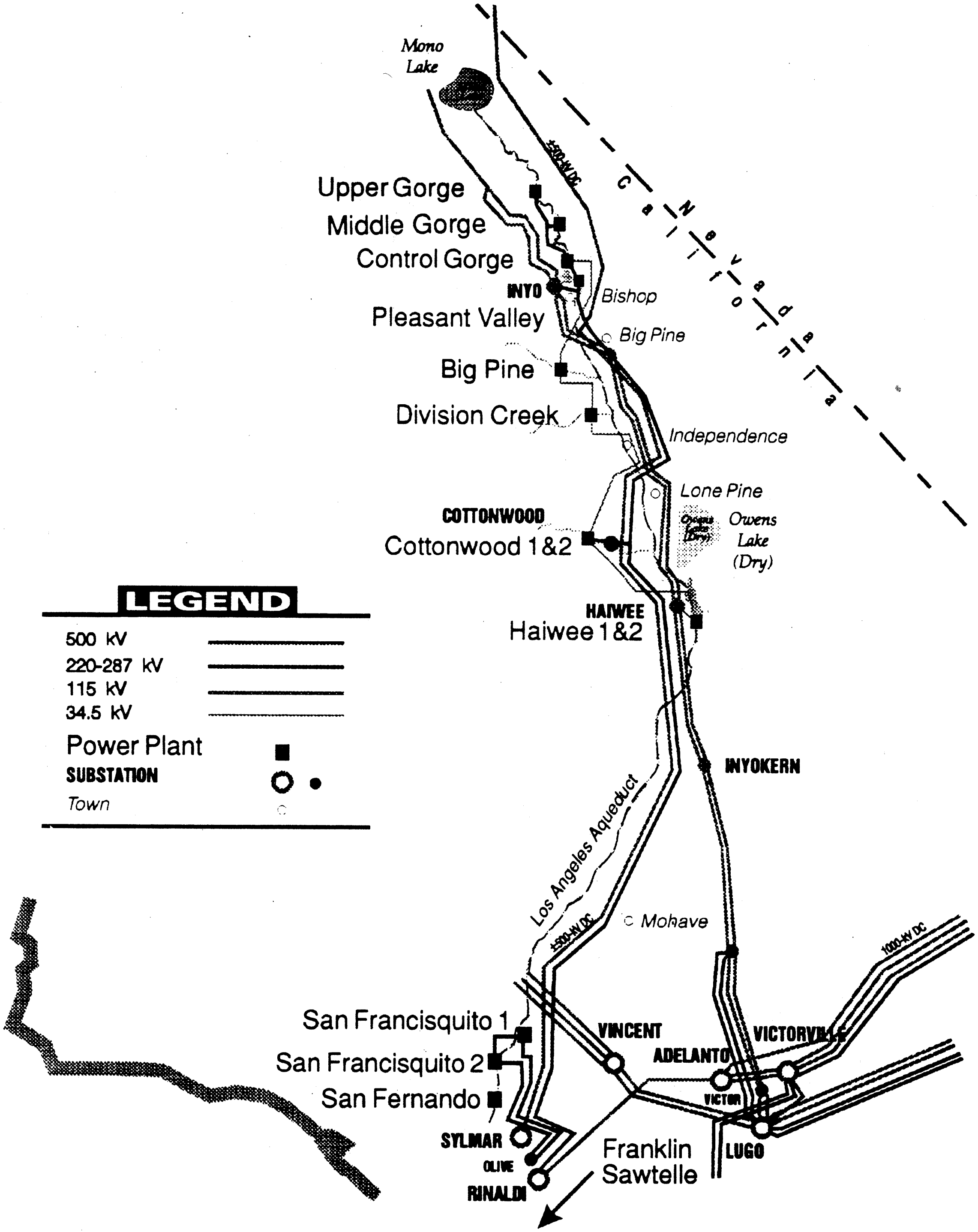
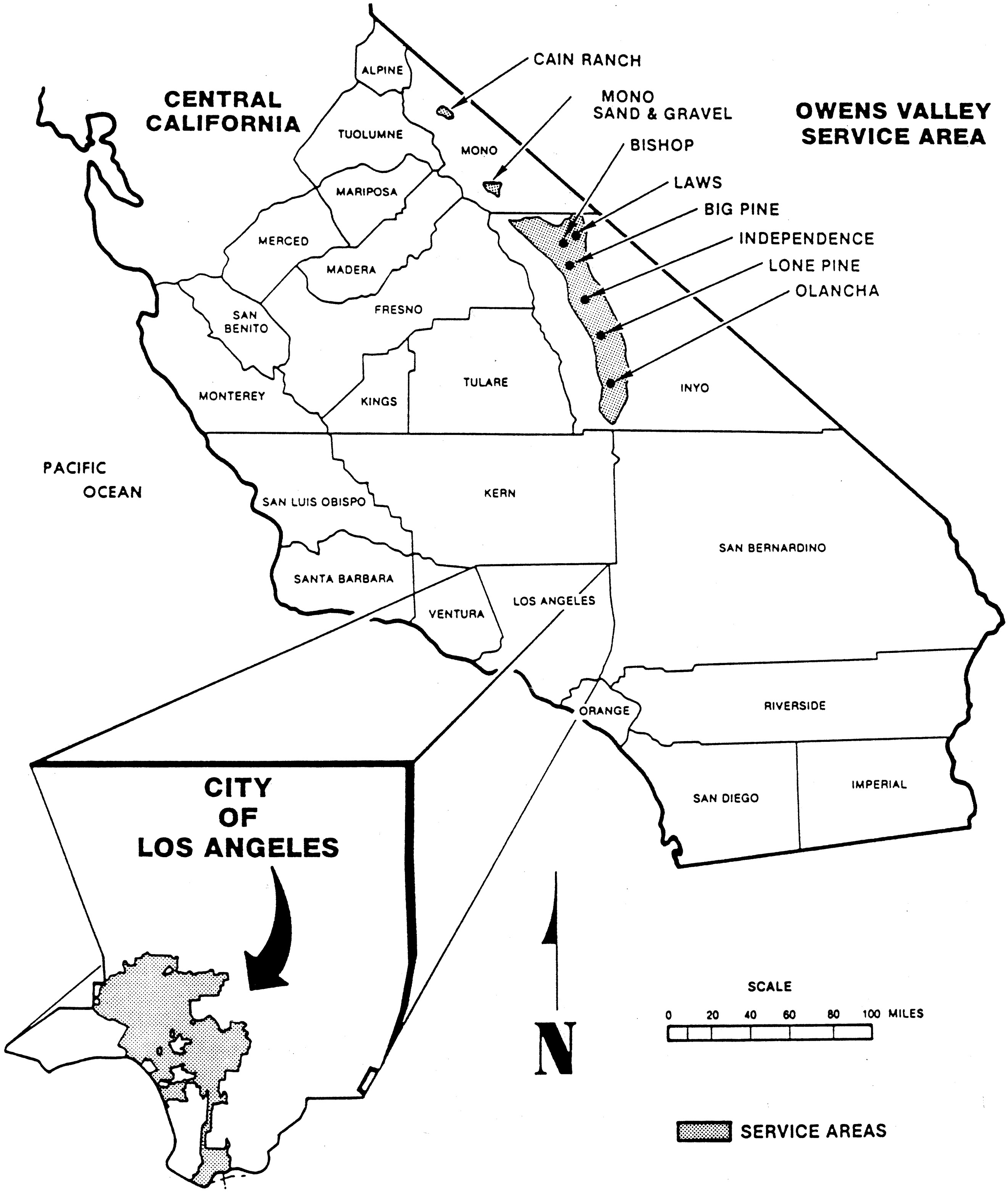
[a] The significance of out-of-basin energy generation impacts are evaluated in terms of pollutant emissions from out-of-basin power plants.



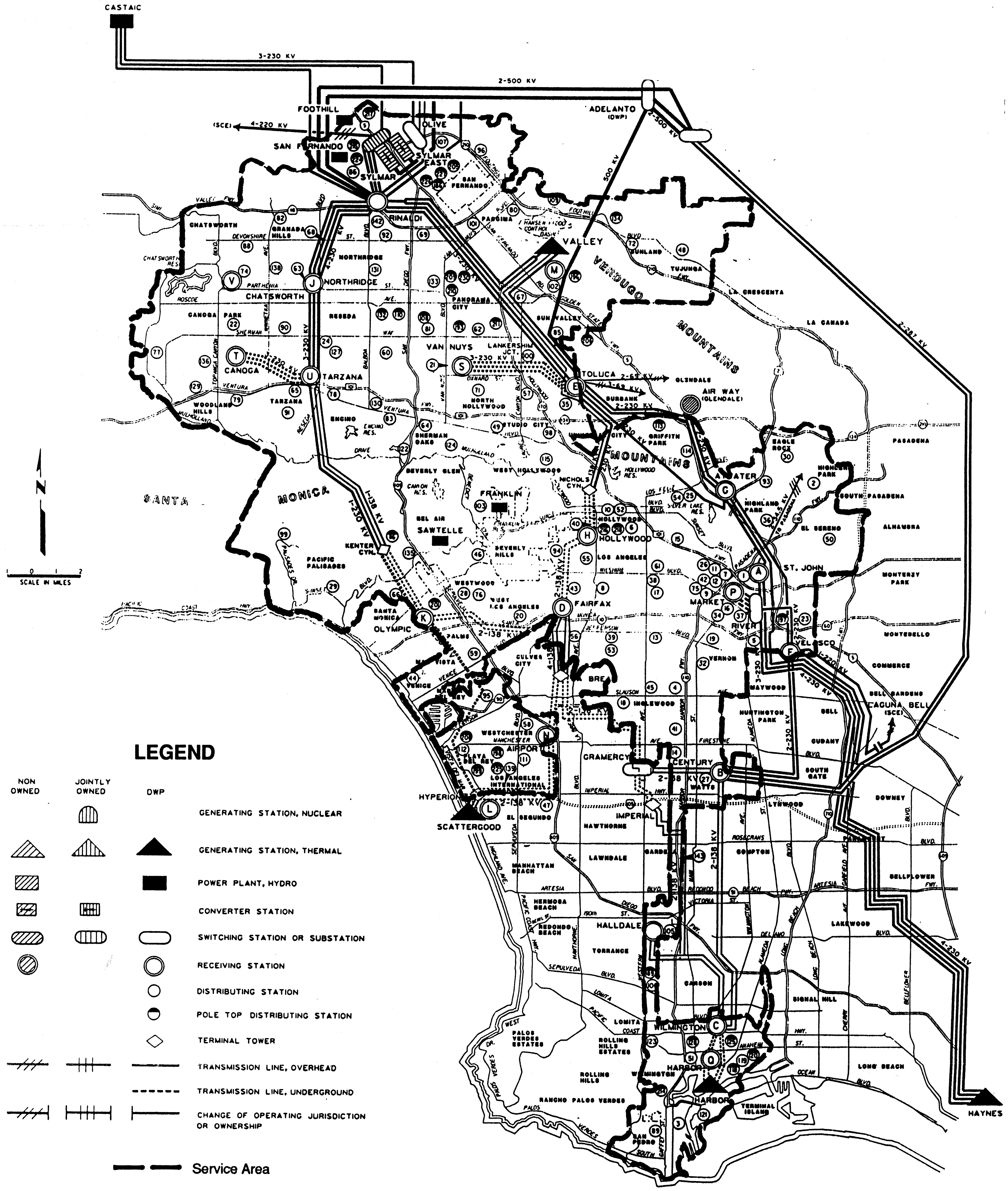
Source: Los Angeles Department of Water and Power 1968

Figure 3M-1.
Power System Facilities along the Los Angeles Owens River Aqueduct



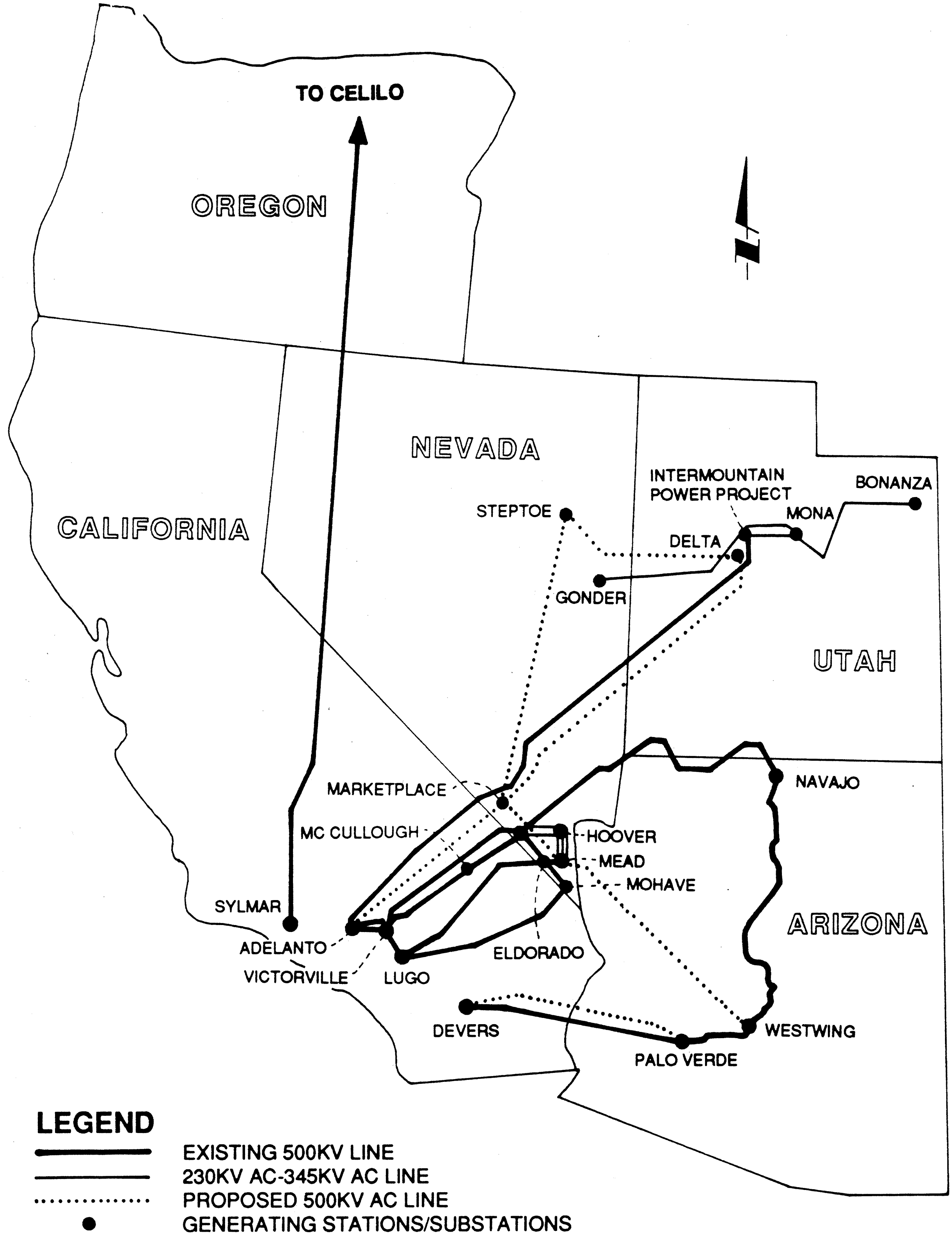
Source: Los Angeles Department of Water and Power 1991

Figure 3M-2.
Los Angeles Department of Water and Power Service Area



Source: Map provided by LADWP (Singley pers. comm.)

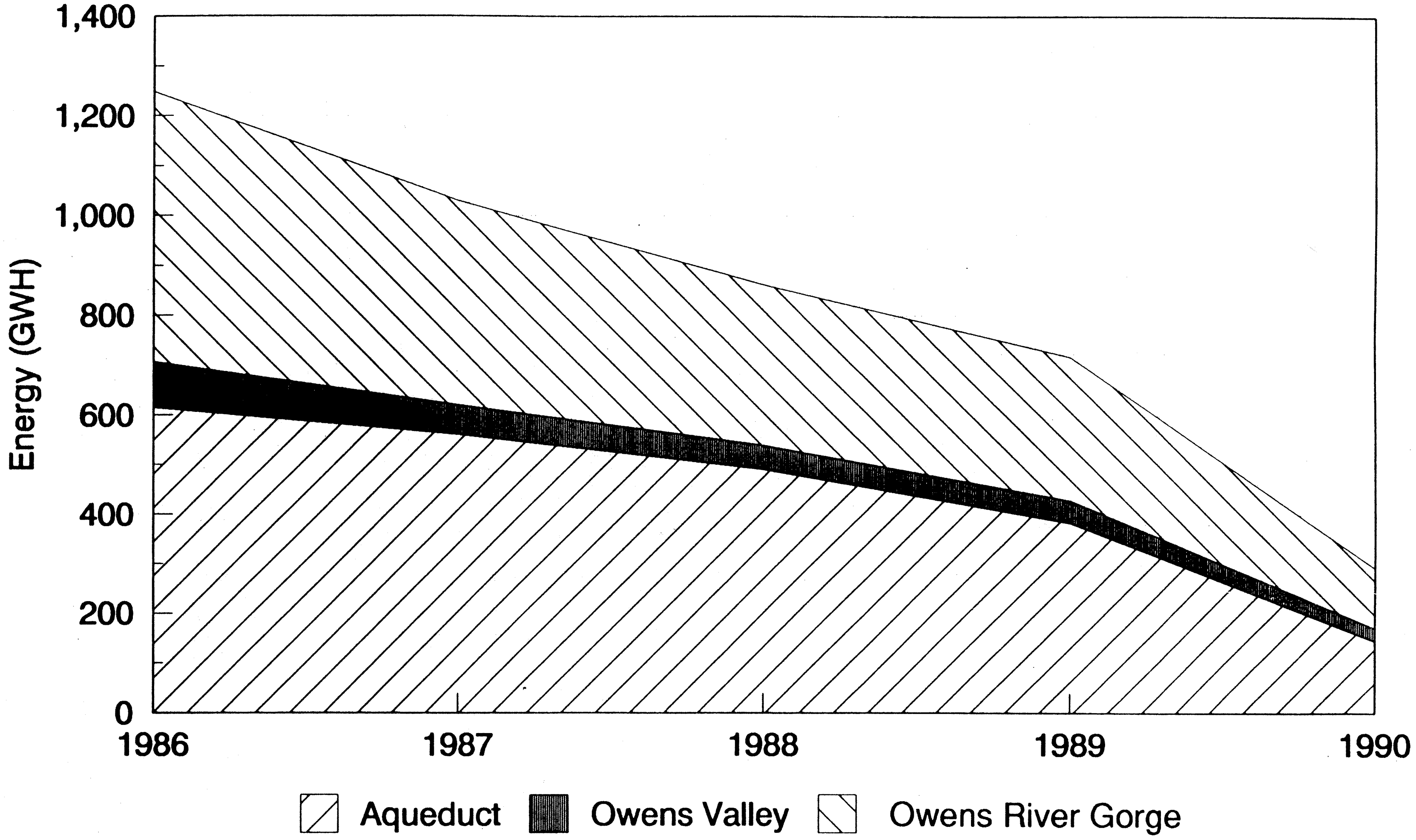
Figure 3M-3.
LADWP Generation and Transmission System in the Los Angeles Basin



Source: Los Angeles Department of Water and Power 1990

Figure 3M-4.
Overview of the External Transmission System

MONO BASIN EIR
Prepared by Jones & Stokes Associates



Source: Singley and Neudeck pers. comms.

Figure 3M-5.
Annual Energy Production from the Los Angeles Owens River Aqueduct Hydroelectric System, 1986-1990

MONO BASIN EIR
Prepared by Jones & Stokes Associates

Figure 3M-6.
Energy Production for the Point-of-Reference Scenario

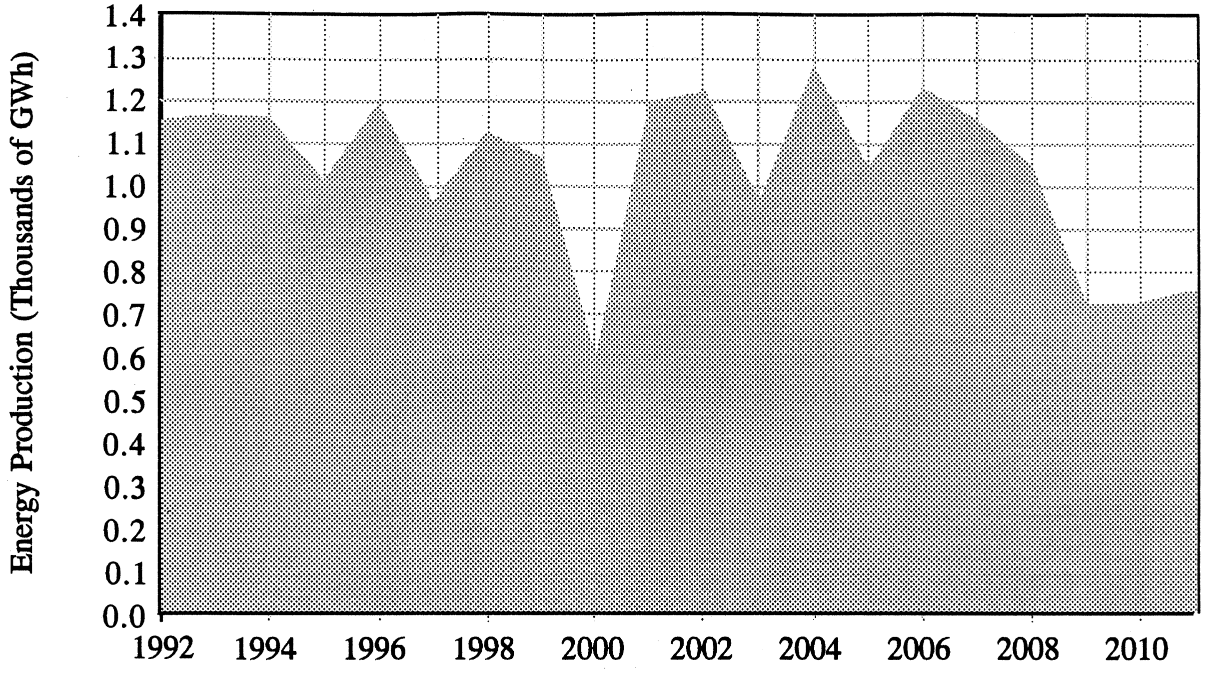
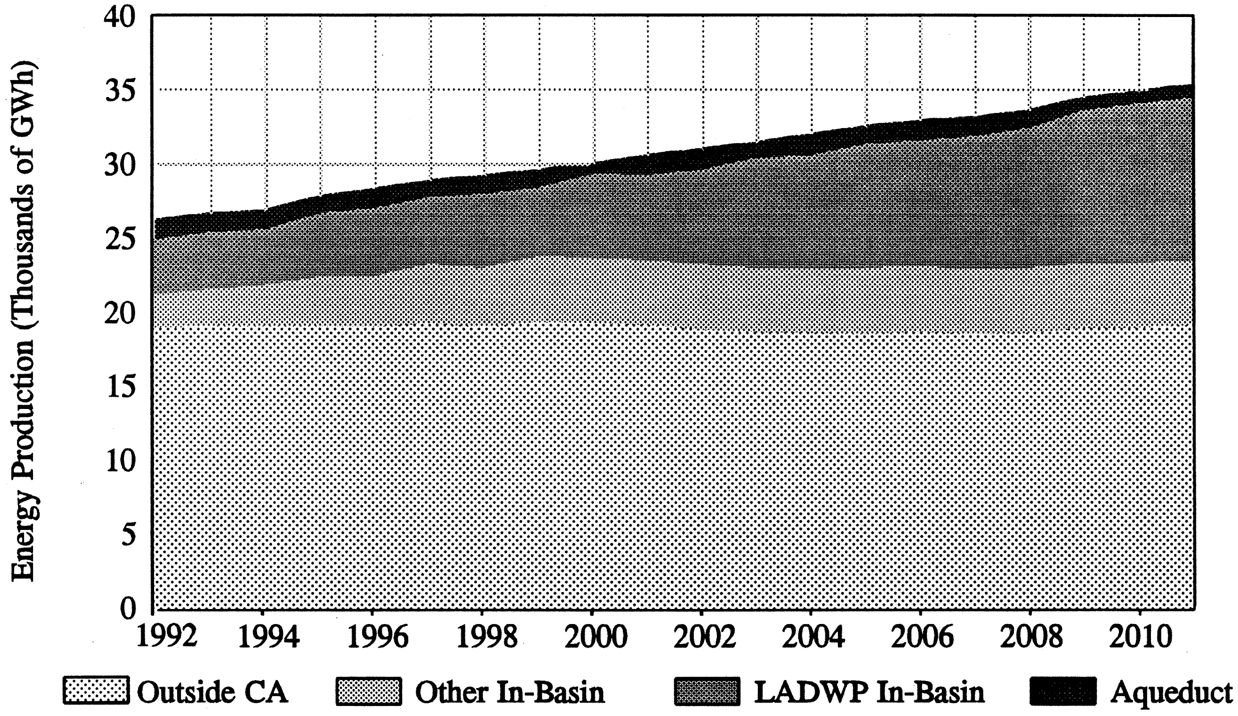


Figure 3M-7.
Energy Production by Location for the Point-of-Reference Scenario



Note: Other in-basin resources are cogeneration and other qualifying facilities in the LA basin that sell power to LADWP.

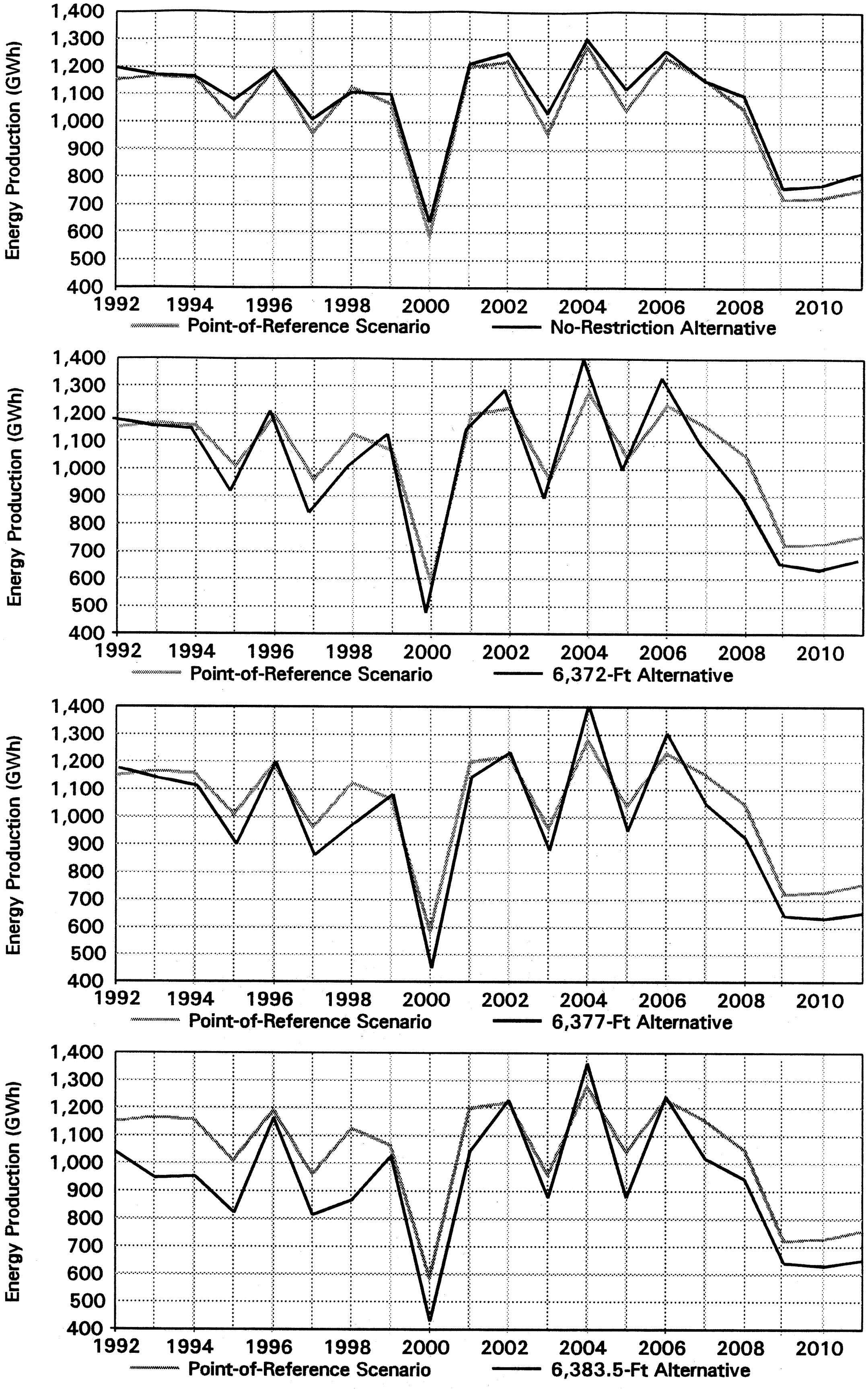


Figure 3M-8a.
Energy Production for the No-Restriction, 6,372-Ft, 6,377-Ft, and 6,383.5-Ft Alternatives Compared to the Point-of-Reference Scenario

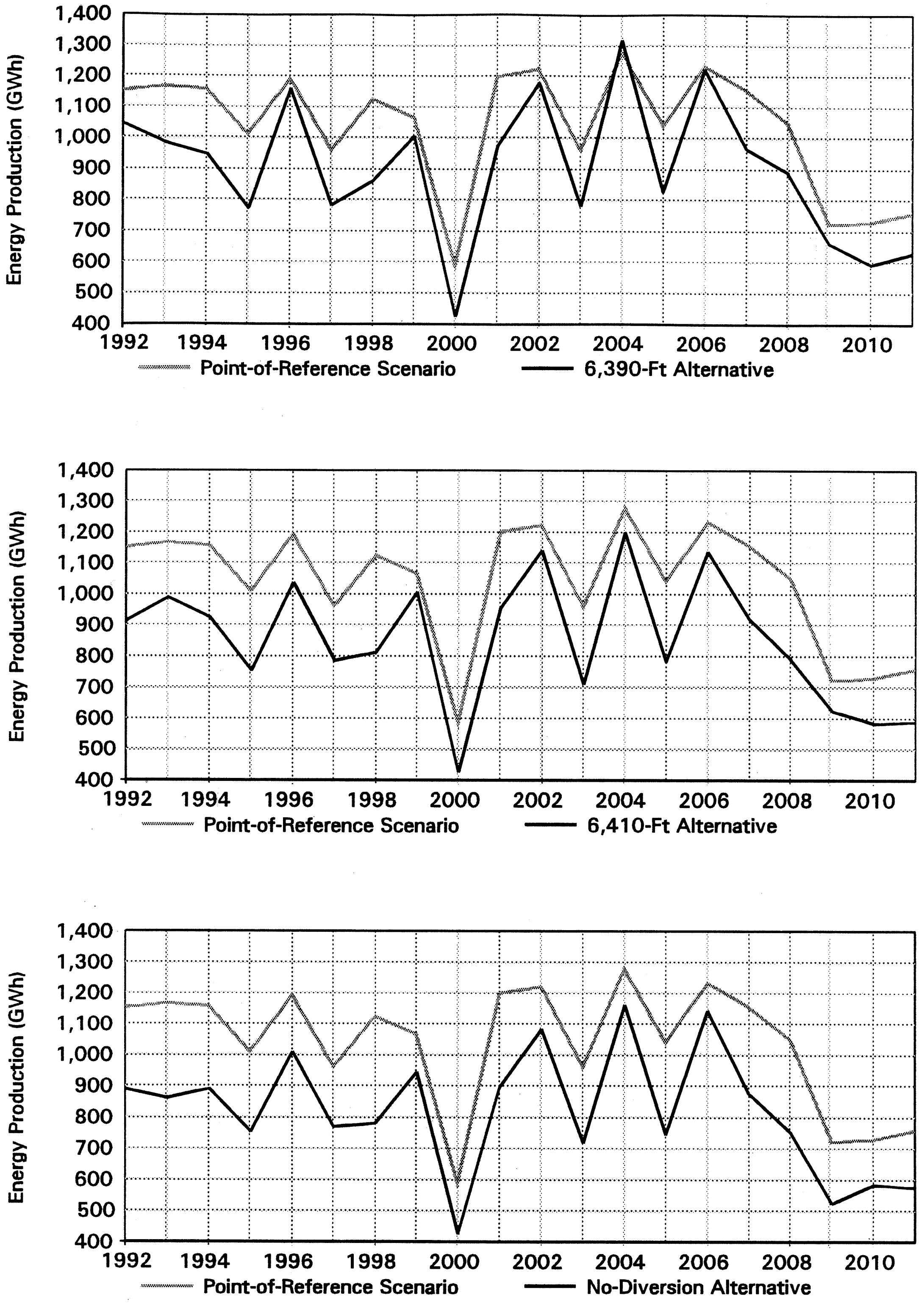
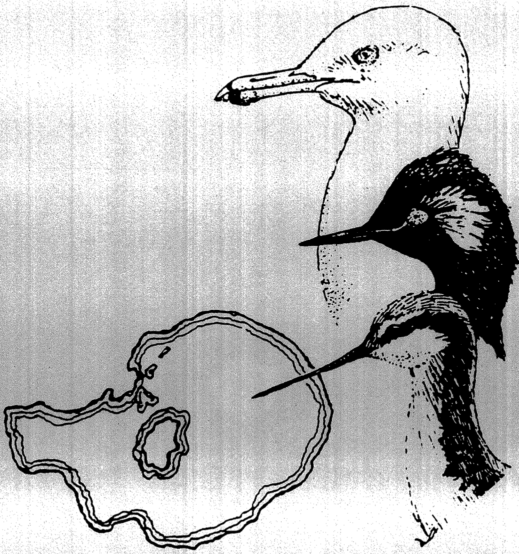


Figure 3M-8b.
Energy Production for the 6,390-Ft, 6,410-Ft, and No-Diversion Alternatives Compared to the Point-of-Reference Scenario

Chapter 3N. Environmental Setting, Impacts, and Mitigation Measures - Economics



MONO BASIN EIR

Prepared by Jones & Stokes Associates

Chapter 3N. Environmental Setting, Impacts, and Mitigation Measures - Economics

This chapter describes the key economic effects caused by implementing the project alternatives. Economic changes focus on two geographic areas: a region defined by the boundaries of Mono and Inyo Counties and the affected area defined primarily by the LADWP service area. Economic effects elsewhere in the state also are evaluated. Appendix X includes additional details of the methodologies used to perform the impact analyses.

Information presented in this chapter is based largely on information contained in other chapters of this document, including Chapter 3G, "Land Use", Chapter 3I, "Recreation Resources", Chapter 3L, "Water Supply", and Chapter 3M, "Power Generation". These chapters should be reviewed for additional information on baseline conditions and effects described below.

PREDIVERSION CONDITIONS

Overview of Socioeconomic Development in the Mono and Inyo Counties Region

Mono County's population increased rapidly during the 19th century because of gold mining activity around Bodie, but fell sharply during the early part of the 20th century. The county's population was stable between 1890 and 1900, declined between 1900 and 1920, and subsequently rebounded (Table 3N-1). The town of Lee Vining was established in the 1920s to serve an emerging tourist industry around Mono Lake. (Phillips 1967.)

As the consumer markets of Mono County's mining communities diminished, the county's agriculture shifted from a mixture of crop and livestock production to primarily livestock and forage production. Irrigated acreage in Mono County decreased by 41% between 1910 and 1940 (U.S. Bureau of the Census 1913, 1932, 1942). As the region's agriculture became dominated by livestock production, a pattern of seasonal grazing developed that involved sheep operators based in Kern County driving stock into Mono County for temporary pasturing. Many flocks were tended by recent immigrants from Spain (especially the Basque province), Portugal, and France. By 1900, over 200,000 sheep grazed the county's ranges (Inyo National Forest 1989).

The population of Inyo County, where development was based on livestock ranching rather than gold mining, grew relatively steadily until 1910 and then stabilized through the prediversion period (Table 3N-1). Southern Sierra Power Company promoted agricultural development in Inyo County based on power supplied by its Mono County hydroelectric facilities. Economic uncertainty, however, led many ranchers to sell their land and water rights. By the late 1920s, LADWP owned approximately 80,000 acres in the Owens Valley and controlled approximately 90% of the water of the Owens River.

Agriculture

This section describes prediversion agriculture conditions in Mono Basin and Long Valley. Mono Basin and Long Valley are the study areas for which agricultural land use and production are analyzed in Chapter 3G, "Land Use".

Mono Basin

Mono County's early agriculturists tapped the streams of the eastern Sierra to convert the semi-desert to arable farmland. Between 1919 and 1929, the area irrigated from Mono Lake tributaries increased from 4,190 acres to 11,500 acres (U.S. Bureau of the Census 1932).

Aerial photographs taken in 1929 indicate that water diverted from Gibbs, Lee Vining, Walker, Parker, and Rush Creeks was being used to irrigate approximately 4,100 acres of nearby pastures. The acreage irrigated remained relatively stable through 1934. Annual water consumption for irrigation and stock watering along the diverted tributaries was estimated at 30,000 af. Other sources indicate that irrigation water applications may have exceeded this level (refer to Chapter 3G, "Land Use"). (Rawson 1990, Court Testimony, Volumes I-V.)

Forage productivity and livestock use of grazing lands are measured in animal unit months (AUMs). One AUM is the amount of forage required by one cow-calf pair (or five sheep) for 1 month (i.e., 800-1,000 pounds of forage). Based on estimated irrigated acreage of 4,100 acres and estimated productivity of 4.5 AUMs per acre, approximately 18,450 AUMs of forage were produced annually on pastures irrigated by diversions from the Mono Lake tributaries in 1929. This amount of forage would support 15,000-20,000 sheep over the grazing season. Managing this number of sheep would require approximately 20-25 shepherds.

Long Valley

Before 1940, Long Valley, which comprises the land along the Upper Owens River, was primarily in private, family ownership. Cattle production was historically the main agricultural activity on irrigated land in Long Valley and in adjacent, unimproved rangelands. Several Long Valley cattle operators also owned lands in the Bishop area that provided winter pasture.

Although little information is available on prediversion agricultural production and employment in Long Valley, the filling of Lake Crowley reservoir probably flooded almost half of the irrigable land in Long Valley. As discussed below, approximately 1,350 acres are currently irrigated in Long Valley. Assuming twice this acreage was in irrigated pasture before 1940 and an average productivity of 4.5 AUM per acre, Long Valley could have supported roughly 2,400 cows and an equal number of calves over the grazing season.

Recreation and Tourism

Mono Basin began to be developed for tourism and recreation shortly after the California gold rush. Development accelerated in the 1920s when highways linking Mono County to the state's major metropolitan areas were constructed. The region's prominent prediversion recreation developments included resorts at Mono Lake; resorts, marinas, and campgrounds on the June Lake Loop; and fishing resorts on the Upper Owens River. Boating, swimming, sunbathing, and waterfowl hunting attracted many tourists to Mono Lake, and Rush Creek was renowned as a trophy fishery. By the late 1930s, tourism had become the region's most important industry.

ENVIRONMENTAL SETTING

Socioeconomic Conditions in Mono and Inyo Basins

Overview

Population. Mono County's population remained stable between 1940 and 1960 and then entered a period of rapid growth, increasing by over 300% between 1960 and 1989. Population in Inyo County grew rapidly in the 1940s, stabilized in the 1950s, and then resumed a rapid growth rate. Since the recession of the early 1980s, its population has increased slowly (Table 3N-1). Both counties' population densities are extremely low in comparison with the statewide average of 187 persons per square mile; Mono County's population density is 5.2 persons per square mile and Inyo County's is 2.8 persons per square mile.

Mono and Inyo Counties each have only one incorporated area. Mono County is relatively more urban than Inyo County, with 48% of its population concentrated in Mammoth Lakes, as compared with 20% of the Inyo County population in Bishop. (California Employment Development Department 1991.)

Employment. In 1990, Mono and Inyo Counties had a combined civilian labor force of 13,525. Their most important employment sectors are services, trade, and government, which jointly account for 82% of the region's total employment (Table 3N-2). The two-county region's unemployment rate was 6.2% in 1990, up from 4.4% in 1989. Unemployment in the region has historically been near the statewide rate (California Employment Development Department 1991).

Approximately 60% of Mono and Inyo Counties' privately owned establishments employed less than five workers in 1988. Only one establishment, a recreational services provider, employed more than 1,000 people. Five other establishments in the two-county region employed more than 100 people. (U.S. Department of Commerce 1990.)

Tourism is the main source of employment in the region. The trade and services sectors, which jointly account for 60% of the region's employment, are heavily oriented toward serving tourists. For example, roughly half of the region's service-sector employees work at motels, resorts, or ski areas, and half of the trade-sector employees work at restaurants, bars, or service stations (California Employment Development Department 1991, U.S. Department of Commerce 1990). Government, the region's third largest employment sector, is also oriented toward serving tourists.

Agriculture, which formerly was an important industry in the region, directly accounts for less than 1% of the region's jobs (California Employment Development Department 1991). The shift from labor-intensive to capital-intensive crops and farming methods within the two-county region is reflected in trends toward fewer, but larger, farms. The number of farms in the region decreased from 320 to 170 between 1940 and 1987, while the average size of farms increased from 750 acres to 1,720 acres (U.S. Bureau of the Census 1942, 1989).

Income. In 1988, per-capita personal income averaged $17,772 in Mono County and $15,300 in Inyo County. These income levels are lower than the statewide average of $18,763. (U.S. Department of Commerce 1990.)

In 1988, payrolls accounted for 74% of all earned income and for 50% of all personal income in the region. Proprietors' income and other labor income accounted for the remaining 26% of earnings. A substantially higher proportion of total personal income is accounted for by earnings in Mono County (77%) than in Inyo County (54%) (Table 3N-3). Unearned income, including government transfers (e.g., social security payments), interest income, and dividends, accounts for a relatively large share of total income in Inyo County. (U.S. Department of Commerce 1990.)

Services, trade, and government are the region's largest sources of earnings (Table 3N-4). The service sector has increased in importance as a source of earnings, while trade and government have contributed relatively stable shares of earnings. The trade sector's share of earnings is smaller than its share of employment; this discrepancy is attributable to the relatively low wage rates characteristic of retail trade occupations.

Agriculture

Regional Production and Employment

Characteristics. Agricultural production in Mono and Inyo Counties at the commencement of Mono Basin water exports in 1940 and in 1987 are shown in Table 3N-5. The major change in farm tenure in the region between 1940 and 1987 was toward larger and fewer farms and corporate leasing as opposed to family ownership.

Between 1940 and 1987, the region's irrigated acreage decreased from 52,600 acres to 35,200 acres. Part of this decrease is attributable to reduced irrigation of lands adjacent to the diverted Mono Lake tributaries. The area irrigated by diversions from these streams decreased from 4,100 acres in 1934 to 2,280 acres in 1989. Another portion of the decrease is attributable to the filling of Lake Crowley reservoir, which displaced an estimated 1,500 irrigable acres, and idling of lands in Inyo County associated with LADWP's property acquisitions.

Cattle production in the region increased substantially in the postdiversion period while sheep production was relatively stable. Cattle and calf sales (excluding sales from stocker operations) increased from 7,760 in 1940 to 19,450 in 1989, while sheep and lamb sales decreased from 34,250 to 19,400 (U.S. Census Bureau 1942, Inyo-Mono Department of Agriculture 1991).

Agricultural production in Mono County generated approximately $13.3 million in agricultural products in 1989, up from $11.6 million (in unadjusted dollars) in 1979 (Table 3N-6). Approximately half of the county's 1989 farm production was generated by sales of livestock and wool. Most of the remaining production consisted of livestock forage, including alfalfa, irrigated pasture, dryland grazing, and grains. Seed crops accounted for the remainder of the county's agriculture.

Inyo County's agricultural sector produced approximately $9.1 million in agricultural products in 1989, up from $7.8 million (in unadjusted dollars) in 1979 (Table 3N-6). Similar to Mono County, more than half of the Inyo County's 1989 farm production was generated by sales of livestock.

Agricultural employment (excluding owners and unpaid family members) in Mono and Inyo Counties since 1974 has ranged from 50 jobs in 1974 to 200 jobs in 1983. (Employment data are not disaggregated for the two counties.) In 1989, agriculture accounted for 100 jobs, or 0.7% of all employment in the two-county region.

Mono Basin. The Mono Basin study area includes agricultural lands in Mono Basin that could be affected by the water diversion alternatives. The study area includes irrigated lands adjacent to the tributaries and relicted lands adjacent to Mono Lake.

Much of the farmland along Lee Vining, Walker, Parker, and Rush Creeks was purchased by LADWP during the 1930s. LADWP has leased Cain Ranch to the Inyo Sheep

Company since 1938. This company is based in Kern County and uses Mono Basin lands for summer pasturing. The number of sheep grazed in the basin by Inyo Sheep Company decreased by approximately 25% between 1940 and 1989, although this decline resulted more from the loss of grazing access to Conway and DeChambeau Ranches in the northern part of the basin than to reduced irrigation on Cain Ranch. Following the sale of a federal grazing permit in 1986, the company reduced its Mono Basin sheep herd to approximately 10,500 head. (Iturriria pers. comm.)

Within the Mono Basin study area, agricultural production occurs primarily on leased LADWP lands and on federal range allotments. Sheep and a few cattle graze these lands from May through September. Few livestock remain in the basin year round because of its harsh climate and lack of forage. The number of sheep and cattle using the basin each summer varies based on forage and water availability, livestock prices, and other factors.

The federal government currently charges permit holders $1.97 per AUM for grazing on federal allotments. LADWP's base lease rates range from $2.00 per AUM for dry rangeland to $3.90 per AUM for irrigated pasture. LADWP annually adjusts its lease rates based on the price of beef. The current lease rate is 1.4 times the base rate (Anderson pers. comm.). For this analysis, forage values of $2.00 per AUM for dryland grazing and $4.00 per AUM for irrigated pasture were used to estimate forage values, regardless of land ownership.

As discussed in Chapter 3G, "Land Use", forage production near Mono Lake and its tributaries during years of normal water availability is approximately 20,600 AUMs, including 9,100 AUMs on federal lands and 11,500 AUMs on LADWP property (Tables 3G-4 and 3G-5 in Chapter 3G, "Land Use"). Forage produced in Mono Basin is valued at an estimated $60,000, or approximately 7% of the total value of Mono County's 1989 forage production (Inyo-Mono Department of Agriculture 1990).

Lands along the diverted tributaries are owned by LADWP and were leased to two sheep operations in 1989: the Mono Sheep Company, based in Barstow (San Bernardino County), and the Inyo Sheep Company, based in Oildale (Kern County). (The Inyo Sheep Company has since purchased the Mono Sheep Company and now controls the Mono Sheep Company's lease with LADWP and its federal grazing permits.) The Mono Sheep Company leases additional LADWP lands elsewhere in Mono Basin. The Inyo Sheep Company also holds federal grazing permits in the basin. The estimated value of forage produced by leased LADWP lands in Mono Basin is shown in Table 3N-7.

The Mono Sheep Company irrigates a portion of the land it leases from LADWP from Gibbs Creek (a tributary to Lee Vining Creek) and Lee Vining Creek. The 149 acres of LADWP land irrigated from these creeks produce 670.5 AUMs of forage, valued at an estimated $2,680, during years of normal water availability.

The Inyo Sheep Company irrigates 1,844 acres of leased LADWP land during normal water years from the Farrington Siphon located on the aqueduct between Lee Vining and Walker Creeks, and from diversions from Walker and Parker Creeks. Pastures irrigated from these creeks produce an estimated 8,298 AUMs with a total estimated value of $33,200.

Much of the economic activity associated with the Mono and Inyo Sheep Companies operations occurs outside of Mono County. Because the sheep herds are moved to various locations throughout the year, revenues and expenditures generated by the operations are spread over several locations and counties. For example, lamb and wool sales occur from locations outside Mono County. (Iturriria pers. comm.)

Labor used by these sheep operations is usually hired through a contract with a Sacramento-based ranch employment firm. Approximately seven herders are required during the summer months when the sheep are grazed in Mono Basin; up to 12 herders are required during winter months. Independent truck drivers hired from the local area are occasionally used to truck sheep to different locations, but trucks owned by the sheep operations are usually used for trucking and are driven by employees. (Iturriria pers. comm.)

Very few goods and services are purchased in the local area while the sheep are based in Mono County. The herders live in trailers on ranches. The companies bus groceries and miscellaneous equipment, including tires, salt, and medicines, in the local area, but major purchases during the year are usually made in Kern County. (Iturriria pers. comm.)

Long Valley. The Long Valley study area consists of agricultural lands along the Upper Owens River that receive irrigation water from the river and could be affected by changes in river flows. It includes lands adjacent to the river between East Portal and Lake Crowley reservoir.

The upper portion of this study area consists of three privately owned cattle ranches, and the lower portion consists of a cattle operation that leases land from LADWP. The three privately owned ranches are John Arcularius Ranch, Inaja Land Company, and Howard Arcularius Ranch. The LADWP lessee is the J&L Livestock Company.

Three of these operations are cow-calf operations involving cattle breeding and calving. Calves produced by these operations are usually sold locally at weights ranging from 500 to 600 pounds before being shipped to Kern County for finishing. One operation is a stocker operation in which steers are grazed for the season and sold when they weigh approximately 500 pounds.

Few cattle overwinter in Long Valley. Operators move their livestock to lower elevation land (usually in the Bishop area) around October and haul them back to Long Valley in May.

Annual forage production in the Long Valley study area averages an estimated 6,200 AUMs, including 3,900 AUMs off private lands and 2,300 AUMs off LADWP lands. This forage has an estimated value of $24,000 (Table 3N-8).

Employment directly generated by cattle operations in the study area is relatively low. In addition to the four ranch managers, fewer than 12 seasonal employees likely work on the four study area cattle operations during months livestock are grazed in Long Valley. Expenditures on supplies and equipment by these operations occur primarily in Inyo County because of Long Valley's proximity to Bishop and because most livestock that use Long Valley in summer overwinter near Bishop.

Recreation and Tourism

Increases in population, disposable income and wealth, leisure time, and mobility have caused tremendous growth in recreation and tourism throughout the United States since Mono Basin waters were first exported in 1941. Recreation and tourism have increased most dramatically in California. The residential population has grown rapidly, and the state has become increasingly attractive to visitors from throughout the nation and the world.

Mono and Inyo Counties have participated in the general development of recreation and tourism over the past 50 years. In addition to the increasing numbers of motels, restaurants, gas stations, resorts, marinas, and campgrounds, a new activity and industry, alpine skiing, has emerged to become the dominant element of the region's recreation and tourism sector. Mammoth Mountain Ski Area is the region's largest employer.

Some elements of the region's recreation and tourism sector have declined during the postdiversion period; these declines are directly related to changes in recreation opportunities resulting from the export of water from the Mono Lake tributaries. Use of lower Rush Creek, formerly a popular and renowned sport fishery, became negligible after it was dewatered. Recreational opportunities on the lower reaches of Lee Vining, Parker, and Walker Creeks were similarly affected. Also, as the level of Mono Lake declined and its water became saltier and its beaches muddier, opportunities for swimming, motorboating, sunbathing, and waterfowl hunting have declined substantially. Conversely, opportunities for viewing tufa towers, one of the lake's principal attractions, have increased substantially as the lake level has declined.

Regional Economic Importance of Recreation and Tourism

Expenditures. Recreation and tourism expenditures in Mono and Inyo Counties are mainly associated with four types of businesses: ski areas, lodging places, eating and drinking places, and service stations. Other sectors, including public transportation and general retail trade, are somewhat less dependent on recreation and tourism. Although no direct information is available regarding how much spending in each of these sectors is generated by recreation and tourism, these spending levels can be estimated in relation to travel-related expenditure levels.

Until 1985, the State of California estimated travel-related expenditures by county (California Department of Commerce 1987). Approximately 71% of all travel-related expenditures in California between 1980 and 1985 was for pleasure travel and 29% was related to business travel. Relatively little business travel occurs in Mono and Inyo Counties. A survey-based study conducted in 1979 estimated that 4.3% of all summer highway travel and 5.2% of all winter highway travel in the region were work related (California Department of Transportation 1979). Estimates of recreation-related expenditures are shown in Table 3N-9, based on the assumptions that 95% of all travel-related spending in Mono and Inyo Counties is related to recreation and tourism and that travel-related spending in Mono and Inyo Counties between 1986 and 1989 varied in proportion to the region's taxable sales. An estimated $339 million was spent on recreation and tourism purchases in the region in 1989, an increase of 49% over the 1983 spending level.

During summer, recreation activities in the region focus on its lakes and streams, including the lakes and streams that could be affected by amendments of Mono Basin water rights. In contrast, winter recreation focuses primarily on downhill skiing, which would not be affected by potential water-rights amendments. The relative importance to the region of summer versus winter recreation is indicated by the seasonal distribution of regional expenditures on lodging. Between 1990 and 1991, 39% of the total regional expenditures on lodging in Mono County occurred between April and September, while 61% occurred between October and March (Wilmot and Mooneyham pers. comms.).

Recreational activity in the region is probably less skewed toward the winter season than is suggested by the seasonal distribution of lodging expenditures, however, because a large share of summer overnight use involves camping, which results in lower per-night expenditures than other forms of lodging. In 1979, 37% of summer overnight travelers surveyed stayed in campgrounds, compared to only 8% of winter overnight travelers (California Department of Transportation 1979).

Employment. Estimates of employment generated by recreation-related spending in Mono and Inyo Counties for 1983-1989 are shown in Table 3N-10. Recreation-related employment increased by approximately 1,900 jobs (52%) over the 7-year period, and the share of regional employment accounted for by recreation increased from 32% to 40% over this period.

Personal Income. Payroll income (in constant 1989 dollars) related to recreation and tourism for 1983-1989 is shown in Table 3N-11. Real income generated by recreation increased by 45% over the 7-year period, and the average annual real earnings per payroll job decreased from $11,700 and $11,200 (4%) over the period.

In 1989, recreation-related employment accounted for 28% of the region's total wages and salaries. This share is lower than the share of employment related to recreation (40%). This discrepancy results from the seasonal nature of recreation-related jobs and their relatively low salaries.

Affected Recreation Resources. This section discusses levels of spending generated by visits to the recreation areas that could be directly affected by amendments of Mono

Basin water rights, and the contributions to regional employment and personal income associated with these expenditures.

Mono Lake. Spending patterns of Mono Lake users were analyzed through a 1992 survey of approximately 300 visitors to the lake. Respondents were asked how much money they spent or intended to spend on groceries and supplies, restaurants, lodging, camping, automotive items, and other items while visiting Mono and Inyo Counties. Results indicate that visitors to Mono Lake spend on average $15.79 per day per person on travel-related purchases (in 1989 dollars) while visiting the region. Local areas benefiting from visitor expenditures include Lee Vining, Mammoth Lakes, and Bishop.

Between 1985 and 1989, annual use of Mono Basin National Forest Scenic Area, which includes all lands in Mono Lake Tufa State Reserve, averaged approximately 270,200 visitor days, of which most use was associated with Mono Lake. Assuming an average daily expenditure of $15.79, visitors to the Scenic Area account for an estimated $4.3 million in annual regional expenditures. Because not all use of lands within the Scenic Area is associated with Mono Lake, some portion of these expenditures is not attributable to Mono Lake visitation.

Lower Reaches of the Mono Lake Tributaries. Use of the lower reaches of Lee Vining, Rush, Parker, and Walker Creeks has been negligible since these reaches were dewatered in the 1940s. Between 1985 and 1990, annual use of the four reaches averaged roughly 370 visitor days (Table 3J-1). Based on a 1991 survey of approximately 200 tributary users, recreationists spend, on average, $9.65 per visitor day on travel-related purchases while recreating at the tributaries. Users of the lower tributaries thus generate approximately $3,600 in annual regional expenditures, most of which likely occurs in Lee Vining.

Grant Lake Reservoir. Based on a 1991 survey of 100 Grant Lake reservoir users, expenditures for groceries, restaurants, lodging, camp sites, and automotive and boating needs averaged $9.72 per visitor day. Between 1986 and 1991 (excluding 1989), annual use of Grant Lake reservoir averaged approximately 46,200 visitor days. Annual travel-related expenditures by Grant Lake reservoir visitors over this period thus averaged approximately $449,100. Local expenditures likely occur in Lee Vining, the June Lake Loop area, and, possibly, Mammoth Lakes.

Lake Crowley Reservoir. Based on surveys of 300 visitors to Lake Crowley reservoir in 1991 and 1992, travel-related expenditures by visitors averaged approximately $14.48 per visitor day. Between 1988 and 1991, total use of Lake Crowley reservoir averaged approximately 127,700 visitor days per year. Use of Lake Crowley reservoir thus resulted in regional expenditures averaging $1.8 million per year. Local spending generated by use of Lake Crowley reservoir would primarily occur in Mammoth Lakes, Bishop, and Toms Place.

Owens River. Approximately half of the 15 miles of the Upper Owens River between Big Springs and Lake Crowley reservoir is publicly accessible, and the other half has restricted access. Annual use of the public and private reaches averages approximately 21,000 and 6,000 visitor days, respectively.

Users of the *private* reach of the Upper Owens River are estimated to spend approximately $50 per day on travel-related items, based on daily lodging costs of about $40 per person and on other costs of an estimated $10 per person per day. Based on results from lower tributary user surveys, users of the *public* reach are estimated to spend about $10 per person in an average day. Based on the estimated number of visitors days in 1987 (Table 3J-5), Upper Owens River users generated approximately $407,000 in 1987 in regional expenditures. Local spending associated with use of the Upper Owens River would occur primarily in Mammoth Lakes and Bishop.

Aquaculture

Aquaculture operations that could be affected by amendments to Mono Basin water rights include a brine shrimp operation at Mono Lake and a trout-raising operation along the Upper Owens River in Long Valley.

Brine shrimp have been harvested from Mono Lake by a single operator, High Sierra (and its predecessor Jungle Laboratories Corporation), for approximately 30 years. High Sierra is the only harvester of brine shrimp in Mono Lake. High Sierra focuses on providing brine shrimp to markets characterized by quality-conscious tropical fish hobbyists, and is believed to be the second largest producer of brine shrimp in the United States (Lai and Insalata 1980).

Shrimp harvesting production levels have varied with changes in the level of effort expended by the company and the introduction of improved harvest technology (including more frequent sampling to locate areas where shrimp density is greater). No direct relationship between harvest amounts and lake levels has been identified; consequently, changes in LADWP operations under the project alternatives are not expected to affect brine shrimp aquaculture operations.

Alpers' Owens River Ranch (Alpers Ranch) is a diversified family-operated business that includes a trout hatchery operation, a limited number of grazing cattle, and a nine-cabin resort for catch-and-release fishing of wild trout (the largest financial contributor). One permanent and two temporary employees are hired to work at the trout hatchery. Although trout migrate upstream to spawn naturally on the property, the trout hatchery operations rely on transplanted fingerlings and are not directly dependent on the migration of wild trout. Consequently, changes in flows in the Upper Owens River resulting from implementation of the project alternatives are not expected to affect trout hatchery operations. (Alpers pers. comm.)

LADWP Service Area

LADWP provides water and power to its service area population within the City of Los Angeles. The service area population has grown unevenly over the past 50 years. The population served by LADWP increased 10% during the 1940s, 34% during the 1950s, 15% in the 1960s, 5% during the 1970s, and 16% in the 1980s. The 1990 population in the LADWP service area was about 3.46 million, representing approximately 1.3 million households.

LADWP obtains its water from local wells, the Los Angeles Aqueduct (LA Aqueduct), the Metropolitan Water District of Southern California (MWD), and reclaimed water. The estimated 1990 total costs of water obtained from these sources are shown in Table 3N-12. As shown, the LA Aqueduct and MWD are by far the largest components of LADWP's estimated $93.9 million water supply costs (based on a supply of 689.9 thousand acre-feet [TAF] of water). Because of cost factors, LADWP generally maximizes the use of LA Aqueduct and well water before it purchases additional MWD water.

LADWP's electrical load is served by a variety of resources, including hydroelectric generating facilities located in the Owens River gorge and the Owens Valley and along the LA Aqueduct. Other generating resources include the Castaic and Hoover hydroelectric facilities, and nuclear-, coal-, oil-, and gas-fueled power stations (Chapter 3M, "Power Generation").

Fixed operation and maintenance (O&M) and fuel expenses incurred by LADWP to generate electricity during 1989 totaled about $886.5 million (ER-90 Report). Table 3N-13 illustrates the distribution of these costs among generating resources. O&M expenses associated with hydroelectric facilities totaled $17.1 million, or 1.9% of total fixed O&M and fuel costs during 1989. The average fixed cost for the hydroelectric facilities, including those potentially affected by changes in Mono Basin exports, was approximately 0.8 cents per kilowatt-hour (kWh) during 1989.

IMPACT ASSESSMENT METHODOLOGY

Changes in LADWP diversions from Mono Basin will have economic effects in the Mono and Inyo Counties region, the LADWP service area, and elsewhere in California. Effects in the Mono and Inyo Counties region would result from changes in agricultural production and recreation activities, and associated direct and secondary impacts on the regional economy. Effects in the LADWP service area are associated with direct changes in power generation and water supplied by the LA Aqueduct; related indirect effects are also likely to occur in other regions.

This section describes the methods used to assess the economic effects of the project alternatives. The analysis focuses on estimating the economic value of predicted changes in the uses and services directly supported by water from the diverted tributaries. These uses and services include:

- agricultural production in Mono Basin and Upper Owens River basin;
- recreation activity at Mono Lake, the lower tributaries, Grant Lake reservoir, Upper Owens River, and Lake Crowley reservoir;
- power generation along the LA Aqueduct;
- consumptive water supply in the City of Los Angeles; and
- protection of public trust resources at Mono Lake.

Changes in the economic value of uses and services are measured in appropriate monetary terms and presented in a benefit-cost analysis.

In addition to estimating the economic value of predicted changes in the uses and services identified above, potential changes in regional economic activity in Mono and Inyo County related to changes in agricultural production and recreation activity are analyzed. Potential indirect effects of changes in LADWP's water supply and power generation on parties in other regions also are considered.

The economic effects analyzed in this chapter are not evaluated in terms of impact significance; however, the results of water supply and power generation economic analyses were used to assess the significance of predicted physical changes on resources discussed in other chapters (i.e., Chapter 3L, "Water Supply", and Chapter 3M, "Power Generation"). This approach to using economic information to assess the significance of physical changes is consistent with the State CEQA Guidelines (Section 15064[f]).

Impact Prediction Methodology

The uses and services directly affected by the project alternatives were analyzed over a 20-year period that extends from 1992 to 2011. The methods used to analyze the economic effects of each directly affected use or service are described below.

Agriculture Production in the Mono and Inyo Counties Region

The project alternatives would affect irrigation and agricultural activities, primarily sheep and cattle production, in Mono Basin and along the Upper Owens River. The economic analysis focused on determining changes in the value of agricultural production associated with the alternatives. Changes in production value are used as a proxy for the incremental cost that operators would incur to replace forage produced on irrigated pasture on LADWP lands.

Livestock production in Mono Basin and along the Upper Owens River depends on forage production, which, in turn, depends on the amount of water available for irrigation of pastures. Determining changes in livestock production in the study area is complicated because sheep and cattle are moved from area to area to maximize the harvesting of forage and to avoid subjecting the animals to harsh weather conditions. Forage production, however, is more directly linked to the amount of water available for irrigation.

The analysis of changes in production value required several steps. First, forage production was estimated by converting streamflows and irrigation releases for the four diverted streams to irrigated acreage based on an assumed annual irrigation rate of 5 af per acre. Results of the Los Angeles Aqueduct Monthly Program (LAAMP) operations model were used to perform this analysis. Forage production on irrigated lands was then estimated using a production rate of 4.5 AUMs per acre. Finally, production value of forage produced by irrigated lands was estimated using a forage unit value of $4.00 per AUM. This rate is similar to the base rate charged by LADWP in 1989 for good, irrigated pasture.

These procedures were followed to estimate the annual production value of irrigated lands under the point of reference and each project alternative. The values for each alternative were then compared to the values for the point of reference to estimate the incremental change in production value under each alternative, which is used as a proxy for the incremental cost incurred by operators.

Recreation Activity in the Mono and Inyo Counties Region

The project alternatives would affect recreation opportunities and use at different recreation areas in Mono and Inyo Counties. The economic analysis of recreation effects focused on determining the changes in recreation use and spending, and user benefits at recreation areas directly affected by changes in water availability.

Recreation Use and Spending. Projections of recreation use and spending were made for five recreation areas in the region that would be directly affected by the project alternatives. These areas include Mono Lake, the lower reaches of the four diverted tributaries of Mono Lake, Grant Lake reservoir, the Upper Owens River, and Lake Crowley reservoir.

Baseline levels of annual visitor days were estimated for each area from recreation use information in Table 3J-1 (Chapter 3J, "Recreation Resources"). Baseline levels were estimated by averaging the number of annual visitor days reported in Table 3J-1 for each area over the period shown. The estimate of baseline visitor days for each area was as follows: Mono Lake, 168,000 days (the number of days to the Mono Lake Tufa State Reserve); the lower reaches of the Mono Lake tributaries, 370 days; Grant Lake reservoir, 46,200 days; Lake Crowley reservoir, 127,750 days; and the Upper Owens River, 18,300 days.

Baseline visitor-day totals were then adjusted to account for projected population growth in California over the 20-year analysis period using a 1.77% compound growth rate projected by the California Department of Finance (1991). The predicted number of visits by persons who resided within and outside the two-county area was estimated to allow for subsequent analysis of changes in regional economic activity by visitors. This disaggregation was performed based on origin information of visitors from the user surveys.

Annual use projections over the 20-year projection period were then made for each recreation area under the point-of-reference scenario and each alternative. These projections were developed based on the relationships of changes in per-visitor use at each recreation area to streamflows and lake levels. (Additional details of the use-estimating methodology for the affected areas are included in Chapter 3J, "Recreation Resources", and Appendix W.) LAAMP model projections were used to perform the analysis. For Mono Lake, annual median lake levels under each alternative were used to estimate annual visitation. For the tributaries, Grant Lake reservoir, and Lake Crowley reservoir, median water conditions over the recreation season (May-October) corresponding to 10%, 50%, and 90% water-year frequencies (i.e., dry, normal, and wet years, respectively) were used to estimate visitation for each year over the 20-year hydrologic sequence.

Spending profiles for each recreation area developed from the recreation user surveys were then applied to the use estimates by locals and nonlocal visitors to estimate regional recreation expenditures for the point of reference and each project alternative.

Recreation Benefits. Outdoor recreation typically provides user benefits that exceed participation costs. These recreation benefits can be measured in terms of users' willingness to pay over and above what they currently pay for the opportunity to participate in different recreation activities. Estimates of net willingness to pay by users are the appropriate economic measure of recreation benefits for benefit-cost analysis.

Several methods are available for estimating recreation benefits or net willingness to pay for recreation opportunities. For this analysis, the contingent valuation method was used in which visitors were asked in onsite interviews if they would pay a specific dollar amount for alternative streamflow or lake level conditions at the directly affected recreation areas. Surveys were conducted at Mono Lake, the lower tributaries, Grant Lake reservoir, and Lake Crowley reservoirs. The streamflow and lake level conditions that were presented to survey respondents are described in Appendix W.

The survey data were then analyzed using statistical models to estimate users' willingness to pay for different streamflow or lake level conditions. Estimates of the mean and median willingness to pay by the sample of visitors were calculated. (Refer to Appendix X for additional details of the analyses.)

Because the surveys were developed before hydrologic conditions of the alternatives were known, the streamflow and lake level conditions described in the surveys did not correspond exactly with the LAAMP results for the project alternatives. Consequently, the estimates of willingness to pay had to be interpreted to approximate values for the point of reference and project alternatives. The procedures used to perform this analysis also are described in Appendix X.

Estimates of average willingness to pay per visitor (or per visitor day) for the streamflows and lake level conditions associated with the diversion alternatives were then expanded to the population of visitors to estimate total willingness to pay. The predicted number of annual visitor days at each recreation area was divided by the average (mean) number of days per visitor to estimate the number of annual visitors. This number was then multiplied by the average willingness to pay per visitor to estimate total willingness to pay for the recreation opportunities provided by each alternative. Estimates of recreation benefits were not made for some recreation areas under certain alternatives because information was not available for estimating willingness to pay for the conditions associated with the alternative.

Regional Economic Effects

Changes in agricultural production and recreation activity would affect economic activity within the Mono and Inyo County region. The analysis of regional economic effects focused on estimating direct and secondary effects on economic output, employment, and personal income from changes in agricultural production and recreation activity of the project alternatives.

Direct effects of alternative levels of agricultural production were estimated based mostly on information obtained from interviews with operators. Estimating direct employment and personal income effects of the alternatives is complicated because of the complex rotations used by livestock producers, especially sheep producers, who operate in the study area and because forage production losses may be replaced, to some extent, by forage or feed produced elsewhere. Notwithstanding these issues, the incremental change in employment and personal income associated with alternative production levels was estimated.

Direct effects of alternative levels of recreation activity were estimated by applying employment and income coefficients from the IMPLAN input-output model, which was developed by the USFS, to estimates of regional spending by nonlocal visitors under each alternative. Spending by nonlocal visitors was used to isolate effects on the region that could result if visitors chose not to visit the region. Spending by local residents was not included because it was assumed that if they changed recreation habits, they would still make expenditures elsewhere in the region (for recreation or other goods and services); therefore, their contribution to regional spending would not change.

Estimates of secondary employment and personal income in Mono County and Inyo Counties under the point of reference and project alternatives also were calculated using the IMPLAN model. Agricultural production values projected for each alternative were used with IMPLAN multipliers to estimate total employment and personal income changes within Mono and Inyo Counties. Projected changes in recreation were applied to appropriate IMPLAN coefficients to estimate total impacts on regional industrial output, personal income, and employment.

Consumptive Water Supply in the City of Los Angeles

Changes in water exports from Mono Basin to Los Angeles would affect LADWP costs of meeting future demands for water. The economic analysis of water supply effects focused on estimating the incremental costs to LADWP to meet future water demands based on predicted changes in supplies from Mono Basin. Changes in water deliveries predicted by the LAAMP model over the 20-year projection period were used in the analysis.

As described in detail in Chapter 3L, "Water Supply", a water supply simulation model that balances annual supply and demand conditions was developed to estimate LADWP's water supply costs for each year over the 20-year analysis period. The model relies on use of increasingly more-expensive sources of water to meet the demands. The simulation model estimates the cost of LADWP's mix of water supplies for the point of reference and each alternative. The incremental change in costs relative to point-of-reference conditions represents the direct economic effect of water supply changes.

In addition to analyzing the direct economic effects on LADWP of the project alternatives, indirect economic effects resulting from LADWP consuming more of the regional supplies provided by MWD were evaluated. LADWP is projected to replace lost Mono Lake supplies by using additional groundwater and reclaimed water and by purchasing additional water from MWD. LADWP's additional purchases of water from MWD would indirectly affect MWD's other member agencies by reducing the availability of MWD supplies.

The evaluation of indirect effects assumes that other MWD member agencies would need to develop other water supplies that are more expensive than MWD supplies. Indirect costs to MWD member agencies of replacing MWD supplies with more expensive alternative supplies were approximated by estimating the average cost differential between MWD supplies and reclamation, which is used as the least-cost alternative, and applying this estimate of incremental costs to the projected amount of increased purchases of water by LADWP from MWD (relative to point of reference) to offset water losses from the LA Aqueduct. The cost differential was estimated by subtracting the projected 20-year average cost of MWD water ($639/af) from the estimated cost of reclaimed water from developing a dual distribution system ($800/af), as identified by the City of Los Angeles Office of Water Reclamation (1990).

Power Generation from LA Aqueduct Hydroelectric Generation Facilities

Changes in water exports from Mono Basin to Los Angeles would affect LADWP costs of meeting future demands for energy. The economic analysis of power generation effects focused on estimating the incremental costs to LADWP to meet future power demands considering changes in energy output from the LA Aqueduct facilities. Predicted changes in power generation were estimated using results of the LAAMP model over the 20-year projection period.

As fully described in Chapter 3M, "Power Generation", power generation impacts were assessed in a three-step process. First, the amounts of energy available from LA Aqueduct hydroelectric generating facilities for alternative water diversion levels were determined on a monthly basis by applying efficiency values for each hydroelectric plant (in kWh per af) to the amounts of water diverted through the plants. The capacity available from aqueduct facilities for given water-diversion scenarios was determined on a monthly basis by applying multipliers determined from a review of historical operation data to the monthly energy production data for each group of hydroelectric plants.

The second step was to use the aqueduct generation information to develop input data representing the aqueduct facilities for the ELFIN production model (see Chapter 3M, "Power Generation"). The amounts and associated costs of energy produced by LADWP's nonaqueduct resources for a given level of aqueduct generation were determined using the ELFIN model.

Step three consisted of performing a comparative analysis of the output of ELFIN simulations representing different levels of aqueduct energy production and capacity availability, and differing levels of energy production and capacity utilization from LADWP's nonaqueduct resources. The results of these simulations were compared to identify changes in LADWP's fuel costs for each alternative.

In addition to analyzing direct costs to LADWP of the project alternatives, indirect effects resulting from additional purchases of energy from other power suppliers were considered. Approximately 20-25% of the energy needed to replace supplies from the LA Aqueduct would come from other purchases. LADWP, which has sufficient capacity over the near- and mid-term to replace these supplies, is expected to obtain energy from existing contracts, which could reduce the amount of less expensive energy available to other utilities. Because the amount of energy purchased from other sources is small, however, the potential effect is considered minimal and is not further evaluated in this analysis.

Protection of Public Trust Resources of Mono Lake

Protecting Mono Lake's natural environment provides social benefits. The economic analysis focused on estimating the public's willingness to pay for different levels of resource protection at Mono Lake.

The contingent valuation method was used to estimate the public's willingness to pay for resource conditions associated with alternative lake levels. A survey of 600 California households was conducted. The survey included contacting households initially by telephone to solicit participation. Survey materials, including a pamphlet describing and visually depicting Mono Lake under alternative lake level conditions, were then mailed to survey participants. A followup interview was conducted by telephone at a predetermined time.

The followup survey included several questions designed to elicit the respondents' willingness to pay for resource conditions at Mono Lake at alternative lake levels. Questions were asked about resource conditions associated with lake levels at 6,375 feet, 6,390 feet, and 6,410 feet. The survey questions were structured in the form of a voter referendum, and respondents were asked whether they would pay different amounts for state-sponsored bonds in which the revenues would be used to purchase additional water supplies for Mono Lake. The survey respondent were told that if a program was not passed by the voters, the lake would drop to 6,372 feet above sea level.

The survey data were analyzed using statistical models described in detail in Appendix X. The average (mean and median) willingness to pay of respondents for the three programs was estimated. These averages were then used to estimate total willingness to pay by state residents for the different lake level alternatives. Procedures used to expand the sample results to the population are also described in Appendix X. Because of data limitations, no estimates were made for the No-Diversion Alternative.

Criteria for Determining Impact Significance

As suggested in the State CEQA Guidelines, the economic effects evaluated in this analysis are not assessed in terms of their impact significance; however, some results are used to assess the significance of physical changes described in other chapter (see Chapter 3L, "Water Supply", and Chapter 3M, "Power Generation").

SUMMARY COMPARISON OF COSTS AND BENEFITS OF THE ALTERNATIVES

As described in the "Impact Assessment Methodology" section, relative economic effects are assessed in this section through several key variables:

- agricultural production in the Mono and Inyo Counties region;
- recreation use, spending, and benefits at directly affected recreation areas in the Mono and Inyo region;
- consumptive water supply costs to the City of Los Angeles;
- power generation costs to the City of Los Angeles; and
- preservation values associated with public trust resources at Mono Lake.

Table 3N-14 provides a summary comparison of the average annual economic benefits and costs associated with the project alternatives relative to point-of-reference conditions. The costs include water supply and power generation costs to the City of Los Angeles. Impacts on the value of agricultural production in Mono and Inyo Counties are not included in the table because they average less than $35,000 per year. The benefits are preservation values associated with public trust resources at Mono Lake and recreation benefits at affected areas in the region. As noted in the table, the recreation benefits at Mono Lake are not included in the net economic benefits because they are already included in the Mono Lake preservation value.

As the table shows, the No-Restriction Alternative decreases water supply and power generation costs for the City of Los Angeles, but also reduces recreation benefits and results in a substantial loss of preservation values. Compared to the point-of-reference conditions, all other alternatives involve higher lake levels that increase water supply and power generation costs for the City of Los Angeles. Recreation benefits and preservation values also increase for other alternatives, except for those above 6,390 feet.

As indicated in Appendix X, a majority of the respondents to the contingent valuation survey regarded higher lake levels as undesirable because of the negative impacts on tufa towers and snowy plover habitat. Some respondents clearly regarded lake levels above 6,390 feet as desirable despite these negative impacts, but most were willing to pay little, if anything, to secure lake levels above 6,390 feet. Given these different preferences, a survey much larger than the one conducted for this study would be required to measure willingness to pay for lake levels above 6,390 feet with the same precision as for lower lake levels. Results from the survey for this study suggest that the *median* willingness to pay for lake levels above 6,390 feet is zero. Even with a larger survey, it seems clear that the overall willingness to pay for lake levels above 6,390 feet would be significantly less than the willingness to pay for the 6,390-Ft Alternative.

The *marginal* benefits and costs associated with moving from one alternative to another are shown in Figure 3N-1 and Table 3N-15. The marginal benefits exceed the marginal costs for all alternatives up to and including 6,390 feet; consequently, net economic benefits are maximized by the 6,390-Ft Alternative. Because the marginal benefit from higher lake levels is several times greater than the marginal cost for the 6,390-Ft Alternative, the marginal benefits could be reduced by as much as 70-80% and the alternative would still be optimal from the standpoint of net economic benefits (i.e., the marginal benefit curve still lies above the marginal cost curve). The marginal benefits curve drops below the marginal costs curve at lake levels above 6,390 feet (Figure 3N-1) and remains below for the higher lake level alternatives.

This "robustness" in the results is important because of the substantial degree of uncertainty associated with projecting costs and benefits over the entire 20 years of the analysis period. The uncertainty is likely to be especially important for the estimate of Mono Lake preservation benefits. Although the survey to determine preservation values explicitly asked about paying higher taxes for each year over the next 20 years, respondents can have difficulty projecting their willingness to pay far into the future because preferences often change. Consequently, for the later part of the analysis period some doubt exists about the willingness to pay. This uncertainty could affect the estimates of average annual preservation value. This issue could be addressed by differentially discounting the preservation values; however, the preservation values could be discounted substantially without affecting the conclusion that the 6,390-foot level is the preferred alternative from an economic point of view.

Regional effects of changes in economic activity in the Mono and Inyo Counties were analyzed, but are not reported in Table 3N-14. These effects, which are measured in terms of employment and personal income, result from changes in agricultural production and recreation activity. As described in the "Impacts" section, these effects are relatively small. The 6,372-Ft, 6,377-Ft, 6,383.5-Ft, and 6,390-Ft Alternatives have a positive effect on economic output and personal income (refer to Table 3N-18); however, all alternatives result in a reduction in employment. Recreation spending is negatively affected by the lower lake alternatives, and agricultural production is negatively affected by the higher lake alternatives.

In addition to direct increases in water supply costs to LADWP, all alternatives, with the exception of the No-Restriction Alternative, would likely increase water supply costs to other members of MWD. Water supplies that are likely more expensive than purchases from MWD would need to be developed. These costs to other MWD members would range from an estimated $2.5 million annually (6,372-Ft Alternative) to $9.7 million annually (No-Diversion Alternative).

CHARACTERIZATION OF POINT-OF-REFERENCE CONDITIONS

The point of reference reflects the base economic conditions to which effects of the project alternatives are compared. The point of reference differs from the seven alternatives in the economic value of uses and level of activity that are supported by the diverted water. The supported uses and services include agricultural production, recreation activity, and regional economic effects in the Mono and Inyo Counties region; consumptive water supply by the City of Los Angeles; power generation along the LA Aqueduct; and protection of public trust resources at Mono Lake.

Agricultural Production in the Mono and Inyo Counties Region

Lands that would be directly affected by changes in streamflows and water availability include irrigated lands along the diverted tributaries in Mono Basin and along the Upper Owens River.

Irrigated Lands along Diverted Tributaries in Mono Basin

Under point-of-reference conditions, maximum irrigation diversions from Lee Vining and Gibbs Creeks that are allowed for lands leased by the Mono Sheep Company and the Inyo Sheep Company would occur. Forage production from the 149 acres irrigated from Gibbs Creek and the Gibbs Siphon Valve by the Mono Sheep Company would be annually maintained at 670.5 AUMs. Based on a forage value of $4.00 per AUM, the average annual value of agricultural production would be approximately $2,680 (in constant 1992 dollars) over the 20-year period.

The amount of land irrigated by the Inyo Sheep Company from Walker and Parker Creeks would be limited periodically. Forage production would vary from a maximum of 8,298 AUMs to minimum of 5,653 AUMs and, over the 20-year evaluation period, would average 7,181 AUMs per year. The value of annual forage production would vary from approximately $22,610 to $33,190. The average annual value of production over the 20-year period would be $28,720.

Total forage production from lands irrigated by the diverted tributary streams would range from 6,323 AUMs to 8,968 AUMs, and would average 7,852 AUMs, over the 20-year period. The annual value of agricultural production would vary from approximately $25,290 to $35,870 over the 20-year period, with an average annual value of approximately $31,410 (Table 3N-16).

Lands Irrigated from the Upper Owens River

Three private landowners and one LADWP lessee, J&L Livestock Company, irrigate from the Upper Owens River south of East Portal. Under point-of-reference conditions, adequate water would be available in the Upper Owens River during all years to meet the existing needs of the four agricultural water users. During dry years, however, flows may be too low to effectively divert water to irrigation ditches. In addition, low flows may inhibit the ability of gravity-flow ditches to deliver water to pastures on higher grounds, which would require modifying irrigation systems. The amounts of irrigated acreage, however, should not vary considerably from year to year.

Assuming that LADWP would not restrict irrigation by J&L Livestock Company to levels below those allowed by its current lease, forage production levels from lands irrigated from the Upper Owens River would be maintained at existing levels over the point-of-reference period. Forage production would average an estimated 6,047 AUMs over the 20-year period. Production values would average approximately $24,190 over the same period (Table 3N-16).

Recreation Activity in the Mono and Inyo Counties Region

Recreation areas that would be directly affected by the project alternatives are Mono Lake, the lower tributaries, Grant Lake reservoir, the Upper Owens River, and Lake Crowley reservoir.

Recreation Use and Spending

Under point-of-reference conditions, recreational use of the five directly affected recreation areas would vary in response to changes in recreation opportunities. Similarly, spending within the two-county region associated with recreation at these areas would vary over the point-of-reference period in response to changes in use levels. Predicted average annual use and spending associated with recreation at each of these directly affected recreation areas under point-of-reference conditions are shown in Table 3N-17.

- At Mono Lake, annual visitation would range from a projected 177,300-227,800 visitor days over the 20-year period, with an average of 195,900 visitor days. Based on average spending of $15.78 per visitor day, annual spending within the two-county region associated with visitation to Mono Lake would average approximately $3.1 million.
- Along the lower reaches of the diverted tributaries, annual recreational use would range from a projected 230 to 830 visitor days over the 20-year period, with an average of 380 visitor days. Based on average spending of $9.65 per visitor day, annual spending within the two-county region associated with recreational use of the Mono Lake tributaries would average approximately $3,700.
- At Grant Lake reservoir, annual recreational use would range from a projected 56,500 to 87,200 visitor days over the 20-year period, with an average of 68,800 visitor days. Based on average spending of $9.72 per visitor day, annual spending within the two-county region associated with recreational use of Grant Lake reservoir would average approximately $668,700.
- Along the Upper Owens River, annual recreation use would range from a projected 19,300 to 26,900 visitor days over the 20-year period, with an average of 22,900 visitor days. Based on average spending of $50 per visitor day on private lands and $10 per visitor day on public lands, annual spending within the two-county region associated with recreation use along the Upper Owens River would average approximately $513,000.
- At Lake Crowley reservoir, annual recreational use would range from a projected 155,000 to 234,200 visitor days over the 20-year period, with an average of 191,900 visitor days. Based on average spending of $14.48 per visitor day, annual

spending within the two-county region associated with recreational use of Lake Crowley reservoir would average approximately $2.8 million.

Recreation Benefits

Streamflows and lake level conditions associated with the point of reference would provide recreation opportunities that yield benefits to those who visit the directly affected recreation areas. Because the point of reference is used as the base condition to assess changes, recreation benefits of point-of-reference conditions are not estimated.

Regional Economic Effects in Mono and Inyo Counties

Changes in agricultural production and recreational spending related to the project alternatives affect levels of economic activity within Mono and Inyo Counties. Both direct and indirect effects on employment and personal income in different sectors of the economy would occur. The following sections describe direct and total effects of economic activity associated with agricultural production and recreation spending. These effects are summarized in Table 3N-18.

Direct Effects

The total value of agricultural production on irrigated lands along the diverted tributaries in Mono Basin and along the Upper Owens River would average $55,600 annually. This production would generate approximately $2,800 annually in personal income and approximately 15 person-years of full-time equivalent (FTE) employment (seven herders and two owner-operators in Mono Basin and 20 seasonal jobs in Long Valley). Employment would not substantially change over the 20-year period.

The projected $6.7 million in annual recreation-related spending would provide an estimated $2.7 million in personal income and support 122 FTE jobs in Inyo and Mono Counties. Most economic activity would occur in the retail trade, restaurant, lodging, and automobile services sectors. Much of the spending and resulting economic activity would occur in commercial centers near the affected recreation areas, such as Lee Vining, Bishop, and Mammoth Lakes.

Together, agricultural production and recreation-related spending would generate a projected $6.7 million in industrial output, provide $2.7 million in personal income, and support 137 FTE jobs within the region.

Total Regional Effects

Agricultural production on irrigated lands along the diverted tributaries and the Upper Owens River would generate an average of $85,200 annually in total industrial output in the two-county region (Table 3N-18). Total personal income within the region provided by these activities would be about $12,600 annually. Total employment in the region supported by agricultural activities would be almost 40 FTE jobs annually.

Projected recreation-related spending associated with use of the five directly affected recreation areas would generate an estimated $10.8 million annually in industrial output, provide $4.1 million in personal income, and support 176 FTE jobs within the region.

Together, agricultural production and recreation spending would generate approximately $10.8 million in industrial output, provide $4.1 million in personal income, and support 216 FTE jobs.

Water Supply Costs to the City of Los Angeles

Under point-of-reference conditions, average annual costs to meet the demand for water within the LADWP service area would total a projected $174.9 million. A projected average of 442,000 acre-feet (af) of water from the LA Aqueduct would be delivered annually to LADWP over the 20-year period (Table 3N-19).

Power Generation Costs to the City of Los Angeles

Under point-of-reference conditions, average annual fuel costs to LADWP to meet the demand for energy within the service area would be a projected $675.5 million. Hydroelectric facilities along the LA Aqueduct system would annually generate a projected average of 1,038,000 megawatt hours (MWh) of electricity over the 20-year period (Table 3N-19).

Protecting Mono Lake's Public Trust Resources

Resource conditions under the point of reference are used as a baseline to assess social benefits associated with changes from this condition. Consequently, benefits of maintaining point-of-reference conditions are not estimated.

IMPACTS OF THE NO-RESTRICTION ALTERNATIVE

Agricultural Production in Mono and Inyo Counties Region

Irrigated Lands along Diverted Tributaries in Mono Basin

Under the No-Restriction Alternative, irrigated lands leased by LADWP to the Mono and Inyo Sheep Companies would continue to receive water from Gibbs, Lee Vining, Walker, and Parker Creeks at historical levels. Agricultural production from irrigated lands over the 20-year period of analysis would be similar to levels under point-of-reference conditions (Table 3N-16).

Lands Irrigated from the Upper Owens River

Under the No-Restriction Alternative, private landowners with riparian water rights would continue to irrigate at levels similar to historical levels. The LADWP lessee irrigating from the Upper Owens River north of Lake Crowley reservoir would also continue to irrigate at historical levels. Consequently, agricultural production from irrigated lands along the Upper Owens River would be similar to levels under point-of-reference conditions over the 20-year period of analysis (Table 3N-16).

Recreation Activity in the Mono and Inyo Counties Region

Recreation Use and Spending

Total visitation at the five affected recreation sites would decrease relative to the point of reference. As shown in Table 3N-17, projected annual average visitation would decrease from 479,880 to 476,460 visitor days under the No-Restriction Alternative. This change would occur primarily because of predicted reductions in visits to Mono Lake, which would more than offset increased recreational use of Grant Lake and Lake Crowley reservoirs.

Recreation spending within the region also would decrease. On average, annual recreation spending would decrease by a projected $59,100, or 1.0%, relative to spending levels under point-of-reference conditions (Table 3N-17). Spending by visitors to Mono Lake would decrease, affecting retail, restaurant, and lodging establishments in Lee Vining, while spending by visitors to Grant Lake and Lake Crowley reservoirs would increase, benefiting communities such as Mammoth Lakes and Bishop.

Recreation Benefits

Under the No-Restriction Alternative, the decline in recreation opportunities and use at Mono Lake and along the lower tributaries would result in a corresponding loss in recreation benefits (Table 3N-20). Increased opportunities and use of Grant Lake reservoir, Upper Owens River, and Lake Crowley reservoir would result in an increase in recreation benefits to those areas. Overall, recreation benefits would decrease by an estimated $2.9 million annually.

Regional Economic Effects in Mono and Inyo Counties

Direct Effects

Under the No-Restriction Alternative, direct output, personal income, and employment generated by recreation spending would decline relative to point-of-reference conditions. No changes in agricultural output, personal income, and employment would occur. As shown in Table 3N-18, average industrial output would decrease by a projected $65,700 annually. This reduction would result in a loss of $26,200 in personal income and 1.2 FTE jobs.

Total Regional Effects

Under the No-Restriction Alternative, total regional output, personal income, and employment would decline relative to point-of-reference conditions. The projected decrease in economic activity would be caused solely by reductions in regional recreation spending.

Average industrial output within Mono and Inyo Counties would decrease by a projected $105,900 annually. This reduction would result in regional loss of 1.7 FTE jobs and $40,100 in personal income annually (Table 3N-18).

Water Supply Costs to the City of Los Angeles

Water deliveries to LADWP from the LA Aqueduct would increase under the No-Restriction Alternative. Annual water availability would average 449,700 af, compared to 442,000 af under point-of-reference conditions. Average water costs to meet the demand for water in the LADWP service area would decrease by a projected $5.1 million annually, or 2.9% lower than average annual costs under the point of reference (Table 3N-19).

Under the No-Restriction Alternative, LADWP would purchase less water supplies from MWD, compared to point-of-reference conditions. Consequently, additional MWD supplies would be available to other MWD member agencies.

Power Generation Costs to the City of Los Angeles

Hydroelectric energy generated from the LA Aqueduct system would slightly increase under the No-Restriction Alternative. Annual average power generation would average 1,072,000 MWh, compared to 1,038,000 MWh under point-of-reference conditions. Average fuel costs to meet the demand for energy in the LADWP service area would decrease by a projected $1.2 million annually, or 0.2% lower than average annual costs under the point of reference (Table 3N-19).

Protecting Mono Lake's Public Trust Resources

Under the No-Restriction Alternative, the elevation of Mono Lake would decline to 6,354 feet over the long term. Based on a survey of California households, the public's total willingness to pay to avoid resource conditions associated with this alternative is estimated at $759.7 million. Consequently, implementing this alternative would incur an equivalent loss in social benefits.

IMPACTS FOR THE 6,372-FT ALTERNATIVE

Agricultural Production in the Mono and Inyo Counties Region

Irrigated Lands along Diverted Tributaries in Mono Basin

Under the 6,372-Ft Alternative, LADWP would terminate irrigation releases from Gibbs, Lee Vining, Walker, and Parker Creeks. Lands currently irrigated from these creeks would no longer be irrigated and would likely be used for dryland grazing.

The loss of forage would substantially affect the operations of the Mono and Inyo Sheep Companies. The forage provides feed for approximately 6,500-8,000 sheep during the 5- to 6-month summer grazing season and accounts for approximately 50% of the forage available to the Mono and Inyo Sheep Companies in Mono Basin. This loss of forage would require these operators to either reduce herd sizes or obtain summer forage elsewhere. Either option would likely result in adverse changes in net revenues for the two operations.

The decrease in forage value in Mono County would annually average $31,410 over the 20-year period of analysis (Table 3N-16). This decrease would represent approximately 3.7% of the total value of irrigated pasture and 0.3% of total agricultural production in Mono County in 1989.

Lands Irrigated from the Upper Owens River

Under the 6,372-Ft Alternative, flows in the Upper Owens River would be adequate during virtually all years to allow for irrigation of pastures along the river; inadequate flows would occur in July in 1 in 20 years. These low flows would affect an estimated 310 of the 1,821 acres typically irrigated from the Upper Owens River, resulting in an average annual production loss of 16 acres over the 20-year period. The production value generated by forage production along the Upper Owens River would be slightly lower than levels under the point-of-reference conditions (Table 3N-16).

Recreation Activity in the Mono and Inyo Counties Region

Recreation Use and Spending

Total visitation at the five directly affected recreation sites would increase relative to the point of reference. As shown in Table 3N-17, projected annual average visitation would increase from 479,880 to 492,260 visitor days under the 6,372-Ft Alternative. This change would occur primarily because of increased visits to Mono Lake, which would more than offset reductions in recreational use of Grant Lake and Lake Crowley reservoirs.

Recreation spending within the region also would increase. On average, annual recreation spending would increase by a projected $224,700, or 3.2%, relative to spending levels under point-of-reference conditions (Table 3N-17). Spending by visitors to Mono Lake and the Upper Owens River would increase, benefiting retail, restaurant, and lodging establishments in Lee Vining, whereas spending by visitors to Grant Lake and Lake Crowley reservoirs would decrease, potentially affecting communities such as Mammoth Lakes and Bishop.

Recreation Benefits

Under the 6,372-Ft Alternative, the increase in recreation opportunities and use at Mono Lake and Upper Owens River would result in a corresponding increase in recreation benefits (Table 3N-20). Decreased opportunities and use at Grant Lake and Lake Crowley reservoirs would result in a decrease in recreation benefits at those areas. Overall, recreation benefits would increase by an estimated $428,900 annually.

Regional Economic Effects in Mono and Inyo Counties

Direct Effects

Under the 6,372-Ft Alternative, direct output generated by agricultural production would decrease by approximately $31,500 annually, while average annual recreation spending would increase by approximately $223,500. These effects would result in a net increase in industrial output of $192,000 annually compared to point-of-reference conditions. Personal income within the region would increase by $87,500; however, the number of jobs would decrease by an estimated 0.9 FTE (Table 3N-18).

Total Regional Effects

Under the 6,372-Ft Alternative, total regional output and personal income would increase and total regional employment would decrease, relative to point-of-reference conditions. The projected increase in regional economic activity would result from increased spending on recreation, offsetting reductions in agricultural production.

Average industrial output within Mono and Inyo Counties would increase by a projected $311,900 (Table 3N-18). Personal income would increase by an average of $129,400 annually. Total employment within the region, however, would decrease by 7.3 FTE jobs relative to point-of-reference conditions. Large secondary job losses resulting from reductions in agricultural production would more than offset secondary employment growth associated with increased recreation spending.

Water Supply Costs to the City of Los Angeles

Water deliveries to LADWP from the LA Aqueduct would decrease under the 6,372-Ft Alternative. Annual water deliveries would average 425,100 af, compared to 442,000 af under point-of-reference conditions. Average water costs to meet the demand for water in the LADWP service area would increase by a projected $10.8 million annually, or 6.2% higher than average annual costs under the point of reference (Table 3N-19).

Under the 6,372-Ft Alternative, LADWP would purchase a projected average of 15,260 af of additional water annually from MWD compared to point-of-reference conditions. Based on an estimated cost differential of $161 per af, other MWD member agencies could incur an additional cost of $2.5 million annually to replace less expensive MWD supplies.

Power Generation Costs to the City of Los Angeles

Hydroelectric energy generated from the LA Aqueduct system would slightly decrease under the 6,372-Ft Alternative. Annual power generation would average 1,005,000 MWh annually, compared to 1,038,000 MWh under point-of-reference conditions. Average fuel costs to meet the demand for energy in the LADWP service area would increase by a projected $1.9 million annually, or 0.3% higher than average annual costs under the point of reference (Table 3N-19).

Protecting Mono Lake's Public Trust Resources

Under the 6,372-Ft Alternative, the elevation of Mono Lake would be at 6,375 feet over the long term. This level is comparable to the point of reference (6,376 feet) and therefore would have no measurable effect on social benefits associated with protecting Mono Lake's public trust resources.

IMPACTS FOR THE 6,377-FT ALTERNATIVE

Agricultural Production in the Mono and Inyo Counties Region

Irrigated Lands along Diverted Tributaries in Mono Basin

Under the 6,377-Ft Alternative, LADWP would terminate irrigation releases from Gibbs, Lee Vining, Walker, and Parker Creeks. Lands currently irrigated from these creeks by LADWP lessees would no longer be irrigated. Forage production and production value effects would be the same as those described above for the 6,372-Ft Alternative (Table 3N-16).

Lands Irrigated from the Upper Owens River

Under the 6,377-Ft Alternative, flows in the Upper Owens River would be adequate during virtually all years to allow for irrigation of pastures along the river. Inadequate flows would occur in June and July in 1 in 20 years, resulting in production effects similar to those described for the 6,372-Ft Alternative (Table 3N-16).

Recreation Activity in the Mono and Inyo Counties Region

Recreation Use and Spending

Total visitation at the five directly affected recreation sites would increase relative to the point of reference. As shown in Table 3N-17, projected annual average visitation would increase from 479,880 to 493,940 visitor days under the 6,377-Ft Alternative. This change would occur primarily because of increased visits to Mono Lake, which would more than offset reductions in recreational use of Grant Lake and Lake Crowley reservoirs.

Recreation spending within the region also would increase. On average, annual recreation spending would increase by a projected $247,500, or 3.5%, relative to spending levels under point-of-reference conditions (Table 3N-17). Spending by visitors to Mono Lake would increase, benefiting retail, restaurant, and lodging establishments in Lee Vining, while spending by visitors to Grant Lake and Lake Crowley reservoirs would decrease, potentially affecting communities such as Mammoth Lakes and Bishop.

Recreation Benefits

Under the 6,377-Ft Alternative, the increase in recreation opportunities and use at Mono Lake and along the tributaries would result in a corresponding increase in recreation benefits (Table 3N-20). Decreased opportunities and use at Grant Lake reservoir, Upper Owens River, and Lake Crowley reservoir would result in a decrease in recreation benefits at those areas. Overall, recreation benefits would increase by an estimated $1.1 million annually.

Regional Economic Effects in Mono and Inyo Counties

Direct Effects

Under the 6,377-Ft Alternative, direct output generated by agricultural production would decrease by approximately $31,500 annually, while average annual recreation spending would increase by approximately $256,900. These effects would result in a net increase in industrial output of $225,400 annually, compared to point-of-reference conditions. Personal income within the region would increase by $100,800 and the number of jobs would decrease by an estimated 0.3 FTE (Table 3N-18).

Total Regional Effects

Under the 6,377-Ft Alternative, total regional output, personal income, and employment would increase relative to point-of-reference conditions. The projected increase in regional economic activity would result from increased spending on recreation relative to point-of-reference conditions, offsetting reductions in agricultural production.

Average industrial output within Mono and Inyo Counties would increase by a projected $365,700 (Table 3N-18). Personal income would increase by an average of $149,800 annually; however, employment losses caused by decreased agricultural production would exceed increased employment by increased recreation spending, resulting in a net decrease of 6.4 FTE jobs.

Water Supply Costs to the City of Los Angeles

Water deliveries to LADWP from the LA Aqueduct would decrease under the 6,377-Ft Alternative. Annual water deliveries would average 413,900 af, compared to 442,000 af under point-of-reference conditions. Average water costs to meet the demand for water in the LADWP service area would increase by a projected $16.5 million, or 9.5% higher than average annual costs under the point of reference (Table 3N-19).

Under the 6,377-Ft Alternative, LADWP would purchase a projected average of 26,410 af of additional water annually from MWD compared to point-of-reference conditions. Based on an estimated cost differential of $161 per af, other MWD member agencies could incur an additional cost of $4.3 million annually to replace less expensive MWD supplies.

Power Generation Costs to the City of Los Angeles

Hydroelectric energy generated from the LA Aqueduct system would slightly decrease under the 6,377-Ft Alternative. Annual power generation would average 984,000 MWh annually, compared to 1,038,000 MWh under point-of-reference conditions. Average fuel costs to meet the demand for energy in the LADWP service area would increase by a projected $2.7 million annually, or 0.4% higher than average annual costs under the point of reference (Table 3N-19).

Protecting Mono Lake's Public Trust Resources

Under the 6,377-Ft Alternative, the elevation of Mono Lake would be at 6,379 feet over the long term. The public's annual willingness to pay to ensure resource conditions associated with this lake level is estimated at $22.9 million. This value reflects the social benefits of maintaining the lake at this level.

IMPACTS OF THE 6,383.5-FT ALTERNATIVE

Agricultural Production in the Mono and Inyo Counties Region

Irrigated Lands along Diverted Tributaries in Mono Basin

Under the 6,383.5-Ft Alternative, LADWP would terminate irrigation releases from Gibbs, Lee Vining, Walker, and Parker Creeks. Lands currently irrigated from these creeks by LADWP lessees would no longer be irrigated. Forage production and production value effects would be the same as those described above for the 6,372-Ft Alternative (Table 3N-16).

Lands Irrigated from the Upper Owens River

Under the 6,383.5-Ft Alternative, flows in the Upper Owens River would be adequate during virtually all years to allow for irrigation of pastures along the river. Inadequate flows would occur in May, June, and July in 1 in 20 years, resulting in production effects similar to those described for the 6,372-Ft Alternative (Table 3N-16).

Recreation Activity in the Mono and Inyo Counties Region

Recreation Use and Spending

Total visitation at the five directly affected recreation sites would increase relative to the point of reference. As shown in Table 3N-17, projected annual average visitation would increase from 479,880 to 491,610 visitor days under the 6,383.5-Ft Alternative. This change would occur primarily because of increased visits to Mono Lake, which would more than offset reductions in recreational use of Grant Lake reservoir, Upper Owens River, and Lake Crowley reservoir.

Recreation spending within the region also would increase. On average, annual recreation spending would increase by a projected $214,300, or 3.0%, relative to spending levels under point-of-reference conditions (Table 3N-17). Spending by visitors to Mono Lake would increase, benefiting retail, restaurant, and lodging establishments in Lee Vining, while spending by visitors to Grant Lake and Lake Crowley reservoirs would decrease, potentially affecting communities such as Mammoth Lakes and Bishop.

Recreation Benefits

Under the 6,383.5-Ft Alternative, the increase in recreation opportunities and use at Mono Lake and along the tributaries would result in a corresponding increase in recreation benefits (Table 3N-20). Decreased opportunities and use at Grant Lake reservoir, Upper Owens River, and Lake Crowley reservoir would result in a decrease in recreation benefits at those areas. Overall, recreation benefits would increase by an estimated $1.9 million annually.

Regional Economic Effects in Mono and Inyo Counties

Direct Effects

Under the 6,383.5-Ft Alternative, direct output generated by agricultural production would decrease by approximately $31,500 annually, whereas average annual recreation spending would increase by approximately $238,400. These effects would result in a net increase in industrial output of $206,900 annually, compared to point-of-reference conditions. Personal income within the region would increase by $93,500; however, the number of jobs would decrease by an estimated 0.6 FTE (Table 3N-18).

Total Regional Effects

Under the 6,383.5-Ft Alternative, total regional output, personal income, and employment would increase relative to point-of-reference conditions. The projected increase in regional economic activity would result from increased spending on recreation relative to point-of-reference conditions, offsetting reductions in agricultural production.

Average industrial output within Mono and Inyo Counties would increase by a projected $335,900 (Table 3N-18). Personal income would increase by an average of $138,500 annually; however, employment would decrease by 6.9 FTE jobs compared to point-of-reference employment levels because of the more significant impact of the change in agricultural production.

Water Supply Costs to the City of Los Angeles

Water deliveries to LADWP from the LA Aqueduct would decrease under the 6,383.5-Ft Alternative. Annual water deliveries would average 400,000 af, compared to 442,000 af under point-of-reference conditions. Average water costs to meet the demand for water in the LADWP service area would increase by a projected $26.4 million, or 15.1% higher than average annual costs under the point of reference (Table 3N-19).

Under the 6,383.5-Ft Alternative, LADWP would purchase a projected average of 39,730 af of additional water annually from MWD compared to point-of-reference conditions. Based on an estimated cost differential of $161 per af, other MWD member agencies could incur an additional cost of $6.4 million annually to replace less expensive MWD supplies.

Power Generation Costs to the City of Los Angeles

Hydroelectric energy generated from the LA Aqueduct system would slightly decrease under the 6,383.5-Ft Alternative. Annual power generation would average 930,000 MWh annually, compared to 1,038,000 MWh under point-of-reference conditions. Average fuel costs to meet the demand for energy in the LADWP service area would increase by a projected $4.2 million annually, or 0.6% higher than average annual costs under the point of reference (Table 3N-19).

Protecting Mono Lake's Public Trust Resources

Under the 6,383.5-Ft Alternative, the elevation of Mono Lake would be at 6,386 feet over the long term. The public's annual willingness to pay to ensure resource conditions associated with this lake level is estimated at $63.0 million. This value reflects the social benefits of maintaining the lake at this level.

IMPACTS OF THE 6,390-FT ALTERNATIVE

Agricultural Production in the Mono and Inyo Counties Region

Irrigated Lands along Diverted Tributaries in Mono Basin

Under the 6,390-Ft Alternative, LADWP would terminate irrigation releases from Gibbs, Lee Vining, Walker, and Parker Creeks. Lands currently irrigated from these creeks by LADWP lessees would no longer be irrigated. Forage production and production value effects would be the same as those described above for the 6,372-Ft Alternative (Table 3N-16).

Lands Irrigated from the Upper Owens River

Under the 6,390-Ft Alternative, flows in the Upper Owens River would be adequate during virtually all years to allow for irrigation of pastures along the river. Inadequate flows would occur in May, June, and July in 1 in 20 years, resulting in production effects similar to those described for the 6,372-Ft Alternative (Table 3N-16).

Recreation Activity in the Mono and Inyo Counties Region

Recreation Use and Spending

Total visitation at the five directly affected recreation areas would increase relative to the point of reference. As shown in Table 3N-17, projected annual average visitation would increase from 479,880 to 490,610 visitor days under the 6,390-Ft Alternative. This change would occur primarily because of increased visits to Mono Lake, which would more than offset reductions in recreational use of Grant Lake and Lake Crowley reservoirs.

Recreation spending within the region also would increase. On average, annual recreation spending would increase by a projected $198,700, or 2.8%, relative to spending levels under point-of-reference conditions (Table 3N-17). Spending by visitors to Mono Lake would increase, benefiting retail, restaurant, and lodging establishments in Lee Vining, while spending by visitors to Grant Lake and Lake Crowley reservoirs would decrease, potentially affecting communities such as Mammoth Lakes and Bishop.

Recreation Benefits

Under the 6,390-Ft Alternative, the increase in recreation opportunities and use at Mono Lake and along the tributaries would result in a corresponding increase in recreation benefits (Table 3N-20). Decreased opportunities and use at Grant Lake and Lake Crowley reservoirs would result in a decrease in recreation benefits at those areas. Overall, recreation benefits would increase by an estimated $2.7 million annually.

Regional Economic Effects in Mono and Inyo Counties

Direct Effects

Under the 6,390-Ft Alternative, direct output generated by agricultural production would decrease by approximately $31,500 annually, whereas average annual recreation spending would increase by approximately $225,300. These effects would result in a net increase in industrial output of $193,800 annually, compared to point-of-reference conditions. Personal income within the region would increase by $88,200; however, the number of jobs would decrease by an estimated 0.9 FTE (Table 3N-18).

Total Regional Effects

Under the 6,390-Ft Alternative, total regional output, personal income, and employment would increase relative to point-of-reference conditions. The projected increase in regional economic activity would result from increased spending on recreation relative to point-of-reference conditions, offsetting reductions in agricultural production.

Average industrial output within Mono and Inyo Counties would increase by a projected $314,800 (Table 3N-18). Personal income would increase by an average of $130,500 annually; however, employment would decrease by 7.3 FTE jobs compared to point-of-reference employment levels.

Water Supply Costs to the City of Los Angeles

Water deliveries to LADWP from the LA Aqueduct would decrease under the 6,390-Ft Alternative. Annual water deliveries would average 394,700 af, compared to 442,000 af under point-of-reference conditions. Average water costs to meet the demand for water in the LADWP service area would increase by a projected $30.4 million, or 17.4% higher than average annual costs under the point of reference (Table 3N-19).

Under the 6,390-Ft Alternative, LADWP would purchase a projected 43,420 af of additional water annually from MWD compared to point-of-reference conditions. Based on an estimated cost differential of $161 per af, other MWD member agencies could incur an additional cost of $7.0 million annually to replace less expensive MWD supplies.

Power Generation Costs to the City of Los Angeles

Hydroelectric energy generated from the LA Aqueduct system would slightly decrease under the 6,390-Ft Alternative. Annual power generation would average 904,000 MWh annually, compared to 1,038,000 MWh under point-of-reference conditions. Average annual fuel costs to meet the demand for energy in the LADWP service area would increase by a projected $5.0 million annually, or 0.7% higher than average annual costs under the point of reference (Table 3N-19).

Protecting Mono Lake's Public Trust Resources

Under the 6,390-Ft Alternative, the elevation of Mono Lake would be at 6,392 feet over the long term. The public's annual willingness to pay to ensure resource conditions associated with this lake level is estimated at $85.9 million. This value reflects the social benefits of maintaining the lake at this level.

IMPACTS OF THE 6,410-FT ALTERNATIVE

Agricultural Production in the Mono and Inyo Counties Region

Irrigated Lands along Diverted Tributaries in Mono Basin

Under the 6,410-Ft Alternative, LADWP would terminate irrigation releases from Gibbs, Lee Vining, Walker, and Parker Creeks. Lands currently irrigated from these creeks by LADWP lessees would no longer be irrigated. Forage production and production value effects would be the same as those described above for the 6,372-Ft Alternative (Table 3N-16).

Lands Irrigated from the Upper Owens River

Under the 6,410-Ft Alternative, flows in the Upper Owens River would be adequate during virtually all years to allow for irrigation of pastures along the river. Inadequate flows would occur in May, June, and July in 1 in 20 years, resulting in production effects similar to those described for the 6,372-Ft Alternative (Table 3N-16).

Recreation Activity in the Mono and Inyo Counties Region

Recreation Use and Spending

Total visitation at the five directly affected recreation areas would increase relative to the point of reference. As shown in Table 3N-17, projected annual average visitation would decrease from 479,880 to 475,010 visitor days under the 6,410-Ft Alternative. This change would occur primarily because of decreased visits to Lake Crowley and Grant Lake reservoirs, which would more than offset increases in recreational use at Mono Lake.

Recreation spending within the region would decrease slightly. On average, annual recreation spending would decrease by a projected $45,900, or 0.7%, relative to spending levels under point-of-reference conditions (Table 3N-17). Spending by visitors to Mono Lake would increase, benefiting retail, restaurant, and lodging establishments in Lee Vining, while spending by visitors to Grant Lake reservoir, Upper Owens River, and Lake Crowley reservoir would decrease, potentially affecting communities such as Mammoth Lakes and Bishop.

Recreation Benefits

Under the 6,410-Ft Alternative, the increase in recreation opportunities and use at Mono Lake and along the tributaries would result in a corresponding increase in recreation benefits (Table 3N-20). Decreased opportunities and use at Grant Lake reservoir, Upper Owens River, and Lake Crowley reservoir would result in a decrease in recreation benefits at those areas. Overall, recreation benefits would increase by an estimated $1.2 million annually.

Regional Economic Effects in Mono and Inyo Counties

Direct Effects

Under the 6,410-Ft Alternative, direct output generated by agricultural production would decrease by approximately $31,500 annually, and average annual recreation spending would decrease by approximately $8,900. These effects would result in a net decrease in industrial output of $40,400 annually, compared to point-of-reference conditions. Personal income within the region would decrease by $5,200, and the number of jobs would increase by an estimated 5.2 FTE (Table 3N-18).

Total Regional Effects

Under the 6,410-Ft Alternative, total regional output and personal income would increase, and total regional employment would decrease, relative to point-of-reference conditions. The projected increase in regional economic activity would result from increased spending on recreation relative to point-of-reference conditions, offsetting reductions in agricultural production.

Average industrial output within Mono and Inyo Counties would decrease by a projected $62,600 (Table 3N-18). Personal income would decrease by an average of $12,500 annually. Employment within the region would decrease by 13.4 FTE jobs under the 6,410-Ft Alternative relative to point-of-reference employment levels. Relatively large secondary job losses resulting from reductions in agricultural production would more than offset secondary employment growth associated with increased recreation spending (Table 3N-18).

Water Supply Costs to the City of Los Angeles

Water deliveries to LADWP from the LA Aqueduct would decrease under the 6,410-Ft Alternative. Annual water deliveries would average 384,400 af, compared to 442,000 af under point-of-reference conditions. Average water costs to meet the demand for water in the LADWP service area would increase by a projected $37.9 million, or 21.7% higher than average annual costs under the point of reference (Table 3N-19).

Under the 6,410-Ft Alternative, LADWP would purchase a projected 51,610 af of additional water annually from MWD compared to point-of-reference conditions. Based on an estimated cost differential of $161 per af, other MWD member agencies could incur an additional cost of $8.3 million annually to replace less expensive MWD supplies.

Power Generation Costs to the City of Los Angeles

Hydroelectric energy generated from the LA Aqueduct system would slightly decrease under the 6,410-Ft Alternative. Annual power generation would average 854,000 MWh, compared to 1,038,000 MWh under point-of-reference conditions. Average fuel costs to meet the demand for energy in the LADWP service area would increase by a projected \$6.6 million annually, or 1.0% higher than average annual costs under the point of reference (Table 3N-19).

Protecting Mono Lake's Public Trust Resources

Under the 6,410-Ft Alternative, the elevation of Mono Lake would be at 6,411 feet over the long term. Based on responses to the public survey, the willingness to pay by California households for conditions associated with this alternative appears to be positive but not statistically different from zero. Consequently, no value is estimated for this alternative.

IMPACTS OF THE NO-DIVERSION ALTERNATIVE

Agricultural Production in the Mono and Inyo Counties Region

Irrigated Lands along Diverted Tributaries in Mono Basin

Under the No-Diversion Alternative, LADWP would terminate irrigation releases from Gibbs, Lee Vining, Walker, and Parker Creeks. Lands currently irrigated from these creeks by LADWP lessees would no longer be irrigated. Forage production and production value effects would be the same as those described above for the 6,372-Ft Alternative (Table 3N-16).

Lands Irrigated from the Upper Owens River

Under the No-Diversion Alternative, flows in the Upper Owens River would be adequate during virtually all years to allow for irrigation of pastures along the river. Inadequate flows would occur in May, June, and July in 1 in 20 years, resulting in production effects similar to those described for the 6,372-Ft Alternative (Table 3N-16).

Recreation Activity in the Mono and Inyo Counties Region

Recreation Use and Spending

Total visitation at the five directly affected recreation areas would decrease relative to the point of reference. As shown in Table 3N-17, projected annual average visitation would decrease from 479,880 to 448,190 visitor days under the No-Diversion Alternative. This change would occur primarily because of decreased visits to Mono Lake and Lake Crowley reservoir, which would more than offset increased recreational use of Grant Lake reservoir.

Recreation spending within the region also would decrease. On average, annual recreation spending would decrease by a projected $583,000, or 8.3%, relative to spending levels under point-of-reference conditions (Table 3N-17). Spending by visitors to Mono Lake and Lake Crowley reservoir would decrease, potentially affecting retail, restaurant, and lodging establishments in Lee Vining and Bishop, while spending by visitors to Grant Lake reservoir would increase, potentially benefiting businesses in communities such as Mammoth Lakes and in the June Lake Loop area.

Recreation Benefits

Under the No-Diversion Alternative, the increase in recreation opportunities and use at Grant Lake reservoir and along the tributaries would result in a corresponding increase in recreation benefits (Table 3N-20). Decreased opportunities and use at Lake Crowley reservoir would result in a decrease in recreation benefits. The impact on recreation benefits at Mono Lake could not be estimated because the lake level is beyond the range of study in the survey. Consequently, the total change in recreation benefits associated with the No-Diversion Alternative could not be estimated.

Regional Economic Effects in Mono and Inyo Counties

Direct Effects

Under the No-Diversion Alternative, direct output generated by agricultural production would decrease by approximately $31,500 and average annual recreation spending would decrease by approximately $606,500. These effects would result in a decrease in regional output of $575,000 annually, compared to point-of-reference conditions. Personal income within the region would decrease by $218,400, and the number of jobs would decrease by an estimated 14.9 FTE (Table 3N-18).

Total Regional Effects

Under the No-Diversion Alternative, total regional output, personal income, and employment would decrease relative to point-of-reference conditions. The projected decrease in regional economic activity would result from decrease spending on recreation relative to point-of-reference conditions and reductions in agricultural production.

Average industrial output within Mono and Inyo Counties would decrease by a projected $924,200 (Table 3N-18). Personal income would decrease by an average of $339,000 annually. Employment within the region would decrease by 27.5 FTE jobs under the No-Diversion Alternative relative to point-of-reference employment levels.

Water Supply Costs to the City of Los Angeles

Water deliveries to LADWP from the LA Aqueduct would decrease under the No-Diversion Alternative. Annual water deliveries would average 375,200 af, compared to 442,000 af under point-of-reference conditions. Average water costs to meet the demand for water in the LADWP service area would increase by a projected $43.2 million, or 24.7% higher than average annual costs under the point of reference (Table 3N-19).

Under the No-Diversion Alternative, LADWP would purchase a projected 60,390 af of additional water annually from MWD compared to point-of-reference conditions. Based on an estimated cost differential of $161 per af, other MWD member agencies could incur an additional cost of $9.7 million annually to replace less expensive MWD supplies.

Power Generation Costs to the City of Los Angeles

Hydroelectric energy generated from the LA Aqueduct system would decrease under the No-Diversion Alternative. Annual power generation would average 817,000 MWh, compared to 1,038,000 MWh under point-of-reference conditions. Average fuel costs to meet the demand for energy in the LADWP service area would increase by a projected $8.2 million annually, or 1.2% higher than average annual costs under the point of reference (Table 3N-19).

Protecting Mono Lake's Public Trust Resources

Under the No-Diversion Alternative, the elevation of Mono Lake would be at 6,427 feet over the long term. Because this lake elevation is above the levels asked about in the public survey, no estimates are made of social benefits associated with maintaining this lake level.

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Table 3N-1. Population Trends in Mono and Inyo Counties, 1900-1989

	Mono County	Inyo County
1900	2,200	4,400
1910	2,000	7,000
1920	1,000	7,000
1930	1,400	6,600
1940	2,300	7,600
Change from 1900 to 1940	4.5%	72.7%
1950	2,100	11,700
1960	2,200	11,700
1970	4,100	15,600
1980	8,700	17,900
1989	9,900	18,300
Change from 1940 to 1989	371.4%	56.4%

Source: California Department of Finance 1970, 1990.

Table 3N-2. Employment in Mono and Inyo Counties

Sector	1975	1985	1990
Agriculture	50	125	75
Mining and manufacturing	800	650	700
Construction	300	625	700
Transportation and public utilities	450	325	350
Trade	2,225	3,000	3,800
Financing, insurance, and real estate	275	425	500
Services	1,850	3,275	4,150
Government	3,000	3,225	3,025
Total	8,925	11,650	13,300

Source: California Employment Development Department 1991.

Table 3N-3. Income by Type and Per Capita, Mono and Inyo Counties

	Mono County		Inyo County	
	1983	1988	1983	1988
Income by type (%)				
Earnings	76.5	76.8	56.1	54.4
Dividends, interest, and rent	13.5	14.2	22.3	23.2
Transfer payments	10.0	9.0	21.6	22.3
Per-capita income ($)	12,712	17,772	11,731	15,300

Source: U.S. Department of Commerce 1990.

Table 3N-4. Earnings by Industry, Mono and Inyo Counties,
(Millions of Dollars)

	Mono County		Inyo County	
	1983	1988	1983	1988
Agriculture	4.8	4.1	3.1	3.9
Mining and manufacturing	--	--	20.5	10.5
Construction	11.7	18.6	6.0	8.0
Trade	15.8	18.9	28.8	32.0
Finance, insurance, and real estate	5.1	7.3	3.3	3.2
Services	23.4	46.3	25.3	43.6
Government	20.7	27.0	35.8	51.0
Other	10.3	10.7	9.6	12.4
Total earnings	91.8	132.9	132.4	164.6

-- = not reported.

Source: U.S. Department of Commerce 1990.

Table 3N-5. Historical Characteristics of Agriculture in Mono and Inyo Counties, 1910-1987

	Mono County				Inyo County			
Characteristic	1910	1930	1940	1987	1910	1930	1940	1987
Number of farms	91	76	92	76	438	218	228	94
Land in farms (acres)	115,672	66,073	56,700	72,900	110,142	94,567	183,564	219,816
Average acres on each farm	1,271	869	616	959	252	434	805	2,338
Value of farmland[a]	$1,587,800	$2,315,800	$1,508,000	$50,575,000	$5,210,600	$12,027,000	$6,277,000	$113,194,000
Number of irrigated farms	76	NA	NA	62	438	NA	NA	57
Acreage irrigated	49,027	NA	29,020	22,134	65,163	NA	23,625	13,034
Number of cattle on farms	5,301	3,500	9,171	9,429	20,308	12,519	15,710	16,516
Value of cattle	$107,900	$189,700	$380,000	$2,112,000	$428,900	$668,200	$651,500	$3,711,000
Cattle sold or slaughtered	625	NA	2,687	5,322	187	NA	5,074	8,541
Number of sheep on farms	63,046	24,351	25,600	NA	43,300	45,029	17,016	265
Value of sheep	$256,500	$176,400	$151,600	NA	$156,300	$302,300	$99,900	NA
Sheep sold or slaughtered	19,240	NA	21,589	NA	18,408	NA	12,656	NA
Value of wool	$41,200	$40,600	$52,900	NA	$27,800	$59,300	$36,300	NA

Note: Values are expressed in nominal (unadjusted) dollars.

[a] For 1987, the value includes the value of lands and buildings; for all other years, the total represents the value of land only.

NA = not available. Census data are not reported when the number of operators is too small to protect confidentiality of respondents.

Source: U.S. Bureau of the Census 1913, 1932, 1942, 1989.

Table 3N-6. Value of Agricultural Production: Mono and Inyo Counties

Product	Mono County			Inyo County		
	1974	1979	1989	1974	1979	1989
Livestock	$732,700	$7,529,100	$6,503,600	$2,136,000	$5,290,300	$4,937,900
Wool	13,200	169,400	249,400	81,000	10,500	20,000
Field crops	1,506,700	3,894,600	5,650,400	1,251,200	2,354,400	3,393,600
Miscellaneous crops	56,300	0	852,800	13,300	55,700	694,800
Apiary	0	0	0	22,682	100,700	19,800
Total	$2,308,900	$11,593,100	$13,256,200	$3,504,182	$7,811,600	$9,066,100

Notes: Values are expressed in nominal (unadjusted) dollars.

The annual crop and livestock reports for Mono and Inyo Counties began in 1975; no data are available for years before 1974.

Source: Inyo-Mono Department of Agriculture 1975, 1981, 1991.

Table 3N-7. Estimated Value of Forage Production on Leased LADWP Lands in the Mono Basin Study Area

Lessee	Irrigated Lands (Value per AUM = $4.00) AUMs	Irrigated Lands (Value per AUM = $4.00) Value ($)	Dry Grazing Lands (Value per AUM = $2.00) AUMs	Dry Grazing Lands (Value per AUM = $2.00) Value ($)	Total AUMs	Total Value ($)
Inyo Sheep Company	8,298	33,192	1,070	2,140	9,368	35,332
Mono Sheep Company	1,560	6,240	485	970	2,145	7,210
Total	9,858	39,432	1,555	3,110	11,413	42,542

Notes: Forage production is based on normal precipitation years. Years when irrigation supplies are limited may result in decreased AUMs available to lessees. For example, forage production on Inyo Sheep Company properties was reduced from 9,368 AUMs to 8,276 AUMs in 1989 due to drought conditions.

The estimated values shown above do not represent actual grazing rates paid by lessees.

AUM = animal unit month, or the amount of feed or forage required by an animal unit (a cow-calf pair or five ewes) for 1 month (approximately 1,000 pounds per month).

Source: Anderson pers. comm.

Table 3N-8. Estimated Value of Forage Production on Private and Leased Lands along the Upper Owens River

Landowner	Irrigated Lands (Value per AUM = $4.00)		Dry Grazing Lands (Value per AUM = $2.00)		Total	
	AUMs	Value ($)	AUMs	Value ($)	AUMs	Value ($)
John Arcularius Ranch	150	600	103	206	253	806
Inaja Land Company	2,100	8,400	53	106	2,153	8,506
Howard Arcularius Ranch	1,500	6,000	6	12	1,506	6,012
J&L Livestock Company	1,997	7,988	243	486	2,240	8,474
Total	5,747	22,988	405	810	6,152	23,798

Notes: Forage production was estimated assuming 3 and 1.5-4.5 AUMs per acre of irrigated private and leased LADWP lands, respectively, and 0.1 AUM per acre of dry grazing land. These estimates do not necessarily correspond to the actual amount of forage harvested by the above ranches. Forage production is based on normal precipitation years. Years when irrigation supplies are limited may result in decreased AUMs available to landowners and lessees.

The estimated values shown above do not represent actual income earned by landowners or grazing rates paid by LADWP lessees.

AUM = animal unit month, or the amount of feed or forage required by an animal unit (a cow-calf pair or five ewes) for 1 month (approximately 1,000 pounds per month).

Source: Table based on information provided by Anderson, H. Arcularius, J. Arcularius, and Rossi.

Table 3N-9. Estimated Recreation-Related Expenditures in Mono and Inyo Counties, 1983-1989 (Thousands of 1989 Dollars)

Year	Mono County	Inyo County	Two-County Region
1983	92,298	137,239	229,537
1984	101,588	143,736	245,324
1985	112,725	152,653	265,378
1986	111,455	148,124	259,579
1987	107,907	203,151	311,058
1988	125,205	195,738	320,943
1989	128,637	210,282	339,019

Notes: Assumes recreation-related expenditures equal 95% of all travel-related expenditures.

Assumes recreation-related expenditures for 1986-1987 varied in proportion to taxable sales for the county.

Source: Travel-related data were from California Department of Commerce 1987; taxable sales-related data were from California Board of Equalization 1987-1990.

Table 3N-10. Estimated Employment Generated by Recreation-Related Spending within the Two-County Region

Year	Recreation-Related Employment			Total Regional Employment	Percent of Total Employment That is Recreation-Related
	Mono County	Inyo County	Two-County Region		
1983	1,329	2,310	3,639	11,425	32
1984	1,525	2,525	4,050	11,725	34
1985	1,661	2,632	4,293	11,650	37
1986	1,624	2,577	4,198	11,550	36
1987	1,653	2,619	4,272	11,425	37
1988	2,015	3,193	5,207	12,475	42
1989	2,143	3,956	5,538	13,650	40

Notes: Assumes recreation-related employment equals 95% of all travel-related employment.

Assumes recreation-related employment varied in relation to real total taxable sales (in 1989 dollars) in 1986-1989.

Source: Travel-related data from the California Department of Commerce 1987; taxable sales-related data from the California Board of Equalization 1987-1990.

Table 3N-11. Recreation-Related Payroll in Mono and Inyo Counties, 1983-1989 (in Thousands of 1989 Dollars)

Year	Mono County	Inyo County	Two-County Region
1983	16,703	26,052	42,755
1984	18,918	28,468	47,386
1985	17,884	30,311	48,195
1986	17,490	29,644	47,134
1987	17,794	30,159	47,953
1988	21,693	36,767	58,460
1989	23,070	39,101	62,171

Notes: Assumes recreation-related payroll equals 95% of travel-related payroll.

Assumes recreation-related payroll from 1986-1989 varies in proportion to real taxable sales in 1986-1989.

Source: Travel-related data are from the California Department of Commerce 1987; taxable sales-related data are from California Board of Equalization 1987-1990.

Table 3N-12. Estimated Total Costs of Meeting LADWP Demand for Water from Available Sources (1990 Dollars)

Source	Water Supplied (af)	Total Cost of Supplied Water (millions of $)	Percent of Total Cost
Los Angeles Aqueduct	380,000	38.0	40.5
Local groundwater	112,000	10.1	10.8
Metropolitan Water District	196,900	45.3	48.2
Reclaimed water	1,000	0.5	0.5
Total	689,900	93.9	100.0

Notes: Total costs were estimated based on estimated water supply needs and average unit costs for each source, and may not reflect actual water supply costs for 1990. Supply and cost estimates are based on average runoff years.

Source: Based on data from LADWP 1991b.

Table 3N-13. LADWP Power Generation - Fixed Operation, Maintenance, and Fuel Costs, 1989

Source	Expenses in Millions ($)	Percent of Total
Nuclear	15.8	1.8
Coal	40.6	4.6
Oil and gas steam	59.9	6.8
Hydroelectric	17.1	1.9
Transmission	33.8	3.8
Distribution	115.0	13.0
Other fixed operations and maintenance	235.3	26.5
Fuel[a]	369.0	41.6
Total	886.5	100.0

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[a] Does not include purchases and imports.

Source: LADWP 1991a.

Table 3N-14. Summary Comparison of Annualized Economic Costs and Benefits of the Project Alternatives, Relative to Point-of-Reference Conditions (in Millions of 1992 Dollars)

Alternative or Condition	LADWP Water Supply[a,b]	LADWP Power Generation[a]	Recreation Benefits[c]	Mono Lake Preservation Values[c]	Net Economic Benefits[c]
Point of reference[d]	--	--	--	--	--
No restriction	+5.1	+1.3	-2.9	-759.7	-753.0[e]
6,372 Ft	-10.8	-1.9	+0.4	0.0[f]	-12.3
6,377 Ft	-16.5	-2.7	+1.1	+22.6	+3.2[e]
6,383.5 Ft	-26.4	-4.2	+1.9	+63.0	+31.8[e]
6,390 Ft	-30.4	-5.0	+2.7	+85.9	+49.9[e]
6,410 Ft	-37.9	-6.7	+1.2	0.0[g]	-43.4
No diversion	-43.2	-8.2	+1.2[h]	0.0[g,h]	-50.9

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[a] Positive values indicate savings and negative values indicate higher costs; all values represent average annual values over the 20-year analysis period (1992-2011).

[b] Values do not include potential savings or costs to other MWD agencies that could be affected by changes in available MWD supplies. Approximations of these values are reported in the text but are not considered sufficiently reliable for including in the summary comparison. Including them would affect the magnitude of the net economic benefits and could potentially affect whether the amount is positive or negative for the 6,377-Ft Alternative.

[c] Positive values indicate a gain, and negative values indicate a loss in social welfare.

[d] No values are reported for the point of reference because it is used as a reference point only.

[e] Totals exclude recreation benefits at Mono Lake because they are included in estimates of Mono Lake preservation values.

[f] Interpreted to be equivalent to the point-of-reference conditions because the average lake level of this alternative would be similar to the point of reference.

[g] Value reflects the results of survey data analysis, which indicates that the median willingness to pay is not statistically different from zero.

[h] Assumed equivalent to the 6,410-Ft Alternative based on generally comparable hydrologic conditions at affected reservoirs, lakes, and streams.

Table 3N-15. Marginal Economic Costs and Benefits of the Alternatives

(see Figure 3N-1)

Table 3N-16. Average Annual Value of Agricultural Production on Lands Directly Affected by the Diversion Alternatives

	Mono Basin		Long Valley		Totals		
Alternative	Forage Production (AUMs)	Production Value (1992 Dollars)	Forage Production (AUMs)	Production Value (1992 Dollars)	Forage Production (AUMs)	Production Value (1992 Dollars)	Change in Production Value from Point of Reference (1992 Dollars)
Point of reference	7,852	31,406	6,047	24,188	13,899	55,594	NA
No restriction	7,852	31,406	6,047	24,188	13,899	55,594	0
6,372-Ft	0	0	5,975	24,115	5,975	24,115	-31,479
6,377-Ft	0	0	5,975	24,115	5,975	24,115	-31,479
6,383.5-Ft	0	0	5,975	24,115	5,975	24,115	-31,479
6,390-Ft	0	0	5,975	24,115	5,975	24,115	-31,479
6,410-Ft	0	0	5,975	24,115	5,975	24,115	-31,479
No diversion	0	0	5,975	24,115	5,975	24,115	-31,479

Note: Reflects estimated forage production and value of production from lands irrigated from the diverted tributaries in Mono Basin and from the Upper Owens River between East Portal and Lake Crowley reservoir.

Table 3N-17. Average Annual Use and Spending Associated with Recreation at Directly Affected Areas

	Mono Lake[a]		Mono Lake Tributaries		Grant Lake Reservoir		Upper Owens River		Lake Crowley Reservoir		Totals			
													Change in Recreation Spending from Point of Reference	
Alternative or Condition	Visitor Days	Recreation Spending (1992 Dollars)	Visitor Days	Recreation Spending (1992 Dollars)	Visitor Days	Recreation Spending (1992 Dollars)	Visitor Days	Recreation Spending (1992 Dollars)	Visitor Days	Recreation Spending (1992 Dollars)	Visitor Days	Recreation Spending (1992 Dollars)	(1992 Dollars)	(%)
Point of reference	195,900	3,091,302	380	3,667	68,800	668,736	22,900	512,960	191,900	2,778,712	479,880	7,055,377		
No restriction	187,100	2,952,438	160	1,544	69,800	678,456	23,600	528,640	195,800	2,835,184	476,460	6,996,262	(59,115)	-0.8
6,372 Ft	212,700	3,356,406	460	4,439	64,600	627,912	23,400	524,160	191,100	2,767,128	492,260	7,280,045	224,668	3.2
6,377 Ft	221,500	3,495,270	540	5,211	64,400	625,968	21,700	486,080	185,800	2,690,384	493,940	7,302,913	247,536	3.5
6,383.5 Ft	229,800	3,626,244	610	5,887	63,500	617,220	19,900	445,760	177,800	2,574,544	491,610	7,269,655	214,278	3.0
6,390 Ft	231,000	3,645,180	710	6,852	62,800	610,416	19,200	430,080	176,900	2,561,512	490,610	7,254,040	198,663	2.8
6,410 Ft	221,600	3,496,848	710	6,852	62,000	602,640	17,900	400,960	172,800	2,502,144	475,010	7,009,444	(45,934)	-0.7
No diversion	176,700	2,788,326	690	6,659	81,000	787,320	17,900	400,960	171,900	2,489,112	448,190	6,472,377	(583,001)	-8.3

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[a] Represents visitation to Mono Lake Tufa State Reserve.

Table 3N-18. Average Annual Economic Effects in the Mono and Inyo County Region Resulting from Changes in Agricultural Production and Recreation Activity

							Totals					
	Agriculture			Recreation			Output		Personal Income		Employment	
Alternative or Condition	Output (1992 Dollars)	Personal Income (1992 Dollars)	Employment (FTE)	Output[a] (1992 Dollars)	Personal Income (1992 Dollars)	Employment (FTE)	Total	Change from Point of Reference	Total	Change from Point of Reference	Total	Change from Point of Reference
Point of reference												
Direct[b]	55,600	2,800	15.0	6,674,600	2,661,830	122.0	6,730,200		2,664,630		137.0	
Total[c]	85,200	12,600	39.6	10,756,785	4,076,860	176.2	10,841,985		4,089,460		215.8	
No restriction												
Direct[b]	55,600	2,800	15.0	6,608,900	2,635,629	120.8	6,664,500	(65,700)	2,638,429	(26,201)	135.8	-1.2
Total[c]	85,200	12,600	39.6	10,650,903	4,036,730	174.4	10,736,103	(105,882)	4,049,330	(40,130)	214.0	-1.7
6,372 Ft												
Direct[b]	24,100	1,196	10.0	6,898,100	2,750,962	126.1	6,922,200	192,000	2,752,158	87,528	136.1	-0.9
Total[c]	36,900	5,500	26.4	11,116,978	4,213,374	182.1	11,153,878	311,893	4,218,874	129,414	208.5	-7.3
6,377 Ft												
Direct[b]	24,100	1,196	10.0	6,931,500	2,764,282	126.7	6,955,600	225,400	2,765,478	100,848	136.7	-0.3
Total[c]	36,900	5,500	26.4	11,170,805	4,233,775	182.9	11,207,705	365,720	4,239,275	149,815	209.3	-6.4
6,383.5 Ft												
Direct[b]	24,100	1,196	10.0	6,913,000	2,756,904	126.3	6,937,100	206,900	2,758,100	93,470	136.3	-0.6
Total[c]	36,900	5,500	26.4	11,140,991	4,222,475	182.5	11,177,891	335,905	4,227,975	138,515	208.9	-6.9
6,390 Ft												
Direct[b]	24,100	1,196	10.0	6,899,900	2,751,680	126.1	6,924,000	193,800	2,752,876	88,246	136.1	-0.9
Total[c]	36,900	5,500	26.4	11,119,879	4,214,473	182.1	11,156,779	314,793	4,219,973	130,514	208.5	-7.3
6,410 Ft												
Direct[b]	24,100	1,196	10.0	6,665,700	2,658,281	121.8	6,689,800	(40,400)	2,659,477	(5,153)	131.8	-5.2
Total[c]	36,900	5,500	26.4	10,742,442	4,071,423	175.9	10,779,342	(62,643)	4,076,923	(12,536)	202.3	-13.4
No diversion												
Direct[b]	24,100	1,196	10.0	6,131,100	2,445,083	112.0	6,155,200	(575,000)	2,446,279	(218,352)	122.0	-14.9
Total[c]	36,900	5,500	26.4	9,880,881	3,744,889	161.8	9,917,781	(924,205)	3,750,389	(339,071)	188.2	-27.5

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[a] Represents nonlocal spending only.

[b] The direct impact represents the change in agricultural and recreation-serving sectors resulting from forage production and recreation spending changes.

[c] The total impact represents the direct, indirect, and induced changes in all industrial sectors in Mono and Inyo Counties resulting from changes in forage production and recreation spending.

FTE = full-time equivalent jobs.

Table 3N-19. Change in Average Annual Water and Power Supply Costs to Meet the Demands of the City of Los Angeles

	Water Supply			Power Supply		
Alternative or Condition	LA Aqueduct Water Deliveries (af)	Change in Water Deliveries (af)	Change in Resource Costs from Point of Reference (1992 Dollars)	LA Aqueduct Energy Generation (MWh)	Change in Power Generation (MWh)	Change in Resource Costs from Point of Reference (1992 Dollars)
Point of reference	442,000			1,038,000		
No restriction	449,700	7,700	-5,095,000	1,072,000	34,000	-1,230,000
6,372-Ft	425,100	-16,900	10,814,000	1,005,000	-33,000	1,900,000
6,377-Ft	413,900	-28,100	16,541,000	984,000	-54,000	2,670,000
6,383.5-Ft	400,000	-42,000	26,447,000	930,000	-108,000	4,170,000
6,390-Ft	394,700	-47,300	30,430,000	904,000	-134,000	5,030,000
6,410-Ft	384,400	-57,600	37,890,000	854,000	-184,000	6,650,000
No diversion	375,200	-66,800	43,221,000	817,000	-221,000	8,180,000

Table 3N-20. Estimated Change in Annual Recreation Benefits
at Directly Affected Recreation Areas, by Alternative[a]
(Thousands of Dollars)

Alternative	Mono Lake	Lower Tributaries	Grant Lake Reservoir	Upper Owens River	Lake Crowley Reservoir	Total
No restriction	-3,162.6	-8.5	107.5	44.0	88.7	-2,930.9
6,372 Ft	573.1	-1.6	-85.3	31.4	-88.7	428.9
6,377 Ft	1,253.2	8.5	-99.2	-81.7	0.0	1,080.8
6,383.5 Ft	2,506.3	13.5	-111.8	-204.2	-266.1	1,937.7
6,390 Ft	3,324.6	14.9	-124.3	-251.3	-266.1	2,697.8
6,410 Ft	1,992.0	14.9	-136.4	-339.3	-354.8	1,176.4
No diversion	NA	14.9	356.4	-342.4	-354.8	NA

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[a] Estimates are relative to point-of-reference conditions.

NA = no estimate available.

Figure 3N-1.
Marginal Economic Costs and Benefits of the Alternatives

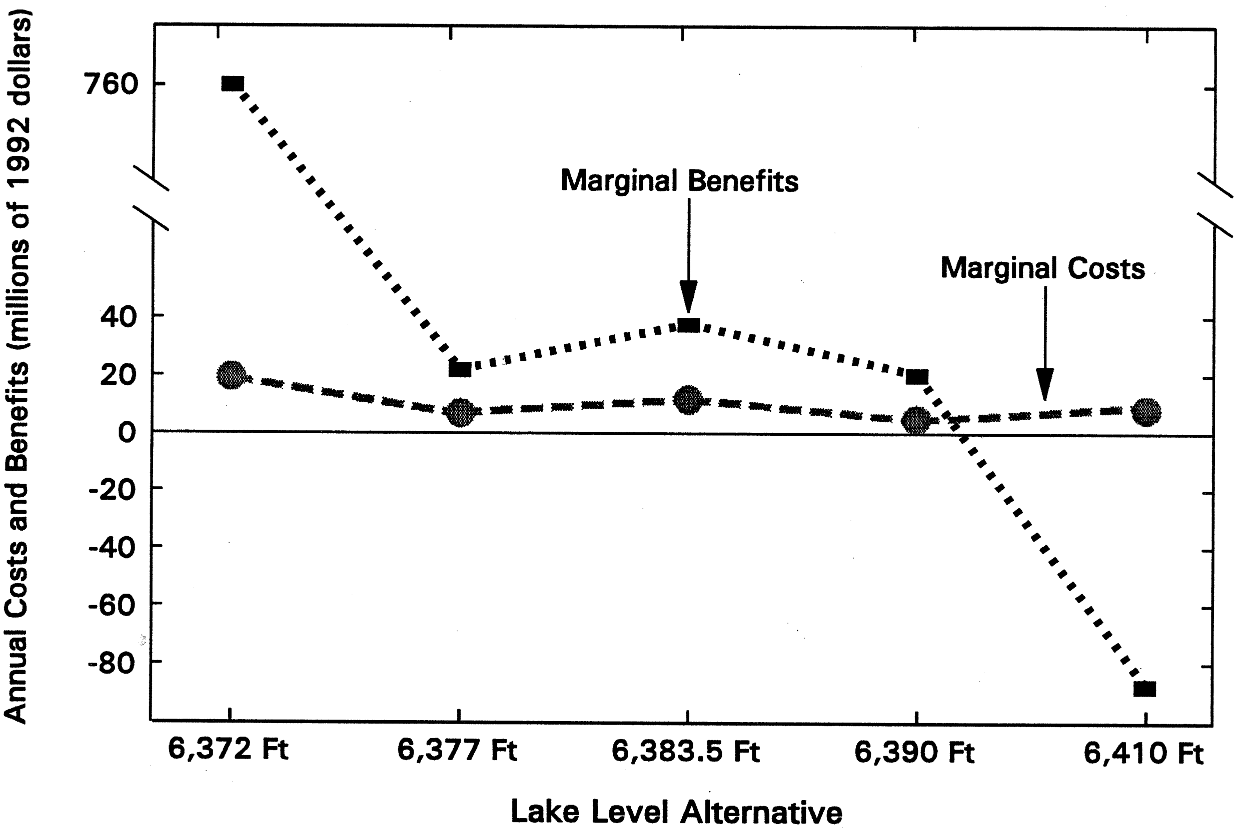
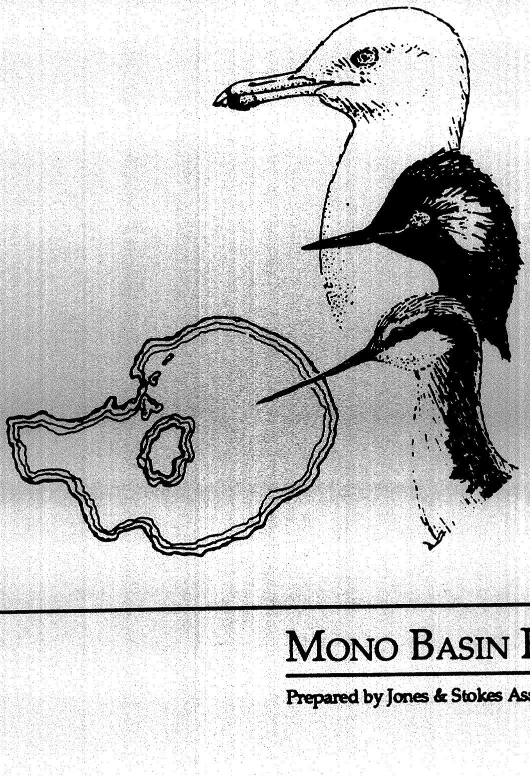


Table 3N-15.
Marginal Economic Costs and Benefits of the Alternatives

Lake Level Alternative	Marginal Benefits[a]	Marginal Costs[b]	Ratio of Benefits to Costs
No Restriction[c]	--	--	--
6,372 Ft	659.8	19.1	34.5
6,377 Ft	22.0	6.5	3.4
6,383.5 Ft	37.7	11.4	3.3
6,390 Ft	20.4	4.8	4.3
6,410 Ft	−87.4	9.2	N/A

[a] Includes recreation benefits and Mono Lake preservation values.
[b] Includes LADWP water supply and power generation costs.
[c] Used as reference for calculating marginal costs and benefits for the 6,372-ft Alternative.
N/A = Not applicable.
Source: Derived from data in Table 3N-14 and Table X-1.

Chapter 4. List of Preparers



Jeff Kozlowski	Fisheries
Sara Brennan	Graphic Artist

Terrestrial Biology and Miscellaneous Topics Team (Vegetation, Wildlife, Land Use, Air Quality, Cultural Resources)

Ken Casaday	Team Leader
Tim Messick	Vegetation
Jim Jokerst	Vegetation
Brent Helm	Vegetation
Edward C. Beedy	Wildlife
Marcus Rawlings	Wildlife
Roger Trott	Land Use
Kelly Sackheim	Land Use
Robert Sculley	Air Quality
Dana McGowan	Cultural Resources

Socioeconomic Team (Visual Resources, Recreation Resources, Water Supply, Power Generation, Economics)

Thomas Wegge	Team Leader
Nick Dennis	Recreation Resources
Gregg Roy	Recreation Resources
Erik Spiess	Recreation Resources
Tim Rimpo	Water Supply
Kelly Sackheim	Water Supply
Roger Trott	Economics

GIS/CAD Team

Bruce Boyd	Team Leader
Steve Whiting	GIS Manager
Chris DiDio	CAD Mapping Specialist, GIS Technician

Chapter 4. List of Preparers

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD STAFF

Jim Canaday	Project Manager and Terrestrial Ecology
Steve Herrera	Aquatic Ecology
Chuck Rich	Engineering and Modeling
Dan Frink	Legal Counsel
Doug Albin	Aquatic Ecology

JONES & STOKES ASSOCIATES

Jordan Lang	Principal-in-Charge
Ken Casaday	Project Manager

Water Resources Team (Hydrology, Water Quality, Aquatic Productivity)

Russ Brown	Team Leader
Michael Zanoli	Water Quality
Philip Unger	Aquatic Productivity
Joanne Field	Aquatic Productivity

Fisheries Team

Phil Dunn	Team Leader
Bill Mitchell	Fisheries
Warren Shaul	Fisheries

Production Team

Fern L. Weston	Project Assistant and Lead Word Processing Operator
Jeanine Hinde	Graphics and Production Coordinator
Judy Bell	Project Startup Assistant and Bibliographic Database Coordinator
Susan Fotter	Word Processing Operator
Victoria Axiaq	Lead Editor
Roberta Childers	Editor
Suzanne Lopez	Citations Editor
Rubby Hampton	Information Retrieval Specialist
Joanne Gorbach	Graphic Artist
Tony Rypich	Graphic Artist
Christy Anderson	Graphic Artist
Beverly Fish	Report Reproduction Specialist

EDAW, INC.

Tom Packard	Visual Resources
Greg Currie	Visual Resources

RMI ASSOCIATES

Dave Lawson	Power Generation

W. MICHAEL HANEMANN

W. Michael Hanemann	Water Supply Economics