VOLUME I
Draft
Environmental Impact Report

WATER FROM THE OWENS VALLEY TO SUPPLY THE SECOND LOS ANGELES AQUEDUCT

- 1970 TO 1990
- 1990 ONWARD, PURSUANT TO A LONG TERM GROUNDWATER MANAGEMENT PLAN

SCH #89080705

City of Los Angeles,
Department of Water and Power
and County of Inyo

Technical Assistance Provided by
EIP Associates

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued) Page

TABLE OF CONTENTS (Continued) Page

TABLE OF CONTENTS (Continued) | Page

TABLE OF CONTENTS (Continued) Page

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (Continued)

SUMMARY

S.1 SETTING

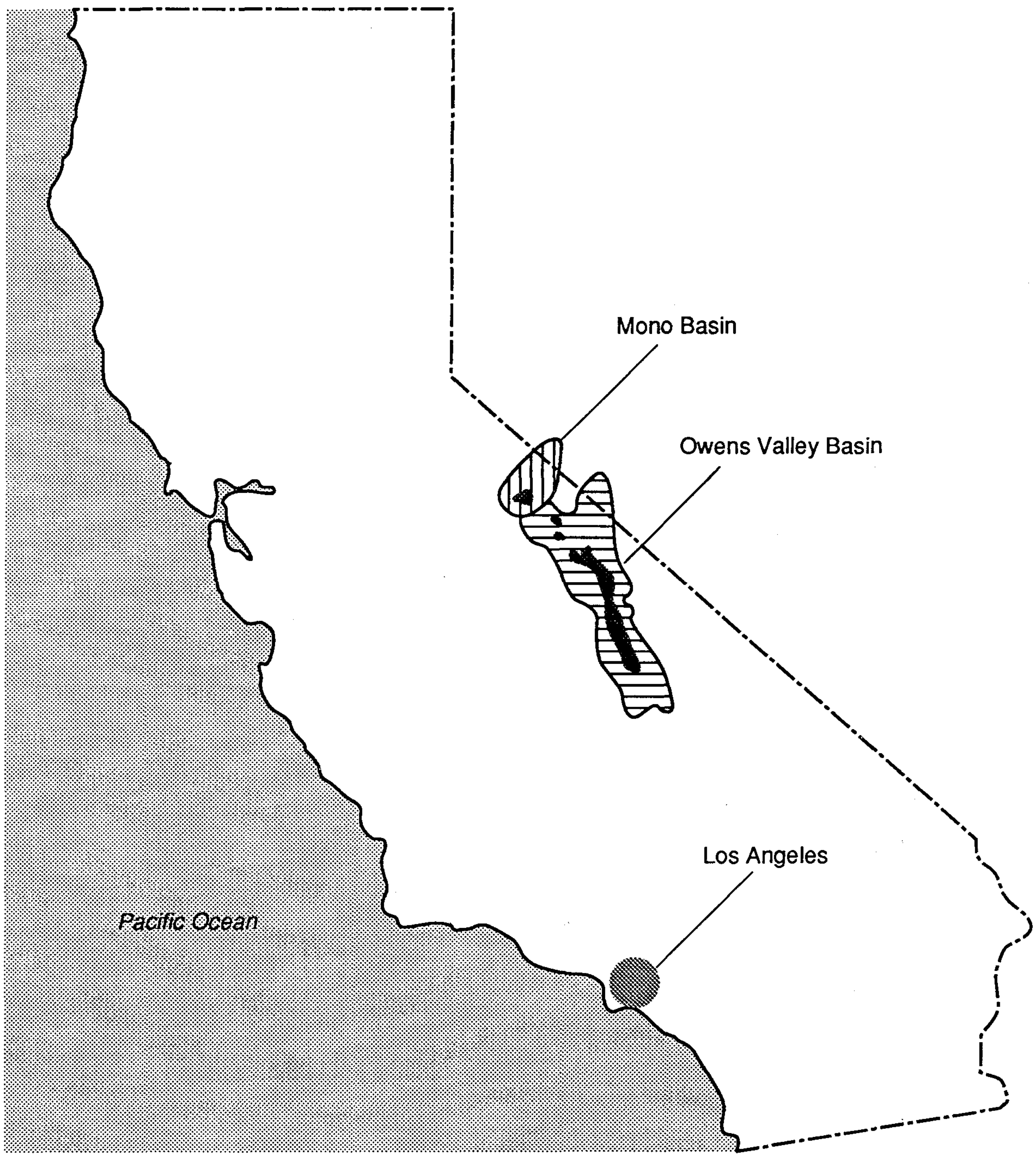
The proposed project is located in the Owens Valley ("Valley") of Inyo County. The Valley is situated between the Sierra Nevada and the Inyo/White mountains, approximately 250 miles north of the City of Los Angeles. The peaks of these mountain ranges rise from 7,000 to more than 10,000 feet above the 4,000 foot elevation of the Valley floor. The Valley is approximately 100 miles long and varies in width from 6 to 15 miles. Figure S-1 shows the location of the Owens Valley and the proposed project.

The Sierra Nevada mountains to the west are largely responsible for the climate and physical character of the Valley. The Valley is in the rain shadow of the mountains, with average annual precipitation of only four to six inches; however, the Sierra Nevada snowpack provides large amounts of water in the form of runoff through streams that flow into the Owens River.

The Owens River is the dominant natural water feature of the Valley, with its headwaters in Long Valley in Mono County and its terminus at Owens Dry Lake. Owens River and its tributary streams support riparian habitat and recharge the groundwater basins that underlie the Valley. Meadows exist in areas where the groundwater is near the surface. Springs and marshes in the Valley support wetland plant and animal species.

S.2 BACKGROUND

In 1913 the City of Los Angeles completed an aqueduct from Owens Valley to Los Angeles. The aqueduct had a capacity of 480 cubic feet per second (300,000 acre-feet/year). The first aqueduct was primarily filled with surface water diverted from the Owens River and the Mono Basin. In



O W E N S V A L L E Y

Lands owned by the City of Los Angeles in the Owens Valley and Mono Basin

Watershed Boundary - Owens Valley

Watershed Boundary - Mono Basin

FIGURE S-1
PROJECT LOCATION

SOURCE: EIP ASSOCIATES

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1970, a second aqueduct with a capacity of 300 cfs (200,000 AFY) began operating, bringing the total capacity of the aqueduct system to about 780 cfs (570,000 AFY). The second aqueduct was to be filled from three sources: increased surface water diversion from Owens Valley and Mono Basin; reduced acreage of Los Angeles-owned lands classified as irrigated in Mono and Inyo Counties; and increased pumping of groundwater basins in Owens Valley. Operation of the second aqueduct and the associated increased diversion of surface water and pumping of groundwater in Owens Valley eventually led to litigation by Inyo County against Los Angeles.

In a suit filed in 1972, Inyo County claimed that Los Angeles' operations in supplying water to the second aqueduct including increased groundwater pumping was harming the environment of the Owens Valley and that the practice should be analyzed in an Environmental Impact Report (EIR) in accordance with the provisions of the California Environmental Quality Act (CEQA). In 1973, the Third District Court of Appeal for the Third Appellate District ruled that Los Angeles must prepare an EIR. Accordingly, Los Angeles prepared two EIRs, one in 1976 and another in 1979, but the Court found both to be inadequate.

In 1984, Inyo County and Los Angeles and its Department of Water and Power (LADWP) entered into a five-year interim agreement that suspended litigation and, through cooperative studies and development of a joint long-term groundwater management plan, sought a permanent resolution of the disputes between the parties. This EIR, which is presented in conjunction with the agreement between Inyo County and Los Angeles on a long-term groundwater plan (Agreement), represents a third effort to satisfy the information requirements of CEQA as required by the Court.

S.3 USE OF THE EIR

This EIR will be used for different purposes by Los Angeles, as lead agency, and Inyo County, as a responsible agency. Because of this, the definition of what constitutes the "no project condition or alternative" differs for the two agencies. In order to comply with the informational requirements of CEQA as mandated by the Court, the EIR must examine the environmental effects of all water management practices and facilities that have been or will be implemented or constructed in Owens Valley to supply water to the second aqueduct, including increased groundwater pumping. From Los Angeles's point of view, the no project condition is the condition of Owens Valley that existed prior to 1970, when the second aqueduct was completed. Thus, as far as is feasible, the EIR is written as if it were prepared by Los Angeles in 1969. From this perspective, the Los Angeles "no project alternative" would be a continuation of the water management practices that prevailed prior to the actions taken to supply water to the second aqueduct.

Inyo County, in its role as a responsible agency, will use the EIR to assist it in deciding whether to give final approval to the Agreement. From Inyo County's point of view, the "no project alternative" is the set of water management practices that Los Angeles would adopt if the long-term plan were not approved and implemented. In this way, the EIR fulfills the informational requirements of CEQA, the Court, Inyo County, Los Angeles, LADWP, and the public.

S.4 THE PROPOSED PROJECT

The proposed project analyzed in this EIR consists of all water management practices and facilities that were implemented or constructed in Owens Valley to supply water to the second aqueduct which was completed in 1970, together with the projects and water management practices contained in the Agreement for Owens Valley and Inyo County. Certain elements of the proposed project are addressed only in general terms and will be evaluated in detail in subsequent environmental documents.

The elements of the proposed project that are fully analyzed in this EIR are:

- The Agreement
- Increased export, beginning in 1970, of water from Owens Valley to Los Angeles.
    - An increase in groundwater pumping for export and in-valley uses. This includes:
        - Increased groundwater pumping from wells constructed and operated prior to 1970.
        - The operation since 1970, of wells constructed before 1970, but not operated before 1970.
        - The operation of wells constructed since 1970.
        - The future construction and operation of 15 new wells.
        - Increased pumping on the Bishop Cone.

- A reduction in the amount of irrigated acreage of Los Angeles-owned land that was irrigated prior to 1968 (from 21,800 acres of irrigated agricultural acreage prior to 1968 to 11,600 acres of irrigated agricultural acreage today, plus 2,600 acres irrigated as part of enhancement/mitigation projects).

- An increase in the amount of surface water diverted for export.

o New groundwater recharge facilities in the Laws and Big Pine areas.

o A continuation of environmental projects implemented by LADWP between 1970 and 1984.

o A continuation of enhancement/mitigation projects implemented since 1985 by the County and LADWP.

Los Angeles and Inyo County will also implement the following elements of the proposed project; however, each of these elements will be addressed in future environmental reviews as allowed by CEQA. These elements are briefly described in this EIR, but implementation or construction of the elements will not occur until after a subsequent review as required by CEQA:

o Implementation of the Lower Owens River Project.

o Provision of a supply of water and funding for water supply ditches in Big Pine.

o Implementation of a salt cedar control program.

o Releases of Los Angeles-owned land for public and private use.

o Transfer of water systems owned by Los Angeles to Inyo County (or other public entity) in the towns of Lone Pine, Independence, Big Pine, and Laws.

o Rehabilitation and expansion of parks and campgrounds on Los Angeles-owned lands that are leased and operated by Inyo County.

o Recreational use of South or North Haiwee Reservoir.

S.5 THE AGREEMENT

Future groundwater pumping and surface water management practices in Owens Valley will be governed by the goals and provisions of the Agreement. For purposes of management, vegetation has been divided into five management types (A through E), based on the dominate species documented on vegetation inventories conducted by LADWP between 1984 and 1987.

One of the primary goals of the Agreement is to manage Owens Valley groundwater and surface water resources to avoid significant decreases in the live cover of groundwater dependent vegetation (management Types B, C, and D), to avoid a change of a significant amount of such vegetation from one management type to vegetation in other management type which precedes it alphabetically, and to avoid other significant adverse effects in Owens Valley. The vegetation conditions documented during the 1984-87 vegetation inventory serve as the base for comparison for determining whether decreases and changes have occurred.

The Agreement provides that groundwater pumping and surface water management would be conducted in a manner that would avoid significant decreases and changes in vegetation from conditions that existed during the 1981-82 runoff year or significant decreases in water-dependent recreational uses and wildlife habitat. Thus, land owned by Los Angeles, that is currently irrigated or supplied with water will continue to be irrigated or supplied with water in the future.

Areas of riparian vegetation dependent on springs and flowing wells, stands of tree willows and cottonwoods, and areas with rare or endangered species will be identified by the Technical Group for monitoring purposes. If it is determined that groundwater pumping or changes in surface water management practices has resulted in severe stress that could cause a significant decrease or change in this vegetation, action will be taken to prevent significant impacts and to reduce any impacts to a level that is not significant. Also, groundwater pumping and surface water will be managed in a manner that is consistent with State and federal laws pertaining to rare or endangered species.

Another management goal of the Agreement is to prevent long-term groundwater mining in Owens Valley. The method that has been established to meet this goal is management of groundwater pumping so that the total pumping from any well field over a 20-year period (the current year plus the 19 previous years) does not exceed the total recharge to the same well field area over the same period.

A Technical Group, comprised of Inyo County and Los Angeles staff, and a Standing Committee comprised of elected and appointed officials and staff from Inyo County and Los Angeles would be primarily responsible for administering the terms of the Agreement, including review and approval of annual plans, the monitoring of the condition of soil water and vegetation, analysis and interpretation of monitoring results, determining whether significant adverse changes could occur or were occurring, and if so, determining what remedial action should be taken. Remedial actions could include the reduction or elimination of pumping in a particular area, and/or implementation of mitigation measures.

In the event that the Technical Group and the Standing Committee were unable to reach agreement on an issue, the disputed issue would be resolved by a mediator/arbitrator or, failing that, a Superior Court judge.

Groundwater pumping may be reduced or discontinued in an area if the Technical Group deems such action necessary to achieve the goals of the Agreement. In addition, if, as of July 1 or October 1, the projected amount of available soil water in an area is less than the estimated water needs of the vegetation for the remaining or subsequent growing season, respectively, the LADWP wells affecting that area site will immediately be turned off.

Under a stipulation and order filed in Inyo County Superior Court in 1940 (commonly called the "Hillside Decree"), Los Angeles is precluded from exporting groundwater from an area surrounding Bishop that is commonly referred to as the "Bishop Cone." The Agreement provides that all future groundwater pumping by LADWP on the Bishop Cone shall be conducted in strict adherence to the provisions of the Hillside Decree and the other goals and provisions of the Agreement.

The Agreement provides for the construction and operation of 15 new wells to increase LADWP's operational flexibility and to facilitate rotational pumping. These 15 wells would be located in the Laws, Bishop, Big Pine, Independence-Symmes-Bairs area and Lone Pine well fields. Construction and operation of these 15 new wells will be in conformance with the provisions of the Agreement. Also, the Agreement provides for the construction of improved or enlarged recharge facilities at the existing Big Pine and Laws spreading areas, to efficiently recharge additional surface water in years of above-normal precipitation when surface water is in excess of in-valley and export needs.

The Agreement provides that environmental projects that were implemented by LADWP between 1970 and 1984, and all enhancement/mitigation projects implemented by the Standing Committee between 1984 and 1990, will continue. Periodic evaluations of the projects will be made by the Technical Group. These projects will continue to be supplied with groundwater as necessary. New projects may be implemented if such projects are approved by the Standing Committee.

The Agreement also provides for the implementation or construction of the project elements listed in Section S-4. In addition, it provides that Los Angeles will provide more than two million dollars ($2,000,000.00) a year in financial assistance to Inyo County and one hundred twenty-five thousand dollars ($125,000.00) a year to the City of Bishop.

S.6 INCREASED EXPORT OF WATER FROM OWENS VALLEY TO LOS ANGELES

Compared to pre-1970 conditions, the project would increase the amount of groundwater and surface water exported from Owens Valley to Los Angeles. The increased amount of water exported would be obtained from an increase in groundwater pumping, from surface water that has been made available by a reduction in the number of irrigated acres owned by Los Angeles and from surface water that formerly did not enter the aqueduct system.

Under the Agreement, vegetation is used as the principal indicator of environmental quality in Owens Valley. Groundwater pumping will be managed to avoid significant decreases or changes in vegetation attributable to groundwater pumping, other significant environmental effects, groundwater mining and significant adverse effects on water quality and water quantity in all wells not owned by Los Angeles. Because of the extensive use of monitoring data as a guide to management of groundwater pumping, and because environmental conditions in the Owens Valley are heavily reliant on precipitation, it is neither possible nor appropriate to accurately forecast the amount of groundwater pumping that will occur on an annual basis in the future. It is believed that average groundwater pumping in the future will not change significantly as compared to the 1970-1990 period. Factors that could affect future pumping include the environmental protection provisions of the Agreement, the effects of rotational pumping, the the effectiveness of groundwater recharge facilities, and the changes in groundwater pumping on the Bishop Cone. However, for the purposes of analysis in this Draft EIR, the average amount of pumping under the Agreement is projected to be 110,000 AFY.

Although groundwater pumping in the future will vary in accordance with conditions, based on current understanding, the rate of pumping that would occur during wet years is expected to fall within the range of 40,000 AFY to 135,000 AFY. It is more difficult to estimate the amount of pumping that could occur during dry years because there is no truly "typical" dry year. If, for example, a dry year is preceded by several wet years, environmental conditions would be such that high pumping would be possible and consistent with the provisions of the Agreement. If, on the other hand, a dry year is preceded by several average or dry years, pumping would have to be low in order to protect the environment. Therefore, a large range of dry year pumping values could be expected under the Agreement. It is estimated that the range of dry year pumping will be 70,000 AFY to 240,000 AFY.

Table S-1 shows the components of aqueduct supply in average years during the pre-project and under the proposed project (1970-1990 and the Agreement). Runoff for the pre-project and 1970 to 1990 periods is the average runoff recorded for these periods. Runoff for the Agreement is the average runoff recorded to date.

Table S-1 also shows the water exported from the Owens Valley to Los Angeles. During the pre-project period 1945 to 1970 average annual export was 130,000 AFY. In the future, under the terms of the Agreement it is estimated to average 190,000 AFY.

S.7 SUMMARY OF IMPACTS AND MITIGATION

This summary provides an overview of the findings contained in Chapters 8 through 15 of this Draft EIR. A tabular summary of all impacts and mitigation measures can be found in Chapter 7.

SIGNIFICANT IMPACTS

Water management practices in effect between 1970 and 1990 altered the water balance associated with groundwater levels and flow in natural streams in the Owens Valley from conditions that existed in the pre project period. With increased export of water to Los Angeles, less water was available for evapotranspiration in the Owens Valley. These changes have, in some locations in the Owens Valley, had significant adverse effects on the vegetation of the Valley. Air quality was adversely affected by the reduction in vegetative cover. Implementation of the proposed Agreement would not result in further significant adverse impacts on vegetation and air quality. In addition, the Agreement calls for mitigation measures, such as the second phase of Lower Owens River Project and for revegetation of certain areas with native vegetation, which are

TABLE S-1

LOS ANGELES AQUEDUCT OPERATIONS
PRE-PROJECT/PROJECT COMPARISON IN AVERAGE RUNOFF YEARS
(1,000s AFY)

	Pre-Project	Proposed Project	
	1945-1970	1970-1990	Agreement[1]
Owens Valley Water Supply			
Runoff[2]	292	313	310
Flowing Wells and Springs	44	17	15
Pumped Groundwater	10	105	110[1]
Total	346	435	435
Water Used in Owens Valley			
Irrigated LA-owned Land	69	53	53
Stockwater, Wildlife, and Recreation Uses	20	23	23
Enhancement/mitigation Project (post 1985)	0	5[4]	30
Other Owens Valley Uses and Losses[3]	127	141	139
Total	216	222	245
Water Exported from Owens Valley to Los Angeles	130	213	190

[1]Actual pumping will comply with provisions of the Agreement and could be more or less than indicated.
[2]Runoff for the pre-project and 1970-1990 periods is the average runoff recorded for those periods. Runoff for the Agreement is the average runoff recorded to date.
[3]Uses on private land, conveyance losses, recharge and evaporation.
[4]An average of 5,000 AFY was supplied to enhancement/mitigation projects during the 1970-90 period. Due to the implementation of several projects, water supplied between 1984 and 1990 greatly exceeded the average for the entire 1970-1990 period.

Source: LADWP and Inyo County Water Department, September 1990 designed to mitigate the effects of water gathering during the period 1970 to 1990. In the future, the health of potentially-affected vegetation would be monitored and protected in accordance with procedures delineated in the Agreement and its associated technical appendix (the "Green Book").

All known areas of significant adverse impact on vegetation have been identified in this EIR. Measures to mitigate or compensate for the adverse effects have been developed and include enhancement and mitigation projects already implemented by Inyo County and LADWP, environmental projects implemented by LADWP, mitigation measures provided for in the Agreement and mitigation measures developed as part of the EIR preparation process. Implementation of the mitigation measures will reduce adverse impacts of the proposed project on vegetation to a less-than-significant level.

The Agreement itself also serves as a mitigation measure. Because of an extremely wet period between 1982 and 1986, the water table recovered to pre-1970 levels in most areas of the Valley. During this same period, because of high runoff, precipitation and the restored water levels, vegetation recovered to its greatest vigor since 1970. Under the provisions of the Agreement, the goal is to manage groundwater and surface water to avoid significant decreases and changes from these vegetation conditions; therefore, these provisions of the Agreement are themselves a mitigation measure.

Under the Agreement, mitigation is not a primary goal, but a secondary tool to be employed if the primary goals are not fully achieved. Future research and study will be conducted by Inyo County and Los Angeles for the purposes of improving the existing methods of managing Owens Valley's water resources and of improving upon existing mitigation techniques. To assist this study effort, a research facility will be constructed in Owens Valley as determined appropriate by the Standing Committee.

Recognizing the experimental nature of some of the management and mitigation techniques, and under the severe conditions of the current drought, it has been agreed by LADWP and Inyo County to conservatively manage groundwater pumping during this drought and during a period of recovery following the drought.

CUMULATIVE IMPACTS

Cumulative impacts are defined by the Guidelines as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." CEQA Guidelines call for evaluating the cumulative impacts of projects past, present, and anticipated, relevant to the proposed project.

The Owens Valley has been subject to the cumulative effects of Los Angeles' water-gathering activities since 1913. The proposed project is the most recent in a series of actions designed to increase export of water to Los Angeles. LADWP's past activities, when considered together with the proposed project, have had significant effects on the Owens Valley environment -- both adverse and beneficial. Since 1913, Los Angeles' water management practices have led to the drying-up of Owens Lake, adversely affected parts of the Owens River, its tributary streams and its associated vegetation and wildlife, adversely affected areas of groundwater-dependent vegetation, dried up springs, and caused limitations on and disruptions of population and economic opportunities. On the other hand, Los Angeles' land management policies have prevented uncontrolled urban development, and the pollution and destruction of natural habitats that inevitably accompany it.

The degree of significance of the cumulative impacts of Los Angeles' activities since the turn of the century varies depending on whether the impacts are compared to a pristine Owens Valley environment, an agricultural Owens Valley in the early 1900s, conditions in 1970, or to an Owens Valley as it might appear today, had Los Angeles never entered the Valley and had the land remained in private ownership. Under the last scenario, one can only speculate on the level of development and environmental change that would have occurred; without doubt, the Valley would likely be different than it is today.

The mitigation measures prescribed for the significant impacts of the proposed project are intended to reduce each impact to less than significant; however, some of the prescribed measures may also mitigate some of the overall impacts of Los Angeles' activities since 1913. An example of this second type of mitigation is the restoration of flow in approximately 50 miles of channel of the lower Owens River.

To prescribe mitigation to reduce all of the overall cumulative impacts of Los Angeles' activities in the Owens Valley is beyond the scope of the EIR; however, the EIR identifies two overall mitigation measures designed to avoid significant cumulative impacts.

Grazing Management

The following grazing management program will continue to be implemented by LADWP:

- Mapping of all LADWP lands for documentation of the vegetation species present, percent cover, and percent composition.
- Establishment of carrying capacity based on the above-noted vegetation documentation.
- Documentation of livestock use on Los Angeles lands in terms of lessee range practices.
- Identification of problem areas and imbalance in either over or under utilization.
- Development, application and enforcement of appropriate range management practices.

Town Water Systems

Between 1934 and 1972, water systems supplying the towns of Lone Pine, Independence and Laws were purchased by Los Angeles. Prior to and after the purchases of these systems, the amount of water available in the soil to supply vegetation in and near these towns was reduced due to several factors. It should be noted that not all of these factors were under the control of LADWP.

Los Angeles will transfer the town water systems in Lone Pine, Independence, Big Pine and Laws to Inyo County or to another public entity. As part of this transfer, for the first five years following the approval of the Final EIR, Los Angeles will supply treated groundwater to each of the town water systems up to certain specified amounts at no cost. At the end of the fifth year, the systems will be transferred to Inyo County (or to another public entity), but LADWP will permanently supply untreated groundwater to each town system up to certain specified amounts at no cost.

The provision of groundwater at no cost to each of the town water systems will allow Inyo County (or another public entity) to have the option of maintaining water rates at a level substantially below the rates that would have to be charged if all of the costs of pumping groundwater and of maintaining the well equipment were to be passed along to the users. The rates could also be substantially less than the rates that would be charged by Los Angeles if the systems were to remain in the control of Los Angeles.

SECONDARY IMPACTS

Secondary impacts are those environmental impacts that do not result directly from the project, but are caused indirectly by economic activity induced or permitted by the proposed project. The proposed project would provide water which would sustain urban development in the City of Los Angeles. The secondary impacts of growth include the conversion of undeveloped land to urban uses and the generation of air and water pollutants.

If the proposed project was not implemented, it is unlikely that the secondary impacts of growth would be avoided. The demographic and economic forces propelling growth in Southern California are powerful. In the absence of voter-approved growth control measures or an economic recession, urban development will most likely continue because water to support growth will be found somewhere. If the proposed project is not implemented, an alternative will be. Water will not likely limit urban growth in California while a substantial proportion of the state's water supply is used to grow crops of modest economic value.

ALTERNATIVES

Seven alternative water management strategies for the Owens Valley are evaluated in this Draft EIR. One of them, the No Project Alternative, would involve no increase in water gathering beyond 1970 levels. The other six alternatives all involve increased water gathering and export to Los Angeles compared to 1970 levels.

In its role as a responsible agency, Inyo County will use this EIR as an informational document to assist it in deciding whether or not to approve the Agreement. (The Agreement is one of several elements of the proposed project.) In this role, Inyo County can only approve or disapprove the Agreement. If Inyo County were to disapprove the Agreement, Los Angeles would choose one of the alternatives to the proposed project, or another course of action, and the County would respond through legal, regulatory, legislative and/or other means. Since Inyo County lacks authority to unilaterally cause the no-project alternative or any other alternative to be implemented, the alternatives presented are those that have been developed by Los Angeles to meet the requirements of CEQA.

The alternatives to the proposed project are:

- o Alternative 1. No Project
- o Alternative 2. No Increased Groundwater Pumping/No In-Valley Irrigation
- o Alternative 3. Water Management by Maintaining Water Tables in Vegetation Rooting Zones
- o Alternative 4. Stabilization of Water Table at 1981 Level
- o Alternative 5. Water Management With No Agreement
- o Alternative 6. Groundwater Management in Accordance with Pumping Table Contained in Los Angeles/Inyo County Interim Agreement
- o Alternative 7. Water Management to Fill Both Los Angeles Aqueducts

The components of the range of Owens Valley alternatives are compared in Figure S-2. The consequences of these alternatives for water supply in Los Angeles are shown on Table S-2.

If the no-project alternative was implemented or on other alternative was implemented that would result in Los Angeles exporting less water from Owens Valley than it would under the proposed project, Los Angeles would have to obtain replacement water from another source or sources or reduce water demand through additional conservation efforts. The alternatives available to Los Angeles to replace or conserve water are:

- o Growth Limitations
- o Expanded Water Conservation
- o Increased Use of Los Angeles River Groundwater Basin
- o Increased Purchase of Water from Metropolitan Water District (MWD)
- o Increased Export from the Mono Basin
- o Expanded Water Reclamation
- o Seawater Desalination

FIGURE S-2

ALTERNATIVES MATRIX	Increased Groundwater Pumping	Increased Export to LA	Environmental Protection Goals of the Agreement	Irrigation: Pre-1970 Levels	Irrigation: 1970-1990 Levels	Enhancement / Mitigation Projects	LADWP Environmental Projects	Increased Pumping on Bishop Cone	15 New Wells, GW Recharge Improvements	Big Pine Ditches	Salt Cedar Control	LA Land Releases	Town Water Systems Transfers	Parks Rehabilitation	Recreational Use of Haiwee
1. No Project				●											
2. No Increased Pumping, No In-Valley Irrigation		●													
3. Maintain Water Tables in Vegetation Rooting Zones	●	○ [1]	●		●	●	●	●	●						
4. Stabilize Water Tables at 1981 Levels	●	●			●	○ [2]	●	●							
5. Water Management With No Agreement	●	●	●		●	○ [2]	●	●	●						
6. Interim Agreement Pumping Table	●	●			●	●	●	●	●						
7. Water Management to Fill Both LA Aqueducts	●	●			●		●	●	○ [3]						
8. Agreement [4]	●	●	●		●	●	●	●	●	●	●	●	●	●	●

[1] Increase in export would be minimal: approximately 5,000 AFY.

[2] All existing enhancement / mitigation projects would be continued, except that no water would be released to the lower Owens River channel. Water would be supplied to the ponds that are part of the Lower Owens River Project

[3] Twenty-eight new wells would be constructed by LADWP

[4] Shown here for comparison.

TABLE S-2

EFFECTS OF OWENS VALLEY WATER MANAGEMENT ALTERNATIVES ON LOS ANGELES

	Water Gained or Lost Relative to the No Project Alternative and the Proposed Project[1]	
Alternative	No Project AFY	Proposed Project AFY
1 No Project	- 0-	-42,000
2 No Increased Groundwater Pumping/ No In-Valley Irrigation	+62,000	+20,000
3 Water Management by Maintaining Water Tables in Vegetation Rooting Zones	+5,000	-37,000
4 Stabilization of Water Table at 1981 Levels	+23,000	-19,000
5 Water Management With No Agreement	+56,000	+14,000
6 Groundwater Management in Accordance With Pumping Table	+75,000	+33,000
7 Water Management to Fill Both Los Angeles Aqueducts	+134,000	+92,000
Proposed Project[2]	+42,000	- 0 -

1 To assist in the comparison of the water management alternatives, runoff is assumed to be the same for all of the alternatives -- that is, the average recorded runoff in the Owens Valley from 1945 to date. Because of this, the estimated increase of 60,000 AFY water export from the Owens Valley from the pre-project to the Agreementshown on Figure S-1 above, differs from the 42,000 AFY increase used in this comparison.

2 Shown for comparative purposes.

o Water Transfers

Except for increased export from the Mono Basin, each of the alternative supplies listed above could produce more water for Los Angeles. Although the exact amount of water that will be exported in the future under the proposed project is uncertain because it will vary in order to meet the vegetation protection goals of the Agreement, for the purpose of analyzing the project alternatives, Inyo County and LADWP have estimated that on average the proposed project would increase export from the Owens Valley by 42,000 AFY above the export levels that would exist if the no project alternative were to be implemented. If either the no project alternative or another alternative that would result in export levels lower than those estimated under the proposed project were to be implemented, LADWP would choose to purchase water from MWD as the replacement source.

If LADWP implemented the No Project Alternative, then approximately 42,000 AFY, the estimated yield of the proposed project would have to be obtained some other way. Expansion of LADWP's existing water conservation and wastewater reclamation programs would be an environmentally benign way of meeting the shortfall. However, it is already LADWP's policy to expand these programs to the extent that they are cost-effective, regardless of whether the proposed project is implemented. This policy reflects a recognition of the uncertainty of future water supplies, including the expected reduction in water diversions from the Mono Basin, the water supply outlook for MWD, and increasing population growth and water demand within Los Angeles.

The bulk of the potential shortfall would have to be met from another source. The only sources of water sufficient to correct the deficit would be increased purchase of water from MWD of Southern California, or seawater desalination. Desalination has not been widely applied in the United States because of its high cost; 30 or 40 times the cost of water from the Los Angeles Aqueduct and 7 to 10 times the cost of water from MWD. Desalination also has the disadvantage or requiring large amounts of energy, thus contributing to the cumulative adverse environmental effects of electrical power generation. Consequently, the only practical alternative to the proposed project is increased purchase of water from MWD.

Although Los Angeles is entitled to a considerable portion of MWD's water supply, it has rarely made large purchases of water from MWD because of the City's access to cheaper water from Inyo and Mono Counties. Historically, large purchases have only been made in times of drought. If the proposed project was not implemented, Los Angeles would have to purchase more water from MWD on a routine basis, rather than as a drought reserve.

MWD obtains its water supply from the Colorado River and the State Water Project. Its allocation of Colorado River water is declining as other states develop and take their full allotments of water. The yield of the State Water Project is not likely to increase in the next few years, and may in fact decrease. If Los Angeles begins to take more water from MWD on a routine basis, then it will increase competition for water among the users of State water, and thus make rationing more likely during dry periods.

State water is diverted from the Sacramento-San Joaquin Delta. The yield of the State Water Project is limited by the need to allow sufficient water to flow out of the Delta to meet Delta water quality standards and by the absence of sufficient storage reservoirs. Diversion cannot be increased to meet additional demand for State water. Thus the only responses to increased demand are allocation of shortages among users, or sale of water by one user to another. Approximately 15 percent of State water is used for municipal purposes, with the remainder used by farms. In the long run, some of the water currently used to grow lower-value agricultural crops will likely be sold and used for municipal purposes.

As noted earlier, CEQA guidelines indicate that an EIR must identify an environmentally-superior alternative. If the environmentally-superior alternative is the no project alternative, then the EIR must identify the environmentally-superior option among the remaining alternatives. The following paragraphs discuss the environmentally-superior alternative for the Owens Valley. The analysis does not take account of environmental effects in Los Angeles and elsewhere in the state. Neither does it take account of the economic and social effects of the alternatives.

In general, as might be expected, alternatives that involve less groundwater pumping would have a lesser adverse effect on the Owens Valley environment. What is not clear is where the proposed project fits within the range of alternatives. Implementation of Alternative 1, the no project alternative, would allow the Valley environment to return to some semblance of its 1970 condition.

It is more difficult to rank the proposed project, taking account of its environmental safeguards and mitigation measures. The safeguards would ensure that vegetation in the Valley would not be allowed to significantly decrease or change from the conditions documented during the 1984-87 vegetation inventory. Clearly the enhancement/mitigation and LADWP environmental projects, and particularly the lower Owens River Project provide considerable environmental benefits. Although a quantitative comparison of benefits is not possible, it is believed that the mitigation measures will reduce the impacts associated with the project to a less than significant level. However, the no project alternative is still judged to be environmentally superior to the proposed project.

Another Owens Valley alternative that is difficult to assess is Alternative 2. It would be similar to Alternative 1, the No Project Alternative, except that Los Angeles would eliminate irrigation of its lands in the Owens Valley. The would result in a greater volume of water being exported from the Valley than under the proposed project. Lands that are now irrigated would be abandoned or used as unirrigated rangeland for cattle. The rapidity with which vegetation recolonized these currently irrigated lands would depend on local soils, microclimate and grazing pressure. It is apparent that much of the thousands of acres of lands removed from irrigated agriculture between 1920 and 1970 have not returned to their pre-irrigation condition. It takes many years before desirable native vegetation becomes established, particularly when livestock grazing is permitted. In the interim, the bare areas, or areas with only minimal vegetative cover, would be visually unappealing and a source of wind-blown dust. The degree to which formerly irrigated areas can be restored to native vegetation by an active planting and maintenance program is unknown.

In light of the uncertainty of restoring previously irrigated lands, and the fact that existing enhancement/mitigation projects would be discontinued, Alternative 2 is probably less desirable from an environmental point of view than the proposed project.

Of the remaining alternatives, Alternatives 6 and 7 would clearly have more severe environmental impacts than the proposed project. The impacts of Alternatives 6 and 7 would be more severe because they involve much higher levels of groundwater pumping than the proposed project.

Alternative 5 is very similar to the proposed project, in that it would involve a similar amount of groundwater pumping. However, it would not include portions of the Lower Owens River Project.

Because it would not accrue some of the wildlife benefits associated with the latter project, its net environmental effect would be less beneficial than the proposed project.

Alternatives 3 and 4 would involve less groundwater pumping than the proposed project, and also include environmental safeguards. In the case of Alternative 4, pumping would be reduced in dry years to maintain water tables at 1981 levels. In the case of Alternative 3, pumping would be reduced in dry years to maintain water in the plant rooting zone. Alternative 3 and the proposed project would retain vegetation in about the condition documented during the 1984-87 vegetation inventory, but the extent to which regrowth of vegetation lost since 1970 would occur is unknown. Under Alternative 4, the level of vegetation protection that would occur is less certain than under Alternative 3 or the proposed project. Thus by process of elimination, Alternative 3 becomes the environmentally-superior alternative when the no project alternative is eliminated from consideration.

AREAS OF CONTROVERSY

The primary impact of the proposed project is on the vegetation of the Owens Valley. While there are many anecdotal accounts of how the vegetation has changed since 1970, there is little quantitative documentary data. Between 1920 and 1970, changes in the Valley's vegetation were largely the result of surface water management practices and changes in agricultural land use. In 1970, when groundwater pumping was increased, a new factor entered the equation. Experts differ regarding the interpretation of aerial photographs and other existing data and their value in determining the cause and extent of vegetation changes that have occurred since 1970. All existing data were examined by a number of technically qualified professionals in order to identify areas of the Valley where significant adverse effects on vegetation have occured. While the analysis was thorough and objective, the deficiencies of the data are such that some room for disagreement among experts remains.

Some residents believe that the Valley should be restored to conditions that existed prior to operation of the second aqueduct in 1970 or prior to the operation of the first aqueduct in 1913. Inyo County and LADWP have agreed that a final court judgement will be entered that will provide that groundwater and surface water will be managed so that the Valley's vegetation will not significantly decrease or change from the conditions that were documented during the 1984 to 1987 vegetation inventory. During this period vegetation was at its healthiest since 1970 as a result of a series of wet years. While the Agreement does not return the Valley to its 1970 condition, it does provide for direct or compensatory mitigation of adverse environmental effects that have occurred since 1970.

Some members of the public have questioned whether the soil water balance methods of the Agreement are adequate to achieve the goal of vegetation protection. The monitoring and management techniques of the Agreement are the subject of the Green Book and of ongoing and planned studies outlined in the Green Book. In order to protect vegetation, the Agreement provides for "increasing, decreasing, or changing the management areas, the monitoring sites, the type of monitoring, the procedures for analyzing and interpreting monitoring results, and for modifying the provisions of the Green Book as a result of information gained from ongoing research and cooperative studies, or for other reasons as may be necessary to improve the effectiveness of the monitoring and the evaluation activities." It should be noted that the soil water balance projection is only one of the tools that will be used to meet the goals of the Agreement and that the Technical Group and the Standing Committee have a significant role in determining the methods of achieving these goals.

Questions have also been raised as to the success of mitigation in the Owens Valley. Mitigation of Type D vegetation has proven successful through application of surface water. Revegetation of shrub species has not been commonly practiced in the west and is, therefore, still largely experimental. LADWP and Inyo County will conduct studies in the near future to develop methods for revegetation. These methods will be used to mitigate formerly irrigated lands that have not successfully revegetated and other areas as described in this Draft EIR. Since the goal of the Agreement is to avoid significant decreases or changes in vegetation in the future, mitigation is viewed only as a secondary tool in the management of Owens Valley resources.

Air quality is an area of ongoing contention in the Valley. Owens Lake, which became dry in the 1920s, is the primary cause of air quality problems. Since the dust problem caused by the lake is attributable to pre-1970 water management practices, it is not dealt with in this Draft EIR. The Great Basin Air Pollution Control District is currently conducting field studies to determine the best way to control dust generation at the surface of the lake bed. Once a control program is selected, it will be the subject of separate environmental review pursuant to CEQA. This Draft EIR addresses only the effects of post-1970 water management practices on air quality.

1. INTRODUCTION

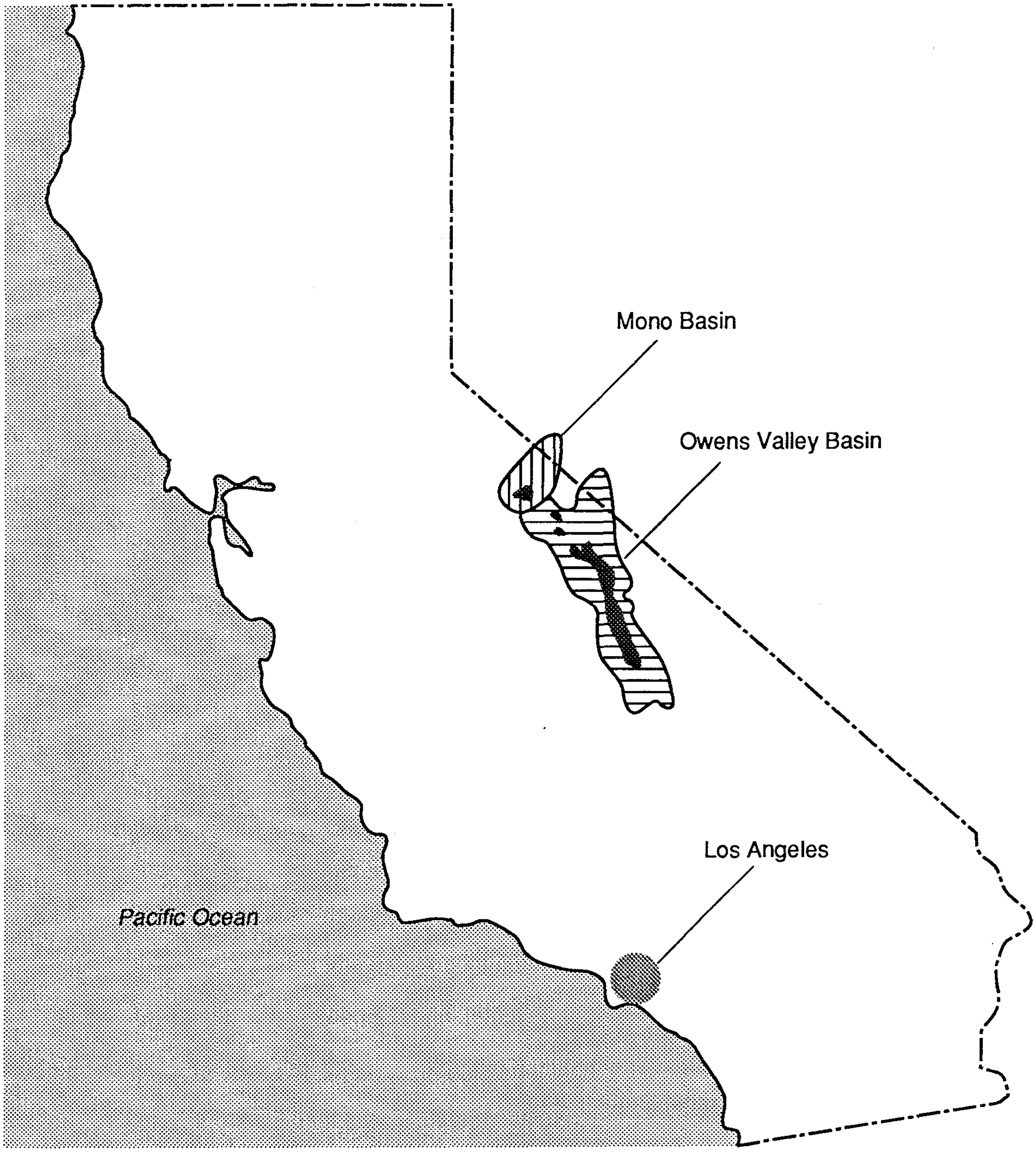
1.1 SETTING

The proposed project is located in the Owens Valley ("Valley") of Inyo County, California. The Valley is situated between the Sierra Nevada and the Inyo/White mountains, approximately 250 miles north of the City of Los Angeles. The peaks of these mountain ranges rise from 7,000 to more than 10,000 feet above the 4,000 foot elevation of the Valley floor. The Valley is approximately 100 miles long and varies in width from 6 to 15 miles. Figure 1-1 shows the location of the Owens Valley and the proposed project.

There are five towns in the Owens Valley: Bishop, Big Pine, Independence, Lone Pine and Olancha/Cartago. The populations of Independence, Lone Pine and Olancha/Cartago are 659, 1,684, and 290, respectively. Big Pine and Bishop have populations of 1,510 and 3,715, respectively. An additional 6,200 residents live in the area surrounding the City of Bishop. The total population of Inyo County is 18,441.[1] There is very little development outside of the towns.

The predominant land uses in the Owens Valley are recreation and ranching. Recreational uses are focused primarily at the Owens River and its tributary streams, while most of the Valley floor is used as rangeland for cattle and livestock. Alfalfa is grown on approximately 2,800 acres.

Los Angeles owns virtually all of the land outside of the towns. In general, Los Angeles' land holdings are located on the Valley floor. The intermediate slopes of the Sierra and Inyo/White mountains are managed by the U.S. Bureau of Land Management, and the mountain ranges themselves are part of the Inyo National Forest.



O W E N S V A L L E Y

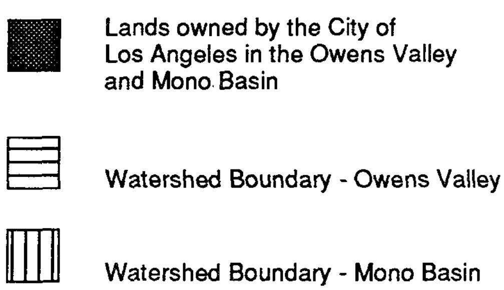


FIGURE 1-1
PROJECT LOCATION

SOURCE: EIP ASSOCIATES

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The Sierra Nevada mountains to the west are largely responsible for the climate and physical character of the Valley. The Valley is in the rain shadow of the mountains, with average annual precipitation of only four to six inches; however, the Sierra Nevada snowpack provides large amounts of water in the form of runoff through streams that flow into the Owens River.

The Owens River is the dominant natural water feature of the Valley, with its headwaters in Long Valley in Mono County and its terminus at Owens Dry Lake. Owens River and its tributary streams support riparian habitat and recharge the groundwater basins that underlie the Valley. Meadows exist in areas where the groundwater is near the surface. Springs and marshes in the Valley support wetland plant and animal species.

1.2 BACKGROUND

In 1913 the City of Los Angeles completed an aqueduct from Owens Valley to Los Angeles. The aqueduct had a capacity of 480 cubic feet per second (cfs) (350,000 AFY). The first aqueduct was primarily filled with surface water diverted from the Owens River and the Mono Basin. In 1970, a second aqueduct with a capacity of 300 cfs (220,000 AFY) began operating, bringing the total capacity of the aqueduct system to about 780 cfs (570,000 AFY). The second aqueduct was to be filled from three sources: increased surface water diversion from Owens Valley and Mono Basin; reduced acreage of Los Angeles-owned lands classified as irrigated in Inyo and Mono Counties; and increased pumping of groundwater basins in Owens Valley. Operation of the second aqueduct and the associated increased diversion of surface water and pumping of groundwater in Owens Valley eventually led to litigation by Inyo County against Los Angeles.

In a suit filed in 1972, Inyo County claimed Los Angeles' operations in supplying the second Los Angeles aqueduct, including increased groundwater pumping, was harming the environment of the Owens Valley and that the practice should be analyzed in an Environmental Impact Report (EIR) in accordance with the provisions of the California Environmental Quality Act (CEQA). In 1973, the Court of Appeal for the Third Appellate District ruled that Los Angeles must prepare an EIR. Accordingly, Los Angeles prepared two EIRs, one in 1976 and another in 1979, but the Court found both to be inadequate.

In 1984, Inyo County and Los Angeles and its Department of Water and Power (LADWP) entered into a five-year interim agreement that suspended litigation and, through cooperative studies and development of a long-term groundwater management plan, sought a permanent resolution of the disputes between the parties. In approving this interim agreement, the Court said that the command of its writ to prepare an EIR could be served even though the EIR is presented to the Court in conjunction with such a joint plan. Los Angeles and Inyo County have prepared a long-term groundwater management plan (Agreement). This EIR, which is presented in conjunction with the joint plan, represents a third effort to satisfy the information requirements of CEQA as required by the Court.

1.3 THE PROPOSED PROJECT UNDER REVIEW

The proposed project analyzed in this EIR consists of all water management practices and facilities that were implemented or constructed in Owens Valley to supply water to the second aqueduct which was completed in 1970, together with the projects and water management practices contained in the Agreement for Owens Valley and Inyo County.

The elements of the proposed project that are fully analyzed in this EIR are:

- The Agreement
- Increased export of water from Owens Valley to Los Angeles.
    - An increase in groundwater pumping for export and in-valley uses. This includes:
        - Increased groundwater pumping from wells constructed and operated prior to 1970.
        - The operation since 1970 of wells constructed before 1970.
        - The operation of wells constructed since 1970.
        - The future construction and operation of 15 new wells.
        - Increased pumping on the Bishop Cone.
    - A reduction in the amount of irrigated acreage of Los Angeles-owned land that was irrigated prior to 1968.
    - An increase in the amount of surface water diverted for export.

- o New groundwater recharge facilities in the Laws and Big Pine areas.
- o A continuation of environmental projects implemented by LADWP between 1970 and 1984.
- o A continuation of enhancement/mitigation projects implemented since 1985 by the County and LADWP.

Los Angeles and Inyo County will implement each of the following elements of the proposed project; however, each of these elements will be addressed in future environmental reviews as allowed by CEQA. These elements are briefly described in this EIR, but implementation or construction of the element will not occur until after a subsequent review as required by CEQA:

- o Implementation of the Lower Owens River Project.
- o Provision of a supply of water and funding for water supply ditches in Big Pine.
- o Implementation of a salt cedar control program.
- o Releases of Los Angeles-owned land for public and private use.
- o Transfer of water systems owned by Los Angeles to Inyo County (or other public entity) in the towns of Lone Pine, Independence, Big Pine, and Laws.
- o Rehabilitation and expansion of parks and campgrounds on Los Angeles-owned lands that are leased and operated by Inyo County.
- o Recreational use of South or North Haiwee Reservoir.

The proposed project does not include the facilities or practices for water gathering by LADWP in the Mono Basin of Mono County. Water gathering by LADWP in Mono County is currently subject to litigation. Those activities are being assessed by the State Water Resources Control Board under the supervision of the courts and are the subject of separate environmental documentation. Unless otherwise noted, all references in this document to groundwater and surface water management pertain to the Owens Valley and Inyo County.

1.4 PURPOSE AND INTENDED USE OF THE EIR

This document is a program EIR. A program EIR addresses the environmental consequences of a plan or program. It does not analyze in detail the environmental effects of all individual projects included in the plan or program. In this case, the EIR addresses the overall environmental consequences of increased water gathering on the Owens Valley environment and the installation of certain facilities. It does not address the impacts of actions identified in the Agreement that have not yet been well defined and will not be implemented at this stage of the project. Such elements will be addressed in future environmental review as allowed by CEQA.

This EIR will be used for different purposes by Los Angeles, as lead agency, and Inyo County, as a responsible agency. Because of this, the definition of what constitutes the "no project condition or alternative" differs for the two agencies. In order to comply with the informational requirements of CEQA as mandated by the Court, this EIR must examine the environmental effects of all water management practices and facilities that have been or will be implemented or constructed in Owens Valley to supply water to the second aqueduct, including increased groundwater pumping. From Los Angeles's point of view, the no project condition is the condition of Owens Valley that existed prior to 1970, when the second aqueduct was completed. Thus, as far as is feasible, this EIR is written as if it were prepared by Los Angeles in 1969. From this perspective, the Los Angeles "no project alternative" would be a continuation of the water management practices that prevailed prior to the actions taken to supply water to the second aqueduct.

Inyo County, in its role as a responsible agency, will use the EIR to assist it in deciding whether to give final approval to the Agreement. From Inyo County's point of view, the "no project alternative" is the set of water management practices that Los Angeles would adopt if the long-term plan were not approved and implemented. In this way, the EIR fulfills the informational requirements of CEQA, the Court, Inyo County, Los Angeles, LADWP, and the public.

To avoid confusion in the text of this report, the term "no project alternative" has been used to denote the no action alternative from Los Angeles' point of view. When reference is made to Inyo County's no project alternative, it is specifically called out as such.

1.5 EIR PROCESS

This Draft EIR will be published and circulated for review and comment by the public and interested parties, agencies, and organizations for a 90-day review period. The public review period will be from September 28, 1990 to December 26, 1990.

Public meetings in Inyo Court on the Draft EIR will be held beginning in late November 1990. The public is invited to attend the meetings and to offer comments on the Draft EIR, and will be notified of the precise dates and locations by way of public notices. All comments or questions about the Draft EIR should be addressed to:

Mr. John A. Davis, P.E.
Senior Vice President
EIP Associates
150 Spear Street, Suite 1500
San Francisco, CA 94105

Following public review, a Final EIR will be prepared in response to verbal and written comments received during the public review period. The Final EIR will be available for public review prior to consideration by Los Angeles and Inyo County. Both agencies will review and consider the Final EIR prior to their decision to approve the EIR. Under existing Court orders, the Draft and Final EIRs must be submitted to the Court of Appeal for the Third Appellate District in Sacramento by one year from the date of public release of the Draft EIR.

Before approving the project analyzed in this EIR, Los Angeles and Inyo County each must "certify" the Final EIR. "Certification" consists of two separate steps: Each agency's governing body must conclude first, that the document has been completed in compliance with CEQA, and second, that the body has reviewed and considered the information within the EIR prior to approving the project.

After review and consideration of the Final EIR, Los Angeles and Inyo County may approve the EIR. To do so requires preparation of written findings for each significant adverse environmental effect identified in the Draft EIR. Findings must be accompanied by a brief explanation of the rationale for each finding and should indicate either 1) that mitigation measures to reduce adverse impacts to less than significant levels have been adopted; 2) that measures to mitigate specific effects are not within the jurisdiction of the agency making the finding; or 3) that specific economic, social, or other considerations make infeasible the mitigation measures or project alternatives identified in the Final EIR, but the project is acceptable because overriding considerations indicate that the benefits of the project outweigh its adverse effects.

An additional requirement is that, when making findings, a monitoring program must be adopted and incorporated into the approved project for mitigation measures that reduce or avoid significant effects on the environment. This reporting or monitoring program would be designed to ensure CEQA compliance during project implementation. The reporting or monitoring program (Public Resources Code 21081.6) was added to CEQA in 1988 by Assembly Bill 3180 (Cortese).

Once the Final EIR has been certified, the governing bodies will consider approval of the project. If, after consideration, each of the governing bodies (the Los Angeles Board of Water and Power Commissioners; the Los Angeles City Council; the Los Angeles Department of Water and Power; and the Inyo County Board of Supervisors) certifies the EIR and approves the project, the necessary legal documents, including this EIR, will be filed with the appropriate courts.

After certification of the Final EIR and approval of the project, Los Angeles and Inyo County must each file a Notice of Determination. The Notice of Determination is a formal legal notification of the approval of the project. The filing of this notice initiates a 30-day statute of limitations period for approval of the groundwater management plan under CEQA.

If the Court of Appeal for the Third Appellate District approves a request to discharge writ as satisfied, the environmental litigation between Inyo County and the City of Los Angeles, which commenced in 1972, will be resolved. If the Inyo County Superior Court approves a Stipulation and Order (setting forth the Agreement), that Court will enter an order withholding final judgment in the City of Los Angeles' legal challenge to the groundwater management ordinance adopted by Inyo County voters in 1980, and setting forth the provisions of the long-term groundwater management plan.

1.6 ORGANIZATION OF THE EIR

This Draft EIR is part of a four-volume set of documents relating to the proposed plan. The first volume contains the Stipulation and Order which sets forth the Agreement on a Long-Term Groundwater Management Plan for Owens Valley and Inyo County. The second contains the Draft EIR. The Technical Appendices for the Draft EIR are contained in volume three. The Final EIR, containing responses to comments received during the public review period, will be contained in volume four. The Draft EIR document is organized into the following sections:

- Chapter 1, Introduction: Provides an introduction and overview describing the intended use of the Final EIR and the EIR review and certification process.

- Chapter 2, History of Water Development in Owens Valley: Summarizes water supply development and use in the Owens Valley, project history and court rulings.

- Chapter 3, Water Supply for Los Angeles: Describes the water supply system of Los Angeles as well as historic and future water use.

- Chapter 4, Water Management in Owens Valley: Describes the physical characteristics of the Los Angeles Aqueduct and water management practices in the Owens Valley prior to operation of the second aqueduct in 1970 and from 1970 through 1990.

- Chapter 5, Proposed Project: Contains a description of the proposed project's elements; a discussion of the goals and objectives of the groundwater management plan; and a summary of the elements and proposed actions included in the plan. The reader is referred to the Agreement in Volume One of this Draft EIR for a detailed description of the elements in the proposed plan.

- Chapter 6, Alternatives to the Proposed Project and Owens Valley Water Management Alternatives: Contains a discussion of conceptual alternatives to the proposed project, including a no project alternative and alternative water supply sources for Los Angeles. Contains a discussion of alternative water management strategies in Owens Valley, including the Inyo County no project Alternative the water management practices which Los Angeles may implement in the absence of a Long-Term Agreement on a Groundwater Management Plan.

- Chapter 7, Environmental Impact Assessment Method and Summary of Impacts and Mitigation Measures: After a description of assessment methodology, this chapter summarizes environmental impacts resulting from the proposed project. This chapter focuses on the major areas of significant environmental impact and corresponding mitigation measures.

- Chapters 8 through 15 of Environmental Settings, Impacts and Mitigation Measures: Each environmental issue of concern is addressed in separate chapters 8 through 15. Within each chapter is a detailed description of environmental settings and impacts of the proposed project. Mitigation measures are identified as appropriate.

- Chapter 16, Impacts of Ancillary Facilities and Related Projects: Discusses the impacts of the construction and operation of 15 new wells, of increased pumping on the Bishop Cone, and of groundwater recharge facilities in the Laws and Big Pine areas.

- Chapter 17, CEQA Considerations: Provides CEQA-required discussions regarding impacts resulting from implementation of the project, including the relationship between short-term uses of the environment and the maintenance of long-term productivity, significant irreversible effects, growth inducement, and cumulative impacts.

- Chapter 18, EIR Authors and Organizations and Persons Consulted: Lists City of Los Angeles and Inyo County Water Department staff, EIR authors, and organizations and persons consulted during the preparation of the Draft EIR.

- Chapter 19, Bibliography: Lists documents and references used in preparing the Draft EIR.

- Chapter 20, Glossary and Abbreviations: Lists terms and abbreviations used in the Draft EIR.

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1. Population estimates for Bishop and surrounding area and for Inyo County - Summary Report, Inyo County Population and Housing Estimates, January 1, 1990; California Department of Finance, Demographic Research Unit. Estimates for other Owens Valley towns: 1987 Population Report, Inyo County, California.

2. HISTORY OF WATER DEVELOPMENT IN OWENS VALLEY

2.1 INTRODUCTION

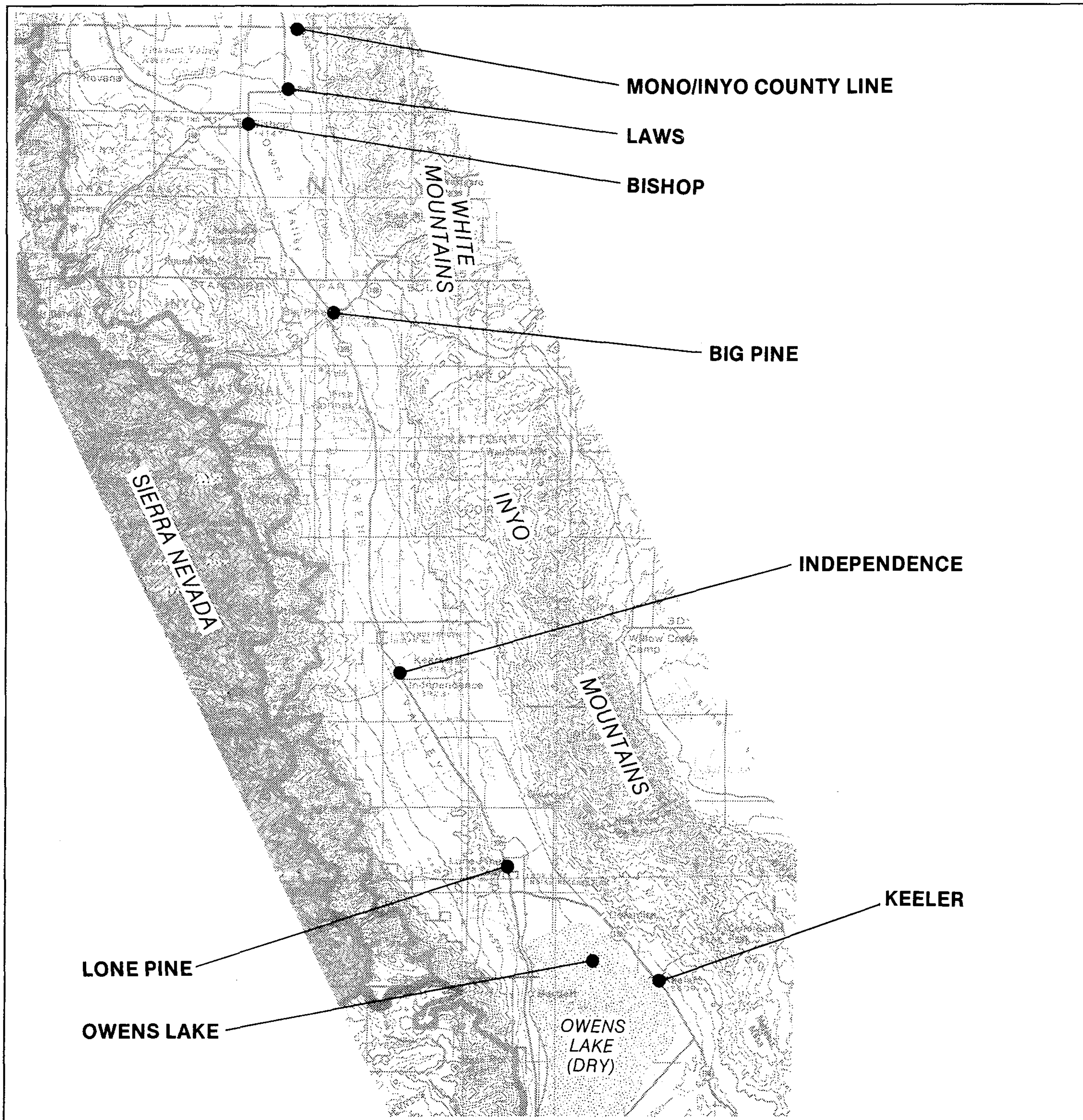
The Owens Valley ("Valley") is located in east central California, primarily in Inyo County (see Figure 2-1). The Valley is approximately 100 miles long and ranges from 6 to 15 miles in width. It is bounded on the west by the Sierra Nevada and on the east by the White and Inyo Mountains. The Valley is drained by the Owens River, which, before it was diverted into the Los Angeles Aqueduct, flowed into Owens Lake, a saline lake (now dry) with no outlet. The Valley floor is in the rain shadow of the Sierra Nevada, is semiarid and receives less than six inches of precipitation in an average year. Despite the lack of precipitation, the Valley has abundant water resources as a result of snowmelt and runoff flowing into numerous streams from the surrounding mountains.[1] The Valley supports a unique flora and fauna adapted to the Valley's combination of low precipitation and abundant surface and groundwater.

This chapter describes the history of water development and how it has affected the Owens Valley. A chronology of key events is shown in Table 2-1.

2.2 EXPORT OF WATER TO LOS ANGELES[2]

EARLY LOS ANGELES

The Pueblo de Los Angeles was established in 1781 by the Spanish colonial authorities adjacent to the Los Angeles River. For the better part of a century the pueblo remained a small agricultural community. In the 1860s, shortly after the completion of the trans-continental railroad, the community began to grow as large landowners started promoting the advantages of life in a pleasant Mediterranean climate. The population of Los Angeles, little more than 5,000 in 1870, grew to more than 100,000 by the turn of the century.



OWENS VALLEY

FIGURE 2-1
OWENS VALLEY AND ENVIRONS

SOURCE: USGS; EIP ASSOCIATES

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TABLE 2-1

CHRONOLOGY OF WATER DEVELOPMENT IN OWENS VALLEY

1780-1904	Pueblo and later City of Los Angeles supplied by water from the Los Angeles River.
1861	Settlement and agriculture in Owens Valley begins.
1902	Federal Reclamation Act passed by Congress.
1903	Owens Valley population reaches 7,000.
1904	Population of Los Angeles reaches 200,000.
1905	Concept of an aqueduct from Owens Valley to Los Angeles approved; the City of Los Angeles files for rights to Owens River water.
1906	Congress passes act providing Los Angeles free right-of-way on public lands.
1907	Bond sale to finance construction of the aqueduct approved.
1908-1913	Construction of First Aqueduct; First Aqueduct becomes operational in 1913.
1913	First Owens Valley water arrives in Los Angeles.
1920-1925	Agricultural productivity peaks in Owens Valley.
1922-1934	Years of bitter dispute between the City of Los Angeles and Owens Valley citizens. The City purchases most of the private land in the Valley.
1924	Owens Lake becomes dry.
1924-1931	City of Los Angeles begins well-drilling program in Owens Valley during drought period.
1930	Bond sale to finance extension of aqueduct to Mono Basin approved.
1940	Hillside Decree prohibits export of groundwater from the Bishop area.
1941	Mono Basin extension comes into operation. Crowley Lake and Grant Lake Reservoirs completed.
1953	LADWP Owens Gorge power plants completed.
1963	Second Aqueduct proposed.
1970	Second Aqueduct completed.
1972	Litigation by Inyo County against Los Angeles over Second Aqueduct operations commences.
1973-1984	Court injunction on groundwater pumping established by courts.
1980	Owens Valley Groundwater Management Ordinance approved by Inyo County voters.
1984	Inyo County and Los Angeles reach interim groundwater pumping agreement.
1985-Present	Groundwater pumping proceeds based on interim agreement.
1989	Los Angeles and Inyo County reach preliminary agreement on a long-term groundwater management plan (Agreement).

Around 1900, it became clear to many people that the City of Los Angeles could not sustain its growth unless a new source of water supply was found. The existing water source, the Los Angeles River and the groundwater basins fed by it, could not provide a reliable supply to existing residents, let alone meet anticipated future needs. In 1868, Los Angeles signed a 30-year lease with a private company to operate a municipal water system. Lacking confidence that the private company would make the improvements necessary to sustain urban development, Los Angeles allowed the lease to expire in 1898 and took over the operation of the water system.

In 1902, the Federal Reclamation Act was passed by Congress. The purpose of this act was to open new lands for settlement through irrigation. The development of an irrigation system in Owens Valley was one of the first projects considered by the newly created Reclamation Service. Early surveys conducted in 1904 indicated that as many as 185,000 acres could be brought into production if irrigation and drainage systems were constructed. Land withdrawals and other initial steps were taken by the Reclamation Service toward an Owens Valley project.

However, two private surveys made in 1885 and 1891 had shown that it would be feasible to construct an aqueduct from the Owens River to Los Angeles that would deliver water by gravity. Little interest was expressed in the idea until 1904, when it became clear that other, closer water sources were too small or the rights to them unavailable. In 1905, the Los Angeles Water Commission approved in concept a plan for an aqueduct from the Owens River. Following this approval, Los Angeles acquired rights to the land and water in Owens Valley necessary to build an aqueduct. The Reclamation Service abandoned its plans for an irrigation project in Owens Valley.

THE FIRST AQUEDUCT

The first aqueduct was designed to convey water 233 miles from Owens Valley to the San Fernando Reservoir at the upper end of the San Fernando Valley. The Owens River was to be diverted at an intake dam, 35 miles north of Owens Lake, and its water conveyed by open channel to the Haiwee Reservoir near Olancha. From Haiwee Reservoir, water would flow through a series of concrete box conduits, pipelines, and tunnels to a reservoir at Fairmont and then through tunnels and pipelines to San Fernando Reservoir. Construction of the first aqueduct commenced in 1908, and export of water from Owens Valley to Los Angeles began in 1913.

Virtually the entire flow of the Owens River was diverted into the first aqueduct. Only spring flow remained in the river downstream of the intake dam. As a result, only intermittent flows occurred in the 50 stream miles of the Owens River below the intake dam, and by 1924 Owens Lake was dry.

MONO BASIN PROJECT

By 1924, the population of Los Angeles was five times greater than when the aqueduct commenced operation in 1913. To meet the expected future demand for water, Los Angeles began planning to extend the aqueduct into Mono Basin to tap the streams tributary to Mono Lake. The sale of bonds to finance the 100-mile Mono extension was approved by the Los Angeles electorate in 1930. Construction started in 1934 and was completed in 1940. The new facilities included diversion structures on Lee Vining, and Walker and Parker Creeks, a conduit conveying flow from these creeks to an enlarged Grant Lake Reservoir on Rush Creek, an 11-mile underground tunnel connecting Grant Lake Reservoir with the Owens River and a new reservoir, Crowley Lake, in Long Valley. Completion of the extension increased the potential yield of the aqueduct system by approximately 40 percent.

THE SECOND AQUEDUCT

By the 1940s, Los Angeles had acquired rights to much more water from Inyo and Mono Counties than was needed or could be delivered to Los Angeles by the first aqueduct. In the 1940s, Los Angeles's population continued to grow steadily. Construction of a second parallel aqueduct, first suggested in the 1920s, was approved in 1963. Los Angeles's decision to approve the second aqueduct was influenced by the State Water Resources Control Board warning in 1959 to make full use of the permitted 200 cubic feet per second flow from the Mono Basin, and by the opportunity to obtain more low-cost water from the Eastern Sierra. Further impetus was provided by an issue pending before the U.S. Supreme Court concerning rights to Colorado River water. In a 1963 decision (Arizona vs. California) the Supreme Court held that Congress, in passing the Boulder Canyon Project Act (Project Act), intended to and did create its own comprehensive scheme for apportioning mainstream waters from the Colorado River among California, Arizona and Nevada. The Project Act became effective in 1929 after six states including California had ratified the Colorado River Compact and the California legislature had accepted the limitation of 4,400,000 acre-feet.[3]

The second aqueduct was designed to increase by 50 percent the amount of water Los Angeles could export from the Eastern Sierra. It was to be filled by three sources: increased surface water diversion from the Mono Basin and Owens Valley; reduced irrigation of Los Angeles-owned lands in Inyo and Mono counties; and increased groundwater pumping in Owens Valley. The second aqueduct came into service in 1970. By 1972, Los Angeles's actions in supplying water to the second aqueduct led to litigation by Inyo County against Los Angeles that continues today. A detailed discussion of the litigation can be found later in this chapter.

GROUNDWATER EXTRACTION IN OWENS VALLEY

Although surface water is the primary source for both aqueducts, groundwater has served as a supplemental source. Groundwater extraction in Owens Valley began in about 1908, when artesian wells were installed near Independence to supply water to the dredges used to build the first aqueduct. In the early years of aqueduct operations only small quantities of groundwater were extracted for export. In 1924, however, a long dry period commenced that lasted until 1931. During this period, Los Angeles drilled numerous wells in Owens Valley to supplement its depleted surface water supplies with groundwater. Groundwater extraction increased in that period to a maximum of 142,740 acre feet (197 cfs) in 1931.

The increased groundwater pumping during this period lowered water tables in the Valley, which reduced subsurface irrigation. Litigation was commenced against Los Angeles by landowners in the Independence and Bishop areas seeking compensation for damage to their properties. The litigation concerning the Independence area was ultimately dismissed, but in 1940 an order called the "Hillside Decree" was entered pertaining to the Bishop litigation, which prohibited Los Angeles from exporting groundwater from within defined boundaries surrounding Bishop.

For the next 30 years, groundwater pumping dropped to an average of about 7,000 acre-feet annually (10 cfs). In the early 1960s another dry period occurred and groundwater pumping again increased to a high of 111,880 acre-feet (155 cfs) in 1961. During the remainder of the 1960s, groundwater extraction declined until the second aqueduct became operational in 1970. High pumping rates in 1971 and 1972 in order to supply the second aqueduct, among other things, led to the litigation between Los Angeles and Inyo County. Pumping rates between 1973 and 1984 were limited by the courts, and, since 1985, have been established annually by agreement between Los Angeles and Inyo County. Since 1970, groundwater pumping has averaged about 105,000 acre-feet (145 cfs) per year.

2.3 DEVELOPMENT OF THE VALLEY

Paiute and Shoshone Indians were the original residents of Owens Valley. They adapted economically and culturally to the arid environment by combining food gathering and hunting activities with irrigated cultivation of native vegetation including wild hyacinth ("nut-grass") and yellow nut-grass, both of which grow tubers.[4]

The first non-Indian settlers in Owens Valley came primarily to stake mining claims in the late 1850s and early 1860s. The Valley's development was subject to the boom or bust cycles common to this stage of California's economic history. There were conflicts between the settlers and Indians during the 1860s. Once peace was achieved, the new settlers expanded to ranching and farming in Owens Valley. Investments were made in land and irrigation improvements, and the need for agricultural labor increased. The population began concentrating in the towns of Bishop (which incorporated in 1903), Big Pine, Independence (the County seat), and Lone Pine.

Completion of the first Los Angeles Aqueduct in 1913 at first proved relatively beneficial to the agricultural economy of Owens Valley. With the completion of a railroad and a highway from Southern California, Valley farmers could expand production to sell to more distant markets.[5]

From 1920, development of the Valley was increasingly influenced by Los Angeles' need for more water. Water law in California is based on riparian principles derived from English Common Law and appropriation principles as developed in the western states. Under the riparian doctrine, the primary right to use of water in a stream belongs to the owners of land touching the stream. The water right and the land are viewed as inseparable; ownership of one cannot be transferred without the other. Thus, under California water law, the best way to secure a reliable water supply is to acquire land immediately adjacent to a flowing watercourse. This practice was followed by Los

Angeles from 1904 onward to obtain water for its aqueduct. Water that is surplus to the riparian owner's needs can be appropriated out of the river drainage.

Although Los Angeles's plan to build an aqueduct from Owens Valley was made public in 1905, there was no plan for overall management of the water resources of the Valley. This created an atmosphere of uncertainty among Valley residents. In 1913, general agreement was reached on certain water management principles, which served to quiet the controversy; in 1921, however, faced with a growing demand for water and increased diversion by upstream users, Los Angeles removed most remaining riparian rights by accelerating its purchase of land and the associated water rights at a time when the agricultural productivity of the Valley was peaking. Prior to these purchases, the citizens of Owens Valley had been led to believe that Los Angeles would only export water surplus to the needs of farmers and ranchers in the northern part of the Valley. However, it became clear through the new land and water rights purchases that this was not to be the case. As a result, Valley farmers banded together to oppose Los Angeles and a decade of sometimes violent conflict began.

By the early 1930s Los Angeles owned about 211,665 acres, or approximately 82 percent of the Valley.[6] Although Los Angeles was willing to lease its lands to ranchers and farmers, they would be provided with a water supply that could be interrupted without prior notification if Los Angeles needed the water, or if runoff was not sufficient to meet both in-valley irrigation and Los Angeles demand.

The interruptible water supply made investment in future agricultural activity and equipment in Owens Valley exceedingly risky, and many farmers closed down. The number of farms in the Valley declined precipitously, from 482 in 1925 to 218 in 1930, and to 173 in 1945, according to the U.S. Census of Agriculture. Irrigated acreage declined from 74,958 in 1920 to 27,488 in 1930, and to 23,625 in 1940. By 1960, irrigated acreage increased to around 29,458 acres, reflecting a shift in the Valley's agricultural economy from a more diverse crop base to one more concentrated in livestock grazing and alfalfa production. Acquisitions of Valley floor lands by Los Angeles led to a loss of tax base for Inyo County and growing unemployment and population loss as people left the Valley. Inyo County's population declined 6.8 percent between 1920 and 1930.

Los Angeles's eventual acquisition of more than 90 percent of the Valley floor lands severely restricted the Valley's agricultural economy and commercial base. Valley residents demanded that Los Angeles make reparations, including purchase of those agricultural lands not already acquired, but also acquisition by Los Angeles of town lots. By 1933, Los Angeles had acquired 95 percent of all farmlands and 85 percent of all properties in the towns.[7]

The Paiute and Shoshone Indians that continued to live in Owens Valley were dispersed on private homesites throughout the Valley, on Los Angeles-owned parcels and at the Fort Independence Indian Reservation just north of the town of Independence. Because the Paiutes were some of the last landowners to retain their land and water rights in the Valley, Los Angeles negotiated in 1939 with the federal Bureau of Indian Affairs (BIA) for an exchange of lands, some of which were owned by Indians, and some by the bureau. The land exchange gave to Los Angeles the water rights the Indians possessed, along with 2,914 acres of land in various locations throughout the Valley. In return, Los Angeles gave the Indians 1,392 acres of prime agricultural land for reservations close to Bishop, Big Pine, and Lone Pine (Fort Independence Indians chose not to participate in the land exchange). Los Angeles also agreed to supply the new reservations with over 6,000 acre-feet of firm water annually for irrigation and domestic purposes.[8]

In the years after World War II, Inyo County's population began increasing again, from 7,625 in 1940 to 11,658 in 1950. By 1960, however, population had essentially leveled out due to modest growth in tourism and recreation employment offset by continued declines in agricultural activity during the 1950s.

Recreation and tourism became important components of the Valley's economy beginning in the 1930s. The establishment of fish hatcheries and the stocking of Long Valley Reservoir (Crowley Lake) helped expand the number of visitors to the Valley who came to camp, fish, hunt, and hike in the area. Motels, service stations, restaurants, and outdoor sporting goods stores became important components of the local economy, as well as providing retail and lodging support for the ski areas that developed to the north at June Lake and Mammoth Lakes. These types of businesses formed a growing base of sales tax revenues for Inyo County and the City of Bishop.

From 1930 onward, the management policies of Los Angeles limited economic growth and population expansion in Owens Valley. Overall, between 1900 and 1960, Inyo County's population (of which Owens Valley is by far the most populous region) grew by 167 percent, while the State of California's population as a whole grew by 958 percent. In only two decades (1900-1910 and 1940-1950) did Inyo County's population grow at a rate comparable to the growth rate of the State as a whole.

2.4 LITIGATION ASSOCIATED WITH GROUNDWATER PUMPING[9]

The second Los Angeles Aqueduct began operation in June 1970. In November 1970, the California State Legislature enacted the California Environmental Quality Act (CEQA) in response to a growing awareness of the importance of the natural environment in the lives of the state's citizens. CEQA required public decision-makers to document and consider the environmental implications of their actions. The body of law comprising CEQA requires agencies to seek means to reduce or avoid significant environmental damage that could otherwise result from their actions. Projects that were completed or under construction at the time of CEQA's enactment were exempt from its provisions.

In 1972, LADWP circulated a draft water management plan for Owens Valley.[10] The plan called for a decrease in acreages that would be supplied with irrigation water in Owens Valley, and for an increase in groundwater pumping and new wells. The estimated long-term average pumping rate was increased to 130,000 acre-feet (180 cfs) per year from 64,000 acre-feet (89 cfs) per year. An average of 666 cfs (481,000 AFY) was to be conveyed to Los Angeles in both aqueducts.

In response to Los Angeles's confirmation of its intent to increase groundwater pumping, and to perceived environmental impacts caused by this increased pumping, Inyo County filed a lawsuit against Los Angeles in November 1972. The lawsuit claimed that Los Angeles had failed to comply with CEQA. This case set the stage for protracted legal proceedings which continue to this date. These proceedings have been chronicled in six decisions emanating from the Third District Court of Appeal, which has assumed and retained jurisdiction over the controversy.

Inyo County's complaint, filed in the Inyo County Superior Court, sought a temporary restraining order, preliminary injunction, and permanent injunction to halt the pumping of groundwater and the increased export of surface water from Owens Valley and Inyo County, until Los Angeles had filed an EIR as required by CEQA. The complaint also addressed both export and in-valley use of surface water within Inyo County. A temporary restraining order was issued by the court limiting any increase in the withdrawal of groundwater in the affected area.

A motion by Los Angeles for a change of venue from Inyo County was granted in accordance with State law. Sacramento County was determined to be a neutral location that was reasonably accessible to both sides. A hearing was held in Sacramento County Superior Court that resulted in a denial of the application for a preliminary injunction and a dissolution of the temporary restraining order on the basis that the project preceded CEQA. Inyo County's ensuing appeal and petition for injunctive relief from the Third District Court of Appeal resulted in that court assuming original jurisdiction to determine the merits of Inyo County's claims. County of Inyo v. Yorty (1973) 32 Cal. App. 3d 795; 108 Cal. Rptr. 377.

The appellate court held that the expanded tapping and extraction of underground water by Los Angeles from lands owned by it in Inyo County required the filing of an EIR as required by CEQA. The Court found that even though the second aqueduct was operative before the effective date of CEQA, the increase in the extraction of groundwater to supply the second aqueduct was a project separate and divisible from the aqueduct and, therefore, an EIR was required on the expanded groundwater extraction.

The Court further ruled on the request for a stay on the pumping. Mindful of the fluctuating annual and seasonal changes in precipitation, the Court stayed further extraction of underground water from Owens Valley groundwater basins in excess of the average amount being taken on November 23, 1970 (89 cfs, or 65,000 AFY), pending a determination by the Superior Court of the mean or average of pumping from July 1, 1970 to the date of the opinion in 1973. When the latter figure was determined, it was intended to be fixed as the maximum allowable withdrawal from Owens Valley groundwater basins until the filing of an EIR and subsequent actions taken by Los Angeles. Los Angeles was directed to modify its pumping in accordance with the stay and to proceed with the preparation and filing of an EIR.

Shortly thereafter, pursuant to the appellate court's order, the Sacramento Superior Court took evidence in October of 1973 and fixed an average pumping rate of about 160,000 acre-feet (221 cfs) annually, commencing each July 1. Inyo County then appealed. The appellate court set aside the order of October 1973, reasoning that the formula that had been established for the Superior

Court's guidance needed refinement. The Court of Appeal then described what it believed to be a more appropriate formula and returned the matter to the Superior Court for further proceedings. This was documented in an unpublished opinion dated September 4, 1974.

The Superior Court then fixed an interim pumping rate not to exceed an average of 178.5 cfs annually, commencing each July 1. Once again Inyo County appealed, protesting that the Superior Court's order was overly generous, not calculated on a runoff year beginning on the first of April, damaging to the environment and out of compliance with the averaging formula directed by the Court of Appeal. Inyo County requested that the Court reassert its original jurisdiction, and that in place of the 1974 formula, the Court restore the annual pumping rate at 89 cfs.

In Inyo v. City of Los Angeles (1976) 61 Cal. App. 3d 91; 132 Cal. Rptr. 167, second in the series of published cases, the appellate court vacated the Superior Court's interim orders. The appellate court agreed with Inyo County's contentions that the Superior Court had established too high a pumping rate and reinterpreted the order to hold that Los Angeles could not withdraw water from the subsurface pool of the Owens Valley groundwater basin in excess of an average of about 108,000 acre-feet (149.56 cfs) for the period of September 1, 1976, through March 31, 1977, nor in excess of an annual average rate of 149.56 cfs for each successive 12-month period commencing April 1, 1977.

The Court of Appeal rejected, however, Inyo County's argument that Los Angeles's extractions should be limited to the rate that prevailed at the date of CEQA's enactment. Los Angeles was ordered to not decrease the quantities of water (whether from subsurface or surface sources) supplied to Owens Valley users below the levels customarily maintained since May of 1975. Observing that Los Angeles had responded to the Court's 1973 mandate by filing an EIR dated May 1976, the Court ruled that its original jurisdiction would continue to enable the Court to evaluate the adequacy of that report. The Court accepted the claim challenging the sufficiency of the EIR in this case, but did not adjudicate the issue until the following year.

THE FIRST EIR, MAY 1976

On July 15, 1976, Los Angeles's Board of Water and Power commissioners certified that the EIR was complete and approved the project which consisted of increased groundwater pumping from Owens Valley Basin. Inyo County objected to the legal adequacy of the EIR.

Los Angeles presented the EIR to the appellate court in 1977, which then rendered the next decision in this case. In County of Inyo v. City of Los Angeles (1977) 71 Cal. App. 3d 185; 139 Cal. Rptr. 396, the Court of Appeal found the 1976 EIR to be inadequate primarily because of a flawed project description and an inadequate range of alternatives. The Court held that the scope of the project description not only expanded and contracted from place to place within the EIR, but also misinterpreted the outline of the project as defined by the 1973 decision. Overall, the project description addressed only the relatively small amount of groundwater to be extracted for Owens Valley use, and excluded discussion of groundwater pumping for export to Los Angeles via the second aqueduct.[11] The Court indicated that the EIR did not adequately inform the citizens of Inyo County and Los Angeles of the true nature of the groundwater pumping proposal and its impact on the people and environment of both communities.[12] The Court explained that its 1973 decision included groundwater pumping both for use in the Valley and for export to Los Angeles. The alternatives considered in the EIR were also found to be deficient in that there was no discussion of a genuine "no project" alternative or a water conservation program within the Los Angeles service area.

The Court concluded that because the EIR was not legally adequate, Los Angeles had not yet complied with the Court's 1973 opinion and issuance of a writ, and therefore the Court would retain jurisdiction until the writ was fully satisfied. In addition, the interim restraints upon the rate of groundwater pumping and upon the decrease of water supplied to Owens Valley uses were to remain in effect.

Two days after receiving the Court's ruling, Los Angeles petitioned a higher groundwater extraction rate of 315 cfs due to drought conditions. Los Angeles's motion was supported by the Metropolitan Water District (MWD), which claimed that its other consumers in Southern California would be harmed if Los Angeles exercised its lawful right to purchase more MWD water. Inyo County objected to the higher extraction rate partially on the basis that Los Angeles had no meaningful conservation plan. In a preliminary memorandum, County of Inyo v. City of Los Angeles, 3 Dev. 13886 (Cal. Ct. App. Mar. 24, 1977) the Court replied that until Los Angeles conserved water, its request would not likely be granted. In August of 1977, after Los Angeles had adopted and implemented an emergency water conservation ordinance, the court allowed groundwater pumping to increase to 315 cfs.

THE SECOND EIR, JUNE 1979

Los Angeles prepared a second EIR, and certified it in June 1979. The Court of Appeal subsequently reviewed the second EIR in Inyo v. City of Los Angeles, (1981) 124 Cal. App. 3d 1; 177 Cal. Rptr. 479. The Court found that the second EIR also failed to comply with the writ and the requirements of CEQA. Like the 1976 document, the 1979 EIR did not include a genuine "no project" alternative, but predicated its alternatives on conditions different from those that preceded the project; thus, the relationship of the project to the export of water to Los Angeles was not fully disclosed.

The Court of Appeal further held that the second EIR's project description omitted from consideration the essential element of the availability of surface water. Specifically, the Final EIR stated that the increase in groundwater pumping would amount to 145 cfs (105,000 AFY) on an average annual basis, of which 66 cfs (48,000 AFY) would be exported to Los Angeles and 79 cfs (57,000 AFY) would be supplied directly or indirectly to uses in Owens Valley. The Court noted that in the EIR there was an asterisk and accompanying footnote which elucidated that the pumped water designated for irrigation or other uses would flow into the aqueduct system and an equal amount of surface water would be diverted from a stream or ditch convenient to the location of use. It was conceded at oral argument that as a physical matter, virtually all of the additional pumped groundwater would eventually flow into the aqueducts and ultimately to Los Angeles. Thus, the water to be made available for in-valley irrigation use was surface water. Yet, the project definition excluded such water from the Final EIR and consequently there was no discussion of whether surface water would in fact be available for in-valley uses.

Finally, the Court held that, as in 1977, the alternatives in the report were not tied to a consistently viewed project. As before, the Court retained jurisdiction, held that Los Angeles had still not complied with the 1973 decision, and ordered Los Angeles to take expeditious action to comply by producing a legally adequate EIR. The interim restraints upon the rate of groundwater pumping and upon the amount of water supplied to Owens Valley uses were to remain in effect.

GROUNDWATER PUMPING ORDINANCE

In 1980, while the Court of Appeal review of the 1979 EIR was pending, Inyo County voters passed a groundwater ordinance intended to regulate groundwater pumping in the Valley through a groundwater management plan to be implemented by a groundwater pumping permit procedure. The ordinance created a county water department to prepare, and a water commission to approve, a water management plan. The plan would identify all the water resources of the Valley and develop a water use program consistent with the health and welfare of Inyo County's citizens. Further, the management plan would aim to maintain the groundwater table at a depth that would support natural vegetation and wildlife and that would minimize air pollution caused by increased wind erosion.[13] The ordinance established a comprehensive procedure for review of pending applications. It also empowered the Inyo County Board of Supervisors to impose fees for the administration of the extraction permit system. In litigation filed by Los Angeles, the ordinance and associated EIR were ruled unconstitutional by a trial court in 1983. A tentative decision was entered in favor of Los Angeles, but the parties reached an interim agreement to jointly manage groundwater resources before a final judgement was entered.

2.5 INTERIM AGREEMENT

A year after the second EIR was ruled inadequate, a Memorandum of Understanding was adopted by Inyo County and Los Angeles. This document expressed the intent of both parties to work together in identifying and recommending methods to meet the water needs of Owens Valley and of Los Angeles. It also stated that the parties desired to have a groundwater study of Owens Valley made by the United States Geological Survey (USGS). Both a Technical Group and Standing Committee, including representatives of both parties, were formed as a result of the memorandum.

The Technical Group is comprised of not more than five representatives selected by Inyo County and five by LADWP. The Standing Committee is comprised of representatives from Inyo County, Los Angeles and LADWP. Inyo County's representatives to the Standing Committee are: at least one member of the Inyo County Board of Supervisors, two Inyo County Water Commissioners and three staff members. Los Angeles's representatives are: at least one member of the Los Angeles City Council, the Administrative officer of the City of Los Angeles, two members of the Board of Water and Power Commissioners and three staff members. Regardless of the number of representatives attending a Technical Group or Standing Committee meeting, each party has only one vote.

In 1983, following the Superior Court's decision invalidating Inyo County's groundwater ordinance, Inyo County and Los Angeles decided to expand negotiations to determine whether an acceptable groundwater management plan could be achieved. In April 1984, the governing bodies of Inyo County and Los Angeles approved an interim agreement. In this interim agreement, the two parties agreed to:

- settle property tax litigation between Inyo County and Los Angeles;
- temporarily suspend Inyo County's appeal of the Court's decision invalidating its groundwater ordinance;
- temporarily suspend litigation on Inyo County's environmental suit and Court-imposed pumping restrictions by substituting jointly developed annual pumping programs;
- lease the town water systems to Inyo County, which would lead to a reduction in water rates;
- conduct five-year cooperative studies together with impartial third parties, including the USGS;
- implement certain enhancement/mitigation projects;
- negotiate a long-term groundwater management plan;
- provide financial assistance to Inyo County from Los Angeles to cover costs of various studies; and
- resume litigation of Court pumping restrictions and the groundwater ordinance's validity if the parties did not develop and adopt a long-term joint groundwater management plan for Owens Valley.

With this agreement, the parties returned to the Court of Appeal in 1984 seeking a modification of the writ of mandate previously issued by the Court in 1973. In County of Inyo v. City of Los Angeles, (1984) 160 Cal. App. 3d 1178, the Court initially denied the motion for approval of the five-year agreement (the Stipulation). Also, the Court specifically explained that the modification did not imply that the joint plan was a new project. The project was intended to remain as it was -- a program increasing the average rate of groundwater pumping and use (both for export and in-valley use), above a baseline rate reasonably representing the average of groundwater pumping and use (both for export and in-valley use) preceding the operation of the second aqueduct. The Court made clear that regardless of the agreement of the parties, it did not want to foreclose CEQA review of their product by other interested parties and ultimately the Court itself. However, the Court did allow that the command of its writ to prepare an EIR could be met if the EIR were to be presented in conjunction with a joint management plan.

The Court took note of the agreement of the parties, together with the proposed modification of the agreement and held that upon submittal of the parties' agreement to implement an annual pumping program, the interim pumping orders of the Court would be modified so as to incorporate those provisions. Contingent upon the above agreement, the Court extended the time within which to comply with its requirement for a legally adequate EIR. If no submittal of an agreement to commence the joint program was made by December of 1984, Los Angeles was required to commence with the CEQA process to comply with the outstanding writ. If the agreement was reached but subsequently terminated by Inyo County, Los Angeles was required to commence the CEQA process on the date that termination was effective. Los Angeles would then be required to present a legally adequate EIR to the Court of Appeal within one year of the date of the CEQA process being commenced. In the event Los Angeles failed to present any EIR to the Court within that time period, the interim pumping order would be modified to provide that the annual pumping rate would be at the level of 64,000 acre-feet (89 cfs). However, in December 1984, Los Angeles and Inyo County modified the agreement consistent with the Court's order, and the Court modified its writ to include the interim agreement. In May 1988, per a joint agreement with Inyo County, LADWP was granted a 16-month extension by the Court (from February 1989 to June 30, 1990) for the purpose of completing studies necessary for development of a management plan and EIR. In June 1990, Los Angeles and Inyo County requested a further 12-month extension from the date of the release of this Draft EIR. On July 25, 1990, the court granted this extension. Under this extension, the Final EIR must be presented to the court one year following release of this Draft EIR for public review.

COOPERATIVE STUDIES

In order to learn more about the relationship between groundwater pumping and its impact on native vegetation, certain studies budgeted at approximately $5 million were undertaken by Inyo County, Los Angeles, and the USGS. As part of the cooperative studies, Inyo County and LADWP developed extensive information on the geohydrology, water budget, soils and vegetation of Owens Valley. The USGS compiled and analyzed the information and summarized its independent findings in a series of technical reports. These USGS reports, together with other cooperative study materials, are the technical foundation for the Agreement.

In accordance with the provision of the joint five-year interim agreement between Inyo County and Los Angeles, the two parties have worked to cooperatively develop and implement numerous projects designed to enhance the environment of Owens Valley. Since inception of the program, the Inyo/Los Angeles Standing Committee has implemented a number of enhancement/mitigation projects ranging in scope from the revegetation and irrigation of certain areas to enhancement of wildlife habitats and recreation areas (see Chapter 5).

2.6 THE GROUNDWATER MANAGEMENT AGREEMENT OF AUGUST 1, 1989

Negotiations between Inyo County and Los Angeles resulted in the Agreement on August 1, 1989. The Stipulation and Order that sets forth the final agreement between the parties can be found in Volume One of this Draft EIR. The Agreement is an element of the proposed project evaluated in this EIR. Chapter 5 contains a detailed description of the Agreement and its relationship to other elements of the proposed project.

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1. U.S. Geological Survey, Geology and Water Resources of Owens Valley, California, Open File Report 88-715, 1988.

2. The historical summary was drawn primarily from William L. Kahrl, Water and Power, University of California Press, 1982, and Richard Coke Wood, The Owens Valley and Los Angeles Water Controversy, Chalfant Press, 1923.

3. State of California v. State of Arizona, 373 US 546, 83 S. Ct. 1468 (1963).

4. See Harry W. Lawton, Philip J. Wilke, Mary DeDecker, and William M. Mason, "Agriculture Among the Paiute of Owens Valley," The Journal of California Anthropology 3:1(1976), p. 33-4.

5. Harry Erlich and P.H. McGauhey, Economic Evaluation of Water, Part II: Jurisdictional Considerations in Water Resources Management, Contribution No. 42, Water Resources Center, University of California, June 1964, p. 59.

6. Inyo County Land Purchase data from David E. Babb, LADWP, March 21, 1990.

7. William Kahrl, Water and Power: The Conflict over Los Angeles' Water Supply in the Owens Valley.

8. See Kahrl, ibid., pp. 354-359; and Nancy Peterson Walter, The Land Exchange Act of 1937: Creation of the Indian Reservations at Bishop, Big Pine, and Lone Pine, California, Through a Land Trade Between the United States of America and the City of Los Angeles, Ph.D Dissertation in Anthropology, Union Graduate School, California State University at Northridge, May 1986, Chapters IV and IX. Walter contends that the U.S. Government failed to consider the water rights of the Indians in the Owens Valley with regard to the Winters Doctrine, and failed to carry out its trust responsibility to protect the property and rights exchange with Los Angeles.

9. This litigation is described in detail in Rossman and Steel, Forging New Water Law (1983), Hastings Law Journal, Vol. 33, p. 903.

10. Owens Valley Water Resources Management Plan, LADWP. October 1972.

11. Ibid., p. 918; 61 Cal App. 3d 91 at 96-98, 132 Cal Rptr at 170-72.

12. 139 Cal Rptr at 405.

13. Rossman and Steel, Forging New Water Law, Hastings Law Journal, Vol. 33, pp. 929-931.

3. WATER SUPPLY FOR LOS ANGELES

3.1 HISTORIC WATER USE

The City of Los Angeles water system supplies water to a population of 3.4 million people, in a service area of approximately 464 square miles. Residential water use represents 63 percent of Los Angeles' water demand, and is the largest single category of demand. Twenty-three percent is used by commerce and industry while agriculture, government and other minor uses represent the remaining 14 percent of water demand in Los Angeles. Population and water use have continued to grow and over the last ten years and annual water demand has reached a level of 692,000 acre-feet. Table 3-1 shows historic population, employment and water use in Los Angeles.

Per capita water use provides a rough measure of water use efficiency in a city. It is inexact because cities have different proportions of residential, industrial and commercial water users. The presence of large numbers of undocumented residents in Southern California together with the large number of people who work in Los Angeles but live elsewhere are not documented, further complicating calculations of per capita use. Per capita daily water use in Los Angeles in the 1980s was in the range of 170 to 189 gallons. Per capita daily water use in other cities in the western United States ranges from about 150 gallons to over 300 gallons, as shown in Table 3-2. The highest use rates in California are usually associated with unmetered service. Examples include Sacramento and Modesto. The City of Los Angeles system is entirely metered, and has been for 80 years.

3.2 PROJECTED FUTURE WATER USE

Total water use is dependent on many factors, but the three primary factors are: climate in the use area; population; and industrial and commercial development. Below-normal rainfall and high temperatures in Los Angeles tend to increase the total water use. Abundant rainfall and low temperatures have the reverse effect. Thus, weather contributes to the year-to-year variation in

TABLE 3-1

POPULATION, AND WATER USE
IN LOS ANGELES 1950 - 1989

Year	Population[1]	Water Use AF	Per Capita Water Use Gallons per Capita/Day[2]
1950	1,800,000	400,000	198
1960	2,500,000	510,000	182
1963	2,604,000	498,000	179
1964	2,662,000	526,000	185
1965	2,715,000	521,000	170
1966	2,772,000	528,000	178
1967	2817,000	513,000	170
1968	2,932,000	551,000	176
1969	2,965,000	546,000	172
1970	2,975,000	593,000	186
1971	2,862,000	584,000	191
1972	2,858,000	603,000	197
1973	2,870,000	573,000	187
1974	2,836,000	565,000	186
1975	2,786,000	567,000	181
1976	2,848,000	611,000	201
1977	2,861,000	566,000	185
1978	2,924,000	486,000	156
1979	2,937,000	554,000	176
1980	2,969,000	580,000	174
1981	2,989,000	617,000	183
1982	3,062,000	608,600	177
1983	3,114,000	594,400	170
1984	3,168,000	652,300	183
1985	3,224,000	675,100	187
1986	3,278,000	675,900	184
1987	3,338,000	705,000	189
1988	3,388,000	688,100	181
1989	3,427,000	694,500	181
1990	3,460,000	694,800	179

[1]Population and water use data were obtained from LADWP Statistical Reports.

[2]Does not include the effects of uncounted population, informally estimated in the 1980s to be 10 to 15 percent of the counted population. If the latter is included, water use rates drop by 10 to 15 percent.

TABLE 3-2

PER CAPITA WATER USE IN SELECTED CITIES

City, State	Gallons per capita/day
Goleta, California	147
East Bay Municipal Utility District, California	170
Los Angeles, California	170-189
Pasadena, California	220
Anaheim, California	235
Modesto, California	330
Sacramento, California	300
El Paso, Texas	215
Denver, Colorado	240
Phoenix, Arizona	330

Source: City of Los Angeles Urban Water Management Plan, 1985, and EIP Associates. Information reflects conditions in the 1980s.

water use. However, the factors that contribute most significantly to the steadily increasing trend in urban water use are commercial development and the continuing growth of Los Angeles' population. Social changes such as the decline in average household size and the increase in two-income families may also play a role.

The California Urban Water Management Planning Act of 1983 requires water suppliers in California to prepare and adopt a specific plan describing their current and future water use and sources of supply, existing and proposed conservation measures, and alternative water supply and management measures. The original Los Angeles Urban Water Management Plan was adopted in 1985. A revised Plan is under preparation and is scheduled to be completed by December 31, 1990.

Pending completion of the Urban Water Management Plan, LADWP has developed an interim estimate of future water demands. These estimates are shown in Table 3-3 and are subject to revision as development of the Urban Water Management Plan proceeds.

3.3 WATER CONSERVATION

Since the 1976-77 drought, some California water purveyors have managed water demand as one means of balancing supply and demand. By increasing the efficiency of water use, the need for new source development is reduced or delayed. LADWP has managed water demand by implementing a variety of voluntary and mandatory water conservation measures aimed at LADWP customers and by improving system maintenance.

Prior to 1977, water conservation was encouraged through the use of water meters. Metered water use areas have substantially lower per capita water consumption rates than areas that are unmetered. The Los Angeles area served by LADWP has been entirely metered since 1927. One of the first actions taken by LADWP in response to the drought of 1976-1977 was the elimination of volume discounts, to encourage conservation by customers who use large amounts of water. Seasonal water pricing was introduced in 1985 to discourage high summertime water use. Summer

TABLE 3-3

PROJECTIONS OF FUTURE POPULATION AND WATER DEMAND[1]

Year	Population, Million[2]	Normal Year Water Demand, AFY[3]
1990	3.46	689,900
1995	3.57	707,300
2000	3.69	728,400
2005	3.79	745,500
2010	3.88	756,500

Source: LADWP, June 1990.

[1] These estimates will be refined in the 1990 Urban Water Management Plan to be published late in 1990.

[2] Based on growth rate estimated by Southern California Association of Governments.

[3] Projected water demands are based on normal rainfall and weather conditions. If weather conditions are abnormally hot and dry or abnormally cool and wet, actual water use could vary as much as plus or minus 8 percent from normal demand.

water rates are currently 25 percent higher than winter rates. Since 1977, Los Angeles has gradually expanded its conservation program.

By 1990, Los Angeles had in place a comprehensive water conservation program that emphasizes education, conservation incentives, water conservation ordinances, incorporation of water-saving devices in new construction, retrofitting of water-saving devices in existing structures, and improved distribution system management to reduce wastage through leaks. Table 3-4 summarizes the various components of the program. The existing components of LADWP's conservation program are described in this section.

CITY OF LOS ANGELES WATER CONSERVATION ORDINANCE

To relieve the City's overtaxed sewer system, and in response to the recent drought, the City Council passed a new emergency water conservation law in 1988. The Water Conservation Ordinance to Reduce Sewer Flows (City Ordinance #163532) made mandatory the installation of water-saving devices (low-flow shower heads and toilet tank displacement devices) in all residential, commercial, industrial and governmental properties by January 13, 1989. Large turf owners (three acres or more) were required to reduce consumption of irrigation water by ten percent compared to 1986 consumption. Failure to comply with these two provisions brought no penalties to single-family residential users; other users were assessed a surcharge of ten percent after written warnings and a grace period. This surcharge increased to 25 percent on January 13, 1990, and will increase to 50 percent and then 100 percent on July 15, 1990 and January 15, 1991, respectively. All customers are required to retrofit their properties with water-saving devices upon sale as a requirement of escrow instructions. The ordinance also required the 250 largest water/sewer users in Los Angeles to conduct water use audits in accordance with guidelines established by LADWP. Additionally, the ordinance mandated that no commercial, industrial or multi-family construction project be issued a building permit until certain landscaping or xeriscape provisions are met. These provisions include appropriate low-water use plantings, non-living ground cover, a low percentage of lawn, a high degree of paving permeability and water-conserving irrigation features. Finally, this ordinance required the installation of ultra-low-flush toilets (using 1.6 gallons per flush or less) in all buildings constructed or remodelled after July 1, 1989 and in all replacements. In connection with this ordinance, LADWP distributes water-saving devices free of charge to residential customers and collects penalties for non-compliance.

TABLE 3-4
WATER CONSERVATION PROGRAMS IN EFFECT IN LOS ANGELES IN 1990

Pricing
- Full Metering
- Uniform Commodity Rate Structure
- Seasonal Water Pricing

Public Information
- Newspaper Advertising, Television and Radio
- Bill Inserts
- Brochures
- Exhibits
- Education Programs in Schools
- Water Awareness Month Promotions
- Drought Busters

Residential Programs
- Ultra Low-Flush Toilet Installation Program
- Water-Saving Device Retrofit Kit Distribution
- Research
- Home Water Audits Conducted Through L.A. Unified School District
- Low-Water-Using Fixtures Required in All New Construction
- Retrofit of All Existing Structures Required
- Low-Interest Loans
- Home Water Surveys
- Lawn Watering Guide Distribution

Business and Industry Programs
- Water Perception "90" Conference
- Information Bulletins and Brochures
- Water Conservation Advisory Committees

Landscape Programs
- Residential Landscape Water Conservation Research
- Demonstration Gardens
- Brochures and Advertising
- Spring Garden Expo/Conservation Gardening Symposia
- Water Conservation Advisory Committees
- Landscape Water Management Programs/Large Turf Audits

System Maintenance Measures
- Leak Repair
- Pressure Regulation
- Cathodic Protection
- Cement Mortar Lining of Pipes

Source: Los Angeles Department of Water and Power, July 1990.

Another ordinance (the Emergency Water Conservation Plan), passed in 1977 in response to the drought at that time, was revised in 1988 for the thirty-third time. The ordinance includes a five-phase program of water-saving and rationing measures that can be implemented in response to a worsening drought. Phase I of the Emergency Water Conservation Ordinance (Municipal Code and the operation Chapter 13, Articles 1 and 2) prohibited certain water uses, including the hosing of paved surfaces and use of non-recycling decorative fountains. It also calls for the timely repair of water leaks, and requires restaurants to serve drinking water only upon request.

RESIDENTIAL USERS

With residential use making up 63 percent of Los Angeles' water consumption, conservation measures directed at this segment of LADWP's customers have been particularly intensive. An important objective for the LADWP has been to raise the public's consciousness of the issue of water conservation. Public awareness about the importance of water conservation, and the appropriate measures to achieve it, is developed through frequent bill inserts, brochures, radio spots, and newspaper ads. A speakers bureau and school education programs perform community outreach. During previous (1976-77) and recent (1988-90) droughts, the campaign to elevate public awareness was further intensified through press conferences and news releases, television ads employing well-known weathercasters, billboard ads, signs on LADWP vehicles, and tent cards displayed on the tables of many Los Angeles restaurants and hotels. Special efforts are made to increase public awareness of water during Water Awareness Month. To enforce the emergency water conservation ordinance and to increase public awareness of the need to conserve, LADWP implemented a "Drought Busters" program in 1990. The LADWP employees not only cite violators of prohibited uses but also distribute water conservation information and devices.

Free water conservation kits, containing toilet tank displacement bags, leak-detecting dye tablets, and showerhead flow restrictors, have been available from local LADWP offices to all residential customers since 1977. In 1981, kits were mailed to all of LADWP's 1.25 million customers, and in 1986, the conservation kits were distributed in some parts of Los Angeles. Since 1988, 1,300,000 low-flow showerheads have been distributed to LADWP customers.

In 1990, the City of Los Angeles Public Works Department will implement a $2.2 million residential retrofit program which involves the door-to-door distribution of free water conservation kits to 100,000 households with free installation available to the homeowner. This program is part of the City's efforts to reduce sewer flows.

In an effort to promote this use of ultra-low flush toilets (toilets that flush at a rate of 1.6 gallons per flush or less), LADWP has implemented a pilot toilet rebate program. Customers replacing existing toilets with City-approved ultra-low-flush toilets are eligible to receive a $100 rebate for each replacement. The LADWP's newest residential water conservation effort is its Home Water Surveys Program implemented in 1990 in response to the current drought. At the request of any residential customer, a LADWP representative will go to the customer's home to survey water use. The surveyor will perform a lawn water audit and then provide a customized irrigation schedule. The surveyor will also check for leaks in toilets and faucets, install flush-reduction devices, faucet aerators, and low-flow shower heads. The customer also receives a report and "how-to" conservation literature.

A variety of measures are used to encourage residential customers to landscape their properties with water-saving, drought-resistant plants, which generally require 30 to 60 percent less water than typical landscape plants. These efforts are considered particularly important because outdoor water use represents between 30 and 50 percent of residential water use. Brochures and lawn watering guides are made available to all customers, including, most recently, a distribution of LADWP's lawn watering guide to all its single-family and duplex customers. A one-third-acre demonstration garden located in front of the LADWP General Office Building is maintained to display a large variety of drought-resistant plants and shrubs, and to demonstrate effective water-efficient gardening practices. Tours of the garden, special exhibits, and dissemination of information are all part of an Annual Spring Garden Expo/Conservation Gardening Symposium which began in 1988.

SCHOOL PROGRAMS

LADWP has developed portable exhibits, films, workbooks, teachers' guides, and other educational materials that it makes available without charge to Los Angeles schools and other water agencies throughout California and the United States. Teacher training programs are also made available to further assist the schools in teaching and developing curricula about conservation. LADWP also sponsors an annual water conservation poster contest in Los Angeles schools, awarding cash prizes and printing the winning entries in calendars and posters.

Incentives for saving water are provided to schools in the form of a 25 percent rebate of utility expenditures when participating schools reduce water, gas and electricity consumption by 10 percent. The rebates are to be used for school improvement projects. In 1990 a new program will be initiated with Los Angeles Unified School District to have students perform abbreviated home water audits using worksheets developed by LADWP. These audits will be returned to LADWP and used to develop future residential conservation programs.

BUSINESS AND INDUSTRIAL USERS

Until 1987, water audits and consultations were provided to commercial and industrial users by LADWP at no charge. Individualized written analyses were provided that included an evaluation of the cost-effectiveness of recommended modifications. Water meters continue to be loaned out to enable business and industrial users to monitor individual points of water consumption within their overall operations, thus pinpointing areas most warranting improvements.

Industry-specific bulletins on water conservation are developed and updated by LADWP and made available without charge to interested customers. To date, brochures have been developed on the following subjects: Commercial Buildings, Schools and Colleges, Restaurants, Laundries and Linen Suppliers, Hotels, Health Care Facilities, Golf Courses, Food Processing Industries, and Beverage Industries. In the near future, LADWP anticipates utilizing the services of consulting engineering firm(s) to conduct demonstration audits for several large water users and industries that use large quantities of water. The results of these audits would then be transmitted to LADWP customers through the Industry Associations or through Industrial Water Conservation Advisory Committees. The Department is currently forming these advisory committees which will provide a forum for water conservation technology exchange for business and industry.

IMPROVING THE EFFICIENCY OF WATER USE

In an attempt to minimize wastage through leakage of water pipes, the LADWP conducted a program of leak detection and repair between 1976 and 1984. Each year more than 500 miles of distribution pipe and over 5,000 meters were surveyed for leaks. During the course of the eight-year program, over 3,836 miles of pipeline were surveyed and, where necessary, repaired.

In order to prevent interior corrosion that leads to leaks, all new installed pipes are cement-lined. There are also full-time leak repair crews that repair identified leaks. There is currently a program underway to line all of Los Angeles' water pipes with cement. Upon completion of the program, LADWP hopes to have a leak-free system.

LADWP has implemented a meter replacement program with the goal of replacing all meters 35 years or older and all damaged or defective meters. The program will save water by eliminating the underbilling that occurs as a result of worn meters.

Cathodic protection is another technique employed by LADWP to minimize corrosion and leakage of pipes. A low-voltage electric current is passed through steel and iron pipes, thus preventing or minimizing corrosion of the pipe. This process is generally used on large-diameter trunk lines. Water is also conserved by the maintenance of a fairly uniform pressure. Pressure is monitored throughout the system to ensure that a minimum pressure is guaranteed, but that no high spots occur which would lead to unnecessarily high water use.

In partnership with the Metropolitan Water District (MWD) of Southern California, LADWP maintains a weather station known as CIMIS (California Irrigation Management System) at Forest Lawn Memorial Park in Hollywood Hills, which assists agricultural users and large turf owners to develop efficient irrigation/watering practices. This station was built in 1988 and is part of a statewide network of remote weather stations. The LADWP also works closely with the MWD on a number of water conservation pilot studies. LADWP's ultra-low-flush program qualifies for MWD's conservation credits program, which contributes funds to agencies that implement water saving activities. In addition, MWD's Drought Action 90 Plan includes a rebate for agencies that reduce their total consumption by more than five percent from 1989 use.

As described in this section, the LADWP has significantly expanded its water conservation activities in response to the current drought. More than $8 million has been budgeted by LADWP for conservation activities during the 1990-91 fiscal year. In addition, MWD has budgeted over $2 million for conservation advertising in Southern California, and the Los Angeles Department of Public Works has budgeted $2 million for its water conservation retrofit program.

In addition to the new conservation programs implemented during the drought, there has been considerable media attention on the current water supply conditions and the prospects for mandatory water curtailment. As a result, water consumption in Los Angeles through the spring and summer months of 1990 has been an estimated 10 to 15 percent below the anticipated normal consumption when considering weather and population changes from prior years.

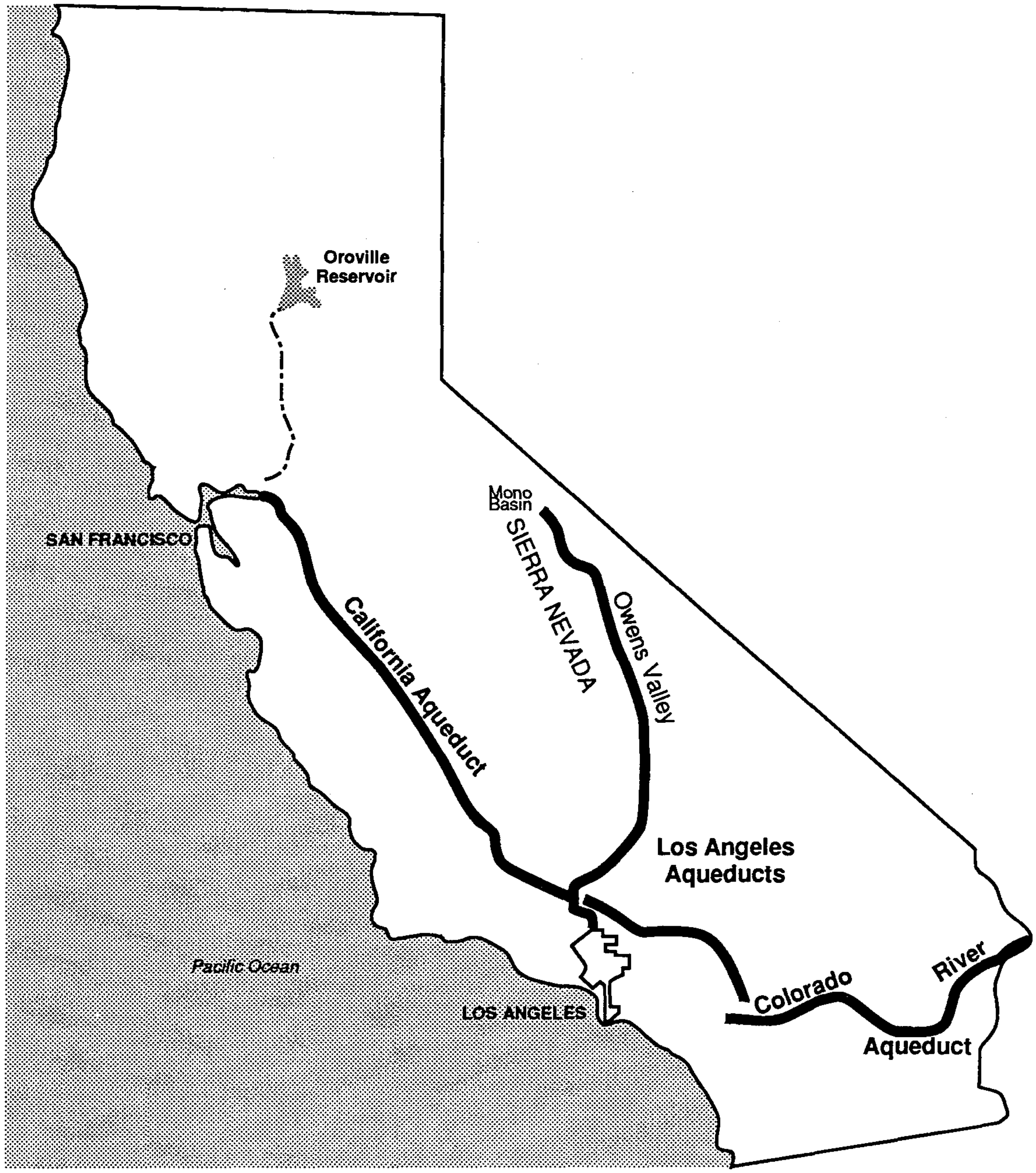
3.4 WATER SUPPLY

Los Angeles relies on three sources for its water supply: groundwater from basins in the Los Angeles coastal plan; imported water delivered by the Los Angeles Aqueducts; and imported water purchased from the Metropolitan Water District of Southern California (MWD). Figure 3-1 shows the water supply sources for Los Angeles.

The amount of water obtained from each source varies from year to year. The highest-quality water available to Los Angeles comes from its sources in Inyo and Mono Counties. Inyo and Mono water is also inexpensive to deliver and generates hydroelectric power en route. Water from the Los Angeles Aqueduct is thus the preferred source. LADWP meets demand with water from the aqueduct to the extent it can, making up any shortfall from its other sources.

Table 3-5 shows the average quantities of water drawn from each source over a 25-year period. Between 1963 and 1970, Los Angeles obtained 62 percent of its water from Inyo and Mono Counties, with the remainder divided fairly evenly between Los Angeles basin groundwater and purchases from MWD. In the decade following completion of the second aqueduct, the proportion of the total supply obtained from Inyo and Mono Counties rose to 78 percent. As water demand grew in the 1980s the proportion of water obtained from the aqueduct fell and purchases from MWD increased. Annual quantities of water obtained from each source between 1970 and the present are shown in Table 3-6.

It is difficult to estimate the amount of water that Los Angeles might be able to obtain from each of its sources in the future because that amount depends on institutional and legal factors beyond Los Angeles' control. At present, Los Angeles is drawing much more heavily on MWD than it has ever done in the past, because deliveries from Inyo and Mono Counties have been curtailed



O W E N S V A L L E Y

FIGURE 3-1

WATER SUPPLY SOURCES FOR LOS ANGELES

SOURCE: EIP ASSOCIATES

NO SCALE

eip 88041

TABLE 3-5

CITY OF LOS ANGELES WATER SUPPLY SOURCES

	1963 - 1970		1971 - 1980		1981 - 1988	
	AFY	%	AFY	%	AFY	%
Groundwater from Los Angeles Basin	107,900	20	87,400	15	106,800	16
Purchases from MWD	96,300	18	42,200	7	90,000	13
Los Angeles Aqueduct	334,300	62	446,800	78	470,000	71
TOTAL	538,500	100	576,400	100	662,200	100

Source: LADWP Statistical Reports

TABLE 3-6

WATER SOURCES FOR LOS ANGELES
1970-1990
(Thousands of Acre-Feet)

Fiscal Year	Los Angeles Aqueduct	Metropolitan Water District	Los Angeles Groundwater	Total
1970	356	147	84	587
1971	454	52	74	580
1972	468	60	75	603
1973	459	33	80	572
1974	461	25	77	563
1975	460	32	82	574
1976	474	25	118	617
1977	333	109	132	574
1978	361	46	93	500
1979	504	19	69	592
1980	495	21	76	592
1981	488	46	95	629
1982	466	35	112	613
1983	511	26	87	624
1984	532	29	116	677
1985	513	47	119	679
1986	486	90	105	681
1987	479	128	99	706
1988	416	151	121	688
1989	327	231	136	694
1990 (est.)	206	395	94	695

Source: LADWP Statistical Reports

by a three-year drought and by court-imposed limits on diversions in the Mono Basin. Each of the water sources and the circumstances pertaining to them are discussed below. A more detailed discussion of water sources and their potential for delivering water to Los Angeles in the future is included in Chapter 6.

GROUNDWATER FROM LOS ANGELES COASTAL PLAIN

Los Angeles pumps groundwater from several different groundwater basins. The largest of these basins are located in the San Fernando Valley, while the smaller basins are located near the coast. Figure 3-2 shows the locations of each of these basins.

Los Angeles' annual groundwater rights in the coastal basin total approximately 111,200 acre-feet, broken down by basin as follows:

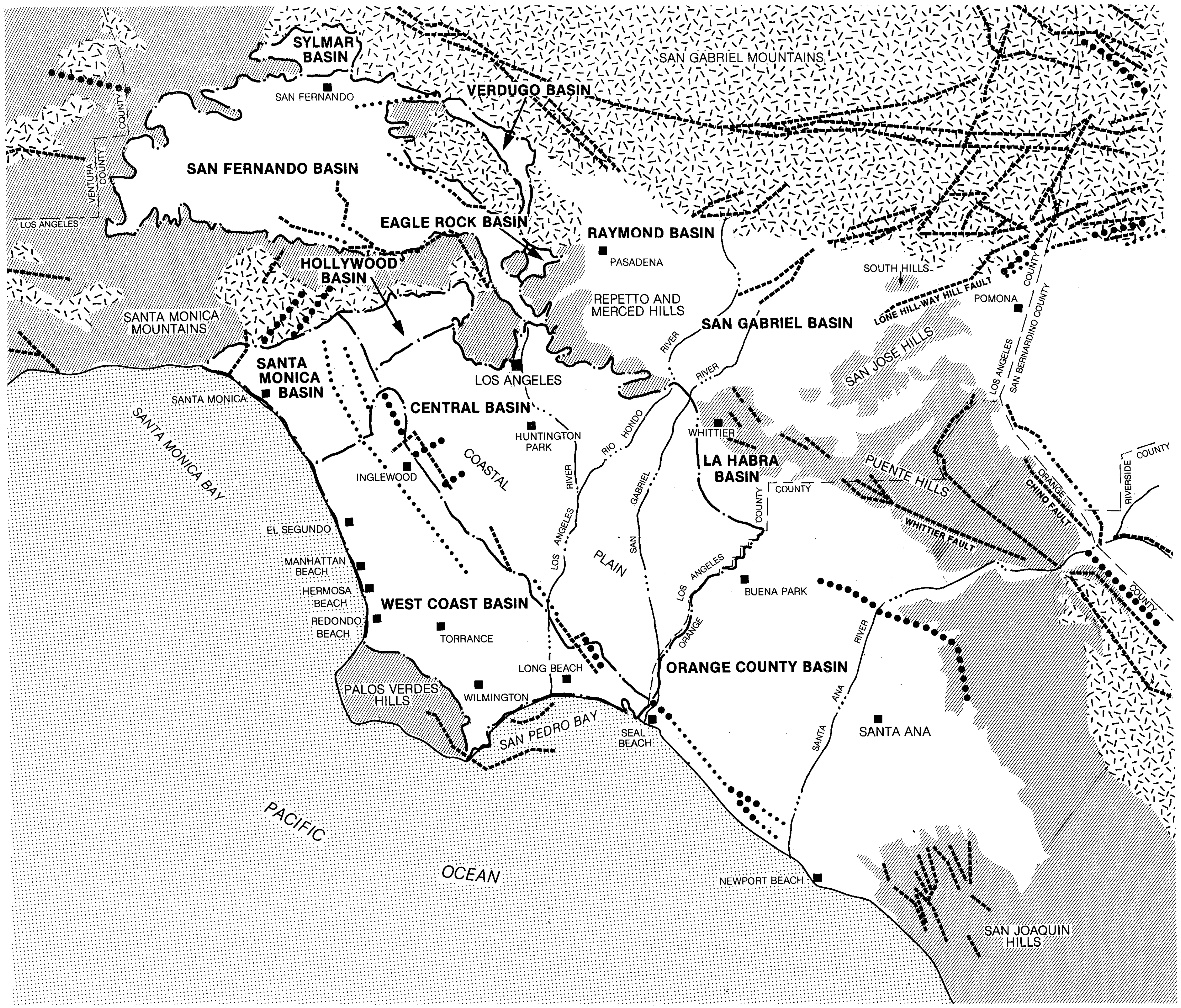
San Fernando Basin	91,600 acre-feet
Sylmar	3,100 acre-feet
Central Basin	15,000 acre-feet
West Coast Basin	1,500 acre-feet

The groundwater basins are managed in accordance with the "safe yield" concept; that is, the long-term average extractions are approximately equal to the long-term average amount of water that enters the basins each year from various sources. Recharge of the groundwater basins occurs naturally as a result of precipitation and percolation of water from streams and drainage channels. Recharge is artificially increased by the spreading of Los Angeles River water and imported water.

In addition to spreading Los Angeles River basin runoff waters into the groundwater basins, LADWP also spreads wet-year surplus waters from the Los Angeles Aqueduct and from MWD into the San Fernando Groundwater Basin for use in dry years. This coordinated management of surface and groundwater supplies is known as "conjunctive use." Aqueduct and MWD water spread into the Basin is credited to Los Angeles for future use in addition to the safe yield entitlement. As a result of conjunctive use operations, Los Angeles had a storage credit of approximately 150,000 acre-feet of water in the San Fernando Basin on September 30, 1989. This water can be pumped in addition to Los Angeles' annual pumping rights.

FIGURE 3-2

LOS ANGELES RIVER GROUNDWATER BASINS



Sedimentary Rock of Marine Origin, Mainly Tertiary with some Cretaceous

Crystalline and Metamorphic Rocks, Jurassic or Older, Some Tertiary Rocks

Alluvium and Associated Deposits of Recent or Pleistocene Age

Known Faults

Inferred Faults

Concealed Faults

Groundwater Basin Boundary

SOURCE: LADWP, AQUEDUCT DIVISION

MILES 0 2.5 5

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Since October 1, 1978, when the City of Los Angeles vs. City of San Fernando, et. al., final judgment provisions for stored water credit went into effect, LADWP's average annual groundwater pumping from the coastal plain equaled 106,900 acre-feet. In the drought years of 1988 and 1989, over 122,500 and 146,000 acre-feet were pumped, respectively, even with water quality restrictions. During the wet years of 1980 to 1983, the average annual groundwater pumping was 57,400 and 65,200 acre-feet, respectively.

Los Angeles' present groundwater extraction system capacity in the San Fernando groundwater basin is approximately 150,000 AFY (207 cfs). This amount is approximately 169 percent of the average-year yield for that basin. This pumping capacity is available because the new Rinaldi-Toluca well field was placed in operation during the summer of 1988. Prior to 1988, pumping from the San Fernando Basin was limited to about 20 percent below historic average annual production due to groundwater contamination in some areas of the groundwater basin. A portion of the groundwater pumping system, the North Hollywood Pumping Station, will be taken out of service and rebuilt in the fall of 1990. During reconstruction, groundwater distribution capacity will be limited to 125,000 AFY.

LADWP pumping rights in the San Fernando Basin are partially dependent on the amount of water pumped from the basin by the cities of Burbank and Glendale. Under the "physical solution" provisions of the judgement, these cities are entitled to extract up to 9,700 AFY which is chargeable to the rights of Los Angeles subject to specified charges that compensate Los Angeles for purchasing replacement water. This has the effect of reducing Los Angeles' rights to water from the basin.

Most of Los Angeles' wells are located in the San Fernando and Sylmar Basins. Water from these basins accounts for about 90 percent of the groundwater pumped from the coastal plain. Other sources of groundwater are the Central Basin, which consists of the Manhattan and 99th Street wells and the West Coast Basin, which consists of the Lomita wells. In recent years LADWP has not pumped groundwater from the West Coast Basin and has reduced pumping slightly from the Central Basin. LADWP has entered into an agreement with the Central and West Basin Water Replenishment District to replenish the groundwater by reduced pumping in accordance with their in-lieu replenishment program.

LOS ANGELES AQUEDUCTS

Between 1945 and 1970, Los Angeles obtained an average of 319,320 AFY (441 cfs) of water from the Eastern Sierra via the Los Angeles Aqueduct. From 1971 to 1988, Los Angeles obtained an average of about 457,000 AFY (631 cfs) of water from the eastern slope of the Sierra Nevada via the Los Angeles Aqueducts. The amount of exports tends to increase in wet years and decrease in dry years.

The first Los Angeles Aqueduct was completed in 1913 to import surface water from the Owens River in the Owens Valley to Los Angeles. The first aqueduct was designed to use a portion of the natural channel of the Owens River and its tributary streams to collect and convey water south through Owens Valley to Los Angeles. A concrete intake structure was built east of Aberdeen in central Owens Valley to divert water from the natural river channel into an aqueduct. The first aqueduct was approximately 233 miles in length and currently has a capacity of about 480 cfs (350,000 AFY).

The first aqueduct was extended approximately 105 miles north to Mono Basin in 1941. As part of the Mono Basin extension project, four of the seven streams feeding Mono Lake were diverted, Crowley Lake Reservoir was constructed and Grant Lake Reservoir was enlarged to regulate the flow in the aqueduct. Pleasant Valley Reservoir was constructed in 1961.

Construction of a second aqueduct was approved in 1963. The second aqueduct was intended to meet increasing water demand in Los Angeles, largely from three sources: increased surface water diversions in Owens Valley and Mono Basin; reduced acreage of irrigated Los Angeles-owned lands in Inyo and Mono Counties; and increased groundwater pumping in the Owens Valley. The second aqueduct became operational in 1970. It roughly parallels the first aqueduct from Haiwee Reservoir south to Los Angeles and increases total export capacity by about 300 cfs (220,000 AFY) to a total of approximately 780 cfs (570,000 AFY).

The diversion by Los Angeles of four of the seven major streams feeding Mono Lake became a focus of controversy in the 1980s. These streams are Rush, Lee Vining, Walker, and Parker Creeks. Since 1970, when the second aqueduct was placed in operation, diversion from these streams increased from an annual average of 51,000 acre-feet to approximately 100,000 acre-feet.

As a result, the lake elevation has dropped 42 feet since 1941, the lake volume decreased by half, and salinity doubled.

On May 18, 1979, a suit was filed against Los Angeles by environmental groups seeking to protect the lake. The case, National Audubon Society v. LADWP, sought to reduce the diversion of Mono Basin streams by LADWP on the basis of the public trust doctrine. In 1983, the California Supreme Court held that the public trust doctrine applied to Los Angeles' existing water rights and declared that the needs of the lake must be balanced with the needs of Los Angeles. The court ordered a public trust balancing trial, balancing the beneficial use of the water by Los Angeles with the needs of the lake.

While this case was being deliberated in various judicial arenas, other legal challenges were filed against Los Angeles concerning the status of Mono Basin streams below LADWP's diversion works. The first two cases seek to restore flows in Lower Rush and Lee Vining Creeks. Both suits seek to require downstream flow sufficient to sustain these fisheries, and both rely on California Fish and Game codes, the public trust doctrine and other legal grounds.

In 1985, two other consolidated lawsuits, one brought by the National Audubon Society and the other by Cal Trout against both the State Water Resources Control Board (SWRCB) and the LADWP, sought to invalidate the City's water licenses and to require mandatory fish flow releases in accordance with Sections 5946 and 5437 of the California Fish and Game Code. Walker, Parker, Rush, and Lee Vining Creeks are affected by these cases.

As of August 1989, all cases concerning Mono Basin were coordinated under Judge Terrence Finney of El Dorado County Superior Court. Judge Finney issued a stay order over all of the cases to permit the SWRCB to exercise its original jurisdiction to review and modify, as necessary, two water licenses issued to Los Angeles to comply with public trust doctrine and statutory requirements. As part of this process, the SWRCB will prepare an environmental impact report to assess the impact of Los Angeles' operation in the Mono Basin. The environmental review process is expected to last until December 1992. The amount of water that Los Angeles will be able to export from the Mono Basin in the future will not be known until the environmental review process is completed.

In August 1989, Judge Finney issued a Preliminary Injunction requiring maintenance of the Mono Lake level at 6,377 feet. To comply, LADWP began releasing 100 cfs down Rush Creek and 20 to 45 cfs down Lee Vining Creek. A second hearing to consider the necessity of continuing the preliminary injunction began in June 1990.

In February 1990, the Third District Court of Appeal ordered Los Angeles to reestablish and maintain the fisheries that existed in the Mono Basin prior to the City's diversions. In response to that mandate, Judge Finney ordered the interim release of over 56,000 acre-feet per year down Lee Vining, Parker, Walker, and Rush Creeks until the SWRCB can set permanent fish flow releases. On June 14, 1990, Judge Finney entered a preliminary injunction requiring Los Angeles to maintain specified rates of flow in the four Mono Basin streams from which it diverts water. On June 19, 1990, Judge Finney stayed further action on the various lawsuits pending completion of the SWRCB's review or until September 1, 1993, whichever is first.

PURCHASE OF WATER FROM MWD

The Metropolitan Water District of Southern California (MWD), formed in 1928, covers over 5,100 square miles of the coastal plain in Southern California, including portions of the counties of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura. MWD's purposes are to develop and sell water at wholesale for municipal and domestic use. It may sell surplus water for other beneficial purposes, including agriculture and replenishment of groundwater basins. There are 27 member agencies in Metropolitan, consisting of 14 cities, 12 municipal water districts, and one county water authority. The City of Los Angeles is one of these member agencies.

Each member agency has preferential rights to a portion of MWD's water supply. Preferential rights under Section 135 of the Metropolitan Water District Act are determined by the total accumulation of amounts paid to MWD by the member agencies on tax assessments and otherwise toward the capital cost and operating expenses of MWD's works. The amount expended by member agencies for purchase of water is not included in the determination. Each member agency's preferential rights are proportionate. The proportion is based on the amount it has paid compared to the total amount paid by all member agencies. As of June 30, 1989, Los Angeles has preferential rights to about 26 percent of MWD's water supply. MWD expects to have 2,400,000 acre-feet of water available in 1990 resulting in a Los Angeles preferential right of about 600,000 AFY.

Generally, the amount of water purchased from MWD by LADWP in any year is the difference between the use in Los Angeles and the other sources of supply available to Los Angeles. The amount of MWD water purchased by LADWP since the second aqueduct was constructed has varied widely as shown previously in Table 3-6. Purchases have averaged 83,000 AFY with a minimum purchase of 19,000 acre-feet in 1978-1979 and a maximum purchase of 385,000 acre-feet during the 1989-1990 fiscal year. Typically, LADWP only takes a small portion of its preferential right from MWD. However, in 1989-1990, when the continuing drought is coupled with the imposition of a preliminary injunction halting LADWP's diversion of water from Mono Lake tributaries, purchases from MWD will approach 65 percent of preferential rights and over 50 percent of the City's entire water supply.

The main sources of water supply available to the service area of MWD are: captured local surface flows; groundwater; imports via the Colorado River Aqueduct, the Los Angeles Aqueduct, and the State Water Project's California Aqueduct; and reclaimed water. The sources directly available to MWD are limited to the Colorado River and State Water Project (SWP) supplies and water made available through its Local Projects Program. Colorado River water is conveyed to Southern California by MWD's 242-mile long Colorado River Aqueduct. SWP water is conveyed from Northern to Southern California by means of the 444-mile long California Aqueduct. MWD's entitlement to water from the Colorado River Aqueduct and SWP totals about 2.5 million AFY, although the SWP cannot yet deliver the full entitlement. At present, MWD imports a total of about 2.4 million AFY through these two aqueducts. The projected future supply and demand in the MWD service area are shown in Table 3-7.

Each of these two MWD water sources require energy for pumping to transport the water to Southern California. Each acre foot of water delivered from SWP to the MWD service area requires an average of 3,000 kwh, and the Colorado River Aqueduct requires 2,000 kwh. The January 1, 1990 population of the MWD service area is 14.9 million. It is expected to grow to 18.2 million by 2010 based on projections by the Southern California Association of Governments and the San Diego Association of Governments.

TABLE 3-7

MWD PROJECTED WATER SUPPLY
AND DEMAND
(acre-feet per year)

	1995		2000		2010	
	Average Year	Dry[2] Year	Average Year	Dry Year	Average Year	Dry Year
MWD Supply[1]	2,090,000	1,750,000	2,110,000	1,740,000	2,120,000	1,720,000
MWD Demand[3]	2,210,000	2,280,000	2,450,000	2,520,000	2,890,000	2,960,000
Potential Shortage[4]	-120,000	-530,000	-340,000	-780,000	-770,000	-1,240,000

[1]Colorado River and State Water Project, including 106,000 AFY from the Imperial Irrigation District.

[2]The dry year projection is the estimated firm water supply currently available during a repeat of the 1928-34 dry period. The California Department of Water Resources is pursuing several programs to improve the yield of the SWP.

[3]Demands may be lower during years of severe drought due to implementation of short-term mandatory water use measures and public awareness. Demand could be greater in years of below normal rainfall and higher temperatures.

[4]Potential shortages during dry periods could be reduced by water management measures such as short-term water exchanges or water transfers. MWD is pursuing several measures to develop additional dependable supplies.

Source: MWD, August 1990

MWD's Colorado River Supply

In accordance with a U.S. Supreme Court decree, the State of California (MWD, Native Americans, and several agricultural water districts) is limited to an annual supply of 4.4 million acre-feet from the Colorado River. Agricultural agencies have priority to beneficial consumptive use of 3.85 million AFY less the amount of water made available by Imperial Irrigation District under the Water Conservation Agreement and Approval Agreement with MWD. Another 80,000 acre-feet must be subtracted for conveyance losses and for use of water by holders of present perfected rights, including Native Americans, leaving MWD with a dependable annual supply of 576,100 acre-feet in 1995. Additional higher-priority water rights may reduce dependable annual supply to 551,110 AFY.

Since the State of Arizona has not yet taken its full apportionment, surplus and unused water has been available from the Colorado River for MWD. The MWD has benefitted from these surplus conditions during the recent drought and has diverted up to 1.3 million AFY from the river. With continuing development of the Central Arizona Project and three successive years of below-normal runoff in the Colorado River watershed reducing the amount of water in storage, the supply available to MWD in 1990 is estimated to be 994,000 acre-feet. As Arizona takes more of its apportionment, MWD will receive a reduced Colorado River supply.

MWD's State Water Project Supply

MWD's second major supply of water is obtained under its contract with the State of California for service from the SWP. MWD's maximum annual entitlement under the contract is 2,011,500 acre-feet. This entitlement was contracted for in order to meet increasing water demands resulting from population growth, and to compensate for the impending loss of a major portion of MWD's Colorado River supply. SWP deliveries for fiscal year 1989-90 are estimated to be 1.4 million acre-feet.

Bonds to construct the initial portion of the SWP were authorized by the State's voters in 1960, with construction in the 1960s and 1970s. The principal facilities of the SWP are Oroville Reservoir on the Feather River, San Luis Reservoir in the San Joaquin Valley, the California Aqueduct and the North and South Bay Aqueducts, and terminal reservoirs in southern California.

Water from the SWP serves municipal and industrial users in southern California, the San Francisco Bay Area, the Upper Feather River area, and agricultural users in the San Joaquin Valley. Thirty water agencies are entitled to water from the SWP. MWD holds the largest contract for approximately 48 percent of the SWP's yield.

The SWP is not completed. The State has contracts with public agencies, including MWD, for a total delivery of 4.2 million acre-feet. At present, the State has a dependable water supply of only about 2.3 million acre-feet, based on the current system capacity. Consequently, the SWP cannot now meet its contractual commitment to deliver the amount of entitlement water requested by the contractors. In order to deliver more water south of the delta, new facilities will be needed. The new facilities could include a cross-delta transfer facility, and additional pumps and storage capacity. The California Department of Water Resources is developing plans for these new facilities, but none have been approved or built.

The amount of water that the SWP can deliver south of the delta may also be affected by the SWRCB's review of delta water quality standards. Diversion of water from the delta by the SWP and the federal Central Valley Project is limited by many factors, such as the need to meet water quality standards in the delta. The SWRCB's delta hearings began in 1988 and are expected to conclude in 1991. If the SWRCB promulgates new standards requiring the release of more water to the western delta and San Francisco Bay, there could be a reduction in SWP's ability to deliver water south of the delta. MWD currently projects an overall shortfall in supply ranging from 340,000 AFY to 780,000 AFY by the year 2000.

3.5 WATER RECLAMATION

Water that has been used once can be treated and used again. This practice is referred to as water reclamation. In Los Angeles about two-thirds of the water used by homes and businesses is discharged as waste to the sewer system and ultimately the Pacific Ocean. If some of the wastewater is treated and reused, the need for other sources of water would be lessened; however, health, legal, cost and public perception considerations have limited wastewater reuse in Los Angeles to date.

The use of reclaimed water in California is limited by a number of interrelated political and technical factors. The California Department of Health Services administers Title 22, California Waterworks Standards, which governs the ways in which reclaimed water can be used. Direct reuse of reclaimed water as potable water supply is not permitted. The most feasible uses for reclaimed wastewater in urban areas are landscape irrigation and industrial use.

Los Angeles operates four sewage treatment plants, the Hyperion and Terminal Island plants located on the coast and two inland wastewater treatment facilities specifically designed to provide water suitable for reuse. One facility is adjacent to the City of Glendale (Los Angeles-Glendale Water Reclamation Plant); another facility is in the Sepulveda Basin (Tillman Water Reclamation Plant). These two plants produce high quality tertiary treated water. Together, they produce 67,200 AFY of reclaimed water. Most of this water is discharged to the Los Angeles River where it commingles with natural flows and runoff from streets and highways and eventually makes its way to the ocean. It is generally accepted that some of the discharge to the river percolates and recharges the groundwater aquifer; however, actual volumes of recharge thus accomplished have not been studied. The Hyperion plant is being upgraded to secondary treatment to meet ocean discharge requirements. Additional treatment would be necessary before the water could be reused. Wastewater from the Terminal Island plant contains high levels of dissolved solids and salts, and is not suitable for reuse without extensive additional treatment.

In 1989, Los Angeles established an Office of Water Reclamation (OWR). The mission of the new office is to greatly expand the use of reclaimed water in Los Angeles, both in the near term and into the 21st century. OWR's preliminary plans are discussed in Chapter 6.

Today, approximately 1,110 AFY of reclaimed water from the Los Angeles-Glendale plant is used for irrigation of portions of Griffith Park and along a seven-mile stretch of the Golden State Freeway. Another area of Griffith Park is scheduled to begin using an additional 2,000 AFY of reclaimed water by 1995. Three golf courses in the Sepulveda Basin will be irrigated with 3,000 AFY of reclaimed water from the Tillman plant, beginning in about 1992. The two projects are expected to deliver reclaimed water at a cost of between $800 and $900 per acre-foot.

By 1991, the Los Angeles Greenbelt project will be delivering an estimated 1,600 AFY of reclaimed water to irrigate the Forest Lawn and Mount Sinai Memorial Parks, Lakeside Country Club and Universal City. Los Angeles is also pursuing the Headworks Reclaimed Water Pilot Recharge Study. Scheduled to begin operation in 1990, the pilot study will evaluate the feasibility of utilizing reclaimed water for groundwater recharge via surface spreading. Operating and approved wastewater reuse projects in Los Angeles are shown in Table 3-8.

Effective April 1, 1990, Los Angeles' new Water Rate Ordinance requires the use of reclaimed water when available for landscape irrigation.

TABLE 3-8

EXISTING AND APPROVED WASTEWATER RECLAMATION PROJECTS[1]

Project	Source	Capacity AFY	Type[2]	Cost	Implementation Date
Griffith Park/ Golden State Freeway Irrigation	Los Angeles/Glendale Reclamation Plant	3,100	Hard	$/AF 900	1995[3]
Los Angeles Greenbelt	Los Angeles/Glendale Reclamation Plant	1,600	Hard	400	1991
Sepulveda Basin (Irrigation)	Tillman Reclamation Plant	3,000	Hard	800	1992
Sepulveda Basin (Lake)	Tillman Reclamation Plant	33,600[4]	Soft	800	1992

[1] Projects in operation or approved for construction before 1995.

[2] Reclamation projects that replace potable water supplies are referred to as "hard" projects, reclamation projects that generated a new water use and replace no potable water are "soft" projects.

[3] Some elements of this project are already in operation.

[4] Estimate based on need for "flushing flows" to minimize algae growth.

Source: Water Reclamation in the Past, Opportunities and Plans for the Future, City of Los Angeles Office of Water Reclamation.

4. WATER MANAGEMENT IN OWENS VALLEY

4.1 INTRODUCTION

As discussed in the previous chapter, Los Angeles has historically obtained most of its water from the Owens Valley and Mono Basin through the Los Angeles Aqueduct. This chapter describes how water in the Owens Valley has been managed in order to supply water for export and for in-valley uses on Los Angeles-owned land within the Owens Valley.

Two distinct periods of water management are discussed in this chapter. First, the practices that prevailed between 1941 and 1970 (after Los Angeles expanded its export capacity through completion of the Mono Basin portion of the aqueduct system) are described. This discussion represents the water management pre-project conditions in the Valley. A description of Los Angeles's water management practices after 1970, when the second Los Angeles Aqueduct went into operation, follows. The specific environmental effects of these water management practices on water resources, vegetation wildlife, and other natural resources are detailed in later chapters.

To place in context the discussion of Los Angeles's management of water in the Owens Valley, a description of the Los Angeles Aqueduct system precedes the sections on management practices.

4.2 THE LOS ANGELES AQUEDUCT SYSTEM

The Los Angeles Aqueduct System consists of several surface and groundwater facilities that were built to capture and deliver high quality water to Los Angeles. The facilities of the aqueduct system consist of diversion structures, open canals and stream courses, closed conduits, tunnels, wells, reservoirs, spreading basins, and hydroelectric generating facilities. All water supplying the aqueduct system is exported from Mono and Inyo Counties. This description of the aqueduct system is limited to the Mono County and Inyo County portions of the aqueduct; a portion of these facilities are shown in Figure 4-1.

The major component of water supply to the aqueduct is surface runoff. The northernmost streams that can be diverted into the aqueduct system are located in the Mono Basin. These creeks are Lee Vining, Parker, Walker, and Rush Creeks, all of which are tributaries of Mono Lake. Lee Vining, Parker and Walker Creeks can be diverted into a closed conduit that empties into Grant Lake Reservoir in the June Lake Loop area. Rush Creek flows into Grant Lake Reservoir. Some water from these creeks is used for irrigation of Los Angeles-owned land in the Mono Basin.

The water from Grant Lake is either released into Rush Creek to flow into Mono Lake or is diverted into the Mono Craters Tunnel, which is a hydrologic and hydraulic link between the Mono Basin and the Owens River watershed. Outflow from the tunnel consists of the water exported from the Mono Basin, as well as groundwater that seeps into the tunnel. The tunnel discharges the water into the upper reaches of the Owens River.

The water then flows down the natural channel of the Owens River, combining with flows from tributary streams en route to Long Valley Reservoir (Crowley Lake), the principal storage reservoir on the aqueduct system. Some of the flow above Crowley Lake is diverted for irrigation of Los Angeles-owned pasture land in Long Valley. Long Valley Reservoir can also receive a portion of the flow from Rock Creek, which has been diverted by Los Angeles from its natural channel. The natural flow of Rock Creek is into Round Valley.

The entire outflow from Long Valley Reservoir passes through three hydroelectric generating plants that have been constructed by Los Angeles in the Owens River Gorge. After passing through the power plants, the water enters Pleasant Valley Reservoir, a small afterbay reservoir. Outflow from the Pleasant Valley Reservoir flows in the natural channel of the Owens River to Tinemaha Reservoir, a regulation reservoir for the aqueduct system at the base of the Poverty Hills.

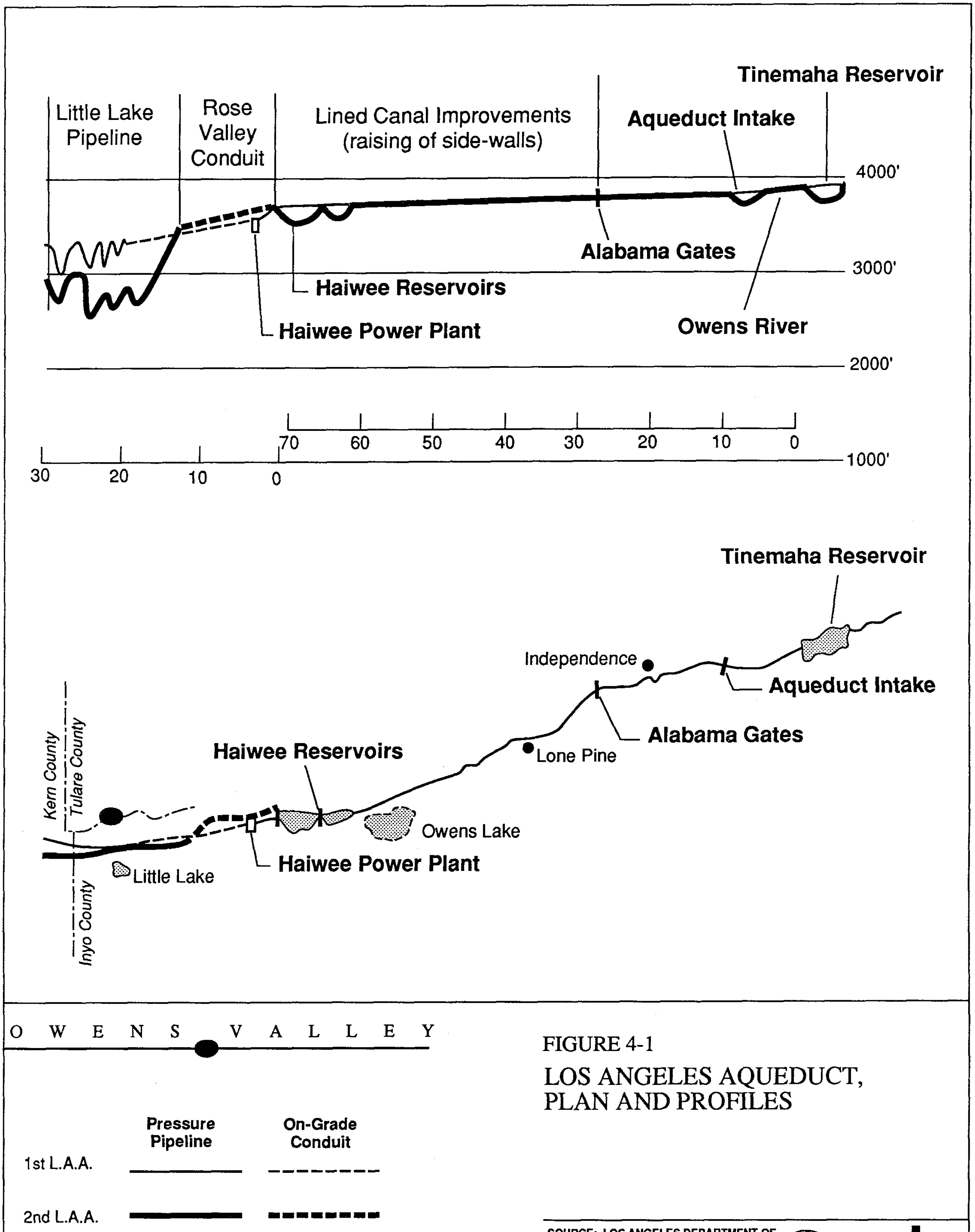

FIGURE 4-1

LOS ANGELES AQUEDUCT, PLAN AND PROFILES

SOURCE: LOS ANGELES DEPARTMENT OF WATER AND POWER

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Water flowing in this reach of the Owens River is increased by tributary stream flow, pumped groundwater, and flowing groundwater. It is decreased by diversions into several canals, most notably the Bishop Creek Canal, the Upper and Lower McNally Canals, and the Big Pine Canal. These canals convey water for irrigation and other uses on Los Angeles-owned land. The canals are also conduits for groundwater pumped from wells, either for in-valley use or export. Some of the flow in the tributary streams is diverted for use in the northern portion of the valley, most notably in the Bishop area.

South of Tinemaha Reservoir, water flows down the Owens River channel a few miles before the entire flow is diverted into the Los Angeles Aqueduct at a small dam known as the Intake Dam. This dam is located east of Highway 395 approximately 11 miles north of Independence. Each of the major tributary streams of the Owens River that flow out of the Sierra Nevada from Goodale Creek on the north to Braley Creek on the south are generally diverted into the aqueduct, which is situated west (upstream) of the Owens River. Because of these diversions, the Owens River below the Intake and the portions of each of the tributary streams located east of the aqueduct are generally dry. Water can be released to the lower Owens River at the Intake Dam. Additional water can be released at certain points along the aqueduct for irrigation and other in-valley uses and to control aqueduct flow in years of high runoff. This released water is lost to the aqueduct system. In wet years, water in some of the tributary streams is allowed to flow over the aqueduct rather than into it.

Flow in the aqueduct between Tinemaha and Haiwee Reservoirs is also increased by the addition of pumped and flowing groundwater. Some of the groundwater enters the aqueduct directly, while some enters ditches and creeks that convey the water to the aqueduct. Some of the pumped water, and some of the flow of the tributary streams, is used for irrigation and other in-valley uses on Los Angeles-owned land south of Tinemaha Reservoir.

4.3 WATER MANAGEMENT PRACTICES PRIOR TO THE SECOND AQUEDUCT

Water management in the Inyo/Mono area was generally consistent during the period between 1941 and 1970. In 1941, Mono Basin was connected to the aqueduct system, and Long Valley Dam (which created Crowley Lake) was completed. The three hydroelectric plants in the Owens Gorge were completed in 1953; the portion of the Owens River below the upper plant has been dry since that time. The operation of the aqueduct system during this period, under average, dry and wet year scenarios is shown in Figure 4-2. The sources of water in the Owens Valley portion of the aqueduct system were surface runoff, springs and flowing wells (flowing groundwater), and pumped groundwater.

Except in dry years, approximately 60 percent of the water from runoff and flowing groundwater remained in the Valley. Water remaining in the Valley (1) percolated into the ground to recharge the groundwater basin, (2) was used for irrigation on a maximum of 21,800 acres that were classified by Los Angeles as irrigated leased land, (3) was released from the aqueduct system to facilitate operation of the aqueduct, (4) was used for local municipal purposes, (5) was used by vegetation, (6) evaporated, or (7) was placed in a reservoir for storage. The amount of groundwater recharge varied, but generally increased with increasing runoff.

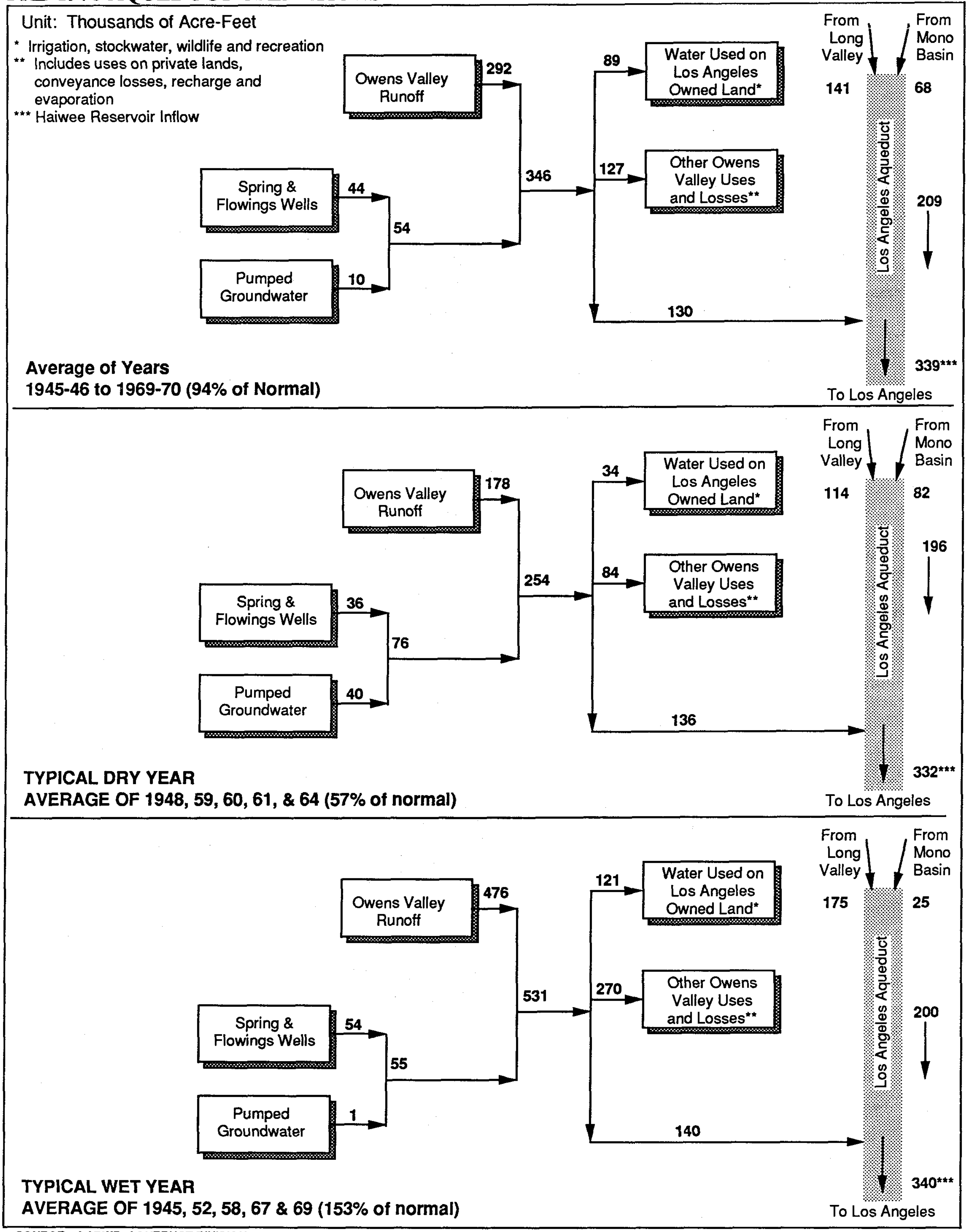
Irrigation water was supplied on a "feast or famine" basis because the terms of the leases of Los Angeles-owned land provided for a total cut-off or partial reduction in irrigation supplies in dry years if Los Angeles determined that the water was needed for export. For example, in extremely dry years (e.g. 1960 and 1961), no irrigation water was supplied, while in extremely wet years (e.g. 1967 and 1969), more than 21,800 acres classified as irrigated were irrigated. The historic irrigation record for Inyo and Mono counties (21,800 acres and 8,300 acres respectively) is presented in Figure 4-3.

Operational releases from the aqueduct were usually made only when available surface water exceeded the capacity of the system. As previously mentioned, once released, this water was not recaptured by the aqueduct system. It generally flowed across the Valley floor, ponding in some areas either naturally or behind dikes constructed by LADWP for the purposes of reducing the amount of water that reached the Owens River channel below the Intake, and ultimately Owens Lake. Despite these and other efforts, in wet years some of the water flowed down the Owens River channel and onto Owens Dry Lake bed. Figure 4-4 presents the amount of such operational releases during the period 1945 to 1969.

Between 1934 and 1972, water systems supplying the towns of Lone Pine, Independence, and Big Pine were purchased by LADWP. These town water systems were supplied by surface water and

PRE-1970 AQUEDUCT OPERATIONS

FIGURE 4-2



SOURCE: LADWP, AQUEDUCT DIVISION

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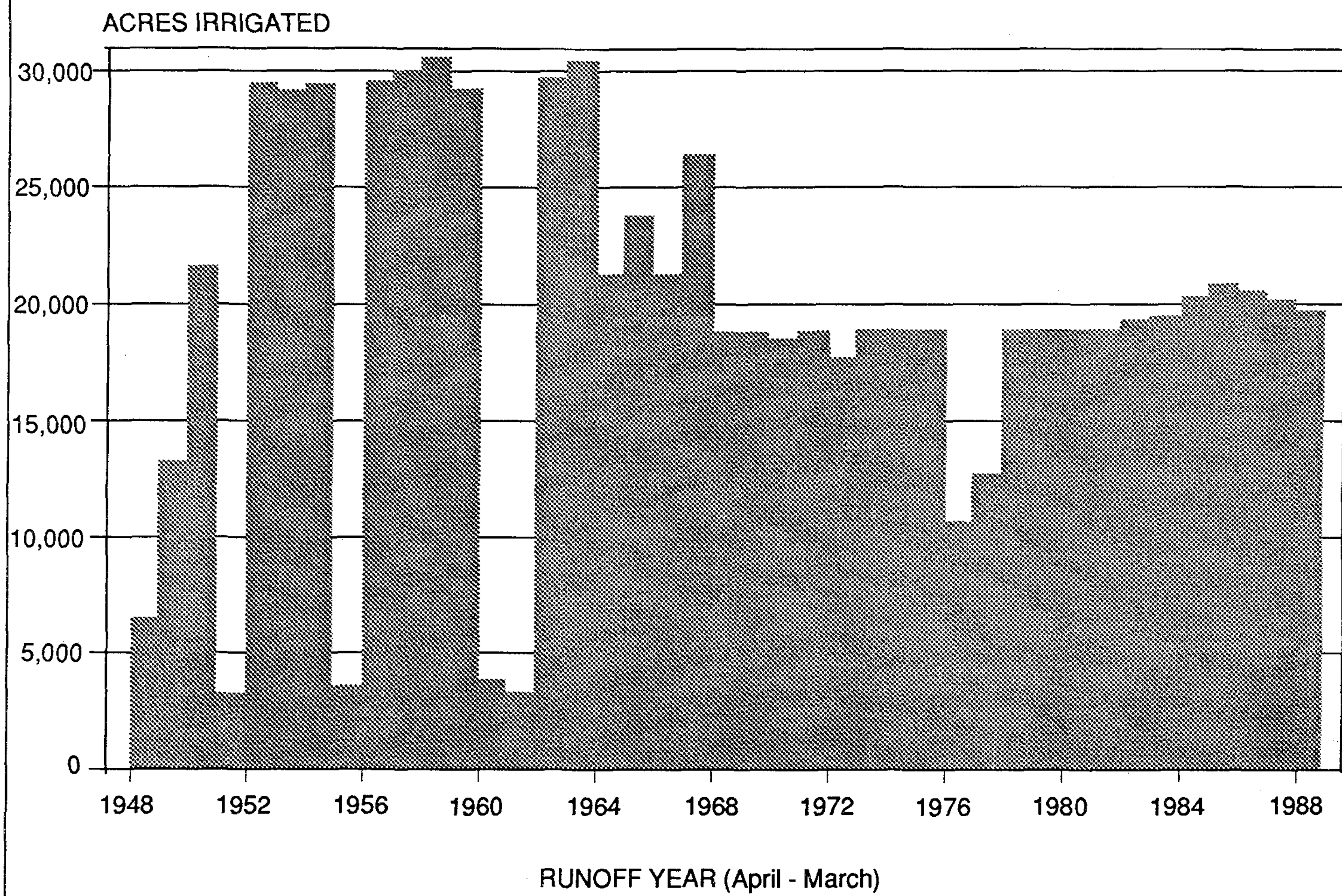

O W E N S V A L L E Y

FIGURE 4-3
HISTORICAL IRRIGATION RECORD
INYO & MONO COUNTIES

SOURCE: LADWP, AQUEDUCT DIVISION

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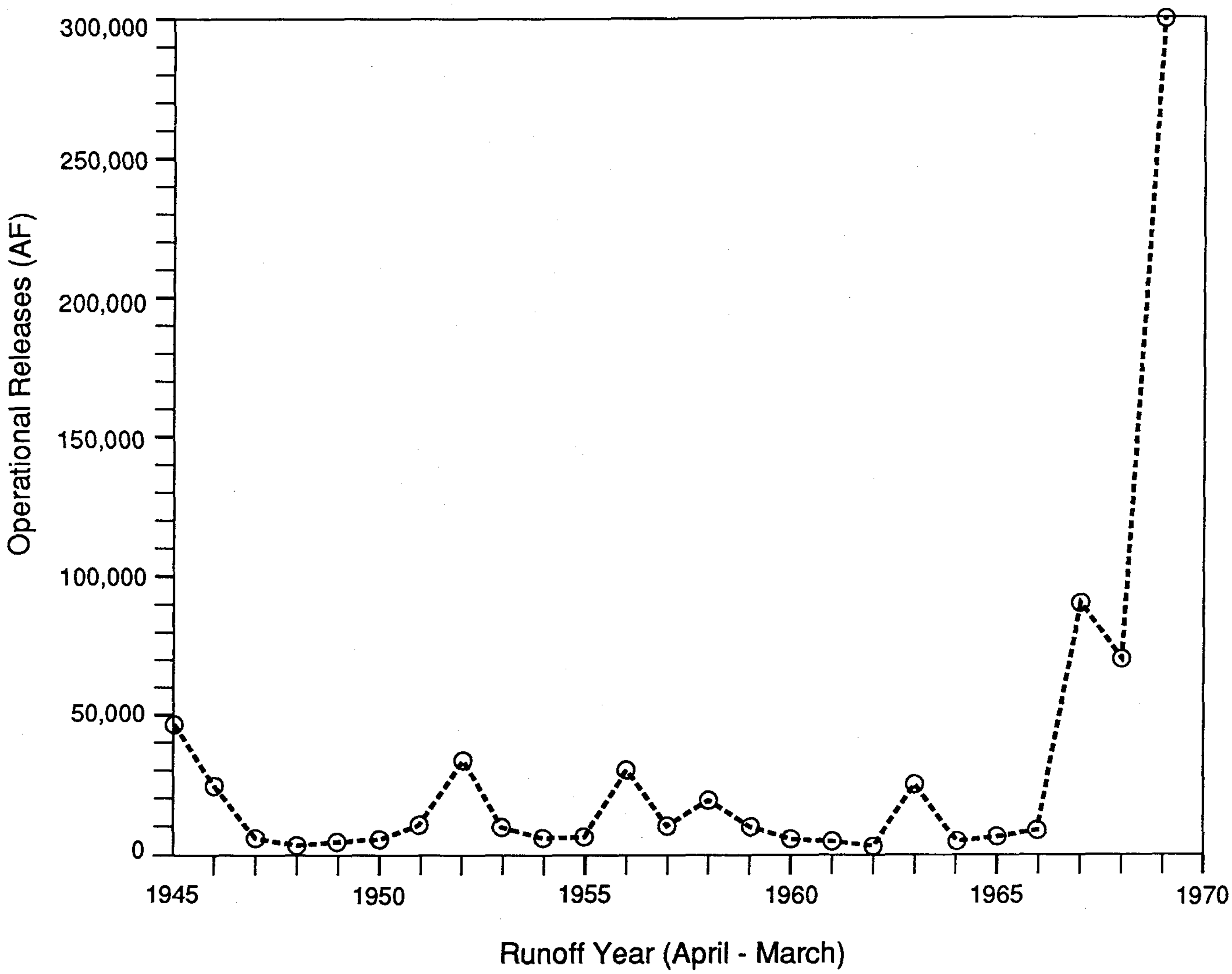

O W E N S V A L L E Y

FIGURE 4-4
OPERATIONAL RELEASES
1945 - 1969

SOURCE: INYO COUNTY

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groundwater prior to 1972. Following 1972, the four towns were supplied entirely by groundwater. Table 4-1 shows town water use from 1956 to 1989.

The amount of groundwater that was pumped to supply the first aqueduct was less than the amount pumped after operation of the second aqueduct began. Prior to 1970, the average amount of pumped groundwater that entered the aqueduct system was generally less than 5,000 acre-feet per year (AFY), except during drought periods such as the 1930s and the early 1960s when pumped groundwater averaged approximately 69,000 AFY. Pumping was as high as 136,100 AFY in 1931. Flowing wells and springs, however, supplied approximately 44,000 acre-feet per year in normal years, and averaged 36,000 AFY even in a typical dry year. Groundwater pumping for the years 1945 to 1970 is shown in Figure 4-5.

In order to improve the operation of the well fields, LADWP developed groundwater recharge facilities and since the 1930s has regularly diverted and spread water to these facilities in above average runoff years. This effort enhanced the natural groundwater recharge of the Valley. The areas of these recharge facilities are shown in Appendix D.

Total annual outflow from Haiwee Reservoir is presented in Figure 4-6 for the period 1945 to 1969.

4.4 WATER MANAGEMENT PRACTICES TO SUPPLY THE SECOND AQUEDUCT

As a result of the second aqueduct, water management practices in the Owens Valley and Mono Basin were altered. Water supply for the second aqueduct came from three sources: 1) increased Mono Basin diversions; 2) increased surface water diversions from the Owens Valley; and 3) increased groundwater pumping in the Owens Valley.

The increased surface water diversions from the Owens Valley came from two sources: 1) reduction in the number of acres classified as irrigated leases by Los Angeles, and diversion of the water into the aqueduct system; and 2) reduction of the amount of water that previously did not enter the aqueduct system or was released from it.

TABLE 4-1

WATER USE IN OWENS VALLEY TOWNS PRIOR TO 1970

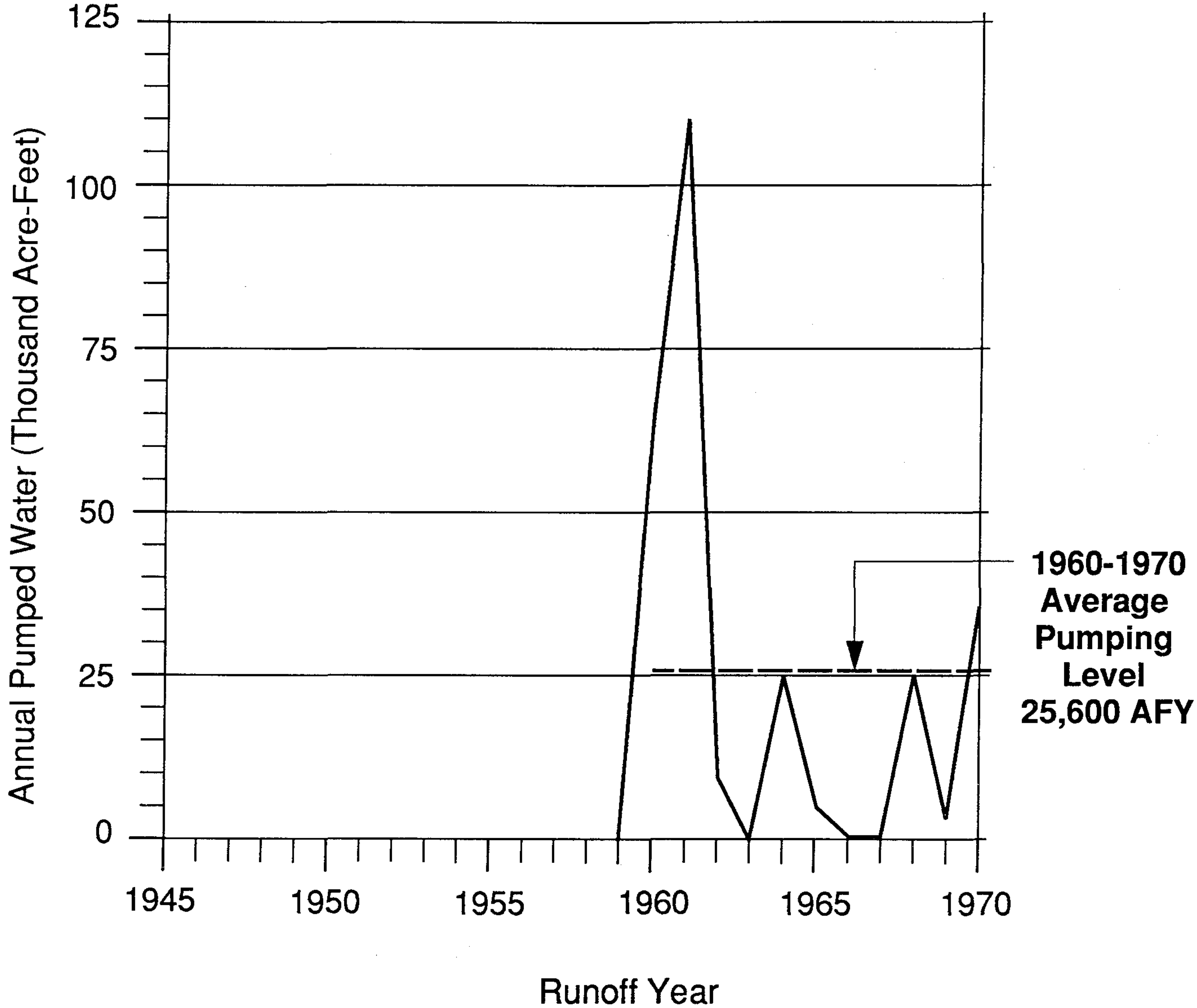
Year	Independence Town Supply (AF)	Lone Pine Town Supply (AF)	Big Pine Town Supply (AF)
1956	857	1,130	1,000
1957	926	1,206	1,035
1958	975	1,170	972
1959	1,069	1,308	1,102
1960	919	1,336	1,342
1961	960	1,341	1,333
1962	1,020	1,248	1,211
1963	964	1,191	1,222
1964	1,135	1,364	1,286
1965	1,095	1,306	1,199
1966	1,200	1,443	1,178
1967	1,115	1,311	1,105
1968	1,137	1,209	1,232
1969	1,062	1,445	1,165

WATER USE IN OWENS VALLEY TOWNS SINCE 1970

Year	Independence Town Supply (AF)	Lone Pine Town Supply (AF)	Big Pine Town Supply (AF)
1970	1,134	1,503	1,039
1971	1,171	1,514	1,249
1972	1,176	1,456	1,025
1973	1,176	1,473	968
1974	1,228	1,411	1,016
1975	1,156	1,245	1,149
1976	906	1,154	1,050
1977	597	937	714
1978	598	905	661
1979	482	760	428
1980	244	365	183
1981	195	358	224
1982	209	331	217 [1]
1983	216	361	220
1984	273	321	259
1985	327	321	294
1986	283	358	397
1987	319	380	337
1988	334	482	326
1989	341	540	335

1. Since 1982, the Big Pine water system has been operated by the Big Pine Community Services District.

Source: LADWP, August 1990.



O W E N S V A L L E Y

FIGURE 4-5
OWENS VALLEY
GROUNDWATER PUMPING
1945-1970

SOURCE: LADWP, AQUEDUCT DIVISION

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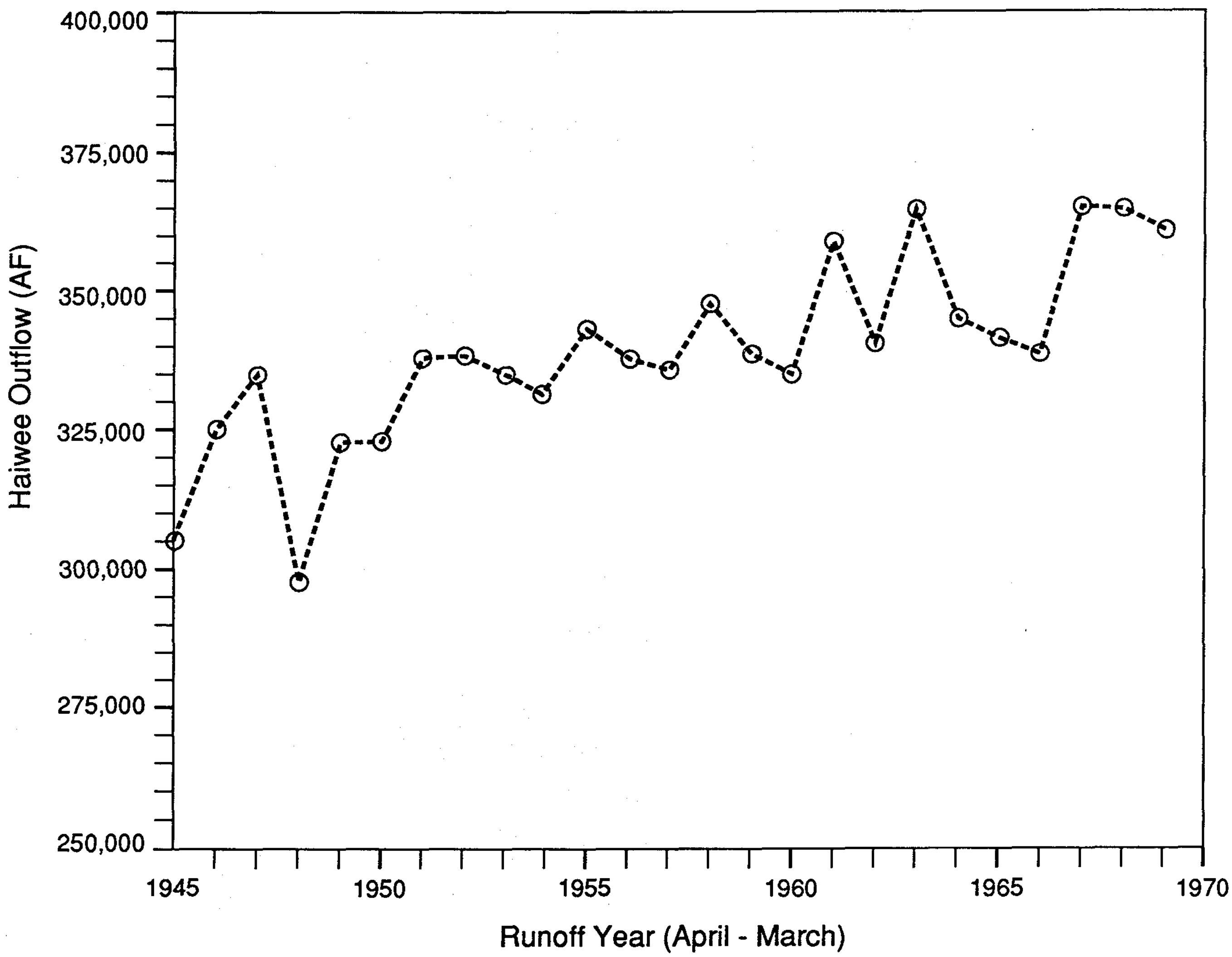

O W E N S V A L L E Y

FIGURE 4-6
TOTAL ANNUAL OUTFLOW FROM HAIWEE RESERVOIR, 1945-1969 [1]

[1] Equivalent to export to Los Angeles

SOURCE: LADWP, AQUEDUCT DIVISION

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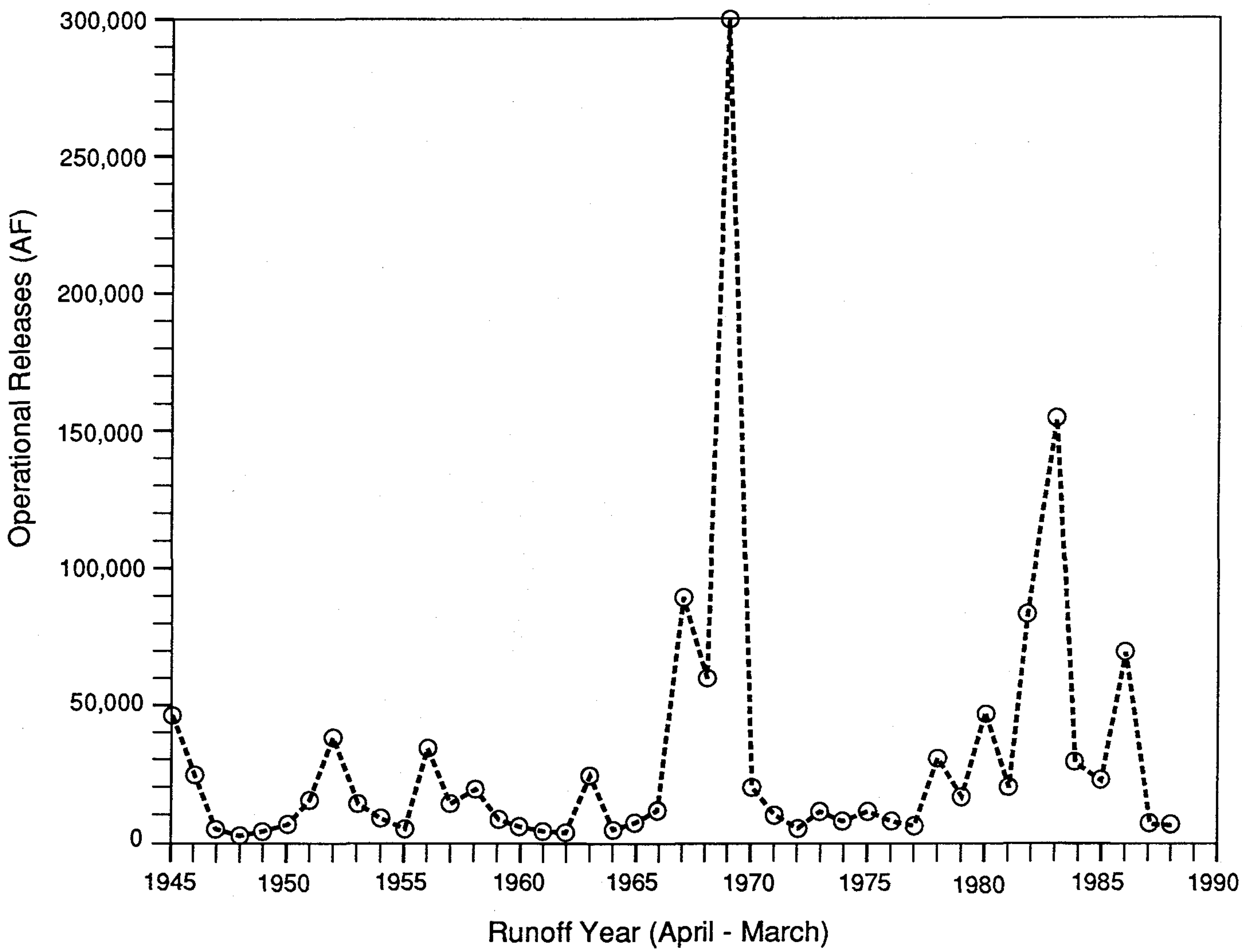
The reduction in irrigated acres began with the modification of leases of Los Angeles-owned land in the mid-1960s. The total leased acreage classified as irrigated by Los Angeles in the Valley was reduced from a maximum of 21,800 acres to 11,600 acres. The leases for the remaining 11,600 acres of irrigated land were provided with a reliable source of water instead of the "feast or famine" approach that had previously existed. The new leases provided that, even in dry years, "firm" allocation (generally five acre-feet per acre) of water would be provided, subject to physical availability. Irrigated leased lands solely dependent on diversions from a creek for irrigation water receive the full allotment only when sufficient water was available from the natural flow in the creek to supply this amount. The number of acres annually irrigated from 1948 to 1988 is presented on Figure 4-3 (shown previously).

The amount of water not captured by the aqueduct, or released from it, was reduced due to the additional export capacity created by the second aqueduct. The amount of operational releases for both pre- and post-1970 are shown on Figure 4-7. Operation of the second aqueduct resulted in less water being released onto the Valley floor, into the lower Owens River, and into Owens Dry Lake. For example, operational releases in years with runoff of 140 to 150 percent of average was higher before 1970 (1967) than in years after 1970.

Groundwater pumping was increased during the period from 1970 to 1990 to supply water for export and irrigation, as well as for other in-valley uses. These in-valley uses included enhancement/mitigation projects that were implemented by Inyo County and Los Angeles. The groundwater pumping during this period was from three classes of wells: 1) wells that had been pumped from 1945 to 1970; 2) wells that existed prior to 1970, but had not been operated before then; and 3) new wells that were constructed after 1970, including wells constructed to replace old wells (see Figure 4-8).

Six replacement wells have been constructed, and six additional replacement wells will be completed in 1991. At present, the pumping capacity of the replacement wells is equal to the pumping capacity of the replaced wells. In the future, larger pumps may be installed in these replacement wells to increase pumping capacity. At present, LADWP groundwater pumping capacity is 376 cfs (272,000 AFY) from 96 wells. In addition, there are 15 unmetered domestic wells that supply various LADWP leases throughout the Owens Valley. The location of each of these wells is shown



O W E N S V A L L E Y

FIGURE 4-7
OPERATIONAL RELEASES, PRE-AND POST-1970

SOURCE: INYO COUNTY

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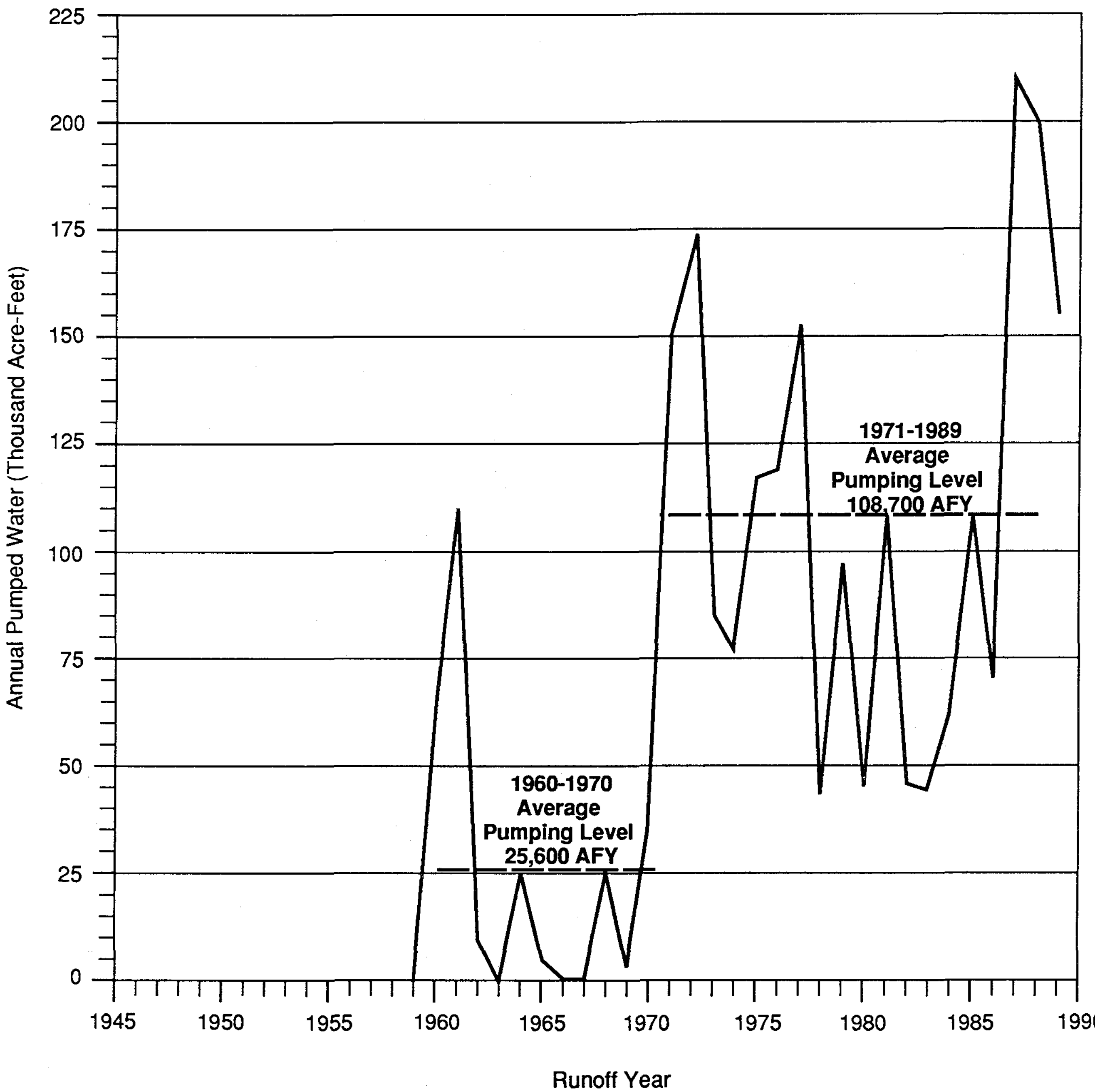

O W E N S V A L L E Y

FIGURE 4-8

OWENS VALLEY
GROUNDWATER PUMPING
1945-1989 [1]

[1] Groundwater pumping figures for the period 1984 to 1989 include pumping to supply enhancement / mitigation projects.

SOURCE: LADWP, AQUEDUCT DIVISION

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in Appendix E. After 1970, LADWP continued to use its previously constructed groundwater recharge facilities.

From the completion of the second aqueduct in 1970 until 1975, the amount of groundwater pumping was determined by LADWP; from 1975 to 1984, the amount of groundwater pumping was subject to Court order; and from 1984 to present, the amount of groundwater pumping has been established by agreement between LADWP and Inyo County pursuant to Court order. The amount of annual pumping from 1945 to 1990 is presented in Figure 4-8 (shown previously). The operation of the aqueduct system from 1970 to 1990 is summarized in flow diagrams in Figure 4-9.

Table 4-2 shows pre-1970 and post-1970 water supply, water use in Owens Valley, and water export to Los Angeles and the changes in these components as a result of the second aqueduct. All of the components of Owens Valley water supply are commingled in the aqueduct system; therefore, there is no precise way to determine how much of the pumped groundwater is used in the Valley and how much is exported to Los Angeles. Depending on one's perspective, all increased groundwater extractions can be allocated either to increased export or to water use in Owens Valley.

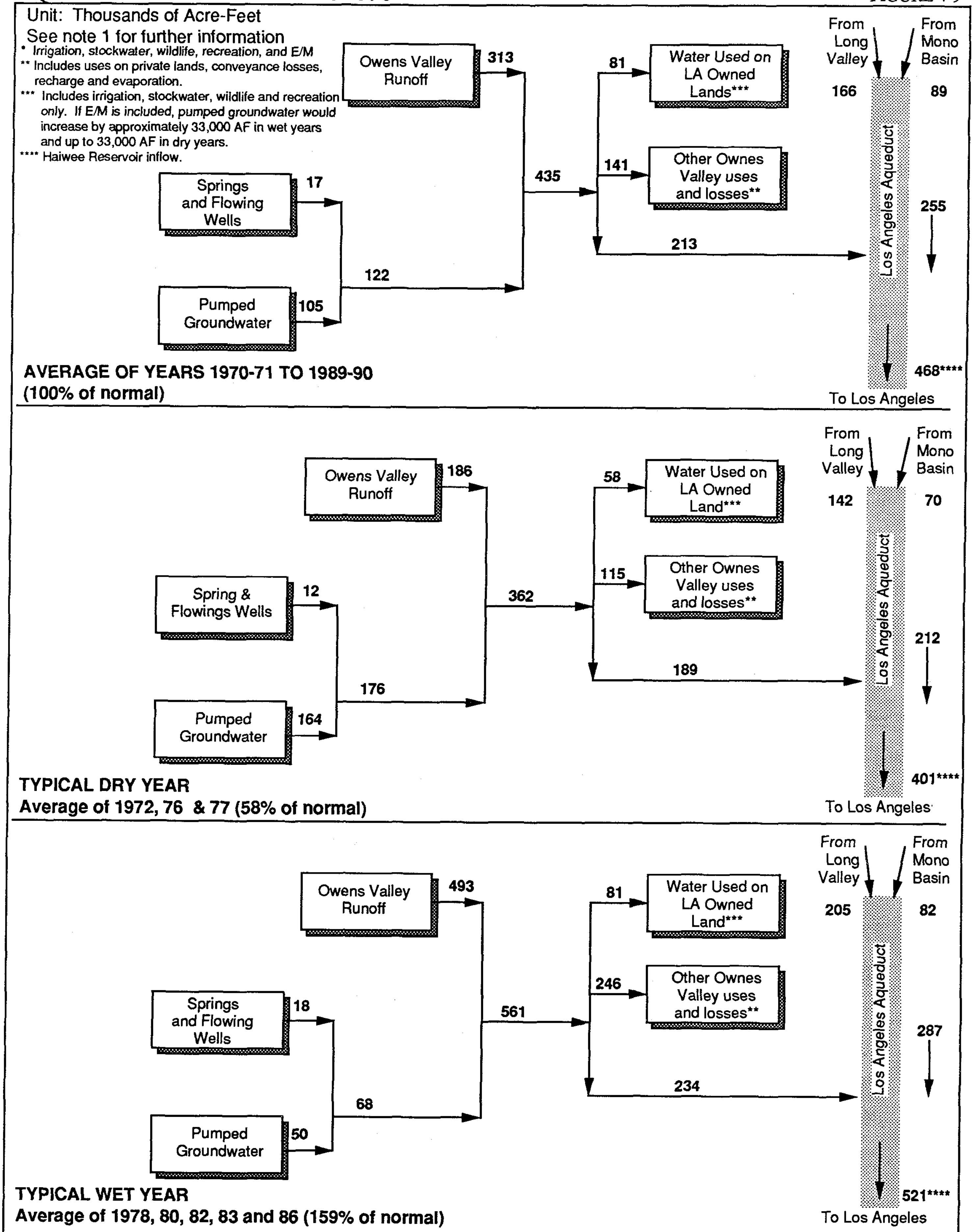
Total export to Los Angeles for the entire period (1945 to 1989) is presented in Figure 4-10. It can be seen that the export amount increased after 1970 due the second aqueduct, but the variability in export also increased as compared to the relatively consistent export amounts from 1945 to 1970. It can also be seen that the management practices implemented as part of the second aqueduct generally did not result in two full aqueducts (except in wet years), and resulted in a larger export amount that was increasingly dependent on pumped groundwater during normal and dry years.

4.5 ENVIRONMENTAL AND ENHANCEMENT/MITIGATION PROJECTS

Between 1970 and 1985, LADWP implemented certain environmental projects. Between 1985 and 1990, Los Angeles and Inyo County planned and implemented several special-purpose irrigation, recreation, fish and wildlife projects. These projects, referred to as enhancement/mitigation (E/M) projects, were designed to enhance the Valley's environment or to lessen or mitigate adverse environmental changes in the Valley that might be attributable to past water management practices.

AQUEDUCT OPERATIONS 1970-1990

FIGURE 4-9



SOURCE: LADWP, AQUEDUCT DIVISION

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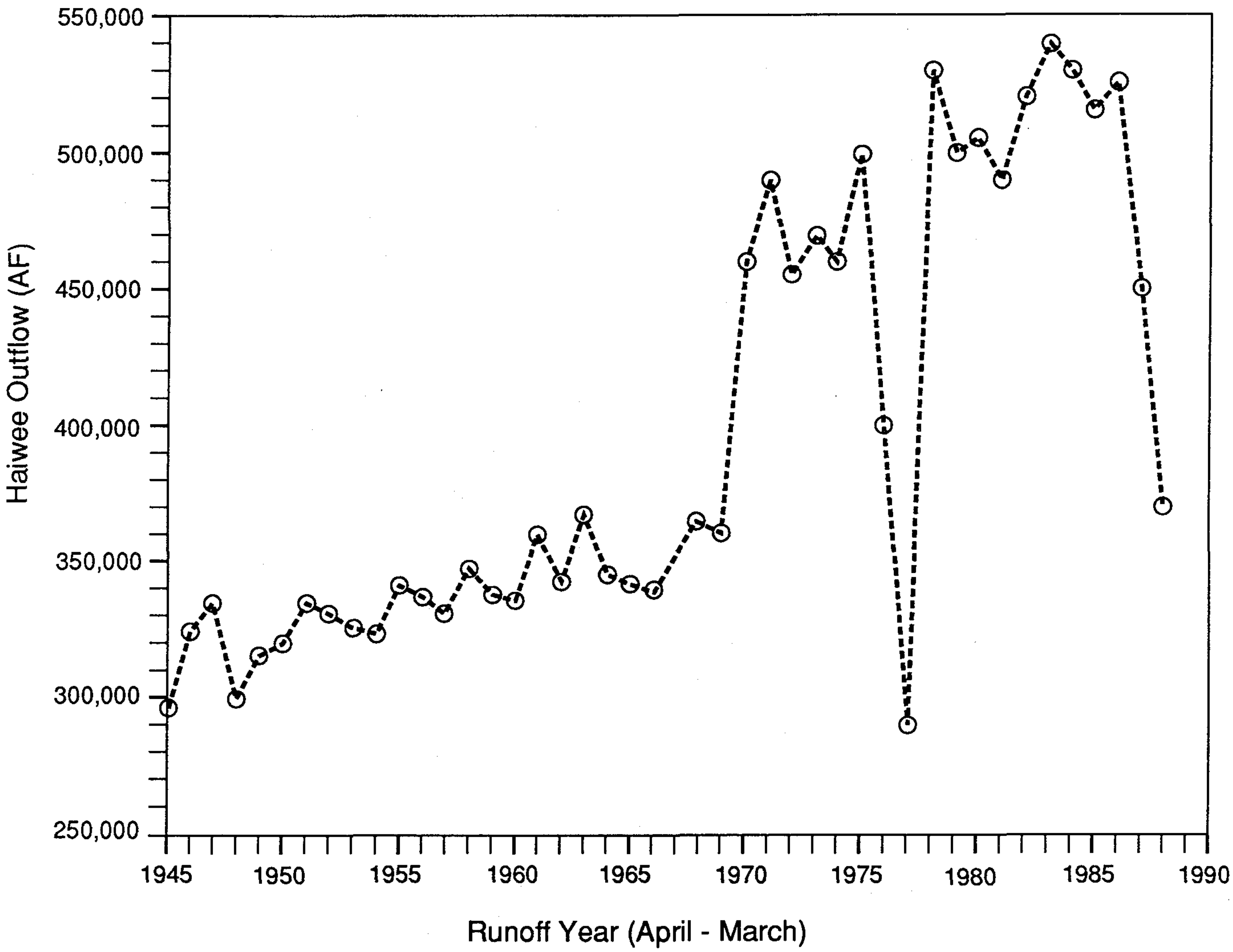
TABLE 4-2
COMPARISON OF 1945-1970 AND 1970-1990
LOS ANGELES AQUEDUCT OPERATIONS
(1,000'S AFY)

	1945-1970	1970-1990	Change in Operations
OWENS VALLEY WATER SUPPLY			
Runoff	292[1]	313[1]	+21
Flowing Wells/Springs	44	17	-27
Pumped Groundwater	10	105	+95
Total	346	435	+89
WATER USED IN OWENS VALLEY			
Water Used on LA-Owned Land[2]	89	81[3]	- 8
Other Owens Valley Uses and Losses[4]	127	141	+14
Total	216	222	+ 6
WATER EXPORTED FROM OWENS VALLEY TO LOS ANGELES	130	213	+83

[1] Average runoff of the period shown.
[2] Irrigation, stockwater, wildlife and recreation.
[3] Includes 5,000 AFY for enhancement/mitigation projects - the average used over the period. By the end of the period, enhancement/mitigation uses totaled 33,000 AFY.
[4] Uses on private land, conveyance losses, recharge and evaporation.

Source: LADWP, August 1990.



O W E N S V A L L E Y

FIGURE 4-10

TOTAL ANNUAL OUTFLOW FROM HAIWEE RESERVOIR 1945 - 1989 [1]

[1] Equivalent to export to Los Angeles

SOURCE: LADWP, AQUEDUCT DIVISION

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The enhancement/mitigation projects are summarized in Table 4-3. Environmental and enhancement/mitigation projects are described in detail in Chapter 5.

TABLE 4-3
ENHANCEMENT/MITIGATION PROJECTS IMPLEMENTED
OR COMMITTED TO BETWEEN 1970 AND 1990

Project	Normal Year Water Supply (AF)	Year First Implemented
Independence Pasture Lands	2,350	1987-1988
Independence Wood Lot	200	1987
Independence Spring Field	1,500	1988
Klondike Lake Project	2,500	1986
Laws Historical Museum	150	In Progress
Laws/Poleta Native Pasture Lands Project	660	1988
McNally Ponds Project	4,000	1986-1987
Lone Pine Riparian Park	750	1987
Lone Pine Woodlot	120	1987
Richards and Van Norman Fields	960	1987
Shepherd Creek Alfalfa Lands Project	990	1986
Millpond Recreation Area Project	--	
Independence Ditch System	725	1987
Lower Owens River (Step 1)	18,000	1986
Eastern Sierra Museum	--	1989
Independence Rest Stop	--	1989
Tree Planting Along Roadways	--	1988
Lone Pine Regreening - West Side	40	1990
Lone Pine Regreening - East Side	55	1990
North Lone Pine Cleanup	--	1989
Independence Regreening - East Side	150	In Progress
Regreening Northeast of Big Pine	750	In Progress
Sports Complex - Town of Lone Pine		In Progress
TOTAL	33,855 AF	

Source: Los Angeles Department of Water and Power, July 1990.

5. PROPOSED PROJECT

5.1 INTRODUCTION

The proposed project consists of all water management practices and facilities that were implemented or constructed in Owens Valley to supply water to the second Los Angeles aqueduct, which was completed in 1970, together with the projects and water management practices contained in the Agreement on a long-term groundwater management plan for Owens Valley and Inyo County.

5.2 OVERVIEW OF ELEMENTS OF THE PROPOSED PROJECT

The proposed project includes several elements, some of which will be implemented shortly after approval of the project, and others that will be implemented at a later time. Those elements that will be implemented in the near future are fully analyzed in this document. Those elements that will be implemented at a later time are briefly described. These elements will be addressed in future environmental reviews prior to their implementation. The elements of the proposed project that are fully analyzed in this EIR are:

- The Agreement
- Increased export, beginning in 1970, of water from Owens Valley to Los Angeles.
  - An increase in groundwater pumping for export and in-valley uses. This includes:
    - Increased groundwater pumping from wells constructed and operated prior to 1970.
    - The operation, since 1970, of wells constructed before 1970, but not operated before 1970.
    - The operation of wells constructed since 1970.

    - The future construction and operation of 15 new wells.
    - Increased pumping on the Bishop Cone.
  - A reduction in the amount of irrigated acreage of Los Angeles-owned land that was irrigated prior to 1968.
  - An increase in the amount of surface water diverted for export.

- New groundwater recharge facilities in the Laws and Big Pine areas.
- A continuation of environmental projects implemented by LADWP between 1970 and 1984.
- A continuation of enhancement/mitigation projects implemented since 1985 by the County and LADWP.

Los Angeles and Inyo County will implement the following elements of the proposed project; however, each of these elements will be addressed in future environmental reviews as allowed by CEQA. These elements are briefly described in this EIR, but implementation or construction of the elements will not occur until after a subsequent review as required by CEQA:

- Implementation of the Lower Owens River Project.
- Provision of a supply of water and funding for water supply ditches in Big Pine.
- Implementation of a salt cedar control program.
- Releases of Los Angeles-owned land for public and private use.
- Transfer of water systems owned by Los Angeles to Inyo County (or other public entity) in the towns of Lone Pine, Independence, Big Pine, and Laws.
- Rehabilitation and expansion of parks and campgrounds on Los Angeles-owned lands that are leased and operated by Inyo County.
- Recreational use of South or North Haiwee Reservoir.

5.3 LONG-TERM GROUNDWATER MANAGEMENT PLAN (AGREEMENT)

CONCEPT

The Agreement is summarized below. The complete text of the Agreement between Los Angeles and Inyo County can be found in Appendix B. Future groundwater pumping and surface water management practices will be governed by the goals and provisions of the Agreement.

MANAGEMENT AREAS

Each well field is included in a management area. The boundaries of each management area have been established so as to contain all vegetation that could be impacted as a result of pumping from that well field under "worst-case" conditions. Worst-case conditions are assumed to be maximum pumping in three back-to-back critically dry years. Management areas are shown in the Agreement contained in Appendix B.

VEGETATION CLASSIFICATION

For purposes of management, vegetation in the Owens Valley has been divided into five categories based on the dominant species documented on vegetation inventories conducted by LADWP between 1984 and 1987. Each of the vegetation categories contains several plant communities and is shown on a series of management maps contained in the groundwater management agreement. The mapped area totals about 227,200 acres. Should it be determined, through ongoing monitoring, studies or analysis, that vegetation is incorrectly classified, it will be reclassified as appropriate.

Type A Vegetation

This classification is comprised of vegetation communities with evapotranspiration approximately equal to average annual precipitation. Evapotranspiration is the transference of water to the atmosphere by transpiration from plants and evaporation from the ground surface. These communities should not be affected by groundwater pumping or by changes in surface water management practices, since this vegetation survives entirely on available precipitation and does not rely on groundwater to supply a portion of its needs. This vegetation is shown in white on the management maps and includes approximately 150,300 acres or 66 percent of the mapped area.

Type B Vegetation

This classification is comprised of rabbitbrush and Nevada Saltbush communities with evapotranspiration greater than precipitation. It is shown in yellow on the management maps and includes approximately 10,400 acres or five percent of the mapped area.

Type C Vegetation

This classification is comprised of grasslands/meadow vegetation communities with evapotranspiration greater than precipitation. The communities comprising this classification exist because of high groundwater conditions, natural surface water drainage, and/or surface water management practices in the area. This classification is shown in green on the management maps and includes approximately 42,000 acres or 19 percent of the mapped area.

Type D Vegetation

This classification is comprised of riparian/marshland vegetation communities with evapotranspiration greater than precipitation. The communities comprising this classification exist because of high groundwater conditions, natural surface water drainage, and/or surface water management practices in the area. This classification is shown in red on the management maps and includes approximately 5,600 acres or two percent of the mapped area.

Type E Vegetation

This classification is comprised of areas where water is provided to City-owned lands for alfalfa production, pasture, recreation uses, wildlife habitats, livestock, and enhancement/mitigation projects. It is shown in blue on the management maps and includes approximately 18,800 acres or eight percent of the mapped area.

MANAGEMENT GOALS OF THE AGREEMENT

Type A Vegetation

This type of vegetation survives on precipitation and should not be affected by groundwater pumping or surface water management practices; however, this vegetation will be monitored for such effects.

Types B, C and D Vegetation

Groundwater pumping and surface water would be managed so as to avoid causing significant decreases in live vegetation cover, and to avoid causing a significant amount of vegetation from changing in composition from one management type to a lower vegetation type (a change from one vegetation type to another that precedes it alphabetically, for example a change from Type B to Type A vegetation).[4] A change from one vegetation community to another within the same vegetation classification would not be regarded as significant.[5]

Type E Vegetation

Type E vegetation exists on land that is supplied with water. Groundwater pumping and surface water management would be conducted in a manner that would avoid significant decreases and changes in vegetation from conditions that existed during the 1981-82 runoff year or significant decreases in water-dependent recreational uses and wildlife habitat. Conversion of cultivated land from one irrigated use to another would not be considered a significant change.

Other Vegetation

Certain areas that contain vegetation of significant environmental value are not shown on the management maps. These areas will be identified by the Technical Group for monitoring purposes. Such areas may include riparian vegetation dependent on springs and flowing wells, stands of willows and cottonwood trees, and areas with rare or endangered species. If, through field observation, monitoring, and other evaluations, it is determined that groundwater pumping or changes in surface water management practices has resulted in severe stress that could cause a significant decrease or change in this vegetation, such action will be taken as is feasible and necessary to prevent significant impacts and to reduce any impacts to a level that is not significant. Groundwater pumping and surface water will be managed in a manner that is consistent with State and federal laws pertaining to rare or endangered species.

Groundwater Mining

One of the management goals of the Agreement is to prevent long-term groundwater mining in Owens Valley. The method that has been established to meet this goal is management of groundwater pumping so that the total pumping from any well field over a 20-year period (the current year plus the 19 previous years) does not exceed the total recharge to the same well field area over the same period. Annual pumping from a well field area may be increased above this amount if a recharge program for that area is implemented, or for other relevant reasons that are consistent with the goals and principles of the Agreement.

MANAGEMENT PROCEDURES

Administration of the Plan

The Inyo County/Los Angeles Technical Group, comprised of Inyo County and Los Angeles staff, would be responsible for administering the terms of the Agreement, including review and approval of annual plans, the monitoring of the condition of soil water and vegetation, and analysis and interpretation of monitoring results. The Technical Group would determine whether significant adverse changes were occurring as a result of groundwater pumping or surface water management practices. If so, the Technical Group would determine what remedial action must be taken. Remedial actions could include the reduction or elimination of pumping in a particular area, and/or implementation of mitigation measures.

The methods and procedures to be used by the Technical Group in gathering information and in making determinations are set forth in a document called the "Green Book," which is a technical appendix to the plan and this Draft EIR. The Green Book may be revised as necessary to improve the effectiveness of the monitoring and evaluation activities.

In the event that the Technical Group is unable to reach agreement on an issue, the disputed issue would be referred to the Inyo County/Los Angeles Standing Committee. The Standing Committee is comprised of policy makers from Inyo County and from Los Angeles. Disputes that cannot be resolved by the Standing Committee would be resolved by a mediator or, failing that, a Superior Court judge.

Annual Operations Plan

By April 20 of each year, LADWP will prepare a proposed operations plan and pumping program for the twelve-month runoff year beginning on April 1. The proposed plan and pumping program must be consistent with the goals and provisions contained in the Agreement.

Monitoring

To determine whether groundwater pumping or surface water management practices are adversely affecting vegetation in the Valley, the condition of soil water and vegetation would be continuously monitored by the Technical Group. Monitoring would include, but not necessarily be limited to, measurement of retained soil water, water levels in deep and shallow wells, and analysis of vegetation, remote sensing, and photography.

Water Balance Projections

Among the tools that would be used by the Technical Group to achieve the goals of the Agreement would be water balance calculations. In making these water balance projections, the Technical Group would compare the estimated amount of soil moisture available to vegetation with the estimated required water needs of the vegetation for the growing season at each monitoring site. By the first of each month, the Technical Group would project the water balance for each monitoring site. These monthly projections would be made unless the Technical Group determines that monthly projections are unnecessary because of high soil water conditions. These projections would be made in accordance with procedures contained in the Green Book.

Cessation of Pumping

Groundwater pumping may be reduced or discontinued in an area if the Technical Group deems such action necessary to achieve the goals of the Agreement. In addition, if, as of July 1 or October 1, the projected amount of available soil water at a monitoring site is less than the estimated water needs of the vegetation for the remaining or subsequent growing season, respectively, the LADWP wells linked to that monitoring site will immediately be turned off.[6] The Technical Group would periodically evaluate existing vegetation conditions in areas where wells have been turned off to determine whether any wells could be turned back on. Wells would only be turned back on if soil water recovered sufficiently to meet the estimated water needs of the vegetation at the time the wells were turned off, or if the Technical Group determined that mitigation measures were effectively preventing vegetation from being harmed. These determinations would be made in accordance with procedures contained in the Green Book.

5.4 INCREASED EXPORT OF WATER FROM OWENS VALLEY TO LOS ANGELES

Compared to pre-1970 conditions, the project would increase the amount of groundwater and surface water exported from Owens Valley to Los Angeles. The increased amount of water exported would be obtained from an increase in groundwater pumping, from surface water that has been made available by a reduction in the number of irrigated acres owned by Los Angeles and from surface water that formerly did not enter the aqueduct system.

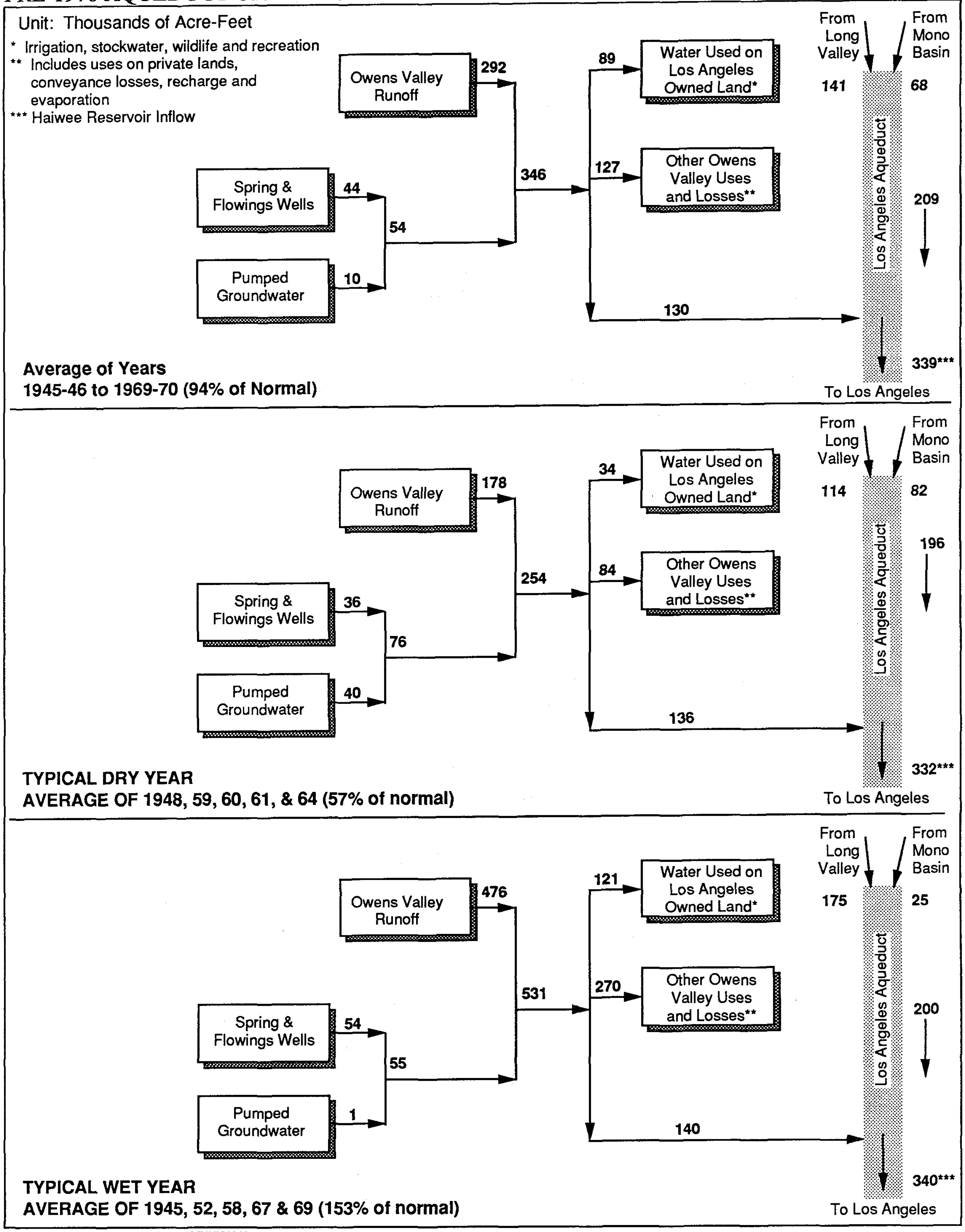
Aqueduct operations in typical average, wet and dry years during the period prior to completion of the second aqueduct are shown on Figure 5-1. Aqueduct operations during the period from completion of the second aqueduct to 1990 are shown on Figure 5-2. These figures are also presented in Chapter 4, Water Management in Owens Valley. Projected aqueduct operations under the Agreement are shown on Figure 5-3.

These projections must not be construed as limits or absolute projections. They reflect the anticipated aqueduct operations, subject to modification as needed, to achieve the environmental goals of the Agreement. Groundwater pumping (shown, as x, y, or z in Figure 5-3), and export to Los Angeles depend on environmental and hydrologic conditions. The amount of pumping is shown to be variable to emphasize the fact that pumping will be based on environmental conditions and not pre-established numbers. In the wet- and dry-year scenarios shown in Figure 5-3 it was assumed that all irrigation and enhancement/mitigation uses would be supplied. The export components for Long Valley and Mono Basin, which are not within the scope of the EIR, were assumed to be the same exports during the 1970 to 1990 period, and the current court order regarding flows in Mono Basin creeks.

Several assumptions were made to develop the average, wet- and dry-year scenarios in Figure 5-3. For the average year scenario, runoff was assumed to be 310,000 AFY, the average runoff recorded to date. The future average rate of groundwater pumping is not known, but is not expected to change significantly as compared to the 1970 to 1990 period. Based on the fact that runoff during the 1970 to 1990 period was above normal and the assumption that long-term future pumping will be in the range of the 1970 to 1990 average pumping, it was estimated that 15,000 AFY of water would flow from wells and springs.

Developing water management scenarios for typical wet and dry years was difficult because of the number of assumptions required. Pumping for the wet-year scenario will vary in accordance with hydrologic and environmental conditions. At this time it is estimated that the range of wet-year pumping is 40,000 to 135,000 AFY.

PRE-1970 AQUEDUCT OPERATIONS



SOURCE: LADWP, AQUEDUCT DIVISION

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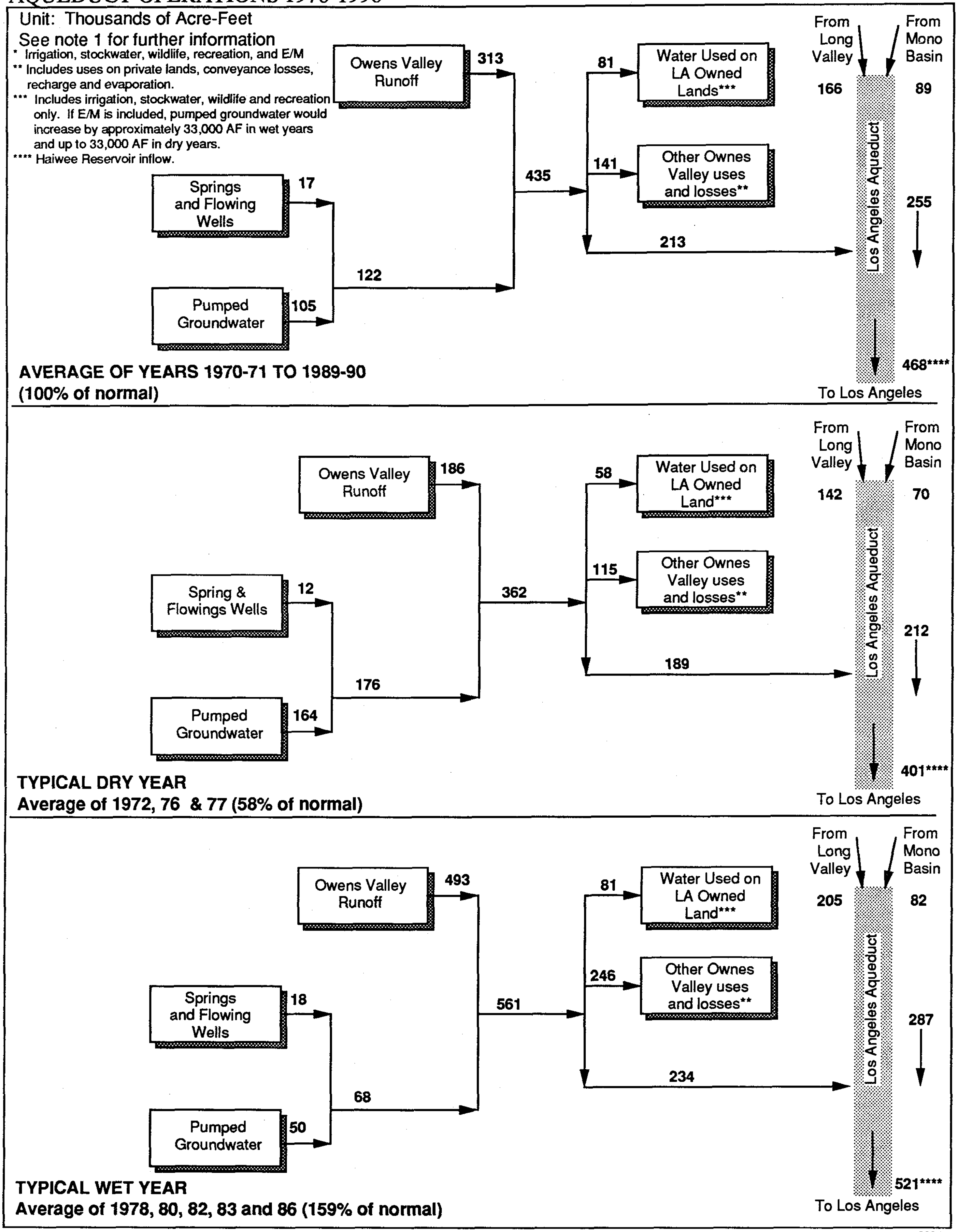
AQUEDUCT OPERATIONS 1970-1990

FIGURE 5-2



SOURCE: LADWP, AQUEDUCT DIVISION

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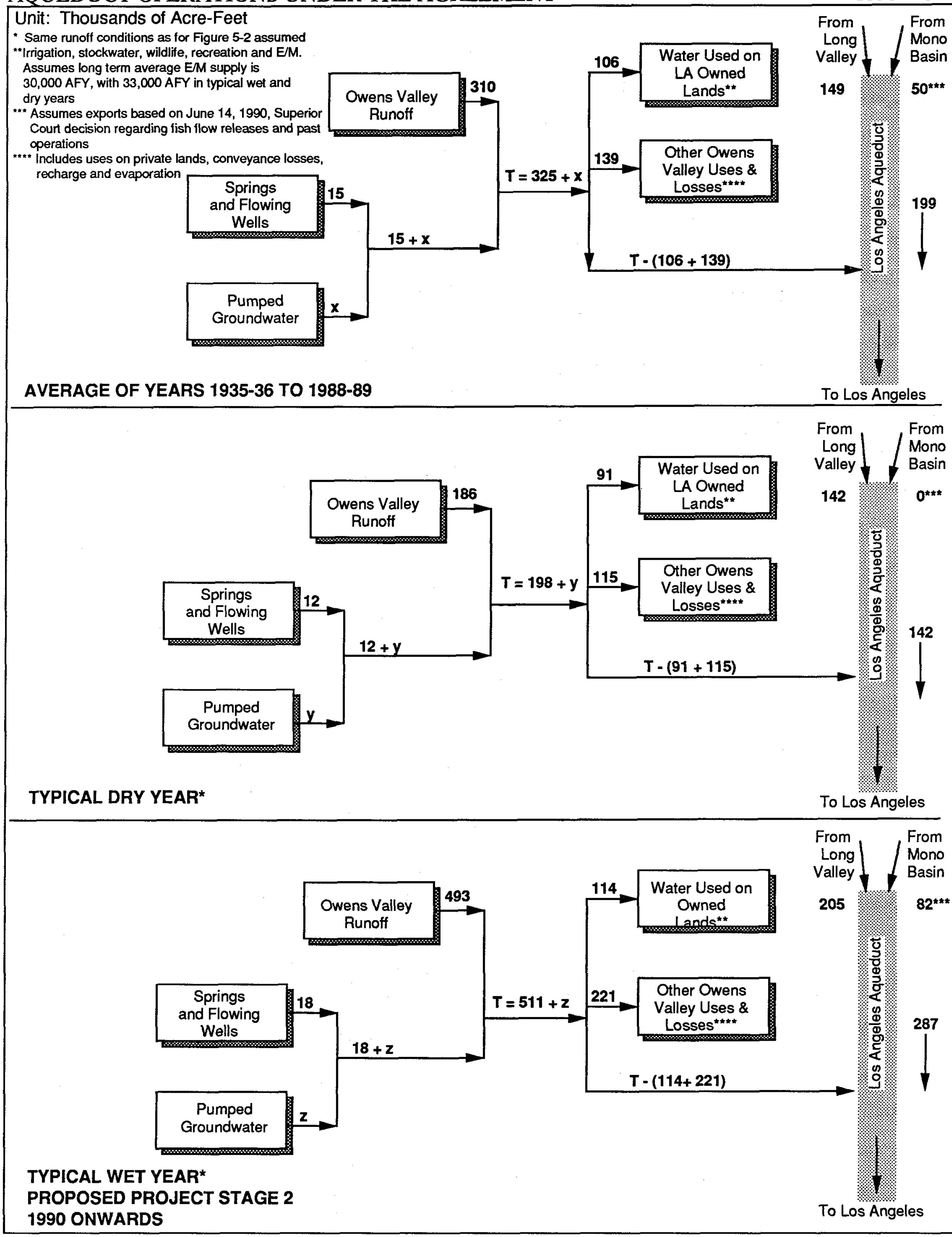
AQUEDUCT OPERATIONS UNDER THE AGREEMENT

FIGURE 5-3



SOURCE: LADWP, AQUEDUCT DIVISION

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It was especially difficult to develop the dry-year scenario because there is no truly "typical" dry year. If, for example, a dry year was preceded by several wet years, environmental conditions would be such that high pumping would be possible and consistent with the provisions of the Agreement. If, on the other hand, a dry year was preceded by several average or dry years, pumping would have to be low in order to protect the environment. Therefore, a large range of pumping values could be expected under the Agreement. At this time, it is estimated that the range of dry year pumping is 70,000 to 240,000 AFY. During successive dry years, the Agreement provides that reasonable reductions in water supply for Los Angeles-owned lands and for enhancement/mitigation projects may be implemented if such reductions are approved by LADWP and the Inyo County Board of Supervisors.

The components of aqueduct supply in average years during the pre-project and under the proposed project (1970-1990 and the Agreement) are shown in Table 5-1. Runoff for the pre-project and 1970-1990 periods is the average runoff recorded for those periods. Runoff for the Agreement is the average runoff recorded to date. For the purposes of comparison and analysis, the average amount of pumping under the agreement is assumed to be 110,000 AFY, as described below. Because of the implementation of enhancement/mitigation projects beginning in 1986, water use for such projects increased from an average of 5,000 AFY between 1970 and 1990 to the 30,000 AFY average shown under the Agreement. These enhancement/mitigation uses will continue in the future under the proposed project.

INCREASED GROUNDWATER PUMPING

Between 1970 and 1990, groundwater pumping averaged 105,000 AFY, an increase of 95,000 AFY from the pre-project period average of 10,000 AFY (see Chapter 4). As explained in Chapter 4, since all of the components of Owens Valley water supply are commingled in the aqueduct system, there is no precise way to determine how much of the additional pumped groundwater is exported and how much is used in the Valley.

Over the past six years, technical studies have been conducted cooperatively by Inyo County, LADWP and the U.S. Geological Survey to learn more about the effects of groundwater pumping on Valley floor vegetation. As a result of the knowledge gained during the studies, Inyo County

TABLE 5-1

LOS ANGELES AQUEDUCT OPERATIONS
PRE-PROJECT/PROJECT COMPARISON
(1,000s AFY)

	Pre-Project	Proposed Project	
	1945-1970	1970-1990	Agreement[1]
Owens Valley Water Supply			
Runoff[2]	292	313	310
Flowing Wells and Springs	44	17	15
Pumped Groundwater	10	105	110[1]
Total	346	435	435
Water Used in Owens Valley			
Irrigated LA-owned Land	69	53	53
Stockwater, Wildlife, and Recreation Uses	20	23	23
Enhancement/mitigation Project (post 1985)	0	5[4]	30
Other Owens Valley Uses and Losses[3]	127	141	139
Total	216	222	245
Water Exported from Owens Valley to Los Angeles	130	213	190

[1]Actual pumping will comply with provisions of the Agreement and could be more or less than indicated.
[2]Runoff for the pre-project and 1970-1990 periods is the average runoff recorded for those periods. Runoff for the Agreement is the average runoff recorded to date.
[3]Uses on private land, conveyance losses, recharge and evaporation.
[4]An average of 5,000 AFY was supplied to enhancement/mitigation projects during the 1970-90 period. Due to the implementation of several projects, water supplied between 1984 and 1990 greatly exceeded the average for the entire 1970-1990 period.

Source: LADWP and Inyo County Water Department, September 1990 and Los Angeles determined that a long-term management regime for Owens Valley water resources should be based on defined environmental standards, rather than on numerical pumping limits. Under the Agreement, vegetation is used as the principal indicator of environmental quality in Owens Valley. The Agreement provides that in the future, groundwater pumping will be managed to avoid significant decreases or changes in vegetation attributable to groundwater pumping, other significant environmental effects, groundwater mining and significant adverse effects on water quality and water quantity in all wells not owned by Los Angeles. (These provisions apply to Indian lands in the Owens Valley.) Because of the extensive use of monitoring data as a guide to management of groundwater pumping, and because environmental conditions in the Owens Valley are heavily reliant on precipitation, it is neither possible nor appropriate to accurately forecast the amount of groundwater pumping that will occur on an annual basis in the future. It is believed that average groundwater pumping in the future will not change significantly as compared to the 1970-1990 period. Factors that could affect future pumping include the environmental protection provisions of the Agreement, the effects of rotational pumping, the effectiveness of groundwater recharge facilities, and the changes in groundwater pumping on the Bishop Cone. For the purposes of comparison and analysis, the average amount of pumping under the agreement, is assumed to be 110,000 AFY.

Future groundwater pumping will occur from the following existing and new wells:

Wells Constructed and Operated Prior to 1970

Between 1970 and 1990, total average annual groundwater pumping from wells that had been constructed and were operated prior to 1970 was increased. (Included in these wells are those that supply the Fish Springs Fish Hatchery.) These wells may be operated in the future subject to the provisions of the Agreement.

Wells Constructed Before 1970, But Not Operated Until After 1970

Between 1970 and 1990, four wells that were constructed prior to 1970, but not operated before then, commenced operation. These wells, with a capacity of 21.3 cfs, may be operated in the future, subject to the provisions of the Agreement.

Wells Constructed Between 1970 and 1990

Between 1970 and 1990, 36 wells were constructed with a total capacity of 160 cfs. Included among these are 16 wells that supply enhancement/mitigation projects with a capacity of 67.8 cfs, and two wells with a capacity of 26.7 cfs that supply the Blackrock Fish Hatchery. These wells may be operated in the future, subject to the provisions of the Agreement. Also, during this period, ten wells with a total capacity of 31.9 cfs were abandoned.

New Wells

The Agreement provides for the construction and operation of 15 new wells to increase LADWP's operational flexibility and to facilitate rotational pumping. These 15 wells would be located in the Laws, Bishop, Big Pine, Independence-Symmes-Bairs area and Lone Pine well fields. Construction and operation of these 15 new wells will be in conformance with the provisions of the Agreement. Chapter 16, Ancillary Facilities, fully describes the construction and operation of these 15 new wells.

Groundwater Pumping on the Bishop Cone

Under a stipulation and order filed in Inyo County Superior Court in 1940 (commonly called the "Hillside Decree"), Los Angeles is precluded from exporting groundwater from an area surrounding Bishop that is commonly referred to as the "Bishop Cone." Under this decree, Los Angeles is permitted to pump and use groundwater on its lands on the Bishop Cone.

The Agreement provides that Los Angeles will continue to irrigate its lands on the Cone that were irrigated in 1981-82, and any other of its lands on the Cone that have been irrigated since 1981-82. It is estimated that Los Angeles has annually supplied approximately 27,000 acre-feet of water (not including conveyance losses) to its lands on the Cone since 1981-82, while Los Angeles has annually extracted only 11,500 acre-feet from pumped and flowing wells on the Cone. Thus, under the Hillside Decree, Los Angeles may increase groundwater pumping from the Cone. (The exact amount of the allowable increase is uncertain, but will be established as set forth below.) Any increase in groundwater pumping on the Bishop Cone is governed by the Hillside Decree and the Agreement. The Agreement provides:

> Any groundwater pumping by the Department on the "Bishop Cone" (Cone) will be in strict adherence to the provisions of the Stipulation and Order filed on the 26th day of August, 1940, in Inyo County Superior Court in the case of Hillside Water Company, a corporation, et al. vs. The City of Los Angeles, a Municipal Corporation, et al. ("Hillside Decree").
>
> The Department's annual groundwater extractions from the Cone shall be limited to an amount not greater than the total amount of water used on Los Angeles-owned lands on the Cone during that year. Annual groundwater extractions by the Department shall be the total of all groundwater pumped by the Department on the Cone, plus the amount of artesian water that flowed out of the casing of uncapped wells on the Cone during the year. Water used on Los Angeles-owned lands on the Cone shall be the quantity of water supplied to such lands, including conveyance losses, less any return flow to the aqueduct system.
>
> Before the Department may increase groundwater pumping above present levels, or construct any new wells on the Cone, the Technical Group must agree on a method for determining the exact amount of water annually used on Los Angeles-owned lands on the Cone. The agreed-upon method shall be based on a jointly conducted audit of such water uses.

Increased groundwater pumping from the Bishop Cone is more fully described in Chapter 16, Ancillary Facilities.

REDUCTION IN THE AMOUNT OF IRRIGATED ACREAGE OF LOS ANGELES-OWNED LAND

From the mid-1960s to 1970, the total leased acreage classified by Los Angeles as irrigated was reduced from 21,800 acres to 11,600 acres. The leases of the remaining irrigated acres provided for a firm commitment of irrigation water for the land even in dry years. This was a change from the earlier leases which provided for a total cut-off or a partial reduction in irrigation supplies in dry years.

Between 1970 and 1990, the amount of irrigated Los Angeles-owned land increased from 11,600 acres to 14,200 acres. Of this amount, 2,000 acres were added because of enhancement/mitigation projects, 400 acres were added because of land purchases by Los Angeles in the Olancha-Cartago area, and 200 acres were added to the existing ranch lease irrigation program. Under the Agreement, LADWP must continue to provide enough water for Los Angeles-owned lands in Inyo County in an amount sufficient to continue the water-related uses of such lands that were in effect during the 1981-82 runoff year. LADWP must continue to provide water to Los Angeles-owned lands in the Olancha-Cartago area such that the lands that have received water in the past will continue to receive water.

Lands to be supplied with water will be managed so as to avoid causing significant decreases and changes in vegetation from conditions that existed on such lands during the 1981-82 runoff year. However, the conversion of cultivated land by LADWP, or its lessee, to other irrigated uses shall not be considered a significant decrease or change. The Agreement also provides that significant decreases in recreational uses and wildlife habitats on such lands (which in the past have been dependent on water supplied by LADWP) are to be avoided.

The Agreement provides that during periods of dry-year water shortages, the Technical Group will evaluate existing conditions. A program providing for reasonable reductions in irrigation water supply for Los Angeles-owned lands in Owens Valley and for enhancement/mitigation projects may be implemented if such a program is approved by the Inyo County Board of Supervisors and LADWP.

INCREASED DIVERSION OF SURFACE WATER FOR EXPORT

The amount of water released form the aqueduct system was reduced after 1970 because of the additional export capacity created by the second aqueduct. This change in aqueduct operations was most apparent during wet years. Expanded aqueduct capacity made it possible for LADWP to capture more of the high volumes of runoff from the Sierra. The reduction in irrigated acres, especially during wet years, yielded additional water for export. (See Chapter 4).

As with the increase in groundwater extraction, it is difficult to accurately quantify the amount of additional surface water diversions that are actually exported, because all of the components of supply are commingled in the aqueduct system. Depending on one's perspective, all increased surface water diversions can be allocated either to increased export or to use in Owens Valley.

5.5 GROUNDWATER RECHARGE IMPROVEMENTS

Between 1970 and 1990, groundwater recharge facilities constructed prior to 1970 continued to be operated by LADWP. These facilities will continue to be used after 1990, but the long-term management of surface water will be governed by the Agreement.

Proposed groundwater recharge improvements include construction of improved or enlarged recharge facilities at the existing Big Pine and Laws spreading areas, to efficiently recharge additional surface water in years of above-normal precipitation when surface water is in excess of in-valley and export needs. This would minimize uncontrolled releases and reduce non-beneficial spreading on the Valley floor. Chapter 16, Ancillary Facilities, fully describes the construction and operation of the recharge facilities.

5.6 CONTINUATION OF ENVIRONMENTAL PROJECTS IMPLEMENTED BY LADWP SINCE 1970

Between 1970 and 1984, LADWP committed about 10,000 acre feet of water annually to implement several environmental projects. In accordance with the Agreement these projects will be continued to avoid significant decreases in recreational uses and wildlife habitats that in the past have been dependent on water supplied by the Department. Table 5-2 describes each of these projects.

5.7 ENHANCEMENT AND MITIGATION PROJECTS

The Agreement provides that all existing enhancement/mitigation projects implemented between 1984 and 1990 will continue unless the Standing Committee agrees to modify or discontinue a project. Periodic evaluations of the projects will be made by the Technical Group. These projects will continue to be supplied with an average of 30,000 AFY from enhancement/mitigation wells as necessary. A new enhancement and mitigation project on the lower Owens River is proposed. New and presently undefined projects may be implemented if such projects are approved by the Standing Committee. The enhancement/mitigation projects implemented between 1985 and 1990 are described in Table 5-3. Enhancement/mitigation project locations are presented in Appendix E.

5.8 ELEMENTS SUBJECT TO FUTURE CEQA REVIEW

Los Angeles and Inyo County will implement each of the following projects; however, each of these elements will be addressed in a future environmental review before it is implemented. These elements are:

TABLE 5-2

LADWP ENVIRONMENTAL PROJECTS, 1970 TO 1984

Between 1970 and 1984, LADWP committed approximately 10,000 acre-feet of water annually to implement and maintain the following environmental projects:

Farmer's Ponds	Water provided in fall of each year to offer increased habitat for migrating waterfowl; two miles north of Bishop.
Buckley Ponds	Water is provided for a warm-water fishery and waterfowl area; three miles southeast of Bishop.
Saunders Pond	Water is provided to a warm-water fishery and waterfowl area, similar to Buckley Ponds, five miles southeast of Bishop.
Mill Pond	Water provided to pond at recreation area either by creek flow or well at site.
Klondike Lake	Water provided for permanent wildlife habitat area (now incorporated in Klondike Lake E/M Project).
Tule Elk Field	Water provided to field heavily used in summer by Tule elk herd; between U.S. Highway 395 and Tinemaha Reservoir.
Seely Spring	Maintained by LADWP well adjacent to Owens River to provide waterfowl and shorebird habitat larger than had existed at Seeley Spring; two miles south of Tinemaha Reservoir.
Calvert Slough	Water provided to maintain habitat; small pond and marsh area near LADWP Aqueduct Intake.
Little Blackrock Spring	Water diverted from ditch to maintain wet area at original spring site.
Lone Pine Pond	Similar to Buckley Ponds and Saunders Pond; water provided by natural seep or spring flow in river with supplemental releases from Alabama Gates (now incorporated in lower Owens River E/M Project); north of Lone Pine Station.
Lower Owens River	Water releases begun in 1975 to provide year-long minimal flows in lower Owens River, as well as releases to Twin Lakes, Billy Lake, and Thibaut Ponds; to maintain waterfowl, marsh, shorebird, and upland gamebird habitat, as well as a warm-water fishery (now incorporated in lower Owens River E/M Project).
Diaz Lake	Supplemental water supply provided to Diaz Lake recreational area.

TABLE 5-3

ENHANCEMENT/MITIGATION PROJECTS, 1985 TO 1990

- Millpond Recreation Area Project: Located west of Bishop, was the first enhancement/ mitigation measure to be completed. Since October 1985, funds have been provided to purchase energy to operate the recreation area's sprinkler irrigation system that waters 18 acres of the community park including two softball fields.

- Shepherd Creek Alfalfa Lands Project: Revegetated 198 acres of abandoned cropland adjacent to U.S. Highway 395 with sprinkler irrigated alfalfa and wind break trees. The property between Lone Pine and Independence had maintained only sparse annual vegetation since 1976. This area was a source of blowing dust.

- Klondike Lake Project: Sustains a year-round water supply in this 160-acre formerly seasonal lakebed area providing nesting and feeding areas for waterfowl, and permitting water skiing and other water sports in summer months. Previously, the lake, located north of Big Pine, had been filled with water only during above-normal water runoff years.

- Laws Historical Museum Project: Provides a regular water supply to improve the native vegetation on a 21-acre parcel, establish irrigated pasture on 15 acres and establish windbreak trees, all adjacent to the museum.

- Laws-Poleta Native Pasture Project: Provides water for irrigation of 220 acres of sparsely vegetated land to reestablish native vegetation on abandoned pasture lands and increase livestock grazing capabilities.

- McNally Ponds Project: Provides water for 300 acres during the spring and summer months to mitigate and sustain vegetation, and to provide water to 60 acres of ponds during the fall months for waterfowl habitat.

- Independence Pasture Lands/and Spring Field Projects: Revegetated approximately 910 acres of abandoned croplands and sparsely vegetated land to create native pasture lands and provides water to native vegetation lands. Involved conversion of sparsely vegetated land east of Independence to productive native pasture land by flood irrigation. The project mitigated a source of blowing dust and stabilized soil previously affected by severe wind erosion.

- Lone Pine Riparian Park: Projects have reestablished abandoned pasture land and provide water to approximately 320 acres of native vegetation lands and increase livestock grazing capabilities.

- Lone Pine Sports Complex: At the request of the community, portions of the Lo-Inyo Elementary School and vacant LADWP property will be converted to an outdoor sports complex consisting of baseball fields, soccer fields, and related parking, picnic and park areas.

TABLE 5-3 (Continued)

- o Independence Roadside Rest: This consists of planting of shade and windbreak trees and grass, installation of an irrigation system, and placement of picnic tables on a 1/2-acre site south of the town of Independence. The project is an aesthetic improvement over the previously blighted area.

- o Eastern California Museum: This project enhanced the appearance of the Eastern California Museum grounds in Independence. It consists of a small pond, trees, expanded lawn areas, and installation of an irrigation system.

- o Town Regreening Projects: These projects were implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the towns of Big Pine, Independence, and Lone Pine. Water was supplied from LADWP facilities to promote and maintain vegetation.

- o Lower Owens River Rewatering Project: This project provided up to 18,000 AFY of continuous flow of water in a 50-mile, previously dry (1913-1986) portion of the river channel creating a warm water fishery and wildlife habitat in the southern Owens Valley. The project also supplies water to five small lakes along the river route providing improved waterfowl habitat in the region. The new fishery supports such warm water species as largemouth bass; and the project's lakes provide breeding and feeding grounds for waterfowl and shorebirds.

Source: LADWP, August 1990

LOWER OWENS RIVER PROJECT

A proposed new enhancement/mitigation project involves increased rewatering of a 53-mile stretch of the lower Owens River. This project would be in addition to the existing lower Owens River rewatering project. The project would be jointly managed by LADWP, Inyo County and the California Department of Fish and Game. LADWP would construct, operate and maintain the system. This project will be the subject of a separate EIR.

The proposed project would include the construction of a pump-back station from the Owens River near Keeler Bridge to the Los Angeles Aqueduct to return the water to the aqueduct that had been diverted to the river channel, so a substantially larger flow could be placed in the river without requiring additional groundwater pumping in the Valley to make up for the loss and to prevent excessive flows through the delta waterfowl habitat onto Owens dry lake bed.

LADWP would commence construction of this facility within three years of the Court's approval of the Agreement. The pump-back system should be able to pump up to 50 cfs from the river to the aqueduct. LADWP is to construct, operate and maintain the pump-back system. Due to seasonal fluctuation in river flow levels, it is anticipated that the average annual pumping in any year would not exceed approximately 35 cfs. Water releases would be made to the river above Blackrock Gate on the Los Angeles aqueduct (but below the aqueduct Intake). River flow would be restored in approximately 50 miles of river channel between the Intake and the Owens River Delta. Off-river lakes and ponds now in existence would be retained and new ponds and wetland areas would be created. A water release would be made from the pump-back station to supply the southern end of the river and the Owens River Delta.

In addition to the above, the Lower Owens River Project would provide for, but not be limited to, the following:

- water flow and schedules needed to maintain a healthy and productive warm-water fishery in the lower Owens River and in the off-river lakes and ponds;
- specific water diversion and release points to supply the project;

- locations of ponds, pools and wetlands in and adjacent to the lower Owens River, and the proposed methods to manage these to produce and maintain a viable fishery and waterfowl habitat;
- requirements for channel maintenance;
- plans for fish stocking; and
- plans for tule and other plant control in the river and the off-stream ponds and lakes.

PROVISION OF A SUPPLY OF WATER AND FUNDING FOR WATER SUPPLY DITCHES IN BIG PINE

The Agreement provides that LADWP is to provide up to $100,000 for reconstruction and upgrading of the ditch system and for construction of new ditches to supply additional properties in the town of Big Pine. The ditch system is to be planned, constructed, operated, and maintained by a Big Pine entity or organization separate from LADWP or Inyo County, except for existing ditches on Los Angeles-owned land that will continue to be maintained by LADWP. This entity or organization is to obtain all necessary rights-of-way prior to construction.

LADWP is to make a flow of up to 6 cfs available to supply the ditch system with water. This is in addition to water now diverted for use by Big Pine Water Association members. Water to replace any water used by this project will come from a new well, which will be constructed by LADWP west of Big Pine. This well may also supply water to the Big Pine Water System.

The stockholders of the Big Pine Water Association have to approve the use of existing ditches. Provisions must be made to ensure that the project funds will only be made available to an appropriate entity or organization and will only be made available as construction of the Big Pine ditch system, or of other approved projects, progresses. Any costs of constructing the ditch system in excess of $100,000 are to be secured prior to commencement of funding of the construction of the ditch system. Project funds would only be made available if substantial construction of the ditch system were commenced within two years of the Court's approval of the Agreement.

SALT CEDAR CONTROL PROGRAM

The Agreement provides that LADWP is to provide funding to the County for an initial three-year salt cedar control effort and, thereafter, for an annual maintenance and control effort in the

Owens Valley area. This effort is to be conducted by Inyo County. The salt cedar control effort will commence as soon as feasible following Court approval of the Agreement.

The initial salt cedar control effort is to be focused on those acres of the Valley floor identified in the Technical Group's "Salt Cedar Control Study Report" as having a high density of salt cedar composition. The priority for implementation of control will be as follows:

- o Lower Owens River Channel
- o Tinemaha Reservoir and Owens Valley North of Tinemaha Reservoir
- o Perennial Streams, Canals and Ditches
- o Springs and Seep Areas
- o High Water Table Meadows
- o Spreading Areas That Normally Receive Water
- o Spreading Areas That Receive Water Only in Very High Runoff Years

The annual control program is to be based on the same control priorities as described above.

RELEASES OF LOS ANGELES-OWNED LAND FOR PUBLIC AND PRIVATE USE

The Agreement provides that Los Angeles is to offer for sale (either at public auction or to the County for public purposes) 75 acres of Los Angeles-owned land. This will be performed in a manner consistent with the requirements of the Los Angeles City Charter for the sale of real property. The County and Los Angeles are to jointly confer on the location of, and the schedule for, the sale of each parcel. Prior to the sale of any such parcels, there is to be available a public water system to serve such property after its sale.

In addition to the sales described above, Los Angeles is to sell at public auction, or sell directly to the City of Bishop or the Bishop Community Redevelopment Agency, properties within the Bishop City limits totaling 26 acres of surplus Los Angeles-owned land.

TRANSFER OF WATER SYSTEMS OWNED BY LOS ANGELES TO INYO COUNTY IN THE TOWNS OF LONE PINE, INDEPENDENCE, BIG PINE AND LAWS

The Agreement provides that Los Angeles is to transfer ownership of the water systems in the towns of Lone Pine, Independence and Laws to the County, or to another Owens Valley public entity or entities. The method of transfer is to be a lease purchase agreement wherein the transfer of ownership of each system will be complete at the end of five years from the date of court approval of the Agreement.

During the five-year lease period, LADWP will be responsible for the operation and maintenance of the wells, pumps, reservoirs and chlorination equipment supplying the water system of the three towns. Treated water is to be supplied by LADWP as needed to each of the three town water systems at no cost, up to the annual amounts set forth below:

System	Amount in Acre-Feet
Lone Pine	550
Independence	450
Laws	50

Inyo County (or other public entity operating the water system) is to pay LADWP for water used in excess of these totals, in an amount that would reflect the actual incremental cost to LADWP of operating and maintaining the wells and reservoirs to provide the excess amount.

Also during the initial five-year lease period, LADWP is to improve the Independence town reservoir, if needed, to provide a facility with an expected service life of at least 15 years with routine maintenance and that also meets all California State Department of Health Service requirements. Further, LADWP, at its option, is to either upgrade the reservoir as needed to meet seismic requirements agreed upon by the Inyo County Board of Supervisors and LADWP, or is to fully repair any damage to the reservoir caused by earthquake during a 15-year period following the transfer of the water system. LADWP will replace the Lone Pine reservoir with a new 500,000-gallon reservoir. Once a replacement well and the new reservoir are in service, groundwater is not to be exported via the Los Angeles aqueduct from the wells supplying the Lone Pine Water System.

During the five-year lease period, Inyo County (or the public entity or entities) is to set the water rates for the three town water systems, operate and maintain all components of the water systems (except the wells, pumps, chlorination equipment, and reservoirs), begin the transition for operating and maintaining the chlorination equipment, handle all billing and related matters, and establish a capital reserve fund for replacing components of the systems in the event of emergency or deterioration.

At the end of the five-year lease period, Inyo County or other public entity or entities is to assume total ownership and operation of each town water system, except that LADWP is to continue to own and operate the wells. LADWP shall supply untreated water to each water system at no cost, up to the annual amounts described above. Inyo County (or other public entity) operating each water system is to pay LADWP for water used in excess of these totals in an amount that reflects the actual incremental costs of supplying such water.

Los Angeles has leased the town water system in Big Pine to the Big Pine Community Services District. This lease requires certain considerations favorable to the District in the event of a permanent transfer of the town water systems in the other Owens Valley towns as part of an overall settlement of litigation. The same benefits and opportunities are to be provided to the Big Pine water system as are available to the three other Owens Valley water systems. This includes providing untreated water to the system without charge on up to 500 acre-feet per year.

REHABILITATION AND EXPANSION OF PARKS AND CAMPGROUNDS ON LOS ANGELES-OWNED LANDS THAT ARE LEASED AND OPERATED BY THE COUNTY OF INYO

The Agreement provides that LADWP is to provide funding to Inyo County for rehabilitation of existing County parks and campgrounds and development of County campgrounds, parks, and recreational facilities and programs. These facilities are located on lands owned by Los Angeles. Inyo County may obtain from Los Angeles, through sale or lease, land within or adjacent to Valley towns for use as a public park or for other public purposes.

During the ten years following Court approval of the final Agreement, Inyo County is to rehabilitate certain existing parks and campgrounds and develop certain new parks, campgrounds, recreational facilities and programs. These facilities are to be developed in accordance with a master plan now being prepared by Inyo County, or in accordance with any future plans developed by Inyo County. The Agreement also provides for an annual payment toward operation and maintenance of parks and campgrounds in Inyo County, and for Bishop City Park.

Among the first facilities to be considered for rehabilitation will be Pleasant Valley Campground, Baker Creek Campground, Dehy Park, and Diaz Lake. Among the first new facilities and programs to be considered for development will be certain campgrounds along the Owens River from Pleasant Valley Reservoir to Owens River Delta, and a recreational use and management plan for that reach of Owens River.

RECREATIONAL USE OF SOUTH OR NORTH HAIWEE RESERVOIR

The Agreement provides that LADWP is to conduct and finance seismic studies required by the California State Department of Water Resources to determine if South Haiwee Dam can be safely operated at reduced storage levels. If such operations are allowed, LADWP and Inyo County are to develop a recreation plan for South Haiwee Reservoir, and LADWP is to open this facility to public recreation pursuant to the Agreement. The recreation plan is to be implemented and operated by Inyo County or by a concessionaire. In the event that the continued operation of South Haiwee is not allowed, a recreation plan to operate North Haiwee Reservoir is to be developed and implemented if it is feasible to do so.

6. ALTERNATIVES TO THE PROPOSED PROJECT

6.1 INTRODUCTION

The California Environmental Quality Act (CEQA) requires that an EIR describe and evaluate a range of reasonable alternatives to a proposed project that can feasibly attain the basic objectives of the proposed project. The range must include a no-project alternative. If the no-project alternative is the environmentally superior alternative, an environmentally superior alternative among the other alternatives must be identified, although a project proponent is not obligated to select it.

The proposed project analyzed in this EIR is the water management practices and facilities that were implemented or constructed by LADWP to supply the second Los Angeles aqueduct together with the management practices and projects contained in the long-term groundwater management plan. This chapter describes and analyzes the reasonable alternatives to the proposed project.

It should be noted that in its role as a responsible agency, Inyo County will use this EIR as an informational document to assist it in deciding whether or not to approve the Agreement. (The Agreement is one of several elements of the proposed project.) In this role, Inyo County can only approve or disapprove the Agreement. If Inyo County were to disapprove the Agreement, Los Angeles would choose one of the alternatives to the proposed project, or another course of action, and the County would respond through legal, regulatory, legislative and/or other means. Since Inyo County lacks authority to unilaterally cause the no-project alternative or any other alternative to be implemented, the alternatives presented below are those that have been developed by Los Angeles to meet the requirements of CEQA.

- o Alternative 1. No Project
- o Alternative 2. No Increased Groundwater Pumping/No In-Valley Irrigation
- o Alternative 3. Water Management by Maintaining Water Tables in Vegetation Rooting Zones
- o Alternative 4. Stabilization of Water Table at 1981 Levels
- o Alternative 5. Water Management With No Agreement
- o Alternative 6. Groundwater Management in Accordance with Pumping Table Contained in Los Angeles/Inyo County Interim Agreement
- o Alternative 7. Water Management to Fill Both Los Angeles Aqueducts

Section 6.2 of this chapter describes each of the alternatives to the proposed project, the impacts these alternatives would have on the Owens Valley environment, and their implications for Los Angeles. If the no-project alternative was implemented or other alternative was implemented that would result in Los Angeles exporting less water from Owens Valley than it would under the proposed project, Los Angeles would have to obtain replacement water from another source or sources or reduce water demand through additional conservation efforts.

Section 6.3 of this chapter analyzes the alternatives available to Los Angeles to replace or conserve water. These alternatives are:

- o Growth Limitations
- o Expanded Water Conservation
- o Increased Use of Los Angeles River Groundwater Basin
- o Increased Purchase of Water from Metropolitan Water District (MWD)
- o Increased Export from the Mono Basin
- o Expanded Water Reclamation
- o Seawater Desalination
- o Water Transfers

As is described in Section 6.3, except for increased export from the Mono Basin, each of the alternative supplies listed above could produce more water for Los Angeles. Although the exact amount of water that will be exported in the future under the proposed project is uncertain because it will vary in order to meet the vegetation protection goals of the Agreement, for the purpose of analyzing the project alternatives, Inyo County and LADWP have estimated that on average the proposed project would increase export from the Owens Valley above the export levels that would exist if the no project alternative were to be implemented. Section 6.3 concludes that if either the no project alternative or another alternative that would result in export levels lower than those estimated under the proposed project were to be implemented, LADWP would choose to purchase water from MWD as the replacement source.

It should be noted that although it would be LADWP's choice to replace water through purchases from MWD, it is LADWP's policy to implement all feasible water conservation and reclamation measures, including water rationing when reduction in other sources mandate its necessity. Los Angeles is committed to this policy regardless of whether the proposed project is implemented or not. This policy reflects a recognition of the uncertainty of future water supplies, including the expected reduction in water diversions from the Mono Basin, the water supply outlook for MWD, and increasing population growth and water demand within Los Angeles.

6.2 WATER MANAGEMENT ALTERNATIVES FOR THE OWENS VALLEY

There are, of course, a broad range of possibilities for water management in the Owens Valley. The alternatives involve different approaches to ground and surface water management. The components of a range of alternatives are shown in Figure 6-1.

At one end of the range of alternatives is the no project alternative. Under this alternative, water in the Owens Valley would be managed as it was before 1970. Export of water to Los Angeles from the Owens Valley would be as in the pre-project period. At the other end of the range would be an alternative that would substantially increase export of water to Los Angeles above pre-1970 levels by filling both Los Angeles aqueducts whenever possible.

Each of the alternatives is described below together with a brief assessment of probable environmental effects in the Owens Valley. Environmental and other implications of the

FIGURE 6-1

ALTERNATIVES MATRIX	Increased Groundwater Pumping	Increased Export to LA	Environmental Protection Goals of the Agreement	Irrigation: Pre-1970 Levels	Irrigation: 1970-1990 Levels	Enhancement / Mitigation Projects	LADWP Environmental Projects	Increased Pumping on Bishop Cone	15 New Wells, GW Recharge Improvements	Big Pine Ditches	Salt Cedar Control	LA Land Releases	Town Water Systems Transfers	Parks Rehabilitation	Recreational Use of Haiwee
1. No Project				●											
2. No Increased Pumping, No In-Valley Irrigation		●													
3. Maintain Water Tables in Vegetation Rooting Zones	●	○ [1]	●		●	●	●	●	●						
4. Stabilize Water Tables at 1981 Levels	●	●			●	○ [2]	●	●							
5. Water Management With No Agreement	●	●	●		●	○ [2]	●	●	●						
6. Interim Agreement Pumping Table	●	●			●	●	●	●	●						
7. Water Management to Fill Both LA Aqueducts	●	●			●		●	●	○ [3]						
8. Agreement [4]	●	●	●		●	●	●	●	●	●	●	●	●	●	●

[1] Increase in export would be minimal: approximately 5,000 AFY.

[2] All existing enhancement / mitigation projects would be continued, except that no water would be released to the lower Owens River channel. Water would be supplied to the ponds that are part of the Lower Owens River Project

[3] Twenty-eight new wells would be constructed by LADWP

[4] Shown here for comparison.

alternatives for Los Angeles and the rest of California are discussed at the end of Section 6.2. The exact amount of water that would be exported in the future under the Agreement is uncertain because it will vary in order to meet the vegetation protection goals. However, for the purposes of this analysis, Inyo County and LADWP have estimated that on average the proposed project would increase groundwater pumping by 100,000 AFY and increase export by 42,000 AFY above average annual no project alternative levels, yielding an estimated average aqueduct export from the Owens Valley of 190,000 AFY. To assist in the comparison of the water management alternatives, runoff is assumed to be the same for all of the alternatives, that is the average recorded runoff in Owens Valley to date. Because of this, the numbers shown for water export from Owens Valley differ for the no project alternative discussed in this chapter and the pre-project period shown in Tables S-1, 4-2 and 5-1, and in Figures 4-2 and 5-1. Runoff for the pre-project period was 292,000 AFY, or the average runoff recorded between 1945 and 1970. Runoff for the no project alternative in this chapter is assumed to be 310,000 AFY, or the average runoff recorded to date. (See Table 5-1 in Chapter 5, Project Description, for a comparison of water export during the pre-project period with the 1970 to 1990 period and with the Agreement.)

6.2.1 ALTERNATIVE 1 - NO PROJECT

This alternative would involve a return to pre-1970 Owens Valley water management practices. Prior to 1970, nearly all of the water exported from the Owens Valley came from surface supplies, springs, and flowing wells. Only during dry years did pumped groundwater contribute significantly to export.

During wet years, as much as 21,800 acres of Los Angeles-owned land in the Owens Valley was irrigated. In very dry years, irrigation supplies were almost completely eliminated. Irrigation water supply was highly variable and irrigation was only conducted to the extent surface water was available after filling the First Aqueduct. Elements of the No-Project Alternative include:

- Groundwater pumping would range from zero in wet years to as much as 142,600 AFY in dry years (this is the actual amount pumped in 1931). Long-term groundwater pumping would average 10,000 AFY.
- Water export from the Owens Valley would be an estimated 148,000 AFY, or about 42,000 AFY less than the proposed project.

- o No groundwater pumping for in-valley uses.
- o All groundwater pumping would be from wells that were constructed prior to 1970 and from replacement wells drilled after 1970. All enhancement/mitigation and other production wells would be abandoned.
- o Irrigation of Los Angeles's lands in Owens Valley would be in accordance with pre-1970 practices and subject to significant variability. During wet years, as much as 21,800 acres would be irrigated. During very dry years, irrigation supplies would be eliminated. Long-term water supply for irrigation would average about 69,000 AFY.
- o All enhancement/mitigation and LADWP environmental projects implemented subsequent to 1970 would be discontinued, including the Lower Owens River Project.
- o LADWP would not operate wells to supply water to the Black Rock and Fish Springs fish hatcheries requiring the hatcheries to use creek water or springs, or to operate their own wells.
- o No mitigation measures would be implemented to reduce the impacts of LADWP's water management practices during the 1970-90 period.
- o The provisions of the Agreement would not be implemented.

Environmental Effects in Owens Valley

The return to pre-1970 groundwater pumping levels would allow water tables in the parts of the Valley that have been affected by groundwater pumping since 1970 to return to pre-project levels. In areas where groundwater dependent vegetation has been affected by pumping, conditions would be created that would be conducive to the regrowth of such vegetation. Also, flow would resume at most springs and seeps that have dried up because of groundwater pumping since 1970. Whether revegetation would fully occur in all areas of groundwater dependent vegetation and of vegetation dependent on springs and seeps, without active replanting, maintenance, protection from overgrazing and other actions is not known. Springs would be subject to periodic drying due to pumping during dry years as occurred prior to 1970.

All areas of land that were taken out of irrigation as a result of the second aqueduct, would be irrigated again under this alternative. After being taken out of irrigation, most of these areas were recolonized by native and introduced plant species. The degree of recolonization that has occurred varies depending on the environmental conditions at each site. In most cases revegetation has been slow and the value of the abandoned agricultural areas for wildlife is small. A return to pre-1970 practices, would result in as much as 21,800 acres of irrigated land in wet years. In very dry years there would be no irrigated acreage. Thus land that is partially-revegetated today would be converted to intermittently irrigated lands. The increase in vegetative cover that would result would decrease the potential for dust generation. Larger areas of the Valley floor would be green in wet years.

Elimination of the enhancement/mitigation and LADWP environmental projects would have adverse effects on water resources, vegetation, wildlife, air quality and recreation. These projects are described in Chapter 5.

It should be noted that because this is a unique project in that many of the elements of the proposed project have been fully or partially implemented since 1970, an immediate return to the environmental conditions that existed during the pre-project period will not occur simply by resuming pre-1970 Owens Valley water management practices.

A reversion to pre-1970 water management practices would result in the discontinuation of a supply of water in all years to the ponds and lakes that are currently supplied as enhancement/mitigation or LADWP environmental projects. These ponds and lakes would receive water in wet years and perhaps in other years, but not during dry years. No water would be supplied to the lower Owens River between Blackrock Ditch and the Delta; however, due to a reduction in groundwater pumping, spring flow discharging into the river along this reach would increase and would result in a flow in portions of the channel. Irrigation of the Independence and Lone Pine Wood Lots, and all other Los Angeles-owned lands currently irrigated as enhancement/mitigation projects that were not irrigated in the pre-project period would be terminated. The fish hatcheries at Fish Springs and Blackrock would either have to convert to surface water, develop their own groundwater sources or cease operation. There would be no mitigation of the impacts on groundwater dependent vegetation as identified in Chapter 10.

In order to lessen the impacts of the abandonment of these activities, mitigation measures would have to be implemented. In order to completely avoid such impacts, it would be necessary to continue the enhancement/mitigation projects and the LADWP environmental projects, a subject beyond the scope of the no project alternative. Because of changes in the Valley since 1970, whether or not mitigation were to be implemented and/or enhancement/mitigation and LADWP environmental projects were to be continued, conditions in some areas of the Owens Valley would not revert to those that existed in the pre-project period if the no project alternative were to be implemented. However, impacts to the Owens Valley environment would be reduced. If existing enhancement/mitigation and LADWP environmental projects were to be continued, it is estimated that aqueduct export from the Owens Valley would average approximately 120,000 AFY, or 28,000 AFY less than the no-project alternative without the continuation of the enhancement/mitigation and LADWP environmental projects.

6.2.2 ALTERNATIVE 2 - NO INCREASED GROUNDWATER PUMPING AND NO IRRIGATION OF LOS ANGELES-OWNED LANDS

This alternative would employ water management practices similar to Alternative 1 (No Project) except water supply for irrigation of Los Angeles-owned lands in the Owens Valley would be discontinued.

Elements of this alternative include:

- Groundwater pumping under this alternative would be the same as under the no project alternative. It would range from zero in wet years to 142,600 AFY in dry years. Long-term groundwater pumping would average 10,000 AFY.
- Water export from the Owens Valley would be an estimated 210,000 AFY, or about 62,000 AFY more than the no project alternative and 20,000 AFY more than the proposed project.
- No groundwater pumping for in-valley uses.
- All groundwater pumping would be from wells that were constructed prior to 1970 and replacement wells drilled after 1970. All enhancement/mitigation and other production wells would be abandoned.
- Irrigation of all Los Angeles-owned lands would be discontinued in all years.
- When surface water supply exceeded aqueduct capacity, water would be spread for recharge in the Owens Valley.
- All enhancement/mitigation and LADWP environmental projects implemented since 1970 would be discontinued, including the Lower Owens River Project.
- LADWP would not operate wells to supply the Black Rock and Fish Springs fish hatcheries, requiring the hatcheries to use creek water, springs, or to operate their own well supply.
- No mitigation measures would be implemented to reduce the impacts of LADWP's water management practices since 1970.

- o The provisions of the Agreement would not be implemented.

Environmental Effects in Owens Valley

The environmental impacts of this alternative would be the same as those described for the no project alternative, except that 11,600 acres that are irrigated today would no longer be irrigated since there would be no irrigation of Los Angeles-owned land. The extent to which these lands would revegetate if irrigation were to be abandoned is uncertain. In addition, adverse impacts to vegetation, wildlife, recreation, and air quality would be created by the abandonment of existing enhancement/mitigation and LADWP environmental projects.

This alternative would attain Los Angeles' basic project objective of obtaining additional water for export, and it would be accomplished without increasing groundwater pumping above pre-project levels. However, the effects of eliminating all irrigation of Los Angeles-owned lands in the Owens Valley would be significant, particularly in the Bishop area where much of the Los Angeles-owned land that is currently irrigated is concentrated.

6.2.3 ALTERNATIVE 3 - WATER MANAGEMENT BY MAINTAINING WATER TABLES IN VEGETATION ROOTING ZONES

Under this alternative, groundwater pumping would be managed to maintain the water table within the rooting zone of groundwater dependent vegetation. Some fluctuations in the water table would occur, but its decline below the rooting zone of groundwater dependent vegetation would be limited. For the purposes of analyzing this alternative, it is assumed that groundwater pumping would be managed so that water tables would not decline to below 10 feet of ground surface in some areas and to below 15 feet of ground surface in other areas, depending on the type of vegetation cover. When water levels within a well field declined to near the maximum depth below the ground surface established for the area, pumping within the well field would be adjusted to maintain the water table above the maximum depth allowed. Elements of this alternative include:

- o Assuming that throughout the Owens Valley, groundwater pumping would be managed so that water tables would not decline to below 10 feet of ground surface, long-term groundwater pumping would average approximately 40,000 AFY. If groundwater pumping throughout the Valley were to be managed to prevent water table decline to below 15 feet of ground surface, long-term groundwater pumping would average 86,000 AFY. The average long-term groundwater pumping under this alternative is estimated to be between approximately 60,000 AFY and 70,000 AFY because some areas would be limited to 10 feet of water table drawdown and other areas would be limited to 15 feet of drawdown. Actual amount of allowable water table drawdown in a given area would have to be determined following field study.

- Assuming average long-term pumping of 65,000 AFY, water export from Owens Valley would be an estimated 153,000 AFY, or 5,000 AFY more than the no project alternative and 37,000 AFY less than the proposed project.

- Irrigation and surface water management practices in the Owens Valley would be the same as under the Agreement.

- All enhancement/mitigation and LADWP environmental projects implemented since 1970 would be continued, including implementation of the Lower Owens River Project as described in Chapter 5.

- LADWP wells to supply the Blackrock and Fish Springs fish hatcheries would be operated in accordance with the rooting zone limitations.

- Fifteen new wells and improvements to groundwater recharge facilities would be constructed by LADWP as described in Chapter 16, Ancillary Facilities. Wells constructed and/or operated before and after 1970 would be operated.

- The provisions of the Agreement would not be implemented.

Environmental Effects in the Owens Valley

This alternative would result in an increase in the average rate of groundwater pumping compared to the no project alternative, and a decrease in the average rate of groundwater pumping compared to the Agreement. Water tables would be maintained in the vegetation rooting zones. Over time, depending on precipitation levels, vegetation conditions would return to those documented in the 1984-87 vegetation inventory, but probably not all groundwater dependent vegetation would recover to pre-1970 conditions.

Since currently irrigated areas would continue to be irrigated, areas that are green today would remain so. Enhancement/mitigation and LADWP environmental projects would also continue to be supplied with water, maintaining the wildlife and recreational values provided by those projects.

All of the impacts of the proposed project described in Chapters 8 through 16 would occur and such impacts would be mitigated as described in those chapters. There would be no other impacts under this alternative.

Alternative 3 would not achieve Los Angeles' basic project objective of obtaining additional water for export since the amount of increased export would only be 5,000 AFY above the estimated export of the no project alternative. Under this alternative the goal of protecting the Valley's vegetation, as proposed under the Agreement, would be achieved. However, because this alternative would maintain the water table at a level where it can supply the groundwater dependent vegetation at all times, little fluctuation in the water table could occur. Studies of the effects of groundwater pumping on Owens Valley groundwater dependent vegetation suggest that water tables may decline below the rooting zone of such vegetation for from one to several years with no significant adverse vegetation impact, depending on the type of vegetation, the type of soil, and the precipitation levels. In addition, this alternative would limit the use of the groundwater basin for water supply purposes by restricting water table fluctuations. Pumping rates would be limited and there would be less available underground storage space to be filled in wet runoff years, resulting in increased surface runoff flowing to Owens Lake, where it would evaporate.

Alternative 3 would establish a permanent, rigid limit on water table fluctuations at a time when it is believed that such permanent, rigid limits are not necessary to protect the Valley's vegetation. The Agreement requires that groundwater be managed to achieve such protection without imposing the conservative limits of Alternative 3.

6.2.4 ALTERNATIVE 4 - STABILIZATION OF THE WATER TABLE AT 1981 LEVELS

In the early 1980s, Inyo County developed a water management plan pursuant to a groundwater management ordinance. A goal of the plan was the stabilization of groundwater levels at 1981 levels by limiting pumping to a certain percentage of runoff in each of several identified hydrologic zones. This is the basis of groundwater pumping under this alternative. Pumping would be low in dry years and high in wet years, the opposite of LADWP's past practices and practices in most groundwater basins. Under this alternative, only the groundwater pumping provisions of the Inyo County management plan are incorporated; the other provisions of that plan are not included.

Elements of this alternative include:

- o Groundwater pumping would range from 50,000 AFY in some dry years, to as much as 160,000 AFY in very wet years. Long-term groundwater pumping would average approximately 70,000 AFY.

- o Water export from the Owens Valley would be an estimated 171,000 AFY, or about 23,000 AFY more than the no project alternative and about 19,000 AFY less than the proposed project.

- o Irrigation and surface water management practices in the Owens Valley would be the same as under the Agreement.

- o All enhancement/mitigation and LADWP environmental projects implemented since 1970 would be continued, except that in the Lower Owens River Project, water would be supplied to only the ponds that are part of the project; no water would be released to the river.

- o No new wells or groundwater recharge improvements would be constructed.

- o Groundwater pumping would be from wells constructed before and after 1970.

- o The provisions of the Agreement would not be implemented.

Environmental Effects in the Owens Valley

Average groundwater pumping levels under this alternative would be greater than the no project alternative and less than is estimated for the Agreement. The groundwater table would recover slowly to 1981 levels. Stabilization of the water table at these levels may not result in the water table being stabilized at a level where, in all areas of groundwater dependent vegetation, groundwater would be supplied to the vegetation rooting zone. Where the water table was stabilized at a level where water was permanently supplied to the rooting zone of groundwater dependent vegetation, the effects on such vegetation would be gradually beneficial. The limits on groundwater pumping in dry years would also benefit groundwater dependent vegetation in many areas because drought-induced stress would not be compounded by stress induced by groundwater pumping.

Since currently irrigated areas would continue to be irrigated, areas that are green today would remain so. Except for the lower Owens River channel, all enhancement/mitigation and LADWP environmental projects would also continue to be supplied with water, maintaining the wildlife and recreational values provided by those projects.

All of the impacts of the proposed project described in Chapters 8 through 15 would occur. There would be no other impacts under this alternative. The impacts of this alternative would be mitigated as described in Chapters 8 through 15, except that mitigation provided by the release of the permanent flow in the channel of the lower Owens Rive from Blackrock Ditch to the Delta would be decreased. However, a flow in portions of this reach of the river would probably exist because of increased flow from springs discharging into the channel, which would result from a reduction in groundwater pumping from current levels.

This alternative would achieve Los Angeles' basic project objective of obtaining additional water for export, although in an amount less than estimated under the proposed project. The estimated long-term pumping rate of 70,000 AFY assumes high pumping in wet years, which would not be feasible because of limited aqueduct and reservoir storage capacities. Therefore, the actual long-term pumping would likely be less than 70,000 AFY. Under Alternative 4, the water table would be stabilized at 1981 levels (the goal of Inyo County's groundwater management plan), but groundwater pumping would not be deliberately managed to protect groundwater dependent vegetation as provided under the Agreement. Therefore, there may be greater impacts to this vegetation under Alternative 4 than under the proposed project. In addition, this alternative provides less water supply flexibility because it requires the greatest pumping in wet years when groundwater is not needed and limits pumping in dry years.

6.2.5 ALTERNATIVE 5 - WATER MANAGEMENT WITH NO AGREEMENT

This alternative is the project Los Angeles would propose to implement if the Agreement is not approved. Under this alternative, LADWP would manage groundwater based on the principles and goals of the Agreement, but all the provisions of the Agreement would not be implemented by LADWP. Monitoring and groundwater pumping and surface water management decisions would be made independently by LADWP rather than through a joint management process with Inyo County. Elements of this alternative include:

- Long-term groundwater pumping is estimated to be in the range of 100,000 to 115,000 AFY, including water pumped for enhancement/mitigation projects. The actual pumping in any year will be determined by LADWP based on numerous factors including vegetation conditions, soil moisture conditions, sources of water available to Los Angeles, reservoir storage levels, and aqueduct maintenance needs. Groundwater facilities would be operated with the goal to cause no significant decease or change in vegetation and to cause no significant adverse effect on the environment.

- o LADWP would implement an extensive vegetation and groundwater monitoring program as defined in the Green Book.
- o Water export from the Owens Valley is estimated to range from 194,000 AFY to 209,000 AFY depending on pumping levels. For purposes of analysis, pumping is assumed to be 110,000 AFY, the same as the proposed project, and export is estimated to be 204,000 AFY. That is about 56,000 AFY more than the no project alternative and 14,000 AFY more than the proposed project.
- o LADWP would utilize vegetation mapping and management areas as provided in the Agreement.
- o LADWP would construct 15 new wells and improvements to groundwater recharge facilities as described in the proposed project. Wells constructed and/or operated before and after 1970 could be operated.
- o Improvements to parks and campgrounds, salt cedar control, and the Big Pine Ditch System, as provided in the Agreement, would not be implemented.
- o Los Angeles would support efforts to transfer the town water systems to Inyo County or other entity under future terms to be negotiated.
- o Irrigation of Los Angeles-owned lands and surface water management practices in the Owens Valley would be the same as in the period 1970-1990, with 11,600 acres of Los Angeles-owned lands provided a firm irrigation supply, except in very dry years such as 1977.
- o Existing enhancement/mitigation and LADWP environmental projects implemented since 1970 would be continued, except the Lower Owens River Project would be modified. Water would be provided for wildlife habitat elements of the project, including ponds and lakes, but the river would not be maintained as a warm water fishery, and the lower Owens River pumpback station would not be constructed.

Environmental Effects in the Owens Valley

LADWP's adherence to the vegetation and environmental protection goals of the Agreement would protect the environment of the Valley. The effects on groundwater levels would differ from the period between 1970 and 1990 because LADWP would construct 15 new wells and modify existing recharge facilities as described in Chapter 16, Ancillary Facilities, to allow LADWP more operational flexibility. Groundwater and surface water would be managed by LADWP to avoid significant decreases or changes in vegetation from conditions documented during the 1984-87 vegetation inventory and other significant effects on the environment.

All of the impacts of the proposed project described in Chapters 8 through 16 would occur and such impacts would be mitigated as described in those chapters, except that permanent release of water to the Owens River channel would not occur.

This alternative would achieve Los Angeles' basic project objective of obtaining additional water for export. However, there would be no joint water management by Inyo County and LADWP as would occur under the Agreement. Under such circumstances, the potential for disputes and litigation between Inyo County and LADWP is increased.

6.2.6 ALTERNATIVE 6 - GROUNDWATER MANAGEMENT IN ACCORDANCE WITH PUMPING TABLE CONTAINED IN LOS ANGELES/INYO COUNTY INTERIM AGREEMENT

The interim agreement between Los Angeles and Inyo County contains a pumping table that defines the maximum amount of groundwater LADWP can extract in a given year in the event Los Angeles and Inyo County cannot agree on an annual pumping program. Although the provisions of that table have never been invoked, the pumping amounts on that table are the basis of this alternative. The pumping table allows increasing pumping rates as runoff declines as shown below. The table excludes groundwater pumping to supply enhancement/mitigation projects (any such groundwater pumping is in addition to the rates shown below).

Owens Valley Runoff % Normal	Maximum Annual Pumping (Acre-Feet)
100% or over	106,000
90-99%	130,000
80-89%	160,000
70-79%	185,000
60-69%	205,000
Under 60%	210,000

Elements of this Alternative include:

- Estimated maximum long-term pumping of 148,000 AFY including water pumped for enhancement/mitigation projects; average pumping would be less than 148,000 AFY.
- Water export from the Owens Valley would be an estimated 223,000 AFY, or about 75,000 AFY more than the no project alternative and 33,000 AFY more than the proposed project.

- o Maximum dry year pumping of 210,000 acre-feet excluding water pumped for enhancement/mitigation projects.
- o Irrigation and surface water management practices in the Owens Valley would be the same as in the period 1970-1990 with a firm irrigation supply provided to 11,600 acres of Los Angeles-owned lands, except in very dry years such as 1977.
- o Continuation of enhancement/mitigation projects including flow releases to the Lower Owens River Project. Water for these projects would come from enhancement/mitigation wells and would be in addition to amounts indicated in the above table.
- o Construct 15 new wells and groundwater recharge improvements as described in the proposed project. Wells constructed and/or operated before and after 1970 could be operated.
- o The provisions of the Agreement would not be implemented.

Environmental Effects in the Owens Valley

Under this alternative groundwater levels would be expected to fall until they reach equilibrium with the increase in average rate of groundwater extraction. Vegetation dependent on groundwater would be eliminated from some parts of the Valley, causing significant adverse impacts to vegetation, air quality and wildlife habitat. Groundwater pumping would not be managed to avoid significant decreases and changes to vegetation as would be the case under the Agreement.

6.2.7 ALTERNATIVE 7 - WATER MANAGEMENT TO FILL BOTH LOS ANGELES AQUEDUCTS

Under this alternative, groundwater pumping and surface water would be managed to provide an average export from Haiwee Reservoir of 481,000 AFY -- the export capacity of the first and second aqueducts. For the purpose of this analysis, it is assumed that average export from the Mono Basin would be 50,000 AFY.

Elements of this alternative include:

- o Long-term groundwater pumping averaging 180,000 AFY. Maximum annual pumping would be 280,000 AFY.
- o Water export from the Owens Valley would be an estimated 282,000 AFY or about 134,000 AFY more than the no project alternative and an estimated 92,000 AFY more than the proposed project.

- o Twenty-eight new wells would be constructed and operated by LADWP and all wells built before or after 1970 would be operated.
- o A vegetation and groundwater monitoring program would be implemented by LADWP and pumping decisions would be made by LADWP to minimize significant adverse impacts to the environment.
- o Irrigation of 11,600 acres of Los Angeles-owned lands in the Owens Valley would continue with a firm irrigation supply provided.
- o Environmental projects implemented after 1970 and before 1985, including Billy and Twin Lakes and Farmer's and Lone Pine Ponds, would be continued.
- o All enhancement/mitigation and LADWP environmental projects implemented since 1985 would be discontinued, including the Lower Owens River Project.
- o The provisions of the Agreement would not be implemented.

Environmental Effects in the Owens Valley

Under this alternative groundwater levels in the Valley would be expected to fall until they reach equilibrium with the increase in average rate of groundwater extraction. Vegetation dependent on groundwater would be eliminated from many parts of the Valley, causing significant adverse impacts to vegetation, air quality and wildlife habitats.

6.2.8 IMPLICATIONS OF OWENS VALLEY ALTERNATIVES FOR LOS ANGELES

Different water management alternatives for the Owens Valley would have different water export implications for Los Angeles. Four of the alternatives would increase the amount of water exported to Los Angeles from the Owens Valley when compared to the proposed project, while three of the alternatives (including the no project alternative) would yield less water for export than the proposed project.

Except for the no project alternative, the effects of these alternatives on Los Angeles would be beneficial in that they would increase the proportion of Los Angeles's water supplies drawn from the Owens Valley, and reduce the pressure on the City's other sources of supply. Together with water from the Mono Basin, Owens Valley water is Los Angeles's highest quality source. In addition, water conveyed from the Owens Valley to Los Angeles generates hydroelectric power en route. The consequences of the Owens Valley water management alternatives for water supply in Los Angeles are summarized in Table 6-1.

If the no project alternative was implemented, Los Angeles's water supply from the Owens Valley would be reduced by an average of 42,000 AFY compared to the proposed project. This is an estimate, because the actual long-term average reduction would depend on the amount of groundwater pumping that could occur under the Agreement Los Angeles has relied on increased exports from the Owens Valley since 1970 and a loss of 42,000 AFY would represent 6.5 percent of the Los Angeles's currently available water supply. LADWP believes that it would not be feasible to replace this quantity of water with reclaimed water in the immediate future or to implement additional conservation measures to reduce water demand by this amount. The shortfall in supply would be made up by LADWP purchasing water from MWD.

The alternative sources of replacement water for Los Angeles are described in Section 6.3, together with their environmental and other implications for Los Angeles and the State of California.

6.3 ALTERNATIVE WATER SUPPLIES FOR LOS ANGELES

This section analyzes the options available to Los Angeles to replace or conserve water if one of the alternatives were to be implemented that would result in less export of water than under the proposed project. Because California relies on a large and complex water supply system, a change in one part of the system will almost inevitably affect other parts, sometimes hundreds of miles away. Thus, Los Angeles' efforts to replace water if the no-project or certain other project alternatives were to be implemented could have ramifications elsewhere in the State. Such geographically-widespread environmental consequences are also described in this section.

The alternative water supplies for Los Angeles are:

- Growth Limitations
- Expanded Water Conservation
- Increased Use of Los Angeles River Groundwater Basin

TABLE 6-1

EFFECTS OF OWENS VALLEY WATER MANAGEMENT ALTERNATIVES ON LOS ANGELES

Alternative	Water Gained or Lost Relative to the No Project Alternative and the Proposed Project[1]	
	No Project AFY	Proposed Project AFY
1 No Project		-42,000
2 No Increased Groundwater Pumping/ No In-Valley Irrigation	+62,000	+20,000
3 Water Management by Maintaining Water Tables in Vegetation Rooting Zones	+5,000	-37,000
4 Stabilization of Water Table at 1981 Levels	+23,000	-19,000
5 Water Management With No Agreement	+56,000	+14,000
6 Groundwater Management in Accordance With Pumping Table	+75,000	+33,000
7 Water Management to Fill Both Los Angeles Aqueducts	+134,000	+92,000
Proposed Project[2]	+42,0000	

[1] To assist in the comparison of the water management alternatives, runoff is assumed to be the same for all of the alternatives -- that is, the average recorded runoff in the Owens Valley from 1945 to date. Because of this, the difference between the numbers shown for water export from the Owens Valley in the pre-project and the Agreement (60,000 AFY) on Table 5-1 of Chapter 5, differs from the 42,000 AFY used in this comparison.

[2] Shown for comparison.

- Increased Purchase of Water from Metropolitan Water District (MWD)
- Increased Export from the Mono Basin
- Expanded Water Reclamation
- Seawater Desalination
- Water Transfers

6.3.1 GROWTH LIMITATIONS

The Los Angeles City Council, an elected body, establishes the City's policies regarding growth. These policies are exposed through the Los Angeles General Plan and 35 individual Community Plans. The plans are currently being revised in a process expected to take about five years.

At present, Los Angeles does not have a specific growth management plan, although some ultimate limitations result from the land use designations and zoning in the General and Community Plans. In 1989, Los Angeles acted to slow growth because of limits on its ability to treat and dispose of wastewater. This constraint will be removed in the mid-1990s when a new sewage disposal plant comes into operation. By that time, Los Angeles may have a growth management plan in place; development of such a plan is just beginning.

Los Angeles could choose to limit growth in order to halt the increase in water demand. Some communities have done this when water demand exceeds available supply. For example, the City of Santa Barbara and the Marin Municipal Water District have both implemented ordinances limiting new connections to their water supply systems until new supplies become available. Los Angeles is unlikely to take similar action because its water supplies are less constrained than those of Santa Barbara or Marin County. If Los Angeles cannot obtain water from the proposed project, it would likely increase its purchases of water from MWD rather than institute growth controls. Growth controls are usually viewed as a last resort because of their adverse economic and political impacts. In addition, some question the practicality of controlling water demand by banning new water connections since population and water demand growth may continue anyway, due to higher occupancy rates in existing household units.

Environmental Effects

Limiting growth in the City of Los Angeles is unlikely to produce environmental benefits in the region because growth would likely be induced in adjacent communities. Water demand might remain stable in Los Angeles but grow elsewhere, so that the pressure on the water resources of Southern California would remain the same. At present, Los Angeles has an imbalance between jobs and housing. Many workers commute into Los Angeles to their jobs. This imbalance has adverse effects on air quality because it encourages commuting. If growth is limited in Los Angeles, the present jobs/housing imbalance could become greater.

Most of the new development in Los Angeles involves redevelopment of already urbanized areas. If growth is exported to neighboring communities, urbanization of presently undeveloped lands may accelerate with associated impacts on natural resources.

6.3.2 EXPANDED WATER CONSERVATION

Since the 1976-77 drought many California water purveyors have been using water conservation as one means of maintaining a balance between supply and demand. By increasing the efficiency of water use, the need for new source development is reduced or delayed.

Los Angeles already has a comprehensive water conservation program including education, dissemination of information to the public, water conservation ordinances, incorporation of water-saving devices in new construction, retrofitting of water-saving devices in existing structures and improved distribution system management to minimize leakage. A detailed description of the existing program can be found in Chapter 3. Additional water could be conserved if the existing water conservation program was expanded.

Elements that might be incorporated into an expanded water conservation program include:

- more complete and rapid retrofit of low-flow showerheads and toilet tank displacement devices in existing single-family structures;
- retrofit of existing structures with ultra-low-flush toilets;
- water audit program;
- increasing block rate water pricing structure; and

Los Angeles has already implemented some of the elements and is studying or testing others, recognizing that some of these programs could potentially be expanded.

Table 6-2 compares the elements of an expanded conservation program with related elements of the existing conservation program. Each of the elements of a possible expanded conservation program are described below. LADWP has reservations about the practicality and cost effectiveness of some of the expanded program elements. Where this is the case, it is so noted.

Retrofit of Existing Structures

Los Angeles has distributed more than 2.4 million free interior plumbing retrofit kits since 1981. The kits consist of shower flow restrictors or low-flow showerheads and toilet tank flush reduction devices. It is estimated that 60 percent of the structures currently have these devices installed.

In 1988, City Ordinance 163532 made mandatory the installation of low-flow showerheads and toilet tank displacement devices in existing structures. All commercial, industrial and multifamily residential customers must certify that conservation devices have been installed. Failure to do so attracts financial penalties. Based on certifications received to date, over 75 percent of these customers have complied with the ordinance. Enforcement of the retrofit requirement for single-family homes is less vigorous in that no penalties for noncompliance are imposed; however, installation of water-saving devices is a mandatory condition of sale, or exchange. While there appears to be no reason to change the procedures for ensuring that water-saving devices have been installed in commercial, industrial and multi-family residential structures, measures could be taken to increase the effectiveness of the program for single-family homes. Possibilities include implementation of a certification program similar to that used for multifamily structures and the imposition of penalties for noncompliance. Los Angeles is now also offering free installation of water saving devices in a pilot door-to-door program covering 100,000 single-and duplex-family residences. The pilot program is expected to cost $2.2 million. If this pilot program proves successful, it could be expanded to cover the entire city.

Assuming the installation of the water-saving devices would save 20 gallons per household, per day, and 50 percent of the targeted households install the devices themselves or consent to installation by the City, then the pilot program would save 1,120 AFY. An estimated 450,000 single-family and

TABLE 6-2

WATER CONSERVATION PROGRAM ELEMENTS

Element	Existing Program	Potential Expanded Program
Retrofit of low-flow shower heads and toilet tank displacement devices into existing structures	Mandatory, but with limited enforcement provisions. Supported by availability of water-saving kits at LADWP offices.	Increased enforcement of retrofit ordinance for single-family residences. City-wide door-to-door distribution of water-saving devices.
Retrofit of ultra-low-flush toilets into existing structures.	Existing program offering $100 rebate for installation.	Continue existing program indefinitely to get greater participation.
Water audit program to aid customers in saving water.	Audit of Los Angeles's 250 largest water users required under Ordinance 163532, offered to all customers during current drought.	Make available teams of technicians to audit residential, commercial and industrial water use on request as a permanent program.
Water pricing to encourage conservation.	Uniform rate structure with summertime water use surcharge.	Increasing block rates that penalize high water users.
Control of water use for landscape irrigation.	Education and demonstration programs. Large user audits. Low water use landscaping required for new industrial, commercial and multi-family residential developments.	Rebates or financial incentives offered to existing customers that convert to lower water use landscaping.

Source: LADWP, August 1990.

duplex residences could qualify for this program. Following the pilot study, Los Angeles will have information on expected responsiveness to such a program and estimated retention of water conservation devices.

Ultra-Low-Flush Toilets

Ultra-low-flush toilets use 1.6 gallons of water per flush compared to about 5 gallons for a standard toilet. Clearly, if standard toilets were replaced with ultra-low-flush toilets, considerable water savings would result. Several cities in California, including Goleta, Santa Barbara and Santa Monica, are encouraging toilet replacement by offering rebates on water bills for each ultra-low-flush toilet installation.

The City of Los Angeles has begun a multi-year pilot program intended to encourage the replacement of an anticipated 7,500 standard toilets per year with ultra-low-flush models by offering a $100 rebate per toilet replaced. The annual program cost is expected to be $950,000. If the rebates prove insufficient to encourage toilet replacement, the program could be modified to increase the participation rate.

The toilet replacement program could be expanded with the goal of replacing most of the standard toilets in use in Los Angeles. LADWP estimates a water saving of 21 gallons each day for every toilet installed. If half the estimated 1.1 million households in Los Angeles each replaced one standard toilet with an ultra-low-flush unit, then the savings would be about 23,000 AFY. Based on a $100 rebate per toilet, the cost of such a program would be approximately $60 million. It is unknown if a $100 rebate would provide sufficient incentive to cause a voluntary replacement of 550,000 toilets. This is a theoretical calculation in that ultra-low-flush toilets have yet to be used on a large scale. Some critics argue that the toilets often flush inefficiently, leading the user to flush a second time.

Water Audit Program

The purpose of this program would be to help water users understand their water use, with the goal of reducing it. At the request of a customer, LADWP technicians would survey the premises, analyze water use and recommend methods for reducing interior and exterior water use. This program could be combined with the plumbing retrofit program so that each audit would include distribution or installation of a water conservation kit as well as leak detection and repair. Several water agencies in California offer an audit program, including the cities of Pasadena and San Jose and East Bay Municipal Utility District in the San Francisco Bay Area. Los Angeles implemented a program of this kind for several years but discontinued it due to lack of interest by customers. The program has been reactivated as part of the response to the drought emergency. It could be retained once the drought is over.

It is unclear how much water programs of this sort can save, but their use may be justified regardless of the savings because of their value as educational and public awareness tools.

Water Pricing

Los Angeles currently uses a uniform water rate structure with a seasonal surcharge. Customers pay 25 percent more for water used during the summer months. The rate structure could be changed to a series of increasing price block rates. A customer would pay a relatively low unit price for the first block rate, which might represent a modest or "lifeline" level of water use. Each succeeding block would have a higher unit price, thus increasing the average unit cost to high water users. A number of water suppliers, including the cities of Tucson, Goleta, Palo Alto and Santa Monica and Las Virgines Municipal Water District, have implemented increasing block rates.

Although increased block rate water pricing would be expected to produce some water savings, the extent of those savings remains unknown. In general, water costs represent a very small portion of total household costs in the United States. It is unclear whether individual habits would be greatly affected by increases in water bills that are still small compared to energy or telephone costs.

LADWP believes that the efficacy of escalating block rate pricing has yet to be demonstrated. Furthermore, increasing the price of water above the actual cost of its delivery would likely be met with public and political opposition in Los Angeles. In 1989 the City of Phoenix discontinued its increasing block rate pricing program (implemented in 1982) due to difficulties in revenue forecasting and complications in dealing with the rate blocks. Phoenix has returned to a seasonal pricing program similar in concept to Los Angeles. The City of Tucson is also considering ending its increasing block rate program for the same reasons.

Landscape Controls

Water use for landscape irrigation can be reduced by imposing controls on the types of landscape permitted or by providing incentives for replacement of high water-using landscaping. Los Angeles already requires that new industrial, commercial and multi-family developments install landscaping that requires low water use. This program could be made more restrictive, allowing, for example, no more than 25 percent of a lot to consist of turf or limiting high water use landscaping to no more than 10 percent of the total landscaped area. It could also be extended to all new single-family homes.

Rebates could be offered to single-family homeowners in return for their replacing high water using landscaping with "hardscape," or low water using vegetation. North Marin Water District pays its customers 0.50 cents per square foot of turf converted to hardscape or low water using plant material.

Outdoor water use accounts for an estimated 25 percent of Los Angeles's total water use and nearly 30 percent of single family housing residential water use according to a recent MWD study. Clearly, measures designed to cut outside water use are effective in reducing total water demand. The contribution of rebate programs, such as that employed by North Marin Water District, to water savings is not fully known since the program has only recently been implemented.

Conclusions

It is difficult to estimate the effectiveness of water conservation programs, particularly those that rely on education, public information and financial incentives. The goal of Los Angeles's 1988 water conservation ordinance is to achieve a 10 percent reduction in per capita water consumption by 1993. An expanded water conservation program would be expected to produce some incremental but presently unquantifiable benefit beyond that attainable with the existing program. Because of the media attention to the drought, new conservation activities and increasing public awareness of the need to conserve water, water consumption in Los Angeles during the spring and summer months of 1990 has been an estimated 10-15 percent below anticipated normal consumption.

Environmental Effects

The environmental effects of expanded water conservation would be minimal. There would be no adverse environmental effects and there may be some modest energy savings as a result of the reductions in hot water use.

6.3.3 INCREASED USE OF LOS ANGELES RIVER GROUNDWATER BASIN

Los Angeles's groundwater rights in Southern California total 111,200 AFY, consisting of 91,600 AFY from the San Fernando Basin, 3,100 AFY from the Sylmar Basin, 15,000 AFY from the Central Basin, and 1,500 AFY from the West Coast Basin. Los Angeles has not pumped its West Coast Basin entitlement in recent years due to poor water quality and the lack of suitable treatment facilities. Thus, in practice, the amount of Los Angeles River Basin groundwater available to Los Angeles averages 109,900 AFY. The City's groundwater rights are already fully utilized, and consequently, there is no possibility of increasing the amount of groundwater taken unless additional water is recharged.[1]

Additional recharge and storage of water in the San Fernando Basin is possible because imported water supplies and spreading grounds are available and the basin currently has unused storage space. In the past, Los Angeles has stored as much as 195,000 acre-feet in the basin and currently has a stored water credit of about 150,000 acre-feet. This stored water may be pumped by Los Angeles over and above its annual pumping rights in the basin.

LADWP estimates that about 250,000 acre-feet of unused capacity is currently available in the San Fernando Basin for additional storage. Use of this available capacity by storing water in wet years and pumping it in dry years would allow an increase in long-term extractions from the basin. Several constraints and unresolved issues make it difficult to estimate the potential increase in pumping that would result from utilizing the available storage. One of the primary constraints is the effect of increasing storage and extractions on current and planned programs to clean-up extensive quantities of contaminated groundwater in the basin. Other factors that must be considered include future availability of surplus water in wet years; the amount of storage space that needs to be reserved in conjunction with spreading reclaimed water from the Tillman Water Reclamation Plant; spreading basin limitations; location and capacity of existing and future groundwater production facilities; and a determination of feasible basin "cycling" or storage change.

LADWP is currently constructing new groundwater extraction and distribution facilities in order to make greater use of the basin's storage. The Department had been building its stored water credits in the basin prior to the current drought and expects to continue increasing storage in the future when water supply conditions improve. Los Angeles anticipates increasing its conjunctive use of the San Fernando Basin in the future to provide increased water supply capability during drought periods.

Much of the stormwater runoff that flows into the Los Angeles River is already stored and spread to recharge groundwater basins. The storage and spreading facilities are operated by the Los Angeles County Flood Control District (LACFCD), the U.S. Army Corps of Engineers, and LADWP. In years of high runoff, flow exceeds the capacity of the storage and spreading facilities and considerable quantities of water escape to the ocean. On average, 40,000 AFY flows to the Pacific Ocean. A portion of this water could be conserved for use if additional storage and spreading facilities were built. Studies by LACFCD indicate that an average of 11,000 AFY could be conserved by constructing a new spreading basin in Dominguez Hills and by increasing the capacity of Hansen Reservoir by removing accumulated silt. It is not clear what portion, if any, of the conserved water might be available to LADWP.

Environmental Effects

The environmental effects of further development of the Los Angeles River groundwater basin are unknown, but probably not significant.

6.3.4 INCREASED PURCHASE OF WATER FROM METROPOLITAN WATER DISTRICT (MWD)

MWD is the wholesale distributor of Colorado River water and State Water Project (SWP) water to most of the metropolitan Southern California coastal area, including Los Angeles. MWD supplies approximately half of the water used in its service area, which consists of portions of Los Angeles, Orange, Riverside, San Bernardino, Ventura, and San Diego Counties. The MWD service area is home to approximately 14.9 million people. Twenty-seven water agencies are members of MWD, including Los Angeles.

Preferential Rights and Water Sources

Although the City of Los Angeles has a significant preferential right to MWD water, it has rarely relied heavily on it as a water source except during droughts since the second Los Angeles Aqueduct was completed in 1970. Water from the other sources available to Los Angeles is less expensive and of better quality than MWD water. LADWP has consequently striven to limit purchase of MWD water unless necessary due to reductions in import from Inyo and Mono Counties. Table 6-3 shows annual purchases from MWD by LADWP from 1963 to 1990. Los Angeles has a preferential right to approximately 26 percent of MWD's water supply. This preferential right is based on the total amount of property taxes paid by Los Angeles to MWD since MWD's inception.

To date MWD has not allocated water supply to its member agencies on the basis of preferential rights. Historically MWD has had sufficient water available to meet all requests from member agencies. Some agencies have taken advantage of the water available and have consistently purchased more than their preferential right, and they have developed a dependence on MWD water which exceeds their legal entitlement. Water demand within the MWD service area continues to increase while firm supplies are limited. When demand exceeds supply, MWD members who have come to rely on surplus conditions may be restricted to only their preferential right. It is possible that such restrictions could lead to challenges to the present structure of preferential rights.

MWD obtains its water from the Colorado River and from the State Water Project (SWP). Because of the relative costs of pumping Colorado River and SWP water, MWD has taken as much water from the former source as possible. In the future it is expected that MWD will obtain less water from the Colorado River and will therefore have to rely more heavily on the SWP.

MWD's Colorado River Water

Use of waters of the Colorado River Basin are managed and apportioned among the states that the river passes through, in accordance with a body of interstate compacts, legislation, contracts, court decrees and an international treaty known collectively as the "Law of the River." Under the terms of the Law of the River, California is entitled to use of 4.4 million AFY of Colorado River water and one-half of any surplus water that may be available from the river. Use of water in

TABLE 6-3

MWD PURCHASES BY LOS ANGELES

Fiscal Year	Amount (AF)	Fiscal Year	Amount (AF)
1963	73,000	1977	109,000
1964	78,100	1978	46,000
1965	80,000	1979	19,000
1966	83,000	1980	21,000
1967	97,000	1981	46,000
1968	94,000	1982	35,000
1969	118,000	1983	26,000
1970	147,000	1984	29,000
1971	52,000	1985	47,000
1972	60,000	1986	90,000
1973	33,000	1987	128,000
1974	25,000	1988	151,000
1975	32,000	1989	230,000
1976	25,000	1990 (est.)	395,000

Source: Los Angeles Department of Water and Power, Statistical Reports.

California by holders of present perfected rights, including Native Americans is about 30,000 AFY. Agricultural users in the Imperial, Palo Verde, Yuma and Coachella valleys have a priority to a beneficial consumptive use of 3.85 million AFY of California's 4.4 million AFY apportionment, less the amount of water made available by Imperial Irrigation District under a Water Conservation Agreement and Approval Agreement with MWD. MWD has priority to 550,000 AFY, plus an additional 662,000 AFY of any water available for California. Under the operating criteria, prior to 1985, MWD was assured of sufficient water to satisfy its full entitlement. Thus, MWD could count on a Colorado River supply of 1,212,000 AFY.

As other basin states take more of the water to which they are entitled, less water will be available for California. In December 1985, the Central Arizona Project commenced operations and under the river operating criteria, the Secretary of the Interior annually determines the availability of water. In the future, MWD will likely be limited to 576,110 AFY, plus an unknown amount of surplus and unused water in certain years. MWD expects to receive 900,000 acre-feet from the Colorado River in 1990 and less in 1991 unless it is successful in negotiating agreements with the other California agencies to make additional water available.

MWD is pursuing a number of measures that would increase the amount of Colorado River water available to it in the future. A program was recently implemented in which MWD is funding a number of water conservation projects within the Imperial Irrigation District, and is receiving the conserved water. This program and other programs that may be implemented would partially offset the loss of water from the Colorado River. Consequently, MWD will need to rely more heavily on State Water Project water in the future as its Colorado River supply declines.

MWD's State Water Project Water

The SWP, as originally conceived and approved by the Legislature and the voters, is to ultimately deliver a firm yield of approximately 4.2 million AFY. Existing SWP facilities, however, are capable of delivering a firm yield of only 2.3 million AFY. This is substantially less than the 1990 demand for SWP of 3.1 million AF. MWD's entitlement to SWP yield amounts to approximately 1.1 million AFY.

With only existing facilities, the firm yield of the SWP would gradually decrease to approximately 2.2 million AFY in 2000 as upstream development reduces the amount of surplus water available for export by the project. In 1984, the California Legislature authorized feasibility and planning studies for a Los Banos Grandes Reservoir. If constructed, the reservoir would provide additional storage south of the Sacramento/San Joaquin Delta sufficient to increase the firm yield of the SWP by up to 275,000 AFY. Also, in 1986, an agreement was reached between the California Department of Water Resources (DWR) and the United States Bureau of Reclamation, operator of the Federal Central Valley Project (CVP), to provide for further coordinated operation of the SWP and CVP. The Coordinated Operation Agreement, as it is known, improves the efficiency with which project water releases necessary to meet Delta water quality standards are made. This is accomplished by providing for further coordinated management of the two projects. The Coordinated Operation Agreement, has increased the firm yield of the SWP by an additional 200,000 AFY.

Other projects for increasing the yield of the SWP are under study by DWR. These include possible use of interim surplus CVP water, construction of Los Vaqueros Reservoir south of the Delta and construction of the Kern River Bank groundwater storage facility in the San Joaquin Valley.

The amount of water that the SWP can deliver south of the Delta may also be affected in the future by the State Water Resources Control Board's (SWRCB) review of Delta water quality standards. Diversion of water from the Delta by the SWP and the CVP is strongly influenced by the need to meet water quality standards in the Delta. The SWRCB's Delta hearings began in 1988 and are expected to conclude in 1991. If the SWRCB promulgates new standards for the delta that are stricter than those in effect today. The SWP's ability to deliver water south of the Delta could be reduced.

MWD's Other Water Supply Programs

MWD has developed several new and innovative water storage, transfer, reclamation, and conservation programs in the recent years to supplement its conventional water sources and to stretch existing supplies. Some of these are described below.

An agreement between MWD and the Imperial Irrigation District will improve Imperial's irrigation efficiency and provide 100,000 acre-feet of water annually to MWD. A similar conservation program calling for the lining of the All-American and Coachella canals in Imperial and Riverside counties was authorized by Congress. Southern California will pay for the lining in return for the water saved.

MWD and the Arvin-Edison Water Storage District developed a water storage project which, following necessary approvals, will allow some of MWD's unneeded supplies in wet years to be stored by Arvin-Edison in an underground aquifer in the southeastern corner of the San Joaquin Valley. In later dry periods, MWD will receive about 100,000 acre-feet annually of Arvin-Edison's surface supplies while the agricultural agency tape the stored groundwater to meet its needs.

In 1981, MWD launched a local projects program aimed at increasing the use of reclaimed water in Southern California. Under this program, MWD provides financial assistance to qualifying projects. As of March 1990, 17 projects totaling 41,585 AFY had been approved and 12 others, expected to reuse 35,800 AFY were under consideration.

MWD also provides financial assistance to member agencies who implement programs to promote water conservation primarily through fixture modification (low flow shower heads, etc.). This program, called the Water Conservation Credits Program, provides $154 per AF or up to 50 percent of the projected cost, whichever is less, toward the implementation of approved water conservation measures by MWD agencies or subagencies. Adopted in September, 1988, the program is projected to provide water savings through conservation of up to 250,000 AFY by the year 2010.

Conclusions

Despite uncertainties with respect to the issue of preferential rights and to MWD's share of Colorado River and SWP water, it is clear that Los Angeles could rely on MWD more heavily as a water source than it has in the past. Use of additional MWD water would thus be an optional replacement source of water for Los Angeles if an alternative were to be adopted that would provide LADWP with less water from the Owens Valley than it would receive under the proposed project.

MWD currently projects that a possible water shortage of 340,000 AFY, based on normal demand and average year water conditions. The projected shortage could exceed 700,000 AFY based on normal demands and existing "dependable" dry year water supply. While the MWD continues to identify and develop new water supply and conservation programs, it appears MWD may be unable to supply the needs of its member agencies. Any increase in the use of MWD water by Los Angeles would aggravate local water supplies and have adverse impacts on other Southern California communities that depend on MWD. As noted earlier, if Los Angeles increased its purchase of water from MWD, MWD would attempt to obtain most of the additional water from the SWP. The SWP's yield is limited by the need to meet water quality standards in the Sacramento-San Joaquin Delta and by the capacity of its facilities. If MWD used more of its entitlement to SWP water, then other users throughout much of the State would receive less water. In wet and normal years, SWP sells water that is surplus to its own needs to agricultural users in the San Joaquin Valley. Less surplus water would be available to these agricultural users if MWD increased its take from the SWP.

In dry years no surplus water is available. All the water available to SWP is used to meet the needs of SWP's own contractors. In very dry years SWP cannot meet the needs of its contractors and must impose reductions in water deliveries. If MWD takes more water from SWP, then the reductions imposed on all its contractors will be more severe.

Environmental Effects

The environmental consequences of Los Angeles relying more heavily on MWD for water and MWD, in turn, relying more heavily on the SWP are unclear because water quality standards in the Delta must be complied with. Regardless of who is using the diverted water, it seems unlikely that the Delta and its natural resources would be adversely affected by increased diversions to a significant degree. Even though Delta standards are complied with, the possibility of other environmental effects cannot be ruled out in the event there are increased SWP diversions.

A disadvantage of increased reliance on MWD water is that it is of poorer quality than Los Angeles Aqueduct water. In general, the mineral quality of Delta water is better than Colorado River water, and aqueduct water quality is better than both. The differences in water quality are the result of differences in watershed characteristics. Aqueduct water originates in undeveloped mountain watersheds that are little affected by man's activities. While Delta water also derives to a considerable extent from mountain watersheds, it flows through the intensely-developed Sacramento area and San Joaquin Valley en route to its diversion point. Water quality is affected by urban and agricultural drainage and waste discharges within the developed valleys.

Probably the most important difference in quality between aqueduct and Delta water is their respective trihalomethane formation potential. When water is disinfected, chemical compounds are formed by the interaction between chlorine, bromide and naturally occurring, organic matter in the water. These substances, called trihalomethanes, have been shown to cause cancer in laboratory animals. The higher the organic content of water, the more trihalomethanes are formed during chlorination. Because Delta water has a much higher organic content than Los Angeles Aqueduct water, it has a greater potential to form trihalomethanes. Delta water treated at MWD's San Fernando Valley water treatment plant has a total trihalomethane content of about 70 parts per billion. Aqueduct water treated at LADWP's San Fernando Valley plant has a total trihalomethane content of 15 parts per billion. The current federal standard for trihalomethane content in drinking water is 100 parts per billion, but this is expected to be reduced to 50 or perhaps even 25 parts per billion by 1994. If the federal standards are made more stringent, Delta water would have to be treated to a greater degree than it is today in order to meet the standards. This may not be the case with Owens Valley water.

The differences in water quality between Delta water and aqueduct water are unlikely to translate into major differences in public health consequences. Drinking water from any source would have to meet increasingly stringent federal standards for drinking water quality. Currently, 93 potential contaminants are regulated, with another 25 to be regulated at five-year intervals. The new standards are based on an analysis and prediction of human health effects primarily inferred from animal tests. Very large factors of safety are built into the standards so that the risk to public health posed by water not meeting the standard is very low.

Another disadvantage of increased reliance on MWD water is the fact that it would increase energy use. Because the additional water needed would come from the SWP, it would have to be pumped over the Tehachapi Mountains to reach Los Angeles. About 3,170 Kilowatt-hours (Kwh) of electrical energy are required to deliver an acre-foot of SWP water to Los Angeles. Owens Valley water, on the other hand, produces 1,030 Kwh/AF as it is conveyed to Los Angeles. When the energy cost of groundwater pumping is taken into account, replacement of 100,000 AFY of Owens Valley groundwater and surface water with MWD water would increase energy use by approximately 403 million Kwh each year, or about two percent of Los Angeles's total energy consumption in 1988. This is roughly equivalent to the annual energy use of 70,000 households.

The future availability of water to MWD from all sources is affected by several uncertainties discussed below, but it is unlikely that MWD's total available supply would be less than 1,500,000 AFY. Based on preferential rights, Los Angeles's share would be approximately 400,000 AFY: almost ten times LADWP's average purchase in the period 1970 to 1989 and about equal to the estimated purchase in Fiscal Year 1989-1990.

6.3.5 INCREASED EXPORT FROM THE MONO BASIN VIA THE LOS ANGELES AQUEDUCT

Since 1970, an average of 100,000 AFY of surface water from the Mono Lake watershed has been diverted into the Los Angeles Aqueduct. Litigation seeking to reduce the amount of water Los Angeles diverts from streams tributary to Mono Lake has been in progress since 1979. Water diversion from the Mono Basin is being adjudicated by the Courts and the State Water Resources Control Board and the outcome is expected to lead to a reduction in LADWP diversions. In October 1989, LADWP was ordered by the Court to divert no water from the Mono Basin until the lake level rises to elevation 6,377 feet above mean sea level. In 1990 the El Dorado County Superior Court ordered interim flow releases of about 60,000 AFY down four streams to support the fisheries until the State Board establishes permanent fishery requirements. It is apparent that any reduction in water exported from the Owens Valley cannot be made up by increasing exports from the Mono Basin.

6.3.6 EXPANDED WATER RECLAMATION

In Los Angeles about 60 percent or about 400,000 AFY of the water used by homes and businesses is discharged as waste to the sewer system and ultimately the Pacific Ocean. If some of the wastewater could be treated and reused, the need for other sources of water would be lessened.

Not all reclamation projects provide water supply benefits. Reclamation projects fall into two categories, sometimes referred to as "soft" reuse and "hard" reuse. A "hard" reuse project is a project that substitutes reclaimed water for an existing potable water use. Griffith Park irrigation is an example of a "hard" reuse project. Before the reclamation system was built the park was irrigated with City water. By using reclaimed water at the park, City water can be saved for uses with more demanding quality requirements. A "soft" reuse project is a project that produces no water supply benefit. An example is proposed Balboa Lake in the Sepulveda Basin Recreation Area, which would create a demand for water that would not exist if reclaimed water were not available. Thus, from the point of view of water supply planners, only the "hard" reuse projects are of primary interest.

The use of reclaimed water in California is limited by a number of interrelated political and technical factors. The California Department of Health Services administers Title 22, California Waterworks Standards which governs the ways in which reclaimed water can be used. Direct reuse of reclaimed water as potable water supply is not permitted. Under the California Department of Health Services current draft guidelines, deliberate recharge of groundwater basins that serve as a source of potable water supply with reclaimed water may be permitted if dilution in the groundwater basin is great and other stringent criteria are met. Groundwater recharge projects of this sort are considered by the Department of Health Services on a case-by-case basis. Currently the most feasible uses for reclaimed water in urban areas are landscape irrigation and industrial use. These uses are often limited by the lack of demand for reclaimed water within a reasonable distance of the wastewater treatment plant. This is evident in Los Angeles, where all of the 1,100 AFY of water currently reclaimed is used for irrigation of Griffith Park and landscaped margins of the Golden State Freeway. Additional projects under construction or approved will reclaim another 7,100 AFY by 1995.

Cost is another reason that only a small fraction of the urban wastewater stream has been reused in Los Angeles. Many components of Los Angeles's water system were built many years ago. Because of inflation, the unit cost of water from a new source is likely to be much higher than the corresponding cost for an existing source. The cost to Los Angeles of water from the Owens Valley is about $80 per acre-foot (not including the cost of filtration or the value of energy generated along the aqueduct), partly because the major components of the system were built many years ago and because the system delivers water by gravity. Most new projects require power to pump the water from the source to the user(s). The cost of water from MWD is currently $230 per acre-foot for non-interruptible treated water. Few water sources being developed today in California cost as little as Owens Valley or MWD water. Reclaimed water is no exception: Most wastewater reclamation projects deliver water at a cost in excess of $500 to $900 per acre-foot. There is consequently no economic incentive to reclaim wastewater when cheaper sources of water are available. This may change in the future as demand exceeds the capacity of older, cheaper water sources and cities have to turn to new, more costly sources.

Despite the regulatory and economic hurdles facing wastewater reclamation, there is considerable public sentiment in favor of it. Many citizens are aware that conventional economic analyses place no value on the environment. Wastewater reclamation projects may be relatively expensive but, unlike many conventional water projects, they do not adversely affect the environment. In fact, they improve environmental conditions by reducing wastewater discharges to receiving waters.

Responding to public interest in wastewater reclamation, the City of Los Angeles established an Office of Water Reclamation (OWR) in 1989. This new unit of city government is developing plans for expanding wastewater reclamation as a means of more efficiently using the Los Angeles's existing water resources and reducing the amount of treated wastewater discharged to the Pacific Ocean. Wastewater discharged to the Pacific Ocean must receive secondary treatment in order to meet environmental standards; with only minor additional treatment the effluent is suitable for reuse for landscape irrigation or industrial cooling.

The OWR has established near-term, mid-term and long-term goals for water reclamation in Los Angeles that correspond with the years 2010, 2050 and 2090. These goals have been adopted by the Los Angeles City Council and are supported by LADWP. The goal for the year 2010 is that Angeles would reclaim 40 percent or about 250,000 AFY of its available wastewater. By 2050 the reclamation goal is 70 percent or 600,000 AFY. For 2090 the goal is 80 percent or 800,000 AFY. A substantial amount of this reclaimed water would be used outside of the city limits and would not replace existing potable water use within Los Angeles. The OWR is currently evaluating system alternatives that would allow Los Angeles to meet these reclamation goals. Preliminary alternatives for 2010 include expanded landscape irrigation and industrial reuse, groundwater recharge and injection into the ground to form a barrier to seawater intrusion. Alternatives for 2050 include further expansion of landscape irrigation, industrial reuse and groundwater recharge, and export of water to the southern San Joaquin Valley for agricultural use. The goal for the year 2090 assumes that reclaimed water would be delivered to the water distribution system for potable use.

In many respects Los Angeles' goals are visionary rather than immediately practical. Wastewater reclamation on the scale envisioned in the OWR plans has not been implemented anywhere in the world. The question that must be answered here is how many of OWR's recommended projects could be implemented immediately and thus represent an alternative to increased groundwater pumping in the Owens Valley.

Table 6-4 lists a number of wastewater reclamation projects that OWR has recommended for construction by 2010. The first four are landscape irrigation and industrial reuse projects that would reuse about 23,000 AFY. All employ well-proven technology, and the only barrier to their implementation is high cost. The largest project on OWR's list of recommended projects is construction of a dual distribution system. Such a system, which OWR estimates could produce 100,000 AFY of water by 2010, would consist of a second network of distribution pipes that would deliver reclaimed water to much of Los Angeles. Consumers would receive potable water from the existing distribution system and water for landscape and yard irrigation from the second system.

While residential yard irrigation is not currently permitted by the health regulatory agencies, common use areas under the control of an organization such as a homeowners association are being irrigated with reclaimed water. The dual distribution system would differ from the greenbelt projects in that it would be designed to provide irrigation water to all users in a given area, however small. The greenbelt projects are designed to provide irrigation or industrial water to a relatively small number of large water users.

Several other agencies have implemented similar projects on a smaller scale. Irvine Ranch Water District in Orange County installed a dual distribution system when development of Irvine Ranch took place. Reclaimed water is used to irrigate median strips, landscaped slopes, parks and large areas of common landscaping in townhouse and condominium developments. Las Virgines Municipal Water District retrofitted a similar reclaimed water distribution system into existing streets and landscaped area.

TABLE 6-4

POSSIBLE FUTURE WASTEWATER RECLAMATION PROJECTS

Project	Capacity	Type	Cost ($/AF)
Chevron Industrial Reuse	5,800	Hard[1]	$500[2]
Los Angeles Greenbelt Expansion	2,200	Hard	$900
Sepulveda Basin Expansion	6,300	Soft/Hard	$800
West Los Angeles Greenbelt	9,000	Hard	---
Dual Distribution	100,000	Hard	$800
Groundwater Recharge	35,000	Hard	$600
Seawater Intrusion Barrier	20,000	Hard[1]	$600

[1]Both of those projects, which are located outside of Los Angeles, would replace MWD potable water use with reclaimed wastewater and thus would only benefit Los Angeles indirectly.
[2]Costs are estimated by City of Los Angeles, Office of Water Reclamation.

Source: Water Reclamation in the Past, Opportunities and Plans for the Future, City of Los Angeles Office of Water Reclamation.

A Los Angeles dual distribution system, which would, of course, have to be retrofitted into existing streets, would differ from the systems noted above in an important way. Irvine Ranch is a planned community, built in the last 25 years, with an abundance of landscaped areas. Much of Los Angeles, on the other hand, was developed to the standards of an earlier era. Residential densities are high; there is a paucity of public open space; and much of the landscaping is contained in private yards. Serving reclaimed water to Los Angeles would consequently be more difficult than serving it to master planned communities with large areas of public landscaping such as Irvine.

LADWP's existing potable water distribution system includes more than 7,000 miles of pipeline used to distribute about 700,000 AFY of water to customers. A reclaimed wastewater distribution system delivering 100,000 AFY and duplicating part of the existing potable water distribution system would likely exceed 1,000 miles of new pipeline. The construction costs of the pipeline would exceed $600 million not including pump stations, storage tanks and customers' on-site plumbing modifications. The cost of water saved would substantially exceed $600 per acre-foot, including annual operating and maintenance costs.

Other projects on OWR's list are groundwater recharge and creation of a barrier to seawater intrusion. Deliberate recharge of reclaimed water into groundwater basins used for drinking water supply has traditionally been opposed by the State Department of Health Services. Such projects, may be allowed when the current draft guidelines are adopted provided strict treatment requirements are adhered to and considerable dilution occurs in the groundwater basin. The Department of Health Services reviews each proposed project separately and on its individual merits. It is uncertain whether the Department of Health Services would permit the projects recommended by OWR.

In addition to the projects listed in Table 6-4, LADWP is currently evaluating the feasibility of a project known as the Valley Generating Station Water Reclamation Project. This project would deliver reclaimed water form the Tillman Water Reclamation Plan in Sepulveda Basin to the Valley Generating Station (VGS) in Sun Valley. Preliminary plans envision the delivery of reclaimed water for irrigation and industrial purposes to customers along the pipeline route and for groundwater recharge at the Tujunga Spreading Grounds. This project could possibly be expanded to deliver reclaimed water to the Hansen Recreation Area Water Reclamation Project, located about two miles northerly of the Valley Generating Station.

Ultimately, an estimated 5,000 acre-feet of reclaimed water could be delivered for irrigation and industrial purposes. In addition, up to 35,000 acre-feet of reclaimed water could be used for groundwater recharge subject to regulatory health agency approval. At least ten miles of large diameter pipeline and two or three pumping stations are needed to deliver the water to customers and to spreading grounds in the vicinity of the power plant. It is anticipated the Valley Generating Station would use reclaimed water in its cooling towers and possibly in its boilers. To be used in either of these applications would require additional treatment of the reclaimed water. Because of the early stage of this study, specific pipeline routes, pipeline and pumping station sizes, and project costs and feasibility are not yet known.

In summary, the first four projects in Table 6-4 could all be implemented within several years. They are conventional in concept and similar to other projects already in operation in Los Angeles. Because they can be implemented within a reasonable time period, they represent a partial alternative to the proposed project. The other projects in the table represent a significant departure from present practices. A number of technical, regulatory and political obstacles would have to be overcome before they could be implemented. It is unlikely that they could be implemented immediately, and thus they cannot be regarded as an alternative to the proposed project. They may be implementable over the longer term and could play an important role in meeting the future water needs of Los Angeles.

Environmental Effects

If wastewater reclamation were practiced on a large scale in Los Angeles in the future the direct environmental consequences would be minor. The increased risk to public health would be slight in light of the present stringent regulation of wastewater reclamation and the safeguards that must be built into any reclamation system. The construction of a separate reclaimed water distribution system would cause considerable temporary disruption of traffic and parking, and would increase noise and dust.

6.3.7 SEAWATER DESALINATION

The technology now exists for desalting large volumes of ocean water to a purity suitable for municipal and industrial purposes. Desalination is not widely applied because it is both costly and energy-intensive. Most of the existing installations are in areas where no other freshwater supplies are available, such as the Middle East or island communities. Several California communities, including the Cities of Santa Barbara and Catalina Island, are considering construction of desalination plants. The cost of water from the plants is estimated to be $2,000-$5,500 per acre-foot. Desalination is a technically feasible, although expensive, alternative to increased groundwater pumping in the Owens Valley. Existing desalination plants are relatively small. The largest known facility in the world, in Saudi Arabia, is rated at 50 mgd.

Seawater desalination would require the construction of a desalting plant, probably at a location near the coast. The plant would have the general appearance of an industrial structure and would occupy 10 to 20 acres of land. Water would enter the plant from an offshore intake or possibly from a network of wells installed in the beach. Concentrated brine would be produced as a waste. Brine would be disposed of in the ocean through an existing wastewater outfall or through a new outfall built for the specific purpose.

Environmental Effects

The desalting processes, either distillation or reverse osmosis, would be powered by electrical energy. The desalination plant would produce no significant pollutant emissions other than the concentrated brine. Because the brine would contain only those chemicals already present in seawater, its disposal to the ocean would not have a significant adverse impact on the ocean environment. Adverse effects could occur in the immediate vicinity of the brine discharge, but these could be readily eliminated by the use of a dispersion structure that induces rapid mixing with ocean water.

Although selecting a site for a desalination plant near the environmentally-sensitive coastal region could be difficult and time-consuming, once the plant is built it would have few impacts on its immediate surroundings. The plant would not produce air pollutant emissions or high levels of noise, nor would it use or produce hazardous materials, or generate large numbers of traffic movements. In order to utilize desalinated water, extensive pumping and conveyance facilities would have to be constructed at substantial cost.

The principal environmental disadvantage of desalination is its high energy use. It is estimated that 10,000 to 16,000 Kwh of electrical energy would be needed to produce an acre-foot of potable water. Replacement of 100,000 AFY of Owens Valley groundwater with desalinated water would require about 1.4 billion Kwh, or about seven percent of electrical energy usages in Los Angeles in 1988. Thus while the local environmental effects of desalination would be minor, such a project would contribute substantially to the demand for electrical energy and the need to build new energy-generating facilities. Construction of new electrical energy-generating facilities would be likely to have significant adverse impacts on the environment wherever they are built. Los Angeles obtains the bulk of its electrical power from coal-fired power plants outside California. If future power demands are met in the same way, the adverse environmental impacts of coal mining and combustion include air pollution, acid rain generation and possible contribution to global warming.

The adverse environmental effects of desalination could be limited if the City's desalination units were used only during droughts. This would likely be the case because the high cost of desalting would dictate that the units would not be used when cheaper sources of water are available. Desalination would thus make most sense as a standby rather than routine water source.

Water Transfers

There has been increasing interest in the concept of water transfers or "water marketing" as a way to obtain additional water for Southern California including the City of Los Angeles. This concept involves the sale and transfer of surplus or conserved water from one part of the State to an area which needs additional water.

As a potential source of long-term dependable supply, water transfers generally refer to marketing water from agricultural areas to urban areas under a long-term agreement. The source of water could be either water conserved on the farm or water made available by changing crops from high water using crops to lower water using crops or by taking farm land out of production.

While water transfers are viewed as a possible source of water for urban areas, actual examples of successful projects providing long-term water supply are few and the obstacles have been significant.

One example of a successful water transfer project is the unique agreement between the Metropolitan Water District of Southern California (MWD) and the Imperial Irrigation District (IID). Under this agreement, MWD will finance conservation improvements within the IID which will reduce the amount of water lost from flows and seepage to the Salton Sea. By 1994, this agreement will yield 100,000 AFY for Southern California. Six years of complex and arduous negotiations were required before reaching an agreement.

As a part of the UCLA Public Policy Program (Mono Lake Group) the City of Los Angeles has participated in numerous meetings involving water marketing as a potential source of replacement water to benefit Mono Lake. For the past two years, the Environmental Defense Fund has worked with the Mono Lake Group and led the search for potential water transfer projects. While two water districts in Central California have indicated an interest in water transfers the amounts of water under discussion are relatively small and the districts have expressed reservation about entering into a long-term agreement at this time. It is unknown at this time if these discussions will eventually lead to an agreement.

Primary obstacles to long-term water marketing agreements are the following

- Concern about giving up water rights by those who have them.
- Sellers unwilling to enter into long-term transfer agreements.
- In many agricultural areas, the water is not owned by the farmer but instead is owned by a water district. One farmer's willingness to sell water may be offset by another farmer in the same district wanting more water.
- Third party impacts associated with taking farmlands out of productions
- Institutional constraints and costs associated with using existing aqueducts and transfer facilities owned by others.

In summary, while water marketing offers promise for the future, it does not appear to be a feasible source of reliable, long-term replacement water for the City at the present time.

6.3.8 EVALUATION OF WATER SUPPLY OPTIONS

Each of the possibilities discussed above could produce more water for Los Angeles, except increased export from the Mono Basin. A major increase in groundwater pumping in the Los

Angeles River Basin would not be feasible because Los Angeles already uses its full entitlement. Some increase in the Los Angeles's ability to pump groundwater from the basin might occur if additional recharge projects are implemented. Sea water desalination is not considered feasible because of high cost, high energy use and the length of time required to implement a project. Expanded water conservation (assuming no rationing) could substitute for a portion, but not all, of the water to be supplied by the proposed project. It is unclear how important a role wastewater reclamation could play in the near future.

It is LADWP's policy to implement all feasible water conservation and reclamation measures. Los Angeles is committed to this policy regardless of whether the proposed project is implemented or not. This policy reflects a recognition of the uncertainty of future water supplies, including the expected reduction in water diversions from the Mono Basin, the water supply outlook for MWD, and increasing population growth and water demand within Los Angeles. If Los Angeles was faced with a reduction of water from the Owens Valley, Los Angeles would choose to purchase MWD water as the most feasible replacement source.

6.4 ENVIRONMENTALLY-SUPERIOR ALTERNATIVE

As noted earlier, CEQA guidelines indicate that an EIR must identify an environmentally-superior alternative. If the environmentally-superior alternative is the no project alternative, then the EIR must identify the environmentally-superior option among the remaining alternatives. The following paragraphs discuss the environmentally-superior alternative for the Owens Valley. The analysis does not take account of environmental effects in Los Angeles and elsewhere in the state. Neither does it take account of the economic and social effects of the alternatives.

In general, as might be expected, alternatives that involve less groundwater pumping would have a lesser adverse effect on the Owens Valley environment. What is not clear is where the proposed project fits within the range of alternatives. Implementation of Alternative 1, the no project alternative, would allow the Valley environment to return to some semblance of its 1970 condition. It is more difficult to rank the proposed project, taking account of its environmental safeguards and mitigation measures. The safeguards would ensure that vegetation in the Valley would not be allowed to significantly decrease or change from the conditions documented during the 1984-87 vegetation inventory. Clearly the enhancement/mitigation and LADWP environmental projects, and particularly the Lower Owens River Project, provide considerable environmental benefits. In the absence of a quantitative comparison of benefits it is believed that the mitigation measures will reduce the impacts associated with the project to a less than significant level. However, the no project alternative is still judged to be environmentally superior to the proposed project.

Another Owens Valley alternative that is difficult to assess is Alternative 2. It would be similar to Alternative 1, the No Project Alternative, except that Los Angeles would eliminate irrigation of its lands in the Owens Valley resulting in a greater volume of water exported from the Valley than under the proposed project. Currently irrigated lands would be abandoned or used as unirrigated rangeland for cattle. The rapidity with which vegetation recolonized these currently irrigated lands would depend on local soils, microclimate and grazing pressure. It is apparent that much of the thousands of acres of lands removed from irrigated agriculture between 1920 and 1970 have not returned to their pre-irrigation condition. It takes many years before desirable native vegetation becomes established particularly when livestock grazing is permitted. In the interim, the bare areas, or areas with only minimal vegetative cover, would be visually unappealing and a source of wind-blown dust. The degree to which formerly irrigated areas can be restored to native vegetation by an active planting and maintenance program is unknown.

In light of the uncertainty of restoring previously irrigated lands, and the fact that existing enhancement/mitigation projects would be discontinued, Alternative 2 is probably less desirable from an environmental point of view than the proposed project.

Of the remaining alternatives, Alternatives 6 and 7 would clearly have more severe environmental impacts than the proposed project. The impacts of Alternatives 6 and 7 would be more severe because they involve much higher levels of groundwater pumping than the proposed project.

Alternative 5 is very similar to the proposed project, in that it would involve a similar amount of groundwater pumping. However, it would not include portions of the Lower Owens River Project, therefore, its net environmental effect would be less beneficial than the proposed project.

Alternatives 3 and 4 would involve less groundwater pumping than the proposed project, and also include environmental safeguards. In the case of Alternative 4, pumping would be reduced in dry years to maintain water tables at 1981 levels. In the case of Alternative 3, pumping would be reduced in dry years to maintain water in the plant rooting zone. Alternative 3 and the proposed project would retain vegetation in about the condition documented during the 1984-87 vegetation inventory, but the extent to which regrowth of vegetation lost between 1970 and 1986 would occur is unknown. Under Alternative 4, the level of vegetation protection that would occur is less certain than under Alternative 3 or the proposed project. Thus by process of elimination, Alternative 3 is the environmentally-superior alternative when among LADWP's alternatives the no project alternative is eliminated from consideration.

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1. DWR, Bulletin 76-81.

7. ENVIRONMENTAL IMPACT ASSESSMENT METHOD AND SUMMARY OF IMPACTS AND MITIGATION MEASURES

7.1 INTRODUCTION

This EIR is unconventional in that it involves analysis of impacts that occurred between 1970 and 1990 as a result of water management practices implemented to supply the second Los Angeles Aqueduct, as well as the potential impacts associated with implementation of the Agreement. In Chapters 8 through 16, these impacts are described and analyzed and, where the impacts are significant, mitigation measures are prescribed. Each of the chapters addresses impacts in the context of a specific resource found in the Owens Valley. As a preface to these impact chapters, this chapter describes the method used in analyzing the environmental impacts of the proposed project and identifying appropriate mitigation measures. A table summarizing the impacts and mitigation measures can be found at the end of this chapter.

7.2 ENVIRONMENTAL IMPACT ASSESSMENT METHOD

Chapters 8 through 15 are organized similarly. Each chapter presents background information regarding the specific resource addressed, as well as a description of the pre-project setting, the impacts of the project and mitigation measures. Chapter 16, Ancillary Facilities, presents the impacts associated with new facilities proposed in the Agreement.

BACKGROUND

In the background sections of Chapters 8 through 15, information regarding the specific resource is presented to provide a contextual basis for the environmental analysis and identification of impacts and mitigation measures to follow.

PRE-PROJECT SETTING

The pre-project setting sections provide a description of the affected environment prior to implementation of the project in 1970. This description serves as the baseline condition for determining whether impacts resulting or that could result from the project are significant. In some cases, pre-1970 conditions are difficult to characterize because information is lacking, and post-1970 data must be used to infer pre-project conditions. Whenever this occurs, it is so noted.

IMPACTS OF THE PROJECT

The impacts of the proposed project on the environment of the Owens Valley are described in this section. Not all impacts described in Chapters 8 through 15 are significant impacts; if an impact is determined to be significant, it is identified as such. At the beginning of each impact section, the criteria used in determining the significance of impacts are delineated. The impact analyses take two forms:

- Analysis and evaluation of the environmental impacts due to water gathering practices that occurred from 1970 to 1990.

- Analysis and evaluation of potential environmental impacts that could occur due to implementation of the Agreement.

Each impact is numbered and discussed separately. The cumulative impacts of the proposed project are discussed in Chapter 17, CEQA Considerations.

MITIGATION MEASURES

Chapters 8 through 15 also identify measures to mitigate significant impacts due to the project. In each case, the implementing entity is described. Some mitigation measures have already been implemented by LADWP or are being implemented jointly by LADWP and Inyo County. Any future mitigation efforts will be implemented jointly by LADWP and Inyo County as provided for in the Green Book.

7.3 SUMMARY OF IMPACTS AND MITIGATION MEASURES

The description of impacts and mitigation measures from Chapters 8 through 15 has been condensed for presentation in Table 7-1. Information in the table, Summary of Environmental

Impacts, has been organized to correspond with environmental issues discussed, beginning with Chapter 8, Geology, Soils and Seismicity. The table is arranged in four columns:

1. Impacts
2. Significance Without Mitigation
3. Mitigation Measures
4. Significance With Mitigation

A series of mitigation measures are noted when more than one measure may be required to reduce an impact to a less-than-significant level. In addition, a distinction is made within Table 7-1 for impacts and mitigations associated with elements of the proposed project that were implemented between 1970 and 1990, as compared to potential impacts which may result from implementation of the Agreement.

TABLE 7-1

SUMMARY OF ENVIRONMENTAL EFFECTS

	Impacts	Significance Without Mitigation		Mitigation Measures	Significance With Mitigation
8. GEOLOGY, SOILS AND SEISMICITY					
8-1	Groundwater pumping associated with the project has not and will not result in ground subsidence.	LS	8-1	None required.	LS
8-2	Fluctuations in water levels associated with the project have not and will not result in significant increased seismic activity.	LS	8-2	None required.	LS
9. WATER RESOURCES					
9-1	The project has resulted in increased flow in the Owens River between Pleasant Valley and the Intake between 1970 and 1990. In the future, flows are expected to be less than those between 1970 and 1990.	LS	9-1	None required.	LS
9-2	Reduction in operational releases and reduced baseflow caused slightly less flow in Owens River below the Intake from 1970 to 1986.	LS	9-2	None required.	LS
9-3	The Lower Owens River project caused increased flow in Owens River between 1986 and 1990.	LS	9-3	None required.	LS
9-4	Flow into Owens Lake was not and will not be substantially changed from pre-project conditions by the project.	LS	9-4	None required.	LS
9-5	Between 1970 and 1990, no stream channels were lined, or the stream flow diverted into pipelines by LADWP.	LS	9-5	None required.	LS

Legend: S = Significant; LS = Less than Significant; B = Beneficial.

Impacts		Significance Without Mitigation	Mitigation Measures		Significance With Mitigation
WATER RESOURCES (Continued)					
9-6	Between 1970 and 1990, the project resulted in beneficial changes to existing lakes and ponds, and the creation of new lakes and ponds, with no significant impact on water resources.	B	9-6	None required.	LS
9-7	Reservoir levels between 1970 and 1990 varied slightly from pre-project conditions due to operation of the second aqueduct, with no significant impact on water resources.	LS	9-7	None required.	LS
9-8	Flows in certain canals and ditches supplying irrigated Los Angeles-owned lands were increased as part of the project, with no significant impact on water resources.	LS	9-8	None required.	LS
9-9	The surface water budget during 1970 to 1990 has been altered as compared to the pre-project conditions.	LS	9-9	None required.	LS
9-10	No loss of groundwater storage capacity has occurred due to subsidence.	LS	9-10	None required.	LS
9-11	Increased pumping between 1970 and 1990 caused alterations of groundwater flow patterns with no significant impact on water resources.	LS	9-11	None required.	LS
9-12	Increased groundwater pumping caused greater fluctuations in groundwater levels between 1970 and 1990, with no significant impacts on water resources.	LS	9-12	None required.	LS
9-13	Continuous pumping between 1970 and 1990 for fish hatchery supply has lowered groundwater levels and eliminated spring flow, with no significant impact on water resources.	LS	9-13	None required.	LS

Legend: S = Significant; LS = Less than Significant; B = Beneficial.

Impacts	Significance Without Mitigation	Mitigation Measures	Significance With Mitigation
WATER RESOURCES (Continued)			
9-14 LADWP pumping between 1970 and 1990 in the Big Pine area contributed to lowered water levels in the wells of Steward Ranch and resulted in an adverse economic effect. It is expected that LADWP will continue to pump from this area in the future. The proposed mitigation measure would reduce this impact to less-than-significant.	S	9-14 Because groundwater pumping in the Big Pine well field was contributing to a lowering of groundwater levels at Steward Ranch that resulted in one of two wells being inoperable, the ranch owners have been fully compensated by LADWP on an annual basis for all reduced alfalfa production caused by a loss of well water, and for future costs of re-establishing any lost alfalfa. LADWP has also lowered the pump in the domestic well at the ranch at no cost to the ranch owners. LADWP has made the following offer (previously made public) to the ranch owners, to permanently mitigate the lowered groundwater levels that have existed since 1972: o A new well would be drilled, equipped with a pump and motor, and connected to the ranch's reservoir at no cost to the ranch owner. o Power bills for this well, and for the second irrigation supply well on the ranch would be adjusted in the future so that the ranch does not pay the cost of lifting water from a depth greater than the depth that existed in the wells in 1972. The ranch would pay the cost of lifting the water from a depth equal to or less than 1972 levels. o The power adjustment would apply to a quantity of water sufficient to irrigate alfalfa on the ranch.	LS
Impact 9-14 (Continued)		o The power adjustment would apply to future owners of the ranch. The ranch owner has not accepted this offer.	

Legend: S = Significant; LS = Less than Significant; B = Beneficial.

Impacts		Significance Without Mitigation	Mitigation Measures		Significance With Mitigation
WATER RESOURCES (Continued)					
9-15	The increased fluctuations in groundwater levels observed between 1970 and 1990, and the extensive drawdown over extended periods of time, have reduced the amount of water that moves from the groundwater system to the vadose zone as compared to pre-project conditions. This has resulted in reduced evapotranspiration, but has otherwise had no significant impact on water resources.	LS	9-15	Under terms of the Agreement, groundwater pumping would be managed to avoid causing significant decreases or changes in vegetation. Any such decreases or changes that do occur would be mitigated. Also see Chapters 10, 11 and 12.	LS
9-16	Increased groundwater pumping from 1970 to 1990 caused significant reductions and/or cessation in the flow of springs, seeps, and flowing wells.	LS	9-16	No mitigation measures are required for impacts to water resources; for mitigation of vegetation impacts, see discussion in Chapter 10, Vegetation.	LS
9-17	The post-1970 groundwater budget was altered as a result of increased groundwater pumping, and reduced recharge as compared to the pre-project conditions.	LS	9-17	None required. Impacts to vegetation are discussed in Chapter 10.	LS
9-18	Surface water quality was changed slightly between 1970 and 1990 as compared to pre-project conditions, with no significant impacts.	LS	9-18	None required.	LS

Legend: S = Significant; LS = Less than Significant; B = Beneficial.

Impacts		Significance Without Mitigation	Mitigation Measures		Significance With Mitigation
10. VEGETATION					
10-1	Flows in Owens River below the Intake were altered, with no significant impact on vegetation.	LS	10-1	None required.	LS
10-2	Implementation of the Agreement will not affect the flow in the Owens River between Pleasant Valley Reservoir and the Intake dam, and will not result in a significant decrease or change in vegetation along this reach of the river.	LS	10-2	None required.	LS
10-3	Between 1970 and 1990, no stream channels were lined, or the stream flow diverted into pipelines by LADWP.	LS	10-3	None required.	LS
10-4	Provisions of the Agreement will have no effect on flow in the existing tributary streams, and will not result in a significant decrease or change in vegetation along these streams.	LS	10-4	None required.	LS
10-5	Between 1970 and 1990, the project resulted in beneficial changes to lakes and ponds, and the creation of new lakes and ponds, with no significant adverse impact on vegetation.	B	10-5	None required.	LS
10-6	Between 1970 and 1990, LADWP continued to spread surplus water in wet years in the spreading areas created by the dikes east of Independence between the aqueduct and the river. This activity increased soil moisture and water tables, but also fostered conditions favorable to the spread of salt cedar, which was established prior to 1970.	S	10-6	A saltcedar eradication and control program will be implemented as described in Chapter 5.	LS
10-7	Reservoir levels varied slightly due to operation of the second aqueduct, with no significant impact on water	LS	10-7	None required.	LS

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Impacts	Significance Without Mitigation	Mitigation Measures	Significance With Mitigation
VEGETATION (Continued)			
resources. The changes and fluctuations in storage volumes have had no significant impact on vegetation.			
10-8 Under the provisions of the Agreement, new ponds and wetlands will be created by the Lower Owens River project and existing ponds will continue in existence. This will have a beneficial effect on vegetation in these areas.	B	10-8 None required.	LS
10-9 No large ditches and no canals were removed from operation between 1970 and 1990.	LS	10-9 None required.	LS
10-10 Under the provisions of the Agreement, LADWP will continue to operate canals in accordance with its practices from 1970 (past practices have included taking canals out of service for maintenance and for operational purposes with the requirement that no significant impacts to vegetation would be allowed to occur).	LS	10-10 None required.	LS
10-11 Fluctuations in water tables due to groundwater pumping has caused approximately 655 acres of groundwater dependent vegetation to die-off. Loss of vegetation cover has occurred on these lands.	S	10-11 As part of the Independence Springfield and woodlot enhancement/mitigation projects, approximately 317 acres of barren or near-barren ground have been revegetated with either native pasture or alfalfa. This area was affected by groundwater pumping and surface diversions of water. A map of the project area is shown in Appendix E.	LS
Impact 10-11 (Continued)		In the near future, two enhancement/mitigation projects will be initiated to mitigate areas affected by	LS

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Impacts	Significance Without Mitigation	Mitigation Measures	Significance With Mitigation
VEGETATION (Continued)			
		groundwater pumping adjacent to the towns of Independence (east side regreening project) and Big Pine (northeast regreening project). Each project will be approximately 30 acres and will be converted to irrigated pasture. A map of the project is shown in Appendix E.	
		Under the Shepherd Creek enhancement/mitigation project, approximately 198 acres of poorly vegetated land has been converted to alfalfa. This area was affected by groundwater pumping and abandonment of irrigation. In addition, an area of approximately 60 acres to the east of the existing project area on the opposite side of Highway 395 is poorly vegetated. If the density of the native cover in this area does not naturally increase, the existing enhancement/mitigation project may be expanded to include this additional area. A map of the project is shown in Appendix E.	LS
Impact 10-11 (Continued)		Approximately 80 acres of land that lost a significant amount of its live native vegetation cover as a result of increased groundwater pumping will be revegetated. The techniques that will be employed to revegetate these lands will be determined through studies that will be conducted by LADWP and Inyo County. These lands will not be permanently irrigated, but will be revegetated with native Owens Valley vegetation not requiring irrigation except perhaps during its initial establishment. Depending on the amount of rainfall and runoff, successful revegetation of these lands could take a decade or longer. The goal will be to restore as full a native vegetation cover as is feasible, but at a minimum, vegetation cover sufficient to avoid blowing dust will be achieved in that area. The lands that will	LS

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Impacts	Significance Without Mitigation	Mitigation Measures	Significance With Mitigation
VEGETATION (Continued)			
		be revegetated are shown on Figures 10-8A through L.	
10-12 Vegetation in an area of approximately 300 acres near Five Bridges Road north of Bishop was significantly adversely affected during 1988 because of the operation of two wells, to supply water to enhancement/mitigation projects.	S	10-12 Water has been spread over the affected area since 1988. By the summer of 1990, revegetation of native species had begun on approximately 80 percent of the affected area. LADWP and Inyo County are developing a plan to revegetate the entire affected area with riparian and meadow vegetation. This plan will be implemented when it has been completed.	LS
10-13 Increased groundwater pumping has significantly adversely affected approximately 60 acres of vegetation in the Symmes-Shepherd well field area.	S	10-13 A revegetation program will be implemented for these effected areas utilizing native vegetation of the type that has died off. Water may be spread as necessary in these areas to accomplish the revegetation.	LS
10-14 Increased groundwater pumping has reduced or eliminated flows from Fish Springs, Big and Little Seely Springs, Hines Spring, Big and Little Blackrock Springs, and Reinhackle Spring. This has caused significant adverse impacts to vegetation at several of these spring areas.	S	10-14 No on-site mitigation will be implemented at Fish Springs and Big Blackrock Springs; however, the CDFG fish hatcheries at these locations serve as mitigation of a compensatory nature by producing fish that are stocked throughout Inyo County.	LS
		In the area of Big and Little Seely Springs, LADWP well number 349, discharges water into a pond approximately one acre in size. This pond provides a temporary resting place for waterfowl and shorebirds when the pumps are operating or Big Seely Spring is flowing. This water passes through this pond to Owens River. Riparian vegetation has become established around this pond.	LS
Impact 10-14 (Continued)		The Hines Spring vent and its surroundings will receive on-site mitigation. Water will be supplied to the area from an existing, but unused, LADWP well at the site. As a result, approximately one to two acres will either	LS

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Impacts	Significance Without Mitigation	Mitigation Measures	Significance With Mitigation
VEGETATION (Continued)			
		have ponded water or riparian vegetation. Hines Spring will serve as a research project on how to re-establish a damaged aquatic habitat and surrounding marshland. Riparian trees and a selection of riparian herbaceous species will be planted on the banks. The area will be fenced.	
		LADWP will continue to supply water from Division Creek to the site of the former pond at Little Blackrock Springs. The marsh vegetation at this site will thus be maintained. When it was determined in the late 1980s that groundwater pumping was affecting the flow from Reinhackle Spring, pumping from certain wells in the area was discontinued and the spring flow increased. No significant adverse impacts on vegetation in this area have resulted from the reduced flow. In the future, either groundwater pumping in the area will be managed to avoid causing such a reduction in flow from this spring to the degree that decreases or changes in native riparian vegetation will result, or LADWP will supply surface water to the native riparian vegetation supplied by the spring to avoid any such decreases or changes due to reduced flow caused by groundwater pumping.	LS
Impact 10-14 (Continued)		Although not all springs and associated riparian and meadow vegetation will receive on-site mitigation, the Lower Owens River Project will provide mitigation of a compensatory nature. This project will rewater over 50 miles of the river channel allowing for restoration of riparian vegetation along the river. This project also will result in the creation of several new ponds along the river and will provide the continuation of existing lakes associated with the project. The project will	LS

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Impacts		Significance Without Mitigation	Mitigation Measures		Significance With Mitigation
VEGETATION (Continued)					
				restore large areas of wetland and meadow vegetation, perhaps exceeding 1,000 acres adjacent to the river and in its delta. In comparison, the area of riparian and meadow vegetation that has been lost and will not be restored because of the elimination of spring flow due to groundwater pumping is estimated to be less than 100 acres.	
				In addition, vegetation dependent on a supply of water from a spring (primarily management Type D) will be maintained in order to avoid a significant change or decrease as provided in the Agreement and the Green Book.	LS
10-15	Under the provisions of the Agreement, and the technical appendix to this EIR and the Agreement, a document called the Green Book, vegetation dependent on springs and seeps must be maintained such that there is no significant decrease or change in vegetation from approximately the conditions as documented by the 1984-87 vegetation inventory. This vegetation and spring flows will be carefully monitored. The Green Book contains procedures for determining the affects of groundwater pumping and surface water management practices on spring flow. Groundwater pumping will be managed to avoid causing reductions in spring flow that would cause significant decreases or changes in associated vegetation, or surface water would be supplied if necessary to avoid such decreases or changes.	LS	10-15	None required.	LS
10-16	Approximately 1,080 acres of formerly irrigated lands, had not successfully revegetated following the abandonment of agriculture. This was a significant	S	10-16	As part of the enhancement/mitigation projects implemented by LADWP and Inyo County since 1985, approximately 942 acres of these abandoned agricultural	LS

Legend: S = Significant; LS = Less than Significant; B = Beneficial.

Impacts	Significance Without Mitigation	Mitigation Measures	Significance With Mitigation
VEGETATION (Continued)			
adverse impact because these lands had a loss of vegetation and were the source of blowing dust.		lands have been revegetated with irrigated pasture or alfalfa. These areas are the Independence Pasture Lands and native pasture lands, the Van Norman and Richards fields, and the Lone Pine woodlot adjacent to Lone Pine. These areas are described further in Chapter 5 (see Appendix E, which shows the location of these projects).	
		A field of approximately seven acres along the Whitney Portal Road in Lone Pine, and a field of approximately 11 acres north of Lone Pine and east of Highway 395, have been converted to irrigated pasture as part of the Lone Pine Regreening enhancement/mitigation projects. The location of these projects and their description is contained in Chapter 5.	LS
Impact 10-16 (Continued)		In addition, 120 acres of formerly irrigated land near Bishop with a loss of vegetation cover will be revegetated. The process to successfully revegetate these lands will be determined through studies to be conducted by LADWP and Inyo County. These lands will not be permanently irrigated, but will be revegetated with native Owens Valley vegetation not requiring irrigation except perhaps during its initial establishment. Depending on the amount of rainfall and runoff, successful revegetation of these lands could take a decade or longer. The goal will be to achieve as full a vegetation cover as is feasible, but at a minimum, a vegetation cover sufficient to avoid blowing dust. The formerly irrigated lands that will be revegetated are shown on Figures 10-8A through L.	LS
		Finally, irrigated lands in Owens Valley (including the Olancha-Cartago area) in existence during the 1981-82	

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Impacts	Significance Without Mitigation	Mitigation Measures	Significance With Mitigation
VEGETATION (Continued)			
		runoff year or that have been irrigated since then, will continue to be irrigated in the future, except perhaps in very dry years. (Reductions in very dry years must be agreed upon in advance by LADWP and the Inyo County Board of Supervisors).	
10-17 Meadow and riparian vegetation that were supplied by tailwater from formerly irrigated lands has been impacted.	S	10-17 The loss of meadow or riparian vegetation that was dependent on tailwater from formerly irrigated fields will be mitigated in the form of compensation by the restoration of meadow and riparian vegetation by the Lower Owens River Project.	LS
10-18 Significant adverse vegetation decrease and change have occurred in the Laws area due to a combination of factors, including abandoned agriculture, groundwater pumping, water spreading in wet years, livestock grazing, and drought.	S	10-18 Approximately 140 acres will be revegetated within the Laws area, which has lost all or part of its vegetation cover due to increased groundwater pumping or to abandonment of irrigation operations to supply the second aqueduct. (See discussion of the impacts of groundwater pumping and of irrigation reductions in irrigation above.) These areas are shown on Figures 10-8A through L.	LS
		In the 1970s, LADWP started the Farmer's Pond environmental project. In the mid-1980s, LADWP and Inyo County implemented the Laws-Poleta Pasture Land, Laws Museum, and McNally Ponds enhancement/mitigation projects in the Laws area totalling approximately 541 acres of pasture land (see Chapter 5). The location of these projects is described in Chapter 5.	LS
Impact 10-18 (Continued)			
		The area where it is suspected that groundwater pumping during the recent drought has caused decreases or changes in vegetation, is being monitored by Inyo County and LADWP. Groundwater pumping has been	LS

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Impacts	Significance Without Mitigation	Mitigation Measures	Significance With Mitigation
VEGETATION (Continued)			
		reduced in the area. Should it be determined that any significant decreases or changes have occurred, the area will be mitigated under the Agreement.	
10-19 Water management practices in a portion of the Big Pine Well Field have resulted in a significant adverse change and decrease of plant cover.	S	10-19 A revegetation program will be implemented for approximately 160 acres within the Big Pine area, which have lost all or part of its vegetation cover due to increased groundwater pumping or to abandonment of irrigation as part of operations to supply the second aqueduct, will be revegetated (see discussion of the impacts of groundwater pumping and of reductions in irrigation above). These areas are shown on Figures 10-8A through L.	LS
		LADWP and Inyo County will implement the Big Pine Regreening enhancement/mitigation project by establishing irrigated pasture on approximately 30 acres to the north and east of Big Pine. The Big Pine Ditch project is planned to be implemented as provided in the Agreement. This area will also be mitigated by the Valley-wide mitigation under the Agreement.	LS
Impact 10-19 (Continued)		An area of approximately 20 acres directly to the east of Big Pine that is poorly vegetated as a result of pre-project activities and activities which are not a part of the project will be evaluated as a potential enhancement/mitigation project. If, in planning this project, it is determined that it is not feasible to permanently irrigate this area, a revegetation program will be implemented. This area is shown on Figure 10-8A through L.	LS
10-20 A significant loss and reduction of marsh vegetation has occurred in the Thibaut-Sawmill area primarily	S	10-20 Portions of the Lower Owens River project are in this area. Portions of the impacted area will be mitigated	LS

Legend: S = Significant; LS = Less than Significant; B = Beneficial.

Impacts	Significance Without Mitigation	Mitigation Measures	Significance With Mitigation
VEGETATION (Continued)			
due to surface water diversion, but also due to lowered groundwater from increased groundwater pumping.		directly, however, for much of the impacted area. Mitigation will be in the form of compensation by restoring wetland, meadow, and riparian vegetation.	
		Any significant decreases in vegetation cover or changes in vegetation composition due to groundwater pumping during the recent drought period will be mitigated under the Agreement as described below.	LS
11. WILDLIFE			
11-1 Changes of surface water management practices and increased groundwater pumping have altered the habitats on which wildlife depends. Vegetation changes have been significant in many locations throughout the Valley (see chapter 10). Therefore, impacts to certain species of wildlife, which were entirely dependent upon the impacted habitat, can be presumed to be significant.	S	11-1 The importance of riparian, marsh and aquatic habitats is recognized for mitigation of the impacts to wildlife that occurred during the 1970 to 1990 period. Wetter habitats support many more species and greater populations of wildlife; therefore, water management to create wet habitats will be used to mitigate the significant adverse impacts of the project.	LS
11-2 The Agreement would protect native vegetation, improve fish and wildlife habitat, and result in beneficial impacts.	B	11-2 None required; however, LADWP would continue to conduct its program of on-going wildlife inventories, monthly wildlife censuses, raptor surveys, habitat assessments, breeding bird surveys, and other ecological studies.	LS

Legend: S = Significant; LS = Less than Significant; B = Beneficial.

Impacts	Significance Without Mitigation	Mitigation Measures	Significance With Mitigation
12. AIR QUALITY			
12-1 Significant impacts on air quality resulting form groundwater pumping during the period 1970 to 1990 have occurred due to vegetation losses.	S	12-1 As part of the Independence Pasture Lands and Springfield enhancement/mitigation projects, approximately 730 acres of barren or near-barren ground have been revegetated with either native pasture or alfalfa. This area was affected by groundwater pumping and surface diversions of water. Approximately 40 acres remain barren and will be revegetated with native pasture. Under the Shepherd Creek enhancement/mitigation project, approximately 200 acres of poorly vegetated land has been converted to alfalfa. In addition, other areas that have the potential to cause significant adverse impacts to air quality have been identified in Chapter 10 and will be mitigated as set forth in that chapter.	LS
12-2 Increased groundwater pumping could result in elevated PM_{10} levels due to vegetation loss.	S	12-2 See Mitigation Measure 12-1 above.	LS
12-3 Significant impacts to air quality have resulted from the abandonment of irrigated lands to supply the second aqueduct.	S	12-3 Approximately 1,240 acres of formerly irrigated agricultural lands that had not successfully revegetated have been planted with pasture or alfalfa (see Chapter 10, mitigation measure 10-11). In addition, other areas that have the potential to cause significant adverse impacts on air quality have been identified in Chapter 10, Vegetation, and will be mitigated as set forth in that chapter.	LS
13. ENERGY			
13-1 The development of wells and pumping of groundwater for the second aqueduct resulted in an increase in the net energy balance of the overall aqueduct power system, with no significant impact on regional energy systems.	LS	13-1 None required.	LS

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Impacts		Significance Without Mitigation	Mitigation Measures		Significance With Mitigation
13-2	Less energy may be created due to environmental constraints.	LS	13-2	None required.	LS
14. LAND USE AND ECONOMIC DEVELOPMENT					
14-1	In anticipation of the proposed project, by 1968 LADWP reduced the amount of land classified as irrigated in Owens Valley from 21,800 to 11,600 acres.	LS	14-1	None required.	LS
14-2	LADWP will continue to provide water for irrigation of Los Angeles-owned land in Inyo County.	B	14-2	None required.	LS
14-3	Changes in irrigation and leasing practices of the proposed project had little effect on overall livestock production in Owens Valley.	LS	14-3	None required.	LS
14-4	The irrigation provisions of the Agreement will assure a stable ranching economy. Chapter 17, CEQA Considerations, describes LADWP's grazing management policy.	LS	14-4	None required.	LS
14-5	Ranch leases in Owens Valley were modified as a result of the project.	LS	14-5	None required.	LS

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Impacts		Significance Without Mitigation	Mitigation Measures		Significance With Mitigation
16. ANCILLARY FACILITIES					
Vegetation					
16-1	The construction phase of the addition of new recharge facilities could result in vegetation decrease or change.	S	16-1	Provisions of the Agreement will be met. No further mitigation measures are required.	LS
16-2	Operation of recharge basins and infiltration trenches during wet years would remove land from grazing or other economic use.	LS	16-2	None required.	LS
Air Quality					
16-3	Air quality could be adversely affected by the construction of recharge facilities.	S	16-3	All disturbed areas would be wetted during construction to minimize generation of fugitive dust.	LS
Energy					
16-4	Equipment used to construct the new recharge facilities would consume energy in the form of fossil fuels.	LS	16-4	None required.	LS
Archaeology					
16-5	Construction of proposed recharge projects could disturb subsurface archaeological resources, with possible significant impact.	S	16-5(a)	The proposed recharge facility project locations would be surveyed for cultural resources prior to the initiation of any ground-disturbing project activities associated with the construction of any culverts, ditches or trenches, once the exact locations of these features are determined. The significance of any site recorded during the survey would be determined through the use of subsurface testing, as appropriate.	LS
Impact 16-5 (Continued)			16-5(b)	In accordance with the requirements of 36 CFR 800.11, should a previously unidentified National Register or	LS

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ANCILLARY FACILITIES (Continued)

Impacts	Significance Without Mitigation	Mitigation Measures	Significance With Mitigation
		eligible property be discovered during construction on any and all parts of the project, LADWP would comply with the provisions of the Archaeological and Historic Preservation Act of 1974 by evaluating the resources and implementing mitigation measures as warranted.	
Water Resources - New Wells			
16-6 It is not expected that water quality or quantity in private wells on the Bishop Cone would be adversely impacted due to a lowering of the water table associated with pumping the new wells on the Cone.	LS	16-6 Monitoring wells will be installed and monitored in accordance with the Agreement to monitor water levels near private wells (see Section 4 of the Green Book).	LS
16-7 New wells in the Big Pine area would lower groundwater levels, and could result in significant impacts to local private wells.	S	16-7 Monitoring will be conducted as provided in the Agreement and the Green Book. If pumping of the new production well is shown to cause a significant adverse impact to any private well, the impact will be mitigated as described in the Agreement and in Section 4 of the Green Book.	LS
16-8 New wells in the five areas described above would result in fluctuations in groundwater levels, but would not result in significant impacts.	LS	16-8 All new wells would be operated in accordance with provisions of the Agreement so as to avoid creating significant impacts to vegetation and to the environment (see above).	LS
16-9 Operation of the two new wells in the Laws area could cause flow in artesian wells to stop or to diminish to a degree that impacts to the vegetation dependent on such flow would result. Impact 16-9 (Continued)	S	16-9 Existing and new monitoring wells will be used to monitor water levels and vegetation as provided in the Agreement and the Green Book. Groundwater pumping will be managed to avoid causing reductions in the amount of water flowing from theses wells such that significant decreases and changes to vegetation would result. If it is projected that such decreases and changes could occur, water will be supplied to avoid such vegetation decreases or changes.	LS

Legend: S = Significant; LS = Less than Significant; B = Beneficial.

Impacts	Significance Without Mitigation	Mitigation Measures	Significance With Mitigation
ANCILLARY FACILITIES (Continued)			
16-10 Pumping of the Big Pine well BP-1 may impact Type D vegetation along the fault zone west of Big Pine.	S	16-10 As provided in the Agreement and the Green Book, existing and new monitoring sites would be utilized to monitor vegetation, water levels, and soil water. Groundwater pumping would be managed to avoid significant decreases and changes in vegetation.	LS
16-11 New wells in the Independence-Symmes-Bairs area may reduce or eliminate the flow from Reinhackle Spring and impact vegetation dependent upon flow from the spring.	S	16-11 If it is projected that a decrease or change in vegetation dependent on flow from Reinhackle Spring will result if flow from the spring stops or is reduced, LADWP will reduce pumping to the degree necessary to restore the flow to avoid such decreases or changes or provide water to avoid such decreases or changes.	LS
16-12 Operation of the proposed new well in the Lone Pine area would result in fluctuations in groundwater levels.	LS	16-12 See Chapter 10 - Vegetation, the Agreement and the Green Book for provisions concerning groundwater management, protection of vegetation, and avoidance of other significant effects on the environment.	LS
16-13 Air quality could be adversely affected by the construction and maintenance of new wells.	S	16-13 All areas disturbed during construction of the new wells would be wetted during construction to minimize generation of fugitive dust.	LS
16-14 The proposed project would increase localized demand for electricity due to the addition of 15 pumps in Owens Valley well fields; however, the water produced would generate an increase in electrical power as it moves through the Aqueduct system to Los Angeles.	LS	16-14 None required.	LS
16-15 Drilling of 15 new wells would remove less than a total of one acre of land from grazing.	LS	16-15 None required.	LS
16-16 Construction of 15 new wells could disturb subsurface archeological resources, with possible significant impact.	S	16-16(a) Construction activity at the LP-1, BP-1, and BP-2 sites will be monitored. If subsurface prehistoric archeological resource evidence is found, excavation	LS

Legend: S = Significant; LS = Less than Significant; B = Beneficial.

Impacts	Significance Without Mitigation	Mitigation Measures	Significance With Mitigation
ANCILLARY FACILITIES (Continued)			
		or other construction activity in the area will cease and an archeological consultant would be retained to evaluate findings in accordance with standard practice and applicable regulations. Data/artifact recover, if deemed appropriate, would be conducted during the period when construction activities are on hold.	
		16-16(b) An appropriate representative of Native American Indian groups and the County Coroner would be informed and consulted if remains are discovered, as required by State law.	LS
16-17 Increased pumping on the Bishop Cone could cause increased fluctuation in groundwater levels but would not result in significant impacts to water resources or to the quality or quantity of water in private wells in the Bishop area.	LS	16-17 Existing and new monitoring wells installed in accordance with the Agreement would be used to monitor changes in water levels and to avoid impacts on private wells. Any significant impacts due to pumping would be promptly mitigated as required by the Agreement (see Section 4 of the Green Book).	LS
16-18 Increased pumping on the Bishop Cone could affect the rate of discharge from flowing wells.	S	16-18 Changes in flow rates from flowing wells will be monitored along with vegetation dependent upon flows from such wells. Groundwater pumping will be managed to avoid significant decreases or changes in vegetation dependent upon water from flowing wells. Water will be provided if necessary to avoid such decreases and changes in vegetation if flows from such wells are diminished due to groundwater pumping.	LS
16-19 Increased pumping on the Bishop Cone could adversely affect vegetation due to lowered water levels or reduced flows from flowing wells.	S	16-19 As provided in the Agreement, existing and new monitoring sites would be utilized to monitor vegetation, water levels, and soil water. Groundwater pumping would be managed to avoid significant decrease and change to vegetation and other significant	LS

Legend: S = Significant; LS = Less than Significant; B = Beneficial.

Impacts		Significance Without Mitigation	Mitigation Measures		Significance With Mitigation
ANCILLARY FACILITIES (Continued)					
				effects on the environment.	
16-20	Increased pumping on the Cone would result in increased power consumption for operation of the well pumps but would not cause a significant adverse impact on energy resources.	LS	16-20	None required.	LS

Legend: S = Significant; LS = Less than Significant; B = Beneficial.

8. GEOLOGY, SOILS AND SEISMICITY

8.1 INTRODUCTION

This chapter addresses the geology, soils, and seismicity of the Owens Valley and provides a brief introduction to the hydraulic characteristics of the geologic units and structures. The discussion of the geologic structure of the Owens Valley introduces the concept of two subbasins, the Bishop Basin and the Owens Lake Basin, prior to their discussion in conjunction with the groundwater models prepared by the Los Angeles Department of Water and Power[1] (LADWP) and Inyo County.[2]

8.2 SETTING

PHYSIOGRAPHY

The Owens Valley is a closed basin bordered on the north, south and east by a basin and range desert environment and on the west by the Sierra Nevada. The Valley comprises approximately 3,300 square miles: about 1,200 square miles of desert mountains, 530 square miles of Sierra Nevada watershed, and 1,570 square miles of outwash slopes and Valley floor. Elevations on the Valley floor range from 4,500 feet at the northern end of the Valley to about 3,500 feet at Owens (dry) Lake. The adjacent mountain ranges rise more than 9,000 feet above the Valley floor.

The Owens Valley floor is incised by the Owens River, which meanders south through the Valley. More than 30 tributaries drain the Sierra Nevada side of the Owens Valley basin and their coalesced alluvial fans have created an extensive outwash slope, which extends beyond the center of the Valley. In contrast, the alluvial fans on the east side of the Valley are typically isolated features (non-coalesced) and are prominent only at the mouth of larger drainages.

REGIONAL GEOLOGY

The marine sedimentary rocks forming the White and Inyo Mountains to the east of Owens Valley were deposited on the floor of a shallow sea during the late Precambrian and early Paleozoic eras. These sediments were subsequently faulted and folded during the middle Paleozoic era. Deformation continued into the Mesozoic with the intrusion of the Sierra Nevada batholith.[3]

The Sierra Nevada consists primarily of batholithic granitic and associated metamorphic rocks, while the White and Inyo Mountains to the east consist of folded and faulted Precambrian to Paleozoic sediments that have been intruded by granitic plutons.

The early Cenozoic was a period of regional uplift and erosion. Basin and range faulting followed the early Cenozoic uplift. Basin and range faulting is characterized by north-south trending normal faults that have produced a series of subparallel mountain ranges and intervening valleys in the western part of the Great Basin. The most recent episode of basin and range faulting began about 13 million years ago in the Death Valley area, approximately 50 miles south and east of the Owens Valley, and migrated westward, reaching Owens Valley between three and six million years ago.[4] Owens Valley is one of the youngest valleys in the basin and range province and is still tectonically active.

The Sierra Nevada escarpment on the western side of the Owens Valley marks the western limit of basin and range faulting. Uplift of the Sierra Nevada along the frontal faults that produced the escarpment began in late Pliocene time (2.3 to 3.4 million years before present), followed soon thereafter by uplift of the White/Inyo Mountains.[5] During this period, the Sierra Nevada, White and Inyo Mountains reached their present elevation.

As the mountains on both sides were uplifted, they separated slightly and the intervening wedge of earth subsided to form Owens Valley. Molten rock from deep below the surface rose periodically along the frontal faults causing localized volcanic eruptions.

The Valley has served as a sediment trap to collect material eroded from the surrounding mountains. Over time, large fans developed, particularly on the western flank of the Valley. Tuff, cinders, and lava flows are locally interbedded with the sediments. Figure 8-1, Geologic Map, identifies surficial deposits of volcanic and alluvial materials and delineates faults that have been identified within the Valley.

Following the major structural events that shaped the Valley, the Volcanic Tableland north of Bishop was formed by an eruption within the Long Valley Caldera. The resulting welded tuff deposit is approximately 400 to 500 feet thick and overlies a buried stream channel of undetermined thickness at the head of the Owens Valley.[6]

STRUCTURE OF THE OWENS VALLEY

The Owens Valley is not a simple tectonic trough. It has undergone complex faulting and shows evidence of rotation and structural warping. Geophysical studies indicate that uplift along the west face of the White and Inyo Mountains primarily occurred across the White Mountain fault zone, a narrow, well-defined, north-south trending fault zone; while uplift on the Sierra side of the Valley occurred along a complex boundary of fault blocks and warped segments.[7] The Owens Valley fault, which was the site of the 1872 earthquake, lies in the center of the Valley throughout most of its length and marks the eastern limit of the faulting along the Sierra front. In addition, while most of the frontal faults are primarily characterized by vertical displacements, the Owens Valley fault exhibits a strong component of horizontal movement.

The graben that underlies the Owens Valley can be divided into two structural subbasins, the Bishop Basin and the Owens Lake Basin. These basins are separated by a bedrock high, where the Valley tapers to its narrowest width just east of the Poverty Hills.[8] The alluvium ranges from 4,000 feet thick near Bishop to less than 1,500 feet over the bedrock high near Tinemaha Reservoir and more than 8,000 feet beneath Owens Lake.[9] These basins are discussed in more detail below.

Bishop Basin

The Bishop basin is bounded on the east by the White Mountain fault and on the west by a series of fault blocks that have produced a broad flexural surface known as the Coyote warp.

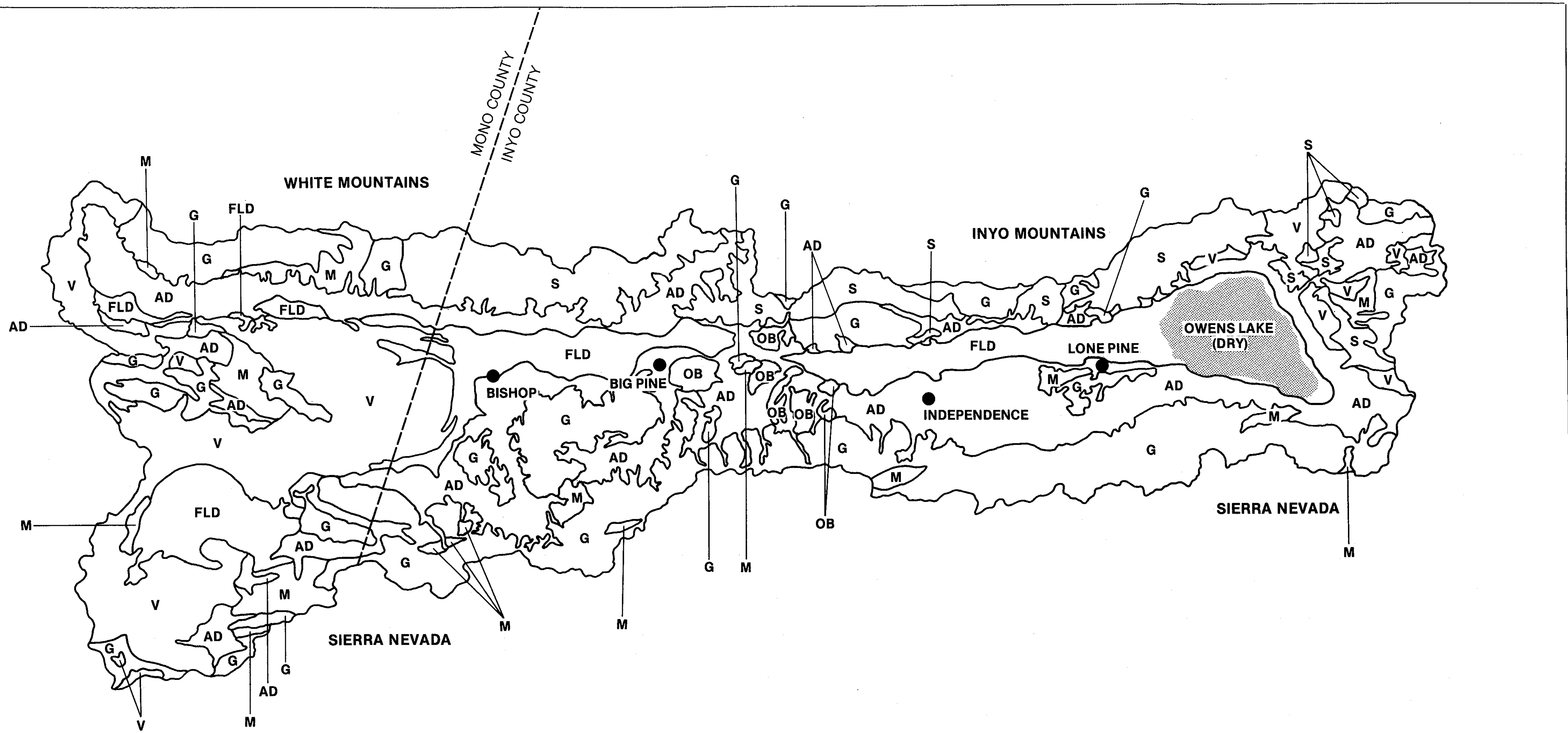
The northern limit of the Bishop Basin is buried beneath the Volcanic Tableland, where a granitic ridge separates Bishop Basin and Long Valley. This ridge is exposed in the Owens River Gorge, between Crowley Lake and Bishop. Beneath the Tableland, the Bishop Basin diverges to form Round Valley to the west and Chalfant, Hammil and Benton Valleys to the east.[10]

The southern limit of the Bishop Basin occurs at the bedrock high east of the Poverty Hills. The bedrock high separating the Bishop and the Owens Lake Basins isolated the depositional systems in the two basins from one another during much of the time the Owens Valley graben was being filled with sediments.[11] In addition, following burial of the bedrock high, periodic volcanic activity in the Big Pine area interrupted surface flow between the Basins by damming the narrow section of the Valley. As a result, a series of intermittent lakes were formed at the southern end of the Bishop Basin.

The lakebed sediments in the southern part of the Bishop Basin include laterally extensive clay layers. For example, a section of blue green clay extends from the area immediately east of the Poverty Hills to the Big Pine area. The blue green clay is thickest immediately east of the Poverty Hills but thins toward the north; it has not been found in the sediments south of the narrows.[12] Alternating beds of clay and fluvial sands and gravels in the stratigraphic section that overlies the bedrock high suggests that the basalt flows that formed dams in the narrows were periodically breached by the ancient Owens River.[13] Less than 1,500 feet of Valley fill, including interbedded volcanic flows overlie the bedrock high in this area. The volcanic deposits northwest of the narrows are an important component of the Bishop Basin groundwater system. Although portions of the flow have high permeability and are prolific producers of groundwater, the Big Pine volcanic field does not appear to have a direct connection to the volcanic field at the northern end of the Owens Lake Basin. The Bishop Basin between Big Pine and the volcanic tablelands is comprised of deep alluvial fan deposits which transition to fluvial and lacustrine deposits at the Valley floor.

Owens Lake Basin

The Owens Lake Basin extends from the bedrock high immediately east of the Poverty Hills south to the Coso Range. The basin is bounded on the east by a two-mile wide zone of normal faults in the Inyo Mountains and on the west by a complex series of faults and downdropped blocks between the Sierra escarpment and the Owens Valley fault. The deepest part of the graben is located beneath the Owens lakebed and east of the Owens Valley fault, where the floor of the



O W E N S V A L L E Y

AD	Alluvial Deposits
FLD	Fluvial and Lacustrine Deposits
OB	Olivine Basalt
V	Volcanics
G	Granitic Rocks
M	Metamorphic Rocks
S	Sedimentary Rocks

FIGURE 8-1

GENERALIZED GEOLOGY OF OWENS VALLEY

SOURCE: USGS OPEN FILE REPORT 88-715

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graben is more than 8,000 feet below the dry lakebed.[14] Sediments at the northern end of the basin are primarily alluvial and fluvial with interbedded and superbedded volcanic deposits. The mid-section of the basin consists of broad alluvial fans transitioning to fluvial deposits on the Valley floor. The southern part of the basin is dominated by the ancient Owens Lake lacustrine deposits with alluvial fans along its upper margins.

GEOLOGIC UNITS

Significant water bearing materials in Owens Valley include alluvial fans, transition zone deposits between the alluvial fans and the Owens River floodplain, fluvial deposits, and basalt. Lake bed deposits are generally less permeable, while the bedrock that forms the sides and floor of the structural trough are relatively impervious.

Bedrock

Granitic rocks underlie the Owens Valley and form the core of the mountains adjacent to the Valley. A mantle of metamorphic rock covers the granitic rock in some areas and has been removed by erosion in others. Since the eastern side of the Valley has undergone less erosion, most of the White and Inyo Mountain Ranges retain the mantle of metamorphic and metasedimentary rock.

The Tungsten Hills near Bishop, the Poverty Hills near Tinemaha Reservoir, and the Alabama Hills west of Lone Pine are bedrock remnants protruding through the alluvial basin. The Tungsten Hills are composed of faulted granitic rocks. Since there are few springs in the Tungsten Hills and there is no evidence that the hills hold or transmit significant quantities of water, they are assumed to form an effective barrier to groundwater flow.[15]

The Poverty Hills are located in a complex tectonic environment. Geophysical evidence suggests that the hills consist of a core of granitic rock overlain by a thin veneer of metasedimentary rock.[16] Although several springs are found at the base of nearby volcanic deposits, the Poverty Hills seem to be relatively impermeable to groundwater flow. The hills apparently restrict the flow of groundwater down the Valley to a narrow trough of alluvial sediments overlying the bedrock high in the vicinity of the Tinemaha Reservoir.[17]

The Alabama Hills are structurally similar to the Poverty Hills and also appear to restrict the movement of groundwater. The Alabama Hills are composed mostly of granitic rocks, although a mantle of metavolcanic rocks partially covers the east side. The scarp of the 1872 earthquake and the geophysical studies of Pakiser and others indicate that a major fault forms the boundary between the east side of the Alabama Hills and the main part of the Valley.[18]

Valley Fill

The depositional environments on the Owens Valley floor ranged from lakes and meandering streams to alluvial fans that dumped coarse-grained sands, gravels, and boulders far out into the Valley. These deposits were selectively reworked by fluvial and lacustrine processes and were in turn buried by later episodes of deposition, gradually filling the Valley to its present surface. Thus, the Valley fill varies greatly in physical character. Lenticular deposits of sand, clay, and gravel occur near the center of the Valley, while wedge-shaped masses of coarse mountain wash are present in the alluvial fans along the Valley sides. In many places, coarse-grained alluvial debris is interbedded with finer grained river and lake deposits.

The total thickness of the alluvial deposits ranges from a few hundred feet beneath the upper part of the alluvial fans to between 3,000 and 8,000 feet in the center of the Valley. To the north the alluvial deposits extend past Bishop and under the Volcanic Tablelands to a bedrock barrier separating Owens Valley from Long Valley.[19] The alluvial deposits also extend northwest into Round Valley and northeast into Chalfant Valley. The southern boundary of the alluvial deposits is formed by the Coso Range in the southeast and by a ridge of granitic rock extending beneath Haiwee Reservoir. The thickness of alluvial deposits above this ridge is not known.[20]

Alluvial Fan Deposits

Large alluvial fans have been formed on the western side of the Valley by more than 30 major streams emerging from the Sierra Nevada. Most of these begin at about 6,000 feet in altitude, slope downward at a grade of about 300 feet per mile, coalesce, and end as much as 2,000 feet lower on the Valley floor.[21] The total thickness of the fans ranges from a few tens of feet near the heads of the fans to more than 1,000 feet at the toes. Logs of wells drilled on the fans show that they are composed of poorly sorted material, ranging in size from clay to boulders more than six feet in diameter. Virtually no clay layers are found in the upper 500 feet of the fan deposits except near the toes of the fans.

The fans found on the eastern side of the Valley are similar in structure but much smaller in size. This disproportion between the size of the fans on the east and west sides of the Valley is a direct result of the rain shadow effect of the Sierra Nevada. The fans resulting from this anomalous distribution of rainfall and runoff have repeatedly pushed the Owens River and, consequently, the Valley floor toward the east side of the Valley.

Generally the alluvial sediments grade laterally from coarse material at the head of the fan near the mountain slopes to fine material toward the Valley floor. Periodic shifting of the stream courses across the fan produces a heterogeneous layering of coarse and fine sediments. Individual layers are often discontinuous and many times difficult or impossible to correlate across the Valley or between even nearby wells. In some places faulting has offset otherwise continuous layers to further complicate geohydrologic properties.

Transition Zone Deposits

The transition from fan to flood plain and lake deposits has produced a zone of longitudinally oriented lenses of coarse-grained sand and gravel. This zone is well developed on the west side of the Valley but is typically missing on the east side. The sediments deposited in the transition zone are characterized by better sorting, fairly continuous north to south correlation and greater hydraulic conductivity than the poorly sorted alluvial fan sediments or the fine-grained fluvial and lakebed deposits in the center of the Valley.[22] In the Owens Lake Basin where these deposits are best developed, the transition zone sediments can be identified by a line of springs where they are in contact with finer grained lakebed or floodplain deposits. These springs are caused by the abrupt decrease in hydraulic conductivity at this interface, which forces groundwater moving from the mountain areas to rise to the surface. Where the alluvial fan has integrated into more meandering fluvial environments, the transition zone can be a complex array of irregular, overlapping and interfingering lenses and layers of fluvial and alluvial materials.

Fluvial and Lacustrine Deposits

Alluvial deposits on the Valley floor consist primarily of stream channel deposits including reworked material from the alluvial fans, floodplain and deltaic deposits formed by the Owens River, and lakebed deposits. During formation of the Valley, the ancient Owens Lake and the lake at the southern end of the Bishop basin repeatedly changed in size. As a result, the Owens River emptied into these lakes at different locations up and down the Valley. At the juncture between the river and the lake, deltaic deposits were formed by flowing water entering the still lake. Upstream of this juncture, cut and fill and floodplain deposits typical of a river system were formed. Beneath the center of the lake, deposits containing a high percentage of clay were formed. Contemporaneously with the depositional processes, the Owens River meandered across the Valley floor, reworking both the coarse alluvial deposits and the finer deltaic deposits. Reworking of the alluvial and deltaic deposits appears to have removed any significant lateral continuity that may originally have been present.[23] In some places, faulting has further disrupted the horizontal continuity of stream channel and deltaic deposits.

Volcanic Deposits

Volcanic olivine basalt deposits on either side of the Tinemaha Reservoir are near-surface expressions of recent volcanic activity that extend all the way north of Bishop to Long Valley and the Mono Basin. The deposits appear as volcanic cinder cones as much as 1,000 feet high and as flows of broken lava. The flows have a shape similar to that of nearby alluvial fans, extending from the edge of the Valley almost to its center. Although the surficial expression of the volcanic deposits is obvious, the subsurface extent can only be approximated but is probably a cast of the ground surface prior to the eruption.

The volcanic deposits near the Tinemaha Reservoir are extremely effective in transmitting large quantities of water. Most of the high production wells in the Owens Valley are located in volcanic deposits, and records indicate that several of these wells are capable of producing more than 4,500 gallons per minute. The high transmissivity is further evidenced by several large springs that occur along the interface where the volcanic flows meet the alluvial deposits near the center of the Valley. These springs are the result of the significant decrease in the ability to transmit water that occurs between the permeable volcanic material and the less permeable silt and clay, forcing the water to rise to the land surface. In addition, faulting within either the volcanic or alluvial deposits can cause a similar obstruction to groundwater flow and result in upward seepage of water.

Bishop Tuff

The largest volcanic deposit in the Owens Valley area comprises the volcanic plateau north of Bishop. This massive formation, locally referred to as the Tablelands is estimated to be more than 400 feet thick and is composed of many individual layers of welded volcanic material. Water is not readily transmitted through the welded members of this formation. However, thin erosional deposits and cooling cracks between layers may conduct some water. These conduits probably result in minor outflow from the Tablelands, such as the springs along the Owens River noted by C.H. Lee.[24] Aerial photos reveal numerous fractures in the top of the plateau, but their vertical extent and ability to transmit water are not known.

SOILS

The development of a soil is influenced by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated, (3) the plant and animal life in and on the soil, (4) the topographic relief, and (5) the length of time these forces have acted on the soil.

In an arid environment, like the alluvial fans and outwash slopes in the Owens Valley, where topographic relief is high and both water and organic material are relatively scarce, soil formation is typically controlled by wind and water erosion. Water erosion selectively transports fine-grained silts and clays from the alluvial fan to the Valley bottom, while infrequent heavy rainstorms may erode and/or bury the soil profiles on the alluvial fans.

These rapid erosional processes typically result in coarse-grained, poorly developed soil profiles on the upper and middle sections of the alluvial fans, which grade to moderately developed, fine-grained sand, silt and clay soils near the toe of the fans.

Wind erosion is also an important factor in the redistribution of soil materials in the Owens Valley. Sand dunes are visible in many locations throughout the Valley. In addition, the deflation of soil materials in the semidesert scrub vegetation communities in the southeastern portion of the

Valley has produced broad areas of regularly spaced vegetated hummocks separated by shallow depressions that usually do not support plant growth.[25]

In those places where the groundwater table is near the surface and vegetation is abundant, the soil profile is relatively well developed. However, areas of high groundwater in an arid environment are typically accompanied by high soil salinities and an elevated soil pH. Soluble ions are absorbed by groundwater as it flows through the alluvial fan and Valley fill materials on its way to the Valley floor. When the groundwater is subsequently lost from the shallow water table, the evapotranspiration processes result in the precipitation from solution of the soluble ions according to their relative solubilities. Strongly alkaline soils have been formed on the Valley floor where either geologic uplifting or groundwater depression has stranded salts in the upper portions of the soil column. In areas where concentrations of these ions decrease as a result of leaching associated with flooding and deep percolation, alkaline hydrolysis of clays and organic matter saturated with sodium causes a rise in pH.[26] The formation of the coarse-textured, highly alkaline soils found under the dryland alkaline scrub community likely resulted from hundreds of years of this process.[27]

SEISMICITY

The seismic history of the Owens Valley is dominated by an estimated 7.8 magnitude (on the Richter Magnitude Scale) earthquake that occurred on March 26, 1872. This event caused the rupture on the Owens Valley fault from Big Pine to Haiwee, a distance of approximately 62 miles. Most of the damage and loss of life associated with the Owens Valley earthquake occurred at Lone Pine, where a maximum fault displacement of 4.4 meters vertically and 10 meters horizontally was reported.[28] The Owens Valley earthquake was accompanied by several estimated 6+ magnitude aftershocks. Recent work in the Lone Pine area, which dates several major prehistoric earthquakes, suggests a recurrence interval for this section of the fault of 5,000 to 10,500 years.[29]

In addition to the Owens Valley fault, the White Mountain fault along the eastern side of the Owens Valley is zoned as active by the California Division of Mines and Geology. The White Mountain fault is believed to be responsible for the 1986 magnitude 6.4 earthquake in the Chalfant Valley. The White Mountain fault is reportedly capable of generating a 7+ magnitude earthquake with a recurrence interval of about 3,000 years.[30]

The Mammoth Basin and the northern portion of the Owens Valley, near Bishop, have been seismically active since the 1872 earthquake. Major earthquakes in the Owens Valley and surrounding areas are presented in Table 8-1, Selected Significant Earthquakes.

8.3 IMPACTS AND MITIGATION MEASURES

The CEQA Guidelines indicate that a project will normally have a significant adverse impact if it will expose people or structures to major geologic hazards. For the purposes of this EIR, significant geologic hazards would pertain to soil and seismic conditions so unfavorable that they could not be overcome by special design using conventional construction and/or maintenance practices.

Impact

8-1 **Groundwater pumping associated with the project has not and will not result in ground subsidence.**

In some areas of the State, subsidence has been induced by continued lowering of the groundwater table over an extended period of time. For example, in the San Joaquin Valley, lowering of water levels between 200 and 300 feet resulted in dewatering of clay layers and subsidence due to the consolidation of these layers.

The result of groundwater pumping from the Owens Valley groundwater basin is very different from what has resulted in the San Joaquin Valley. Since 1970, water levels in the Owens Valley declined during the first eight to ten years of pumping; however, they recovered to pre-1970 levels during the 1982-83 and 1983-84 runoff years. Based on available data, land subsidence is not believed to have occurred in the Owens Valley. Given the anticipated groundwater pumping under the Agreement, subsidence is not expected to occur.

Mitigation Measure

8-1 *None required.*

TABLE 8-1

SELECTED SIGNIFICANT EARTHQUAKES[1]

Year	Magnitude	Location	Responsible Fault
1872	7.8	Owens Valley	Owens Valley fault
1889	5.6	Mammoth	
1896	5.9	Independence	Owens Valley fault
1908	6.5	Death Valley	
1910	5.5	Bishop	
1912	5.5	Bishop	
1917	5.5	Owenyo	
1927	6.0	Mammoth	
1929	5.5	Independence	Owens Valley fault
1938	5.7	Mammoth	
1938	5.0	Ridgecrest	
1941	6.0	Mammoth	
1946	6.3	Walker Pass	
1961	5.2	Brown	
1978	5.8	Mammoth	
1980	6.4	Mammoth	
1983	5.2	Mammoth	
1984	6.2	Bishop	
1986	6.4	Chalfant Valley	White Mountain fault

[1]Modified from Earthquake History of the Owens Valley Region.

Source: Geotechnical Consultants, February 1990.

Impact

8-2 **Fluctuations in water levels associated with the project have not and will not result in significant increased seismic activity.**

Scientific evidence indicates that water level fluctuations in the range associated with the project will not have any effect on earthquake incidence or risk in the Owens Valley.

Mitigation Measure

8-2 *None required.*

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3. S. Russel and W. Nokleberg, "Superimposition and Timing of Deformation in the Mount Morrison Roof Pendant and in the Central Sierra Nevada, California", Geological Society of America Bulletin, v 88, No. 3 (1977).

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5. E.S. Schweig III, "The Inception of Basin and Range Tectonics in the Region Between Death Valley and the Sierra Nevada, California," Geological Society of America Abstracts, v 18, No. 2.

6. P.C. Bateman, Geology and Tungsten Mineralization of the Bishop District, California. USGS Professional Paper 470 (1965).

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8. USGS Open File Report 88-715.

9. USGS Professional Paper 438.

10. USGS Open File Report 88-715.

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12. Ibid.

13. Ibid.

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17. Ibid.

18. USGS Professional Paper 438.

19. Ibid.

20. USGS Open File Report 88-715.

21. USGS Water Resources Investigations Report 88-4003

22. USGS Open File Report 88-715.

23. USGS Water Resources Investigations Report 88-4003

24. C.H. Lee, An Intensive Study of the Water Resources of a Part of the Owens Valley, California, USGS Water Supply Paper 294 (1912).

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26. Ibid.

27. Ibid.

28. G.W. Simila and G.R. Roquemore, Earthquake History of the Owens Valley Region, Geology and Mineral Wealth of the Owens Valley Region, California, South Coast Geological Society Annual Field Trip Guidebook 15 (1987).

29. L.K.C. Lubetkin and M.M. Clark, Late Quaternary Activity Along the Lone Pine Fault, Eastern California, Seismological Research Letters, c. 58, No. 1, p. 32 (1987).

30. S.G. Wesnousky, Earthquakes, Quaternary Faults, and Seismic Hazard in California, Journal of Geophysical Research, v. 91, No. B12 (1986).

9. WATER RESOURCES

9.1 INTRODUCTION

Chapter 4 presented a discussion of water resources management in the Owens Valley, before and after completion of the second aqueduct, and Chapter 5 presented a description of the project which is the subject of this EIR. This chapter describes the environmental impacts of the project on the water resources of the Owens Valley compared to the pre-1970 environmental conditions.

This section focuses on the impacts of the project on water resources in the Owens Valley groundwater basin. The groundwater basin is located within portions of Inyo and Mono Counties, however, this EIR primarily focuses on the area within Inyo County. This discussion of the project's impacts on water resources is drawn from several studies of the hydrology of the project area (see list of references), and the reader is referred to these studies for more detail.

The Owens Valley is a closed hydrologic system. That is, because of the impermeability of the bedrock beneath the Valley walls and floor, and the fact that there is no surface outlet and a small amount of subsurface outflow, all water entering the Valley is eventually consumed within its boundaries, except for the water exported by LADWP.

The source of all natural water entering the project area is from precipitation falling within the Owens River watershed. Precipitation amounts vary from a mean of less than six inches per year on the Valley floor to over 40 inches per year near the crest of the Sierra Nevada on the west side of the basin. The Inyo and White Mountains along the east side of the project area lie within the rain shadow of the Sierra Nevada and, therefore, receive very little precipitation by comparison. Most of the precipitation is in the form of snow that accumulates in the high mountains during the winter months. In the spring, the melting snow-pack flows down through Sierra canyons, across the alluvial fans, onto the Valley floor and into the Owens River, except in the southern Owens Valley where the flow is intercepted by the Los Angeles Aqueduct. In addition, water is imported to the project area from the Mono Basin, which lies north of the project area. Groundwater in the basin is derived from percolation of surface flows, from a relatively small amount of precipitation in the alluvial fans, and subsurface inflow from Round Valley and Chalfant Valley.

For the purposes of this analysis, the water resources of the Owens Valley will be viewed in terms of three systems: (1) the surface water system (which consists of both the natural surface water system and the aqueduct system), (2) the groundwater system (the saturated zone below the water table), and (3) the vadose zone (the unsaturated zone of the soil above the water table),

WATER BUDGETS

The three water resource systems can be described qualitatively and/or quantitatively by use of water budgets. Water budget analysis quantifies the components of inflow, outflow and change in storage of the system under consideration. This method is based on the principle of conservation of mass: inflow must equal outflow, plus or minus any storage change. Because of this principle, the water budget is a useful tool to analyze and predict the water resource impacts of the proposed project. Where specific data do not exist, such as in the case of the vadose zone, a qualitative description of the components of the water budget will be used to describe the impacts.

The increase in groundwater pumping in the Owens Valley after 1970 will be analyzed by considering the effects on other components of the groundwater budget: decreases in evapotranspiration and flowing groundwater, decreased spring and seep flow, and decline in groundwater storage in the vicinity of the fish hatcheries. Thus, water budget analysis provides the information to place in context and evaluate impacts to other natural resources (e.g., the associated loss of vegetation cover) resulting from effects on water resources that are presented in other sections of the EIR.

The various components of the water budgets have been derived from the extensive records maintained by LADWP, through joint research by Inyo County and LADWP, and through the development and calibration of groundwater flow models by the U.S. Geological Survey, Inyo County, and LADWP.

9.2 PRE-PROJECT ENVIRONMENTAL SETTING

This section describes the pre-project (pre-1970) conditions of the three systems of the water resources in the project area. These pre-project conditions serve as the base for evaluating impacts to water resources resulting from the proposed project.

SURFACE WATER SYSTEM

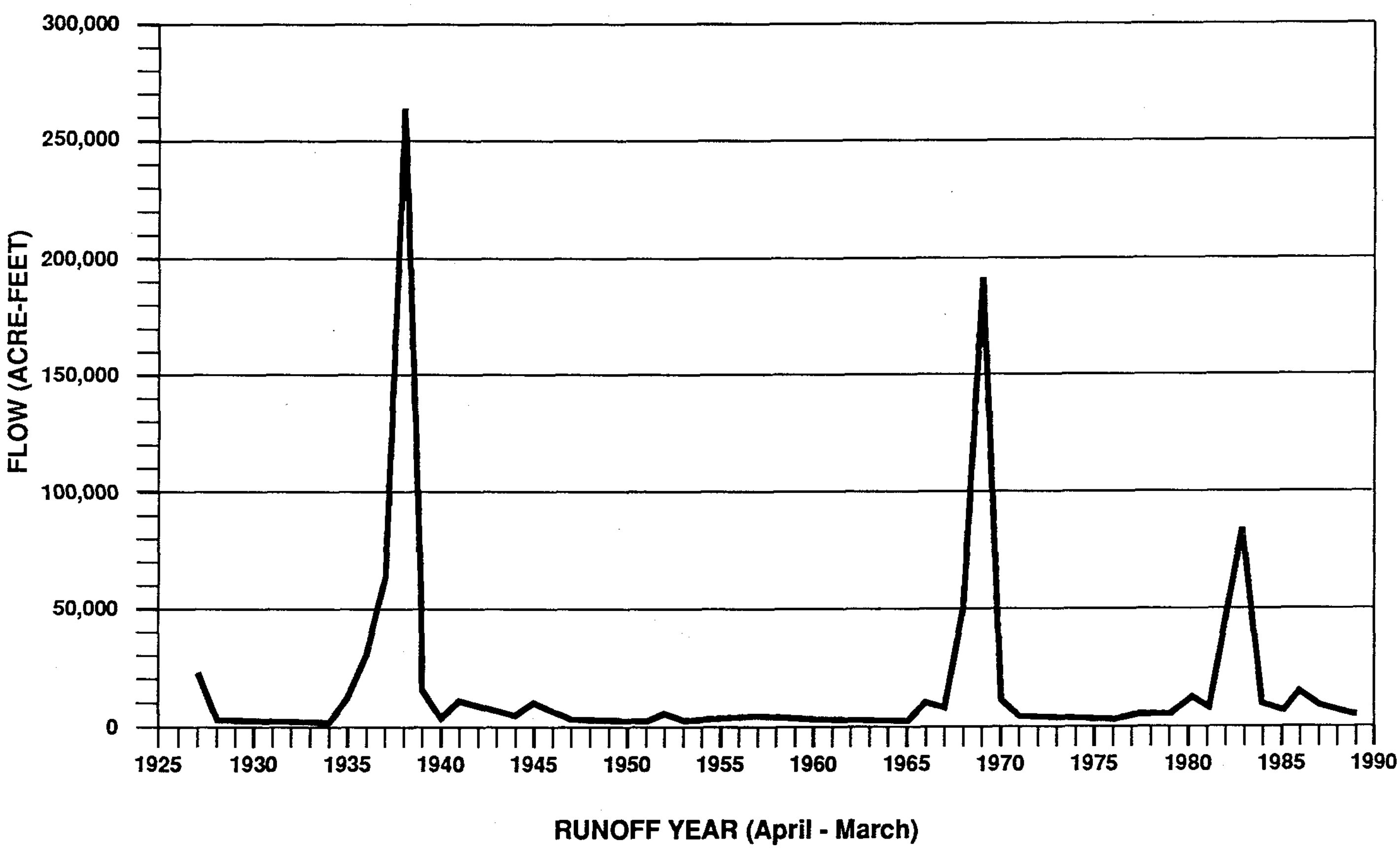
In general, the surface water system consists of the Owens River and all of its tributary creeks, Owens Lake, ponds, lakes and reservoirs in the Owens Valley, the Los Angeles Aqueduct, all canals and ditches that convey water to places of in-valley use and convey water to the aqueduct, and the water associated with springs and seeps as it flows across the land surface.

Owens River and Los Angeles Aqueduct

The dominant feature of the surface water system in the project area is the Owens River, which flows south from its headwaters in Long Valley through a deep gorge in the Volcanic Tableland, and down the length of the Owens Valley, to Owens Lake at the southern end of the Valley. The channel and flow of the Owens River had already been substantially altered by 1970, when the second Los Angeles aqueduct began operation.

Beginning in the late 1800s, local residents diverted water from the Owens River and its tributaries for irrigation of crops, reducing flows in the river during the irrigation season. In 1913, the first aqueduct was completed, and the entire flow of the Owens River was diverted at the aqueduct Intake dam east of Aberdeen.

The Intake dam diverted the entire river flow from approximately 50 miles of channel, as well as from Owens Lake. Only in wet years, when the aqueduct was full, did LADWP release water to the lower reach from the Intake and from release gates on the aqueduct. However, even though all flow was diverted at the Intake, some water entered the river from springs and seeps (groundwater baseflow). The river has been gauged at Keeler Bridge since 1927. The amount of flow at this station since 1927 is presented in Figure 9-1.



O W E N S V A L L E Y

FIGURE 9-1
OWENS RIVER FLOW AT KEELER BRIDGE, RUNOFF YEARS 1927-1989

SOURCE: LADWP, AQUEDUCT DIVISION

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The construction of dams by LADWP along the river above the Intake created Tinemaha Reservoir in 1929, Long Valley Reservoir (Crowley Lake) in 1941, and Pleasant Valley Reservoir in 1956, inundating the river channel and surrounding areas at these sites. In 1953, LADWP diverted the entire outflow of the river from Long Valley Reservoir into three hydroelectric facilities. This diverted the flow from 18 miles of channel in the Owens River Gorge. (Some minor flow remains between the dam and the upper gorge plant due to seepage through the dam.) LADWP's operation of these reservoirs, most notably Long Valley Reservoir, together with the importation of Mono Basin water to the Owens River system after 1941, caused an increase in the annual flow of the river, and an alteration in the seasonal flow pattern. Average pre-project flow in the Owens River as outflow from Long Valley was about 210,000 acre-feet per year.

The Owens River is a pool and riffle stream, with a meandering course along the Owens Valley. The slope of the flood plain averages 0.005 (five feet of fall in 1,000 horizontal feet). The geometry of natural channels is a product of flow characteristics (volume of flow, seasonal and annual variations in flow, and streambed gradient), and geologic conditions (such as composition of bed and banks, and size and amount of material carried in from tributaries). Under unaltered conditions, the forces of nature affecting channel geometry reach general equilibrium, with dramatic changes occurring during high river flows. If one or more of the natural processes are disturbed, the channel must adjust until a new equilibrium is reached.

Although changes in flow patterns and sediment load in the river channel have been in progress since the first diversion was constructed in the 19th century, they were accelerated as a result of the reservoirs, and the increased flows from Mono Basin in the 1940s. Construction of Crowley Lake in 1941 and Pleasant Valley Dam in 1954 reduced the range of river flows. Also, construction of the dams resulted in a retention of sediment behind the dams. This retention, combined with the elimination of sediment loading from the Owens River Gorge, altered the sediment transport characteristics of the river in the project area.

On the Owens River below Pleasant Valley, the dominant processes of bank erosion are frost wedging and undercutting followed by gravity sloughing, especially during low-flow conditions in the winter months. Large blocks of fine-grained material have been deposited in the channel due to these processes. A study by the USGS determined from aerial photographs (1947-71) and a field survey in 1972, that the net channel width has increased between 1947 and 1972.[1] The channel has clearly entrenched itself, with flow being increasingly confined to the main channel; this entrenchment has proceeded downstream. The Owens River is also migrating in a general northerly direction toward the Volcanic Tableland.

Owens Lake

The natural terminus of the Owens River drainage basin is Owens Lake. All water that reaches Owens Lake evaporates. Prior to any water development in the Owens Valley, lake inflow and evaporation were in a state of relative equilibrium, and the lake had a surface area of approximately 110 square miles. The lake began to shrink in the 1890s due to diversion of the Owens River and its tributaries for irrigation, and by 1904 was reduced to approximately 68 square miles in area. Because of the diversions of the flow of the Owens River and the diversion of each of its tributaries into the aqueduct below the Intake, by 1924 Owens Lake was essentially dry.

As discussed in Chapter 4, Water Management in Owens Valley, in wet years water was allowed to enter the Owens River channel. Some of this water, and flows from creeks directly tributary to Owens Lake caused periodic ponding on the dry lake bed. A detailed analysis of the hydrology of the lake is the subject of Lopes.[2]

Tributary Streams

Most of the streams that flow into the Owens Valley flow out of the Sierra Nevada on the west side of the Valley. Prior to the construction of the first Los Angeles Aqueduct, these streams flowed across the alluvial fans, onto the Valley floor, and into the Owens River or Owens Lake. Tributary streamflow is gauged at more than 60 sites on 34 tributaries, both at the base of the mountains and near the river/aqueduct system. Table 9-1 summarizes maximum, minimum and mean annual discharge for the tributary streams in Owens Valley over the period 1935 to 1984.[3] The locations of the stream gaging stations is presented in Appendix E.

Prior to 1970, the alteration of tributary stream channels and flow from natural conditions included the diversion of flow for local irrigation, partial or complete diversion of flow, and the physical alteration of channels (piping, lining, etc.). The diversion of flow in all creeks south of the Intake into the aqueduct eliminated flow in the creeks east of the aqueduct in all but the wettest years.

TABLE 9-1

MAXIMUM, MINIMUM, AND MEAN ANNUAL DISCHARGE
MEASURED AT BASE-OF-MOUNTAINS AND OWENS RIVER-LOS ANGELES AQUEDUCT
SYSTEM GAUGING STATIONS FOR TRIBUTARY STREAMS IN OWENS VALLEY
WATER YEARS 1935-1984

		Stations at Base of Mountains			Stations at Owens River-Los Angeles Aqueduct			
Site No.	Name	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Remarks
1	Horton Creek	13,520	2,900	6,138	21,549	2,814	7,380	--
2	McGee, Birch & Coyote Creeks at Bishop Creek	16,220	7,142	11,140	--	--	--	--
3	Bishop Creek	120,148	32,665	67,748	--	--	--	([1])
4	Freeman Creek at Keough	--	--	--	650	0	45	--
5	Rawson Creek	1,727	960	1,347	--	--	--	--
6	Coldwater Canyon Creek	1,384	423	741	--	--	--	--
7	Silver Canyon Creek	2,556	488	1,233	--	--	--	([2])
8	Fish Slough	7,877	5,176	6,066	7,050	1,431	5,248	([3])
9	Baker Creek	17,946	2,998	6,212	--	--	--	([1])
10	Big Pine Creek	60,838	19,059	31,334	49,923	8,354	22,079	--
11	Birch	11,384	2,895	5,559	8,335	0	2,316	([4])
12	Fuller Creek	378	2	143	--	--	--	--
13	Tinemaha Creek	10,966	2,358	5,741	12,126	2,113	7,202	--
14	Red Mountain Creek	8,097	1,431	3,829	--	--	--	([1])
15	Taboose Creek	12,352	3,691	6,685	19,318	634	5,325	([1,5])
16	Goodale Creek	9,493	2,623	5,194	14,860	257	3,167	([5])
17	Division Creek	6,104	1,582	4,433	6,749	87	3,698	([1,5])
18	Sawmill Creek	8,528	1,895	3,840	3,893	1,052	2,153	([5])
19	Thibaut Creek	1,205	3	371	--	--	--	([1,6])
20	Oak Creek, north fork	11,194	3,339	7,104	--	--	--	([1])
21	Oak Creek, south fork	7,,996	1,693	4,888	--	--	--	([1])
22	Oak Creek, below forks	--	--	--	7,447	0	633	--
23	Independence Creek	21,322	3,184	10,133	9,003	66	2,932	--
24	Mazourka Canyon Creek	457	0	51	--	--	--	([7])
25	Symmes Creek	6,058	696	2,799	276	0	30	([1])
26	Shepherd Creek	16,597	2,619	7,865	9,618	1,071	4,398	([5])
27	Bairs Creek, north fork	5,823	546	2,094	--	--	--	--
28	Bairs Creek, south fork	5,413	345	1,665	--	--	--	--
29	Bairs Creek, below forks	--	--	--	2,375	0	528	([5])
30	George Creek	13,562	2,285	6,444	6,420	0	2,271	([1,5])

TABLE 9-1 (Continued)

Site No.	Name	Stations at Base of Mountains: Maximum	Minimum	Mean	Stations at Owens River-Los Angeles Aqueduct: Maximum	Minimum	Mean	Remarks
31	Hogback Creek	7,835	950	2,978	2,658	0	766	--
32	Lone Pine Creek	21,280	4,848	9,417	16,393	0	3,294	--
33	Tuttle Creek	11,699	2,794	5,562	5,857	0	808	([8])
34	Lubkin Creek	--	--	--	1,891	113	412	--
35	Caroll Creek	--	--	--	1,545	0	254	--
36	Cottonwood Creek	50,447	3,196	16,406	44,549	0	9,668	--
37	Braley Creek	--	--	--	3,186	379	1,041	--
38	Ash Creek	--	--	--	11,261	306	3,128	--

[1] Diversions are made upstream from the base-of-mountains station.

[2] Includes data for three different base-of-mountain stations.

[3] Includes data for two different base-of-mountain stations; period of record is water years 1945-84 for the river-aqueduct station.

[4] Period of record is water years 1945-84 for the river-aqueduct station.

[5] Well discharge is added to the stream above the river-aqueduct station.

[6] Base-of-mountains station is located midway down alluvial fan.

[7] Period of record is water years 1961-72.

[8] Discharge for the river-aqueduct station is a measurement of flow diverted into the Los Angeles Aqueduct and does not include undiverted flow.

Source: Hollett and others (1989).

Between 1913 and 1970, flow in portions of four creeks (Goodale, Sawmill, Thibaut and Division Creeks) had been diverted into pipelines or lined channels above the aqueduct. The locations of the diverted sections of these creeks are shown in Appendix E.

Ponds, Lakes, and Reservoirs

Collection of water in topographic depressions on the Valley floor created natural small ponds and lakes in areas of the Owens Valley. The most notable of these are Klondike Lake and Warren Lake near Big Pine, Sawmill Pond west of Bishop, several small lakes in the center of the Valley from east of Aberdeen to east of Independence along the 1872 Earthquake Fault, and Diaz Lake near Lone Pine (see Figure 9-2, which depicts the location of these features). Prior to 1970, these lakes were still in existence, but diversion of water from streams for irrigation, and into the aqueduct system, caused large fluctuations in the levels in these lakes. In some years, these surface water features and the associated wetlands dried up as a result of such diversions.

Storage in Tinemaha Reservoir from the time of construction to 1969 is depicted in Figure 9-3.

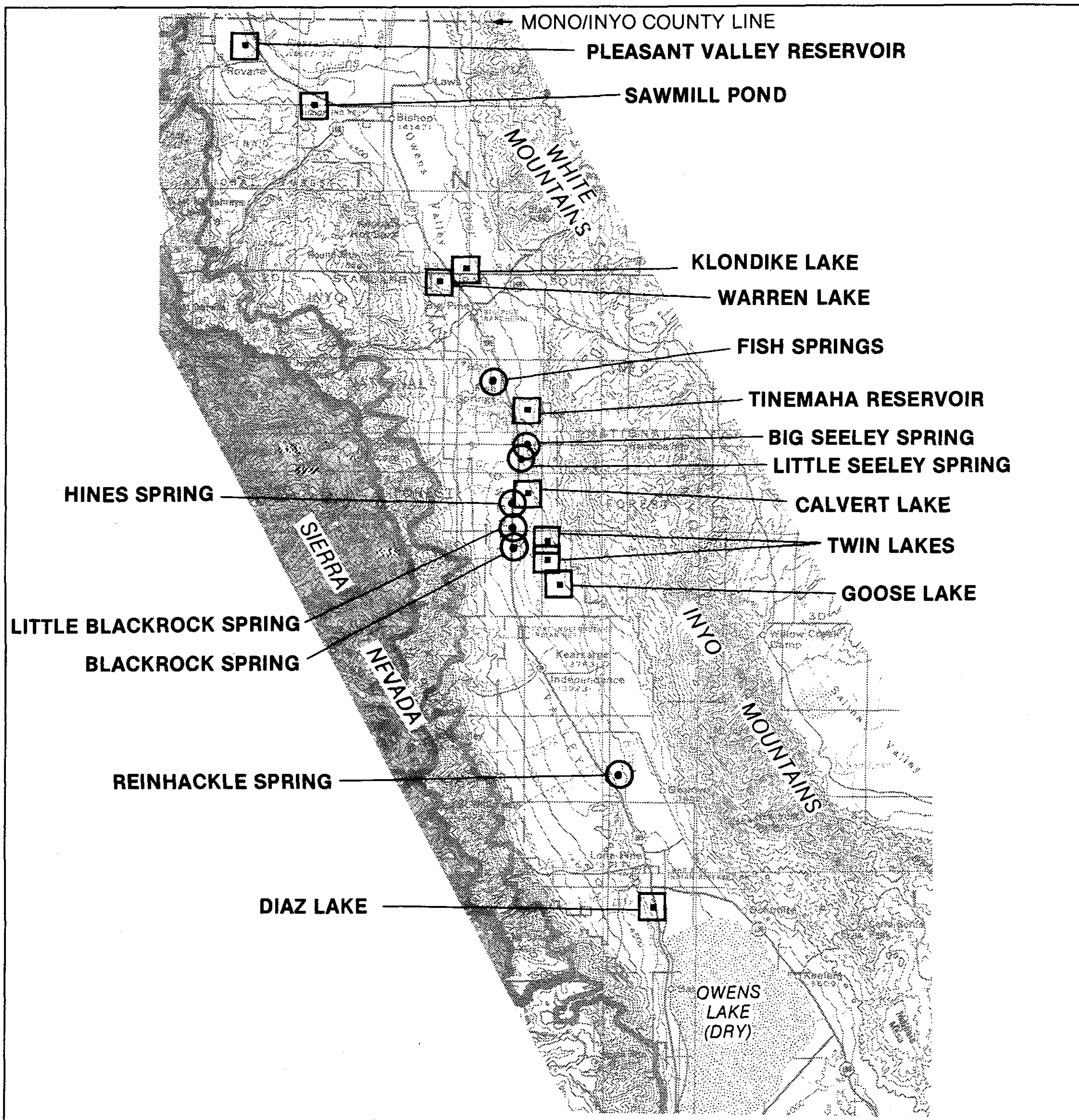
In response to a 1945 trial court judgement, and a 1950 State Supreme Court reaffirmation and modification, LADWP constructed dikes on the Valley floor east of Independence to prevent water from ponding in Owens Lake. In years when runoff was in excess of the export capacity of the aqueduct, water that was released from, or bypassed, the aqueduct ponded behind these three-to-eight-foot high dikes. Such ponding occurred in wet years such as 1967 and 1969.

Canals and Ditches

A network of canals and ditches was constructed in the latter half of the 19th century to convey water for irrigation, livestock, drainage, and other uses. As Los Angeles purchased and retired irrigated land between 1924 and 1970, many of these canals and ditches were taken out of service. This occurred primarily between 1924 and 1935.

Springs and Seeps

Springs and seeps can be considered part of both the surface water and groundwater systems of the Valley. Springs and seeps represent a groundwater outflow, but the fact that the water flows



O W E N S V A L L E Y

FIGURE 9-2
LAKES, PONDS, RESERVOIRS, SPRINGS AND SEEPS OF OWENS VALLEY

Lakes, Ponds and Reservoirs

Springs and Seeps

SOURCE: USGS; EIP ASSOCIATES

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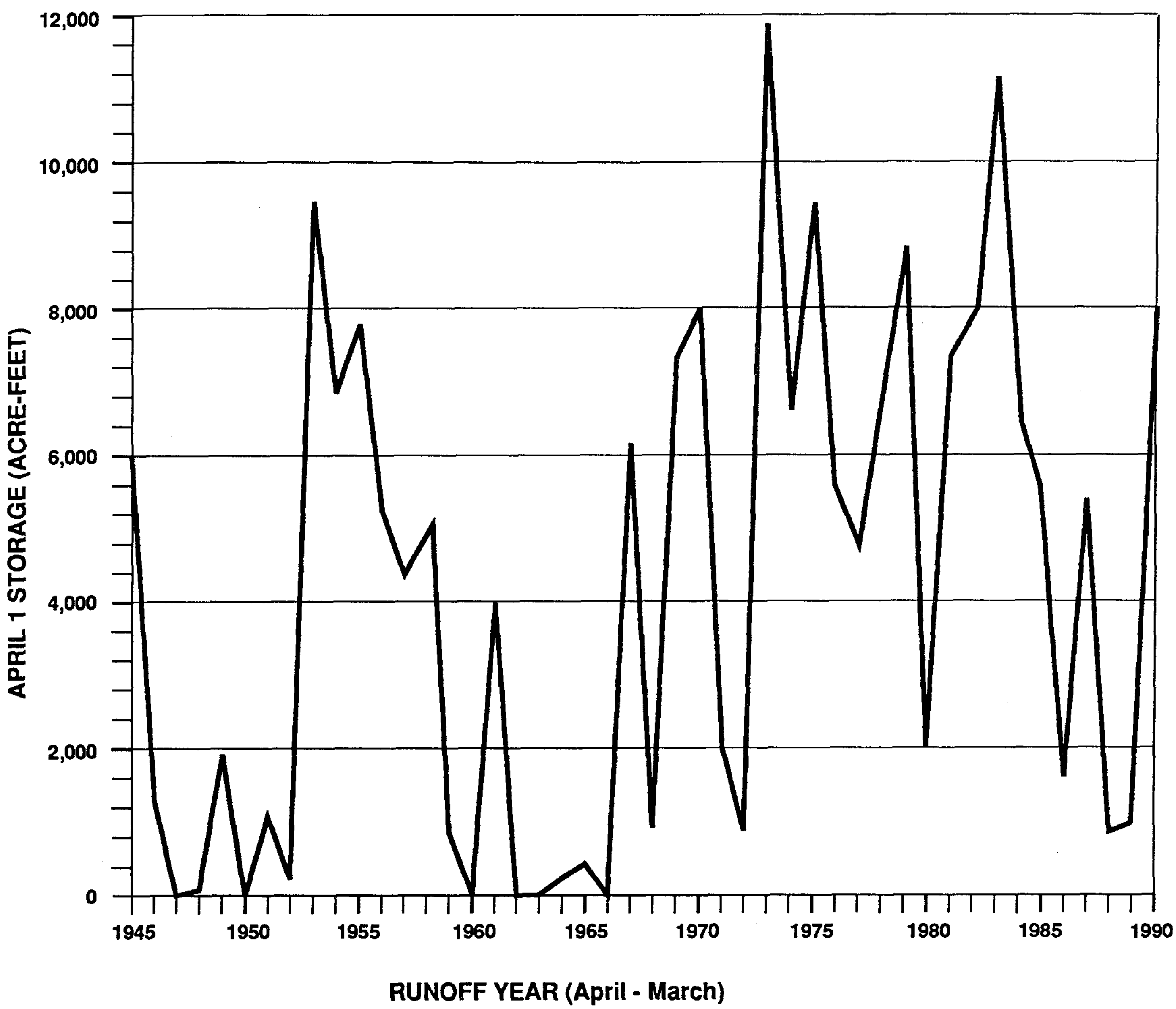

O W E N S V A L L E Y

FIGURE 9-3
TINEMAHA RESERVOIR STORAGE, 1945-1989

SOURCE: LADWP, AQUEDUCT DIVISION

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on the land surface suggests that it can also be treated as surface water. For the purposes of this EIR, because groundwater pumping directly affects the flow in springs and seeps, the detailed discussion of seeps and springs is presented in the groundwater section.

Surface Water Budget for Pre-Project Setting

The components of the surface water system are the tributary streams that flow out of the mountain areas: the Owens River, including the reach of the river below the Intake; the Los Angeles Aqueduct below the Intake; all canals and ditches; and Owens Lake. Inflow to this system is from surface flow in the Owens River that enters the project area as Long Valley outflow (including water imported from the Mono Basin), runoff from the mountain areas, and pumped and flowing groundwater that is conveyed through the system for in-valley use or export. Precipitation that falls on the intermediate mountain slopes, alluvial fans, and Valley floor contributes little to runoff, and is more properly a component of the vadose zone and groundwater system.

Outflow from the system includes in-valley uses and losses (natural groundwater recharge, artificial groundwater recharge, and uses on LADWP land), pumping loss in creeks, operational spreading, transit losses, evaporation from Tinemaha Reservoir, and export to Los Angeles (defined by inflow to Haiwee Reservoir).

The total surface runoff from the mountain areas into the project area is presented in Figure 9-4. Runoff from the mountain areas into the project area occurs naturally (and therefore is not impacted by management practices). The entire period of record is shown to present the variability of the inflow. It can be seen that runoff can vary widely from one year to the next. Figure 9-5 depicts the flow of the Owens River from 1946 to 1969 as Long Valley outflows. This period corresponds to first aqueduct operations after the importation of Mono Basin water into the Owens River system began. The water budget for this system is derived from the records of LADWP, and covers the period April 1945 to March 1970, and is presented in Table 9-2.

GROUNDWATER SYSTEM

This section on the groundwater system of the Owens Valley describes (1) the aquifer system and the occurrence of groundwater that builds from a foundation presented in Chapter 9, Geology; (2)

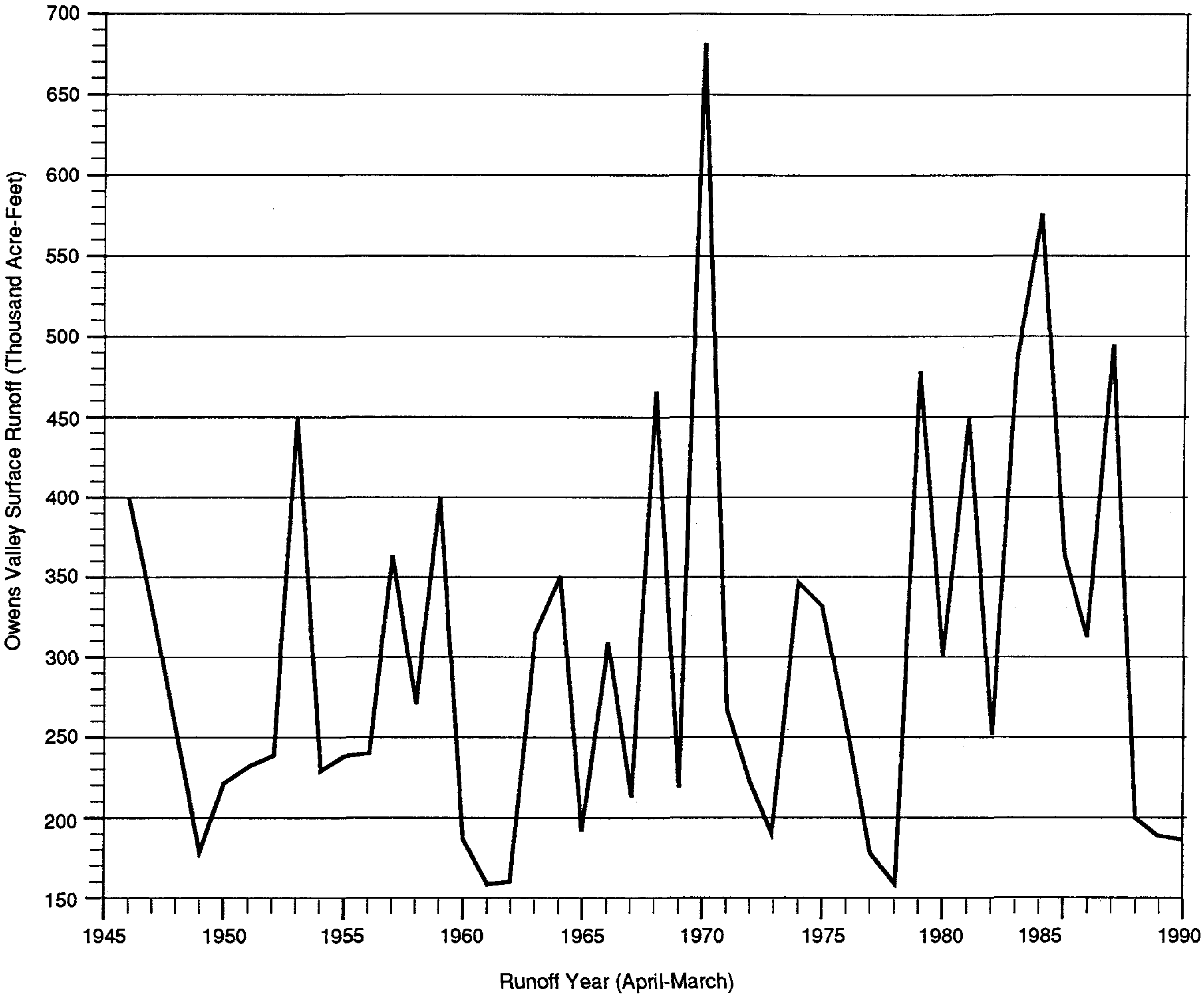

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FIGURE 9-4
OWENS VALLEY SURFACE RUNOFF, 1946-1990

SOURCE: LADWP, AQUEDUCT DIVISION

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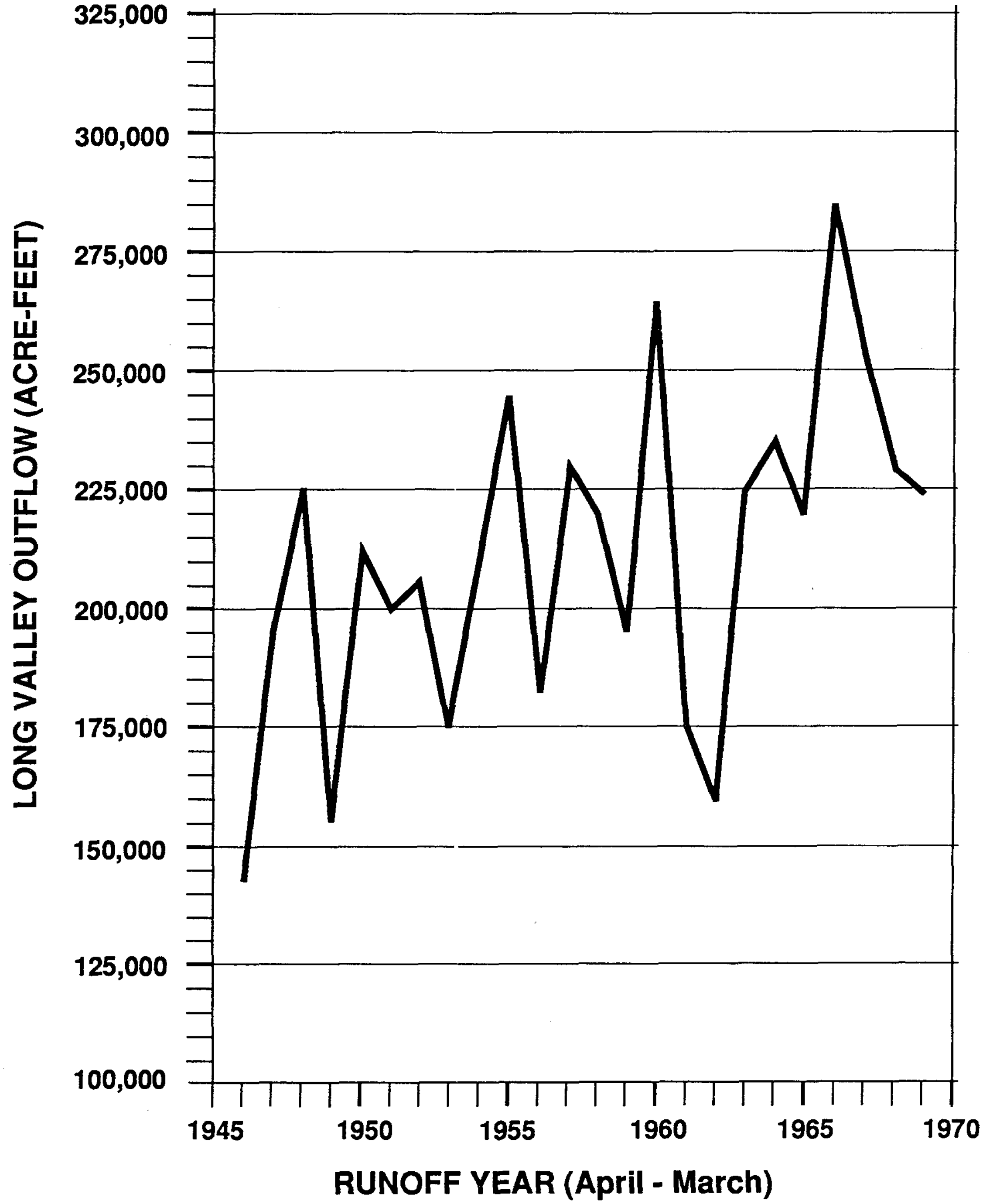

O W E N S V A L L E Y

FIGURE 9-5
OWENS RIVER FLOW AT LONG VALLEY, 1946-1969

SOURCE: LADWP, AQUEDUCT DIVISION

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TABLE 9-2

SURFACE WATER BUDGET
PRE-PROJECT AND 1970-1990 (1,000's acre-feet)

	1945-1946 to 1969-1970
Long Valley Outflow	210
Runoff (Long Valley to Haiwee)	292
Flowing Groundwater	44
Pumped Groundwater	10
	556
Uses and Losses[1]	189
Pumping Loss in Creeks	0
Operational Spreading	29
Transit Loss	-3
Tinemaha Evaporation (Net)	2
Haiwee Inflow	342
Total Outflow	559
Error	-3

[1]Includes uses on LADWP land and natural and artificial recharge.

the movement of groundwater within the aquifer system, the link between the groundwater system, the natural surface water system, and the vadose zone, and the causes and range of groundwater level fluctuations and flow patterns; (3) springs, seeps and flowing wells; (4) groundwater pumping during the pre-project period; and (5) the pre-1970 groundwater budget.

Aquifer System Description and Groundwater Occurrence

Virtually all groundwater in the project area occurs in the unconsolidated alluvial deposits and interbedded volcanic rocks that comprise the valley fill. As illustrated in Figure 9-6, the basin can be divided into two subbasins, the Bishop Basin and the Owens Lake Basin.[4] Approximately 30 million acre-feet of groundwater is estimated to be in storage in the Owens Valley.[5]

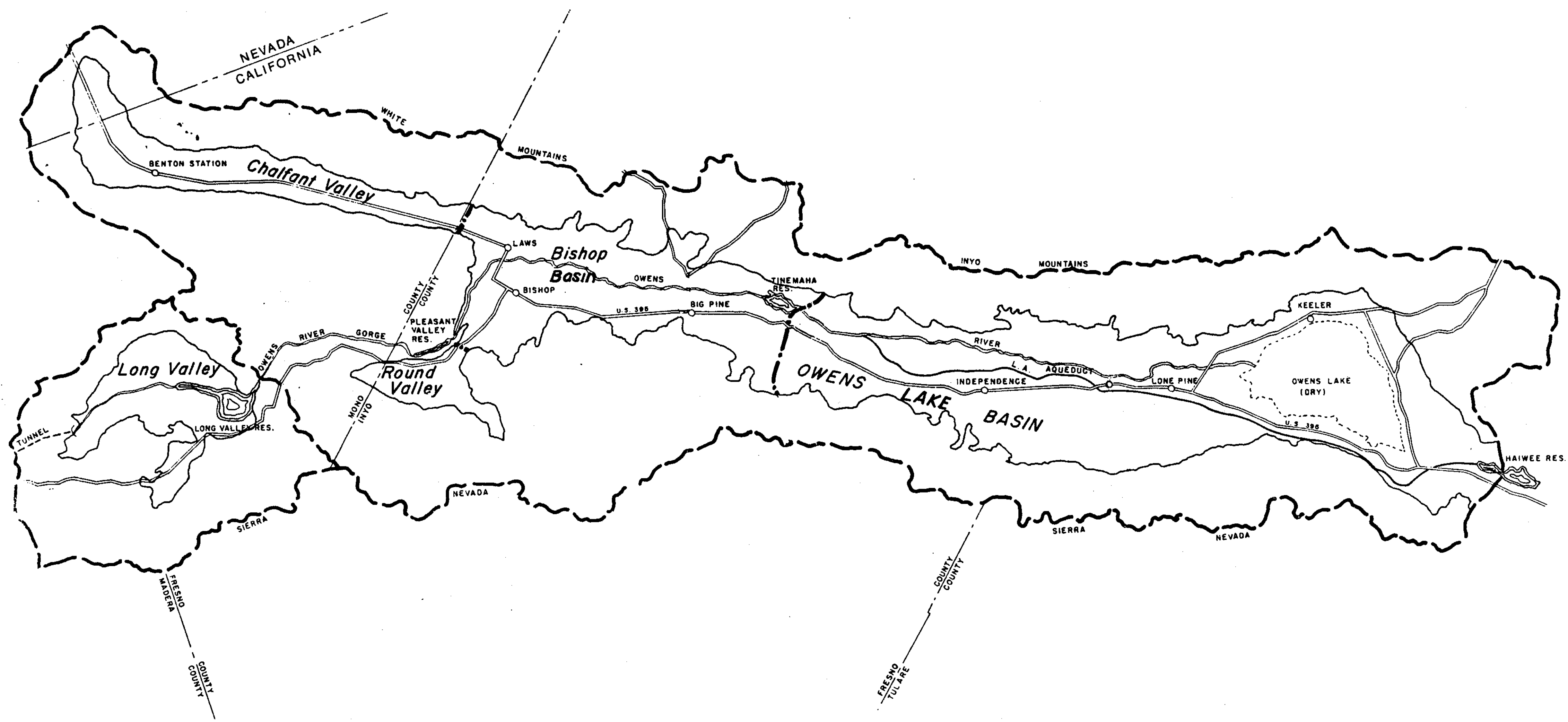
The groundwater system has been conceptualized as a series of alluvial and volcanic units that are a heterogeneous mixture of gravel, sand, silt, and clay lenses and interbedded volcanic flows that are laterally discontinuous and vertically complex.[6] The hydraulic nature of the aquifer system, however, provides a convenient method to vertically subdivide the system. The conceptualized aquifer system is diagrammatically depicted in Figure 9-7, and discussed below.

The upper unit of the aquifer system under this conceptualization is an unconfined aquifer, and occurs throughout the project area. In an unconfined aquifer, depth to water in a well is equal to the vertical distance from the ground surface to the water table, which is the top of the saturated zone (the zone where the spaces between the sediments are completely filled with water). The aquifer is characterized by sand and gravel deposits with little or no clay or silt, or by fractured volcanic rock. The depth to water in this upper aquifer ranges from near zero on the Valley floor to several hundred feet on the alluvial fans.

Where clay layers are present with sufficient thickness and areal extent, a confining layer is also present that defines the boundary between two aquifers. A confining layer restricts vertical movement of groundwater between the aquifers above and below the confining layer. Under natural conditions, flow is generally from the lower aquifer to the upper aquifer. Confining clay layers generally extend from the toes of the alluvial fans along the Sierra Nevada to the toe of the fans along the Inyo-White Range along the entire length of the Owens Valley. In areas where no confining layer exists, primarily on the alluvial fans, only one unconfined aquifer exists.

FIGURE 9-6

OWENS VALLEY GROUNDWATER SUB BASINS



Groundwater Basin Boundary

Watershed Boundary

Hydrologic Unit Divide

SOURCE: LADWP, AQUEDUCT DIVISION

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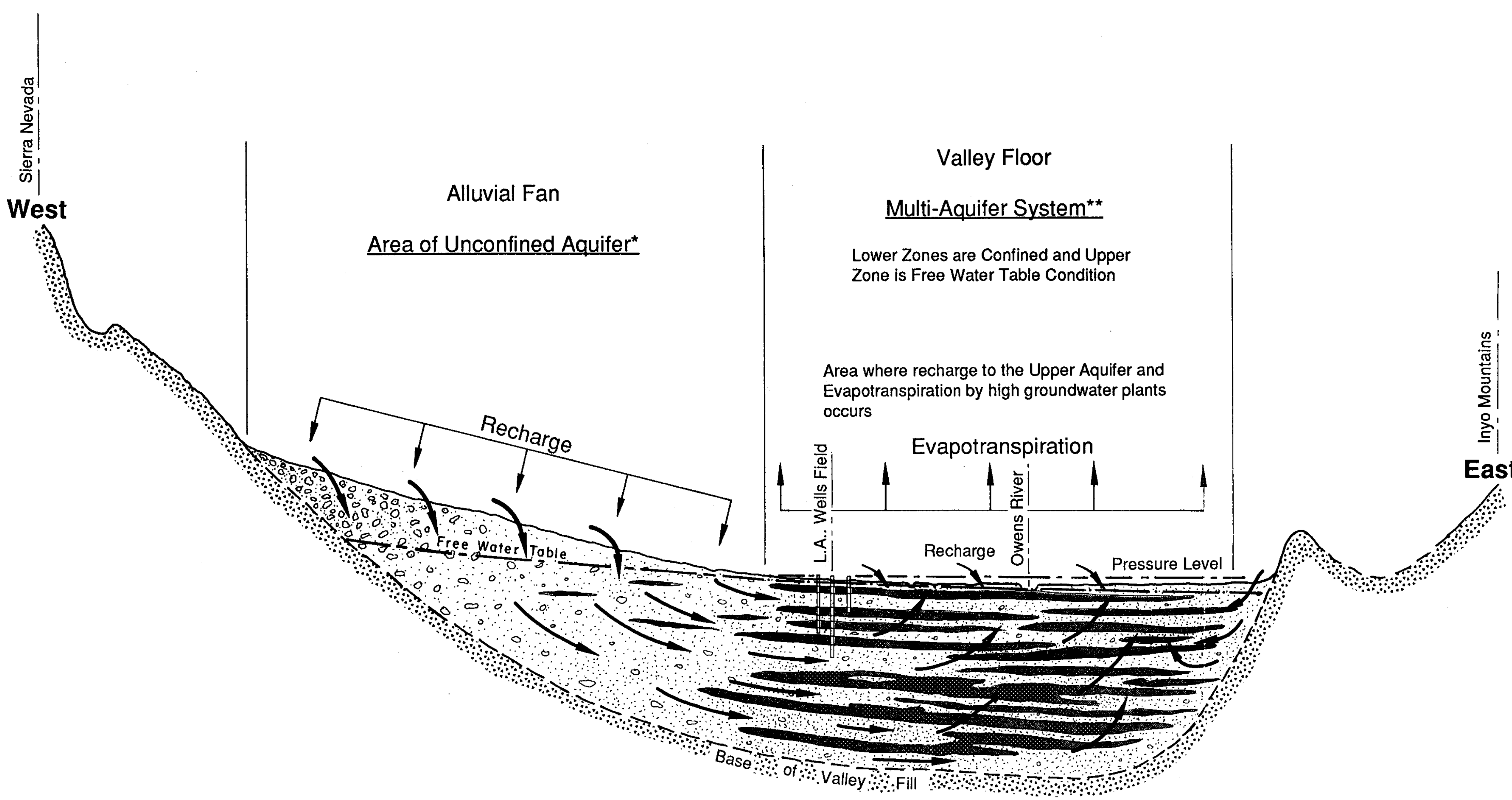
FIGURE 9-7

CONCEPTUAL ILLUSTRATION OF OWENS VALLEY AQUIFER SYSTEM



* Area where charge to the lower confined aquifers occurs. Water flows from here to the lower confining zones.

** Area of recharge to the upper zone. Deeper confined zones have a higher pressure level than the shallow water table zone forcing the groundwater to flow upwards from the lower to the shallow zone.

SOURCE: LOS ANGELES DEPARTMENT OF WATER AND POWER

NO SCALE

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Below the uppermost confining layer, several confined aquifers exist due to the interbedded nature of aquifers and confining layers. For the purposes of practical analysis, all confined aquifers can be conceptualized as one confined aquifer system, referred to as the lower aquifer unit. Because of the confining layer, water in a well that is completed in the lower aquifer unit will rise above the top of the lower aquifer (as defined by the confining layer) due to hydraulic pressure created beneath the confining layer. The confined pressure, or artesian pressure, is defined as the vertical distance between the water level in the well and the top of the lower aquifer. If the pressure is sufficient to cause the water in a well to rise above the ground surface, a flowing well results.

The elevation to which water rises in a well that taps a confined aquifer is called the potentiometric level. The potentiometric level in several wells can be used to define the potentiometric surface of the aquifer, which is analogous to the water table of the unconfined aquifer. In an unconfined aquifer, the water table and the potentiometric surface can be considered the same. The potentiometric surface of the lower aquifer in the project area ranges from 200 feet below land surface to over 30 feet above land surface. In certain areas where the potentiometric level is above the ground surface and where geologic conditions are favorable, springs and seeps exist.

Groundwater occurs in volcanic rocks in voids and fractures within the otherwise impermeable rock, under both unconfined and confined conditions. As explained in Chapter 8, Geology, Soils and Seismicity, variations in the extent and continuity of fractures and voids within the individual volcanic flows are the controlling features in separating aquifers (permeable zones) from impermeable zones that act as confining layers.

The hydraulic characteristics of the aquifer system can be described by the aquifer transmissivity or hydraulic conductivity, the aquifer storativity, and the leakage of the confining layer. The hydraulic conductivity of an aquifer is analogous to the permeability, and the transmissivity is the hydraulic conductivity times the thickness of the aquifer. The storativity is a measure of how much water is released from storage with a unit decline in potentiometric level over a unit area of the aquifer. Leakage of the confining layer is a measure of how readily water can move vertically across the confining layer. Hydraulic characteristics are generally best obtained through aquifer tests. Over 100 such tests have been run in the project area, and the results were used to develop groundwater flow models of the groundwater basin. The hydraulic parameters were used to define areal subunits of the basin, largely on the basis of transmissivity. Typical values for hydraulic properties of identified units are presented in Table 9-3.

Groundwater Movement and Groundwater Levels

Groundwater in the study area generally flows north to south, with a strong west to east component along the Sierra front where most of the recharge takes place. The pre-project groundwater flow conditions for the shallow and deep aquifers in the northerly and southerly project areas are depicted in Figures 9-8 and 9-9 respectively. These figures are computer generated based on the Bishop Basin and Owens Lake Basin groundwater flow models. It was necessary to rely on model results because the actual field data necessary to create these maps were not adequate.

Groundwater moves from areas of recharge to areas of discharge. Recharge occurs primarily by infiltration of runoff as creeks cross the alluvial fans. Lesser quantities of recharge are attributable to the infiltration of water from canals and ditches on the Valley floor, irrigation water in excess of crop requirements, leakage from the aqueduct, underflow from Round Valley and Chalfant Valley, and small infiltration of rainfall on the alluvial fans. On the Valley floor, precipitation is generally equal to or less than the transpiration requirements of the native vegetation; therefore, precipitation on the Valley floor is not a source of groundwater recharge.

Hydrographs for typical monitoring wells are presented as Figures 9-10 and 9-11. In the 1930s and again in the 1960s, water levels significantly declined due to groundwater pumping by LADWP, but recovered shortly after groundwater pumping ceased. Pairs of hydrographs are shown for the well fields to demonstrate the shallow and the deep aquifer response to pumping.

The amount of recharge prior to 1970 was altered due to LADWP management practices. As described in Chapter 4, in the areas where water was diverted on the alluvial fans and ponded behind dikes by LADWP, recharge was increased over natural levels. Where creek beds had been lined or the flow diverted into pipelines or the aqueduct, recharge was reduced below natural levels.

TABLE 9-3

HYDRAULIC CHARACTERISTICS OF THE AQUIFER SYSTEM

Zone[1]	Transmissivity[2] (gpd/ft)	Storativity[3] (dimensionless)
Alluvial Fans	6,000 to 100,000	10^{-1} to 10^{-4}
Transition Zone	80,000 to 300,000	10^{-1} to 10^{-4}
Valley Floor (Owens Lake Basin)	120,000 to 140,000	10^{-1} to 10^{-4}
Valley Floor (Bishop Basin)	25,000 to 300,000	10^{-1} to 10^{-4}
Volcanics	300,000 to 1,500,000	10^{-1} to 10^{-4}

[1] See Chapter 8 for a discussion of zones.
[2] Transmissivity is the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient. Transmissivity values are given in gallons per minute through a vertical section of an aquifer one foot wide and extending the full saturated thickness under a hydraulic gradient of one.
[3] Storativity is the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head. Storativity values have no dimension.

Note: Fault zones reduce transmissivity values by 1/2 to 1/20 of appropriate zone value.

Source: LADWP (1988); Hutchison (1988); Danskin, USGS (written communication, 1988, 1990).

Between 1950 and 1968, LADWP constructed facilities to enhance natural groundwater recharge in the Owens Valley. These facilities include structures to divert water out of various streams and canals during years of high runoff. This water is then allowed to spread and percolate into the ground. Current LADWP spreading facilities are located in the Laws, Big Pine and Independence areas. The locations of existing LADWP spreading facilities are shown in Appendix D.

Natural discharge (evapotranspiration, baseflow to the Owens River, flow from seeps and springs) are consequences of and dependent on the pattern of groundwater flow in the unaltered, natural system. Groundwater flowed towards these areas of discharge.

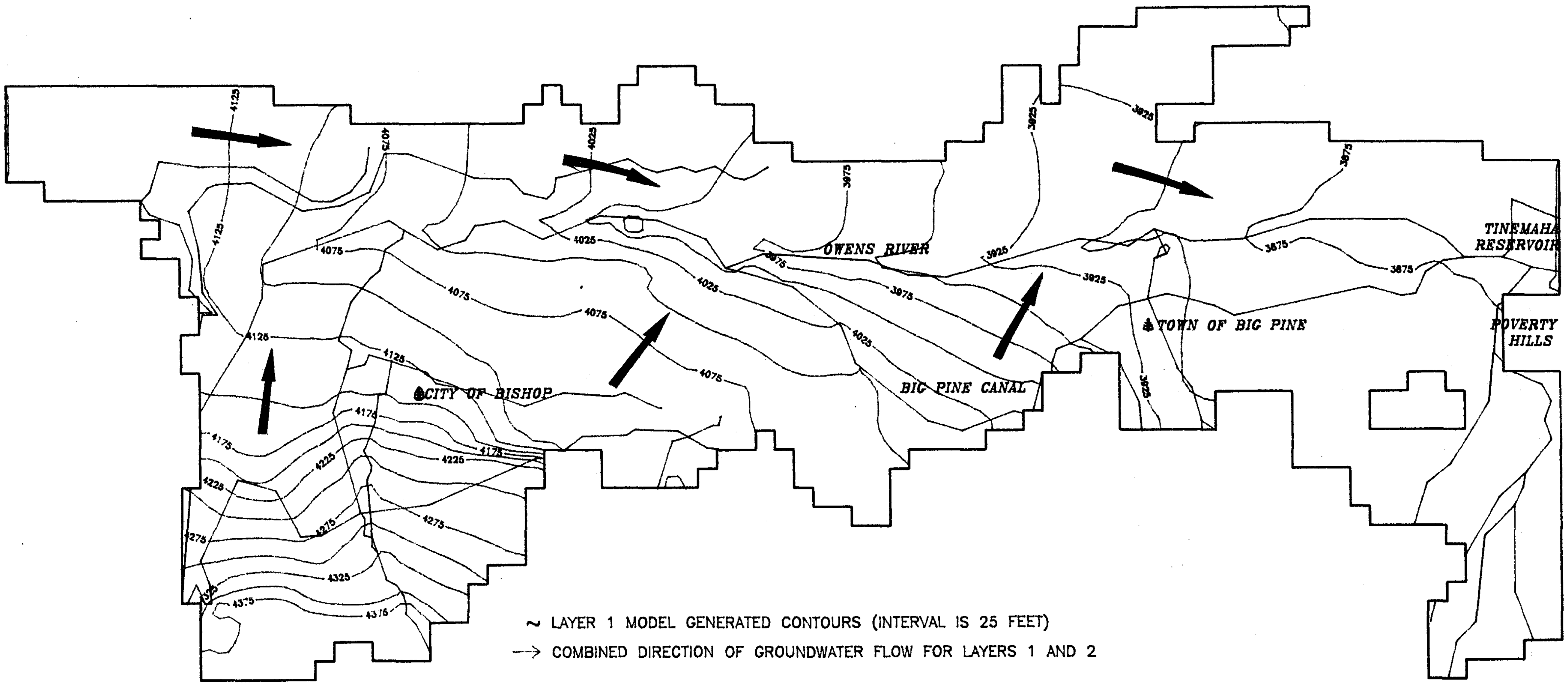
The pattern of groundwater flow was altered by groundwater pumping prior to 1970. When groundwater is pumped from a well that is completed in the unconfined aquifer, the water table is lowered in response to that pumping, and local flow patterns are altered toward the pumping well (Figure 9-12). When groundwater is pumped from the confined aquifer system, the potentiometric surface of the lower aquifer unit is lowered, the upward movement of water is altered, the water table in the unconfined aquifer can be lowered as a result, and groundwater flows toward the well (Figure 9-13). If a pumping well is completed in both the unconfined and confined aquifers (a common occurrence of LADWP wells completed in the pre-project period), the lowering of the water table is more rapid than a well completed only in the confined aquifer. This occurs because of the combination of the direct drawdown, and the reduction or reversal of the vertical gradient (Figure 9-14).

Groundwater is moved from the water table (the top of the saturated zone) into the vadose, or unsaturated soil zone, largely driven through the process of evapotranspiration in areas where depth to the water table in the unconfined aquifer is within the root zone. Through its root system, vegetation extracts water from the vadose zone. If the water table is shallow, capillarity and negative pressure gradients (suction) created by the root systems causes water from the water table to move upward. Where the water table is within four feet of the ground surface, a similar movement of groundwater toward land surface can be driven by evaporation. If the water table is below the root zone, the physical process of capillarity still acts, but with no vegetation extraction of the water, and the upward "flow" due to the evapotranspiration does not occur.

O W E N S V A L L E Y

FIGURE 9-8

BISHOP BASIN, GENERALIZED GROUNDWATER FLOW PATTERNS, PRE-1970



SOURCE: HUTCHISON, 1988

MILES 0 1 2

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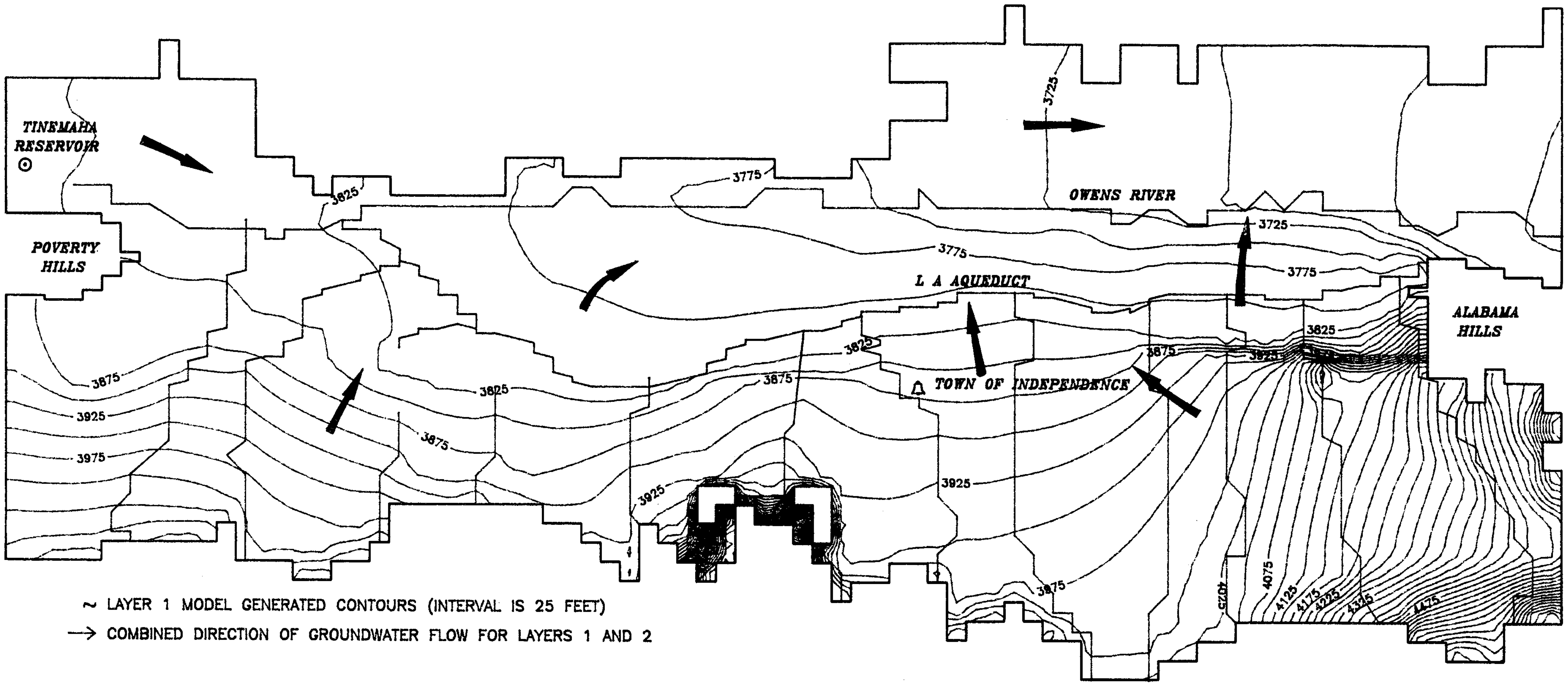
OWENS VALLEY

FIGURE 9-9

OWENS LAKE BASIN, GENERALIZED GROUNDWATER FLOW PATTERNS, PRE-1970



~ LAYER 1 MODEL GENERATED CONTOURS (INTERVAL IS 25 FEET)

→ COMBINED DIRECTION OF GROUNDWATER FLOW FOR LAYERS 1 AND 2

SOURCE: LADWP, 1988

MILES 0 1 2

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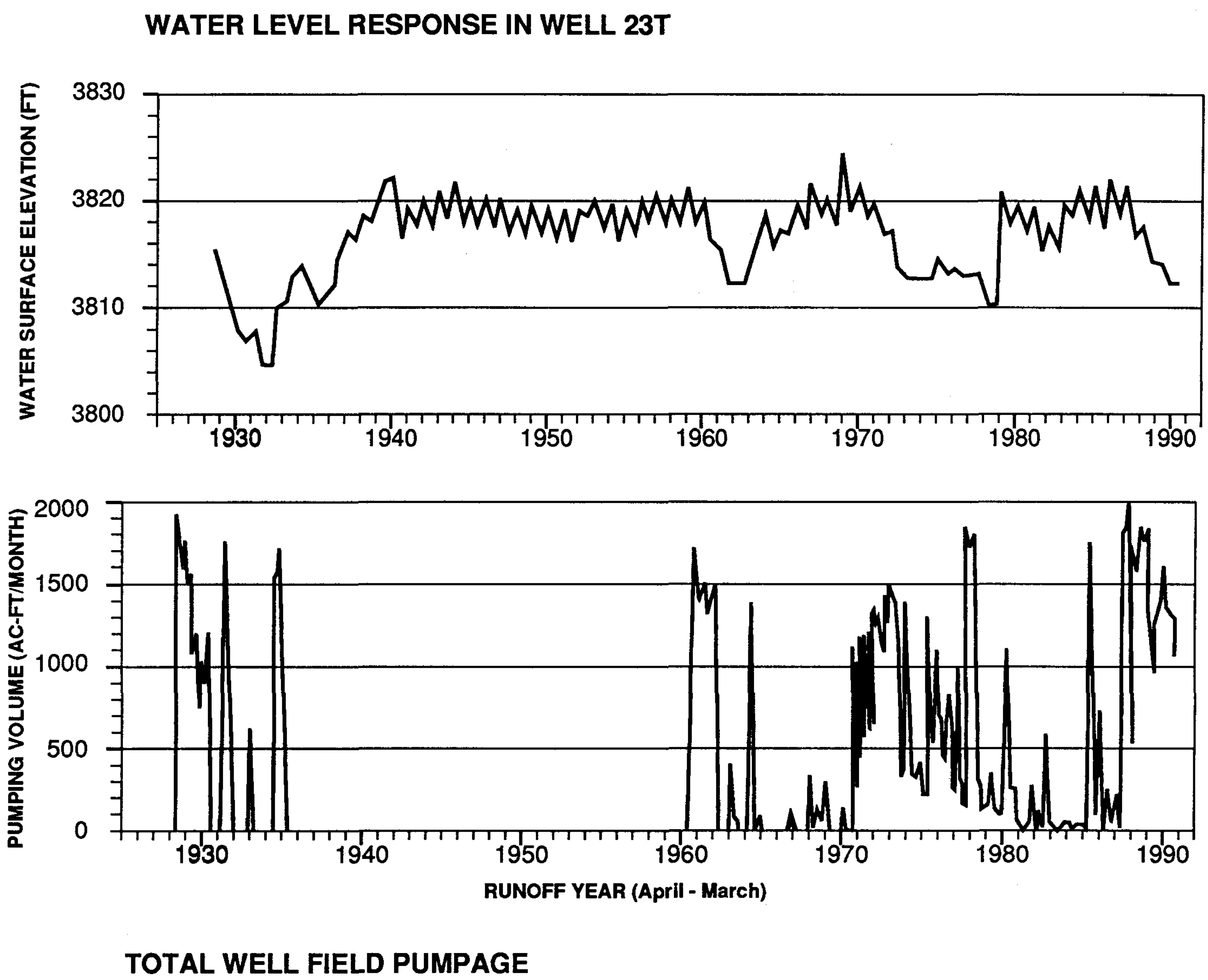

O W E N S V A L L E Y

FIGURE 9-10
WELL 23T,
INDEPENDENCE WELL FIELD,
HISTORIC HYDROGRAPH

SOURCE: LADWP, AQUEDUCT DIVISION

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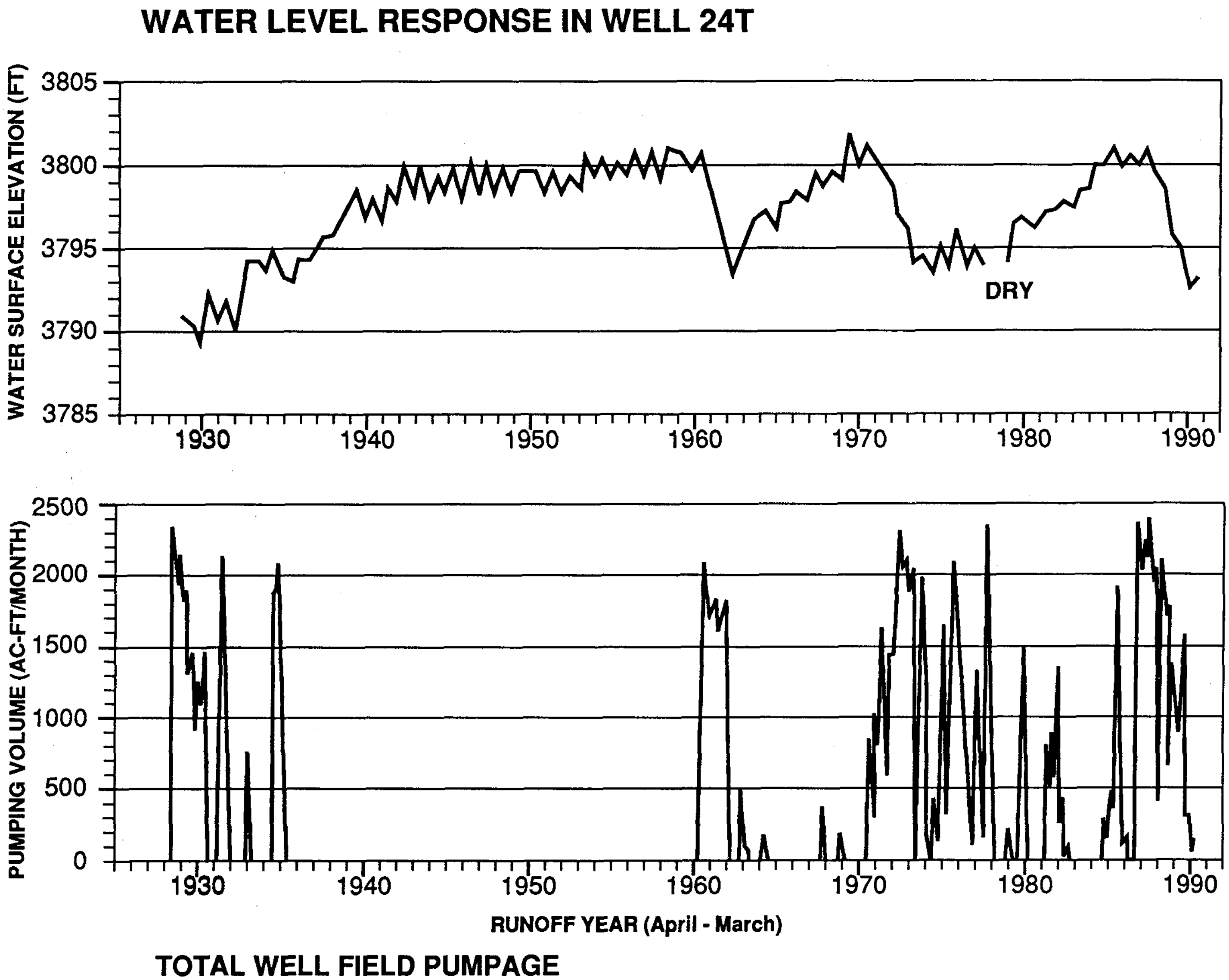

O W E N S V A L L E Y

FIGURE 9-11
WELL 24T,
SYMMES-SHEPARD WELL FIELD,
HISTORIC HYDROGRAPH

SOURCE: LADWP, AQUEDUCT DIVISION

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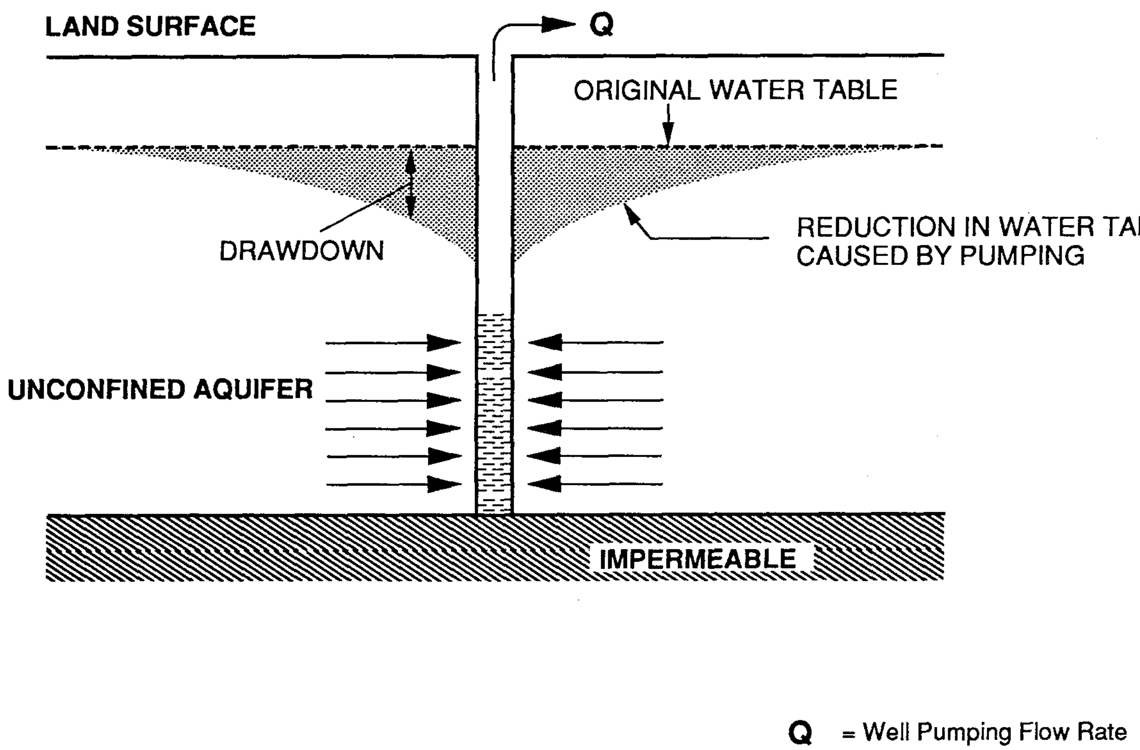

O W E N S V A L L E Y

FIGURE 9-12
GROUNDWATER TABLE RESPONSE TO PUMPING IN AN UNCONFINED AQUIFER

SOURCE: EIP ASSOCIATES

NO SCALE

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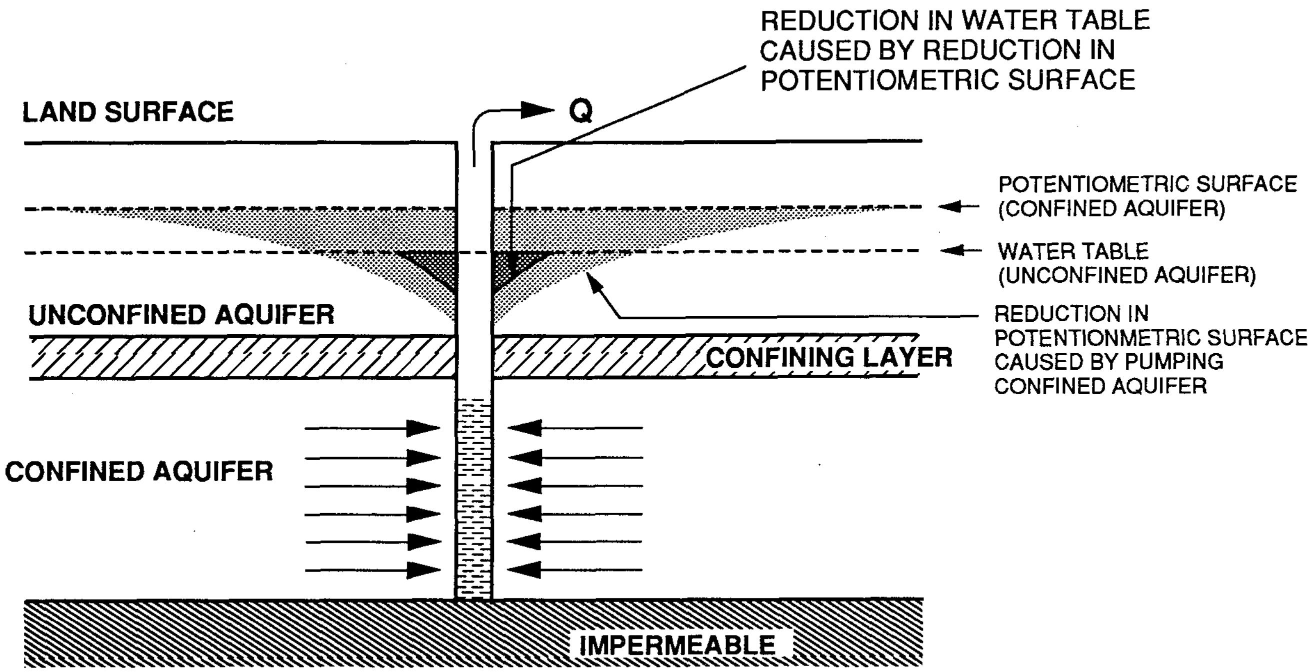


Q = Well Pumping Flow Rate

O W E N S V A L L E Y

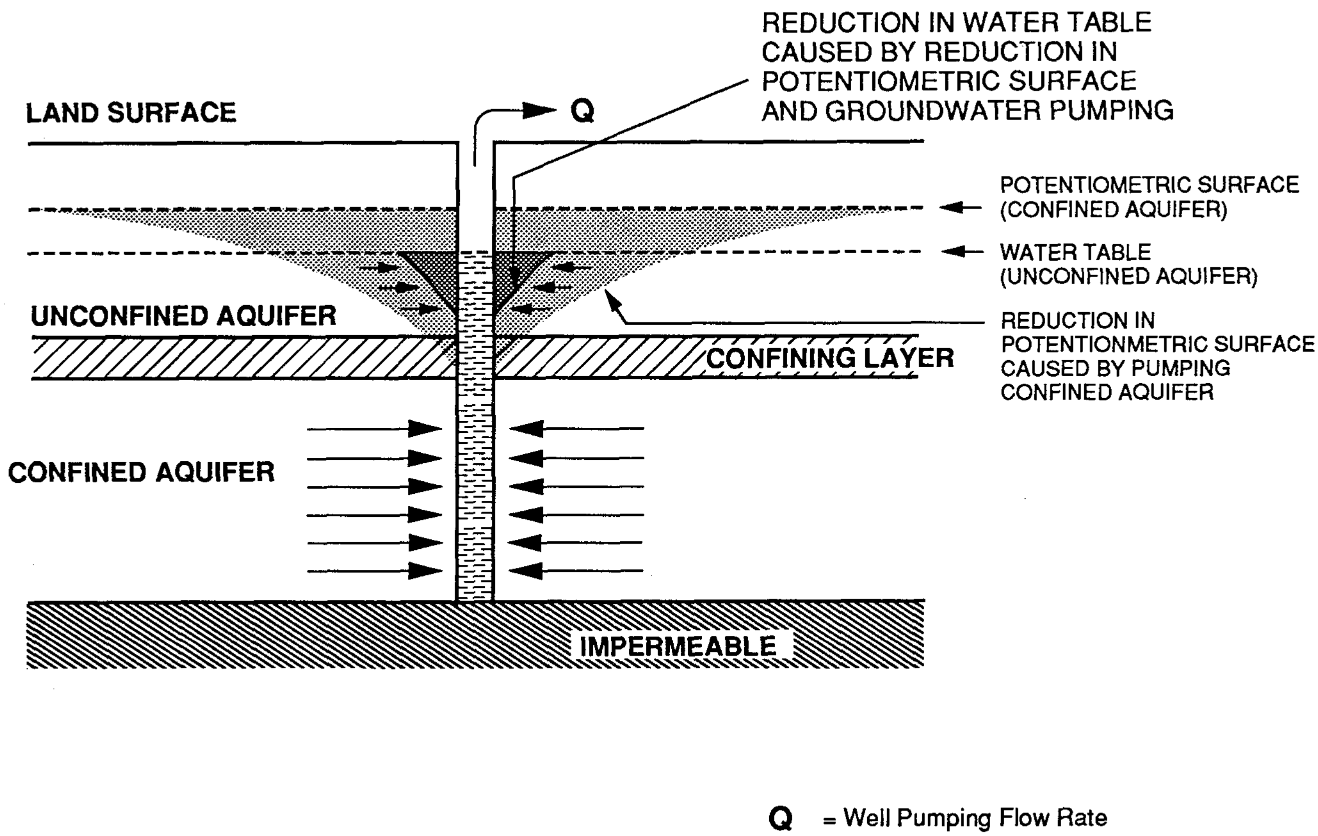
FIGURE 9-13

GROUNDWATER TABLE RESPONSE TO PUMPING IN A CONFINED AQUIFER

SOURCE: EIP ASSOCIATES

NO SCALE

eip 88041



O W E N S V A L L E Y

FIGURE 9-14

GROUNDWATER TABLE RESPONSE TO PUMPING IN A COMBINED UNCONFINED AND CONFINED AQUIFER

SOURCE: EIP ASSOCIATES

NO SCALE

eip 88041

The movement of groundwater flow in the project area is also influenced by faults, discontinuous alluvial materials, and variable hydraulic conductivity in the volcanics, each of which can result in substantial changes in groundwater flow patterns over relatively small horizontal and vertical distances. Faults located in the alluvium can inhibit the flow of groundwater. Often, shallow groundwater conditions or springs exist on the upgradient side of the fault. Many of the hydrologically important faults in the Valley are oriented in a north-south direction, perpendicular to the flow direction on the western side of the Valley. These faults retard groundwater flow if they contain zones of lower hydraulic conductivity (gouge zones), or if they cause a juxtaposition of material of relatively high hydraulic conductivity and material of relatively low hydraulic conductivity along a fault line. In some areas, the faulting has caused groundwater to rise to land surface in the form of seeps and springs. The Independence Springfield is a good example of the creation of a seep and spring area through faulting, change in hydraulic properties, and change in slope of land surface.

The major springs in the area are examples of areas where the contact of high hydraulic conductivity material with material of low hydraulic conductivity causes changes in groundwater movement (Fish Springs, Hines Springs, Seeley Springs, Blackrock Springs etc.). These springs, located at the contact between fractured volcanics and either unfractured volcanics or alluvium, were created when groundwater flowing through highly fractured volcanic rocks encountered material with lower hydraulic conductivity (unfractured volcanics or alluvium), and rose to land surface at this interface.

Springs, Seeps, and Flowing Wells

Flowing groundwater is important to the Valley's ecology (see Chapter 10, Vegetation) and the aqueduct system (see Chapter 4, Water Management in Owens Valley). Prior to 1970 several areas of flowing groundwater existed, including Fish Springs south of Big Pine, Seeley, Hines, Little Blackrock, and Big Blackrock Springs in the volcanic area south of the Poverty Hills, the unnamed springs and seeps east and south of Independence (the most notable area is known as the Independence Springfield), Reinhackle Spring, springs north of the Alabama Hills, and the several flowing wells along the Owens River in the east of Bishop and along the Los Angeles Aqueduct east and south of Independence. Table 9-4 presents average flow data, and Figures 9-15 and 9-16 present annual data for individual springs and for the two recognized groups of flowing wells. As

TABLE 9-4

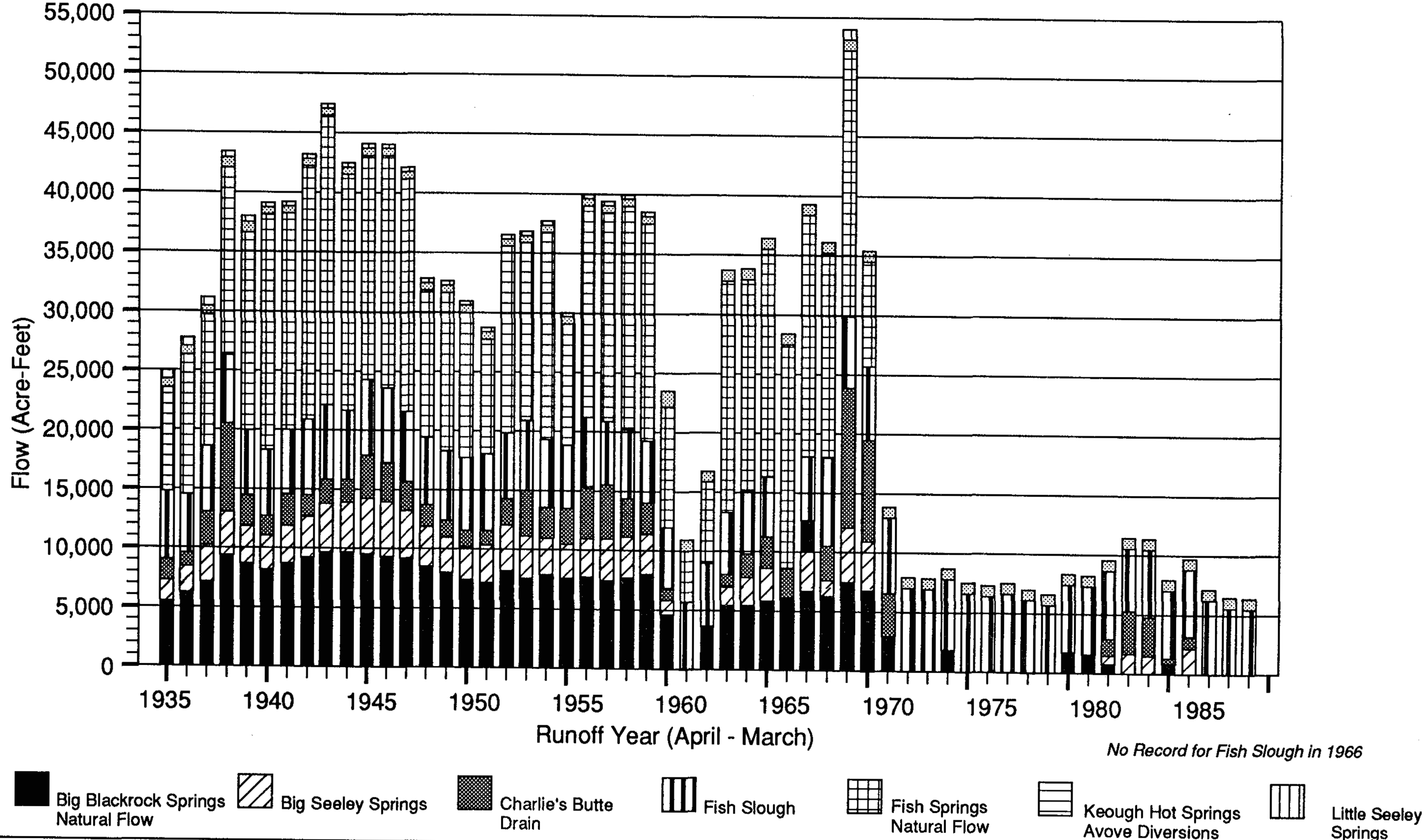
OWENS VALLEY SPRING FLOWS IN ACRE-FEET

Runoff Year	Big Blackrock Springs Natural Flow	Big Seeley Springs	Charlie's Butte Drain	Fish Slough Outflow	Fish Springs Natural Flow	Keough Hot Springs Above Diversions	Little Seeley Spring	Total
1935	5592	1767	1598	6086	8586	917	274	24820
1936	6282	2289	829	5438	11574	861	379	27652
1937	7166	3046	2652	5921	10992	846	506	31129
1938	9443	3602	7499	5979	15494	$45	715	43577
1939	8609	3258	2591	5620	16555	853	523	38009
1940	8131	2963	1452	5972	19579	869	336	39302
1941	8493	3343	1883	6527	17927	859	368	39400
1942	9036	3673	1698	6631	21572	844	467	43921
1943	9484	4306	1878	6576	24171	878	565	47858
1944	9469	4300	1640	6225	19704	860	557	42755
1945	9320	4895	3636	6387	19279	890	662	45069
1946	9106	4678	3379	6402	19462	946	602	44575
1947	8937	4050	2368	6057	19555	950	517	42434
1948	8276	3296	1777	6160	12179	941	431	33060
1949	7899	2954	1621	6186	12846	918	356	32780
1950	7167	2880	983	6301	12490	966	378	31165
1951	7061	3001	1243	6650	9818	920	320	29013
1952	7922	4026	1859	5870	15697	976	443	36793
1953	7401	3736	3626	6183	15007	928	359	37240
1954	7721	3206	2463	5810	17429	933	285	37847
1955	7349	3108	2476	5879	10085	901	256	30054
1956	7524	3557	3994	6156	17683	868	276	40058
1957	7191	3460	3821	6326	17518	863	255	39434
1958	7498	3510	2939	6183	19147	834	194	40305
1959	7766	3320	2577	5594	18032	908	173	38370
1960	4314	1395	716	5429	10314	935	99	23202
1961	61	0	0	5606	4003	895	0	10565
1962	2994	200	44	5619	6837	903	12	16609
1963	5116	1713	835	5449	19592	912	140	33757
1964	5307	2358	1817	5331	17841	886	121	33661
1965	5569	2667	2502	5462	18862	821	87	35970
1966	5736	2564	1832	1,111	17381	825	75	28413
1967	6266	3422	2508	6253	19437	811	200	38897
1968	5878	1487	2725	7659	16981	813	106	35649
1969	6968	4723	11732	6240	22266	783	816	53528
1970	6318	4451	8290	6235	8891	772	425	35382
1971	229	06	304	6438	0	760	13	13520
1972	0	0	22	6777	0	725	0	7524
1973	0	0	0	6485	0	718	0	7203
1974	12	0	1398	6006	0	846	0	8262

TABLE 9-4 (Continued)

Runoff Year	Big Blackrock Springs Natural Flow	Big Seeley Springs	Charlie's Butte Drain	Fish Slough Outflow	Fish Springs Natural Flow	Keough Hot Springs Above Diversions	Little Seeley Spring	Total
1975	0	0	0	6219	0	979	0	7198
1976	0	0	0	508	0	958	0	6946
1977	0	0	0	6387	0	955	0	7342
1978	34	0	0	5876	0	958	0	6868
1979	0	0	0	5766	0	992	0	6758
1980	0	93	134	686	0	1096	63	8544
1981	0	221	863	5161	0	1068	24	7337
1982	442	681	1001	5997	0	1026	55	9202
1983	0	1441	331	509	0	963	88	11222
1984	5	109	3131	5684	0	1006	103	11018
1985	0	436	406	5785	0	1017	75	7719
1986	0	1588	770	6087	0	1052	63	9560
1987	0	0	0	5831	0	1021	0	6852
1988	0	0	0	508	0	100	0	6498
1989	0	0	0	5294	0	1024	0	6318

Source: LADWP Aqueduct Division, August 1990.



O W E N S V A L L E Y

FIGURE 9-15

OWENS VALLEY SPRING FLOWS, RUNOFF YEARS 1935-1989

SOURCE: LADWP, AQUEDUCT DIVISON

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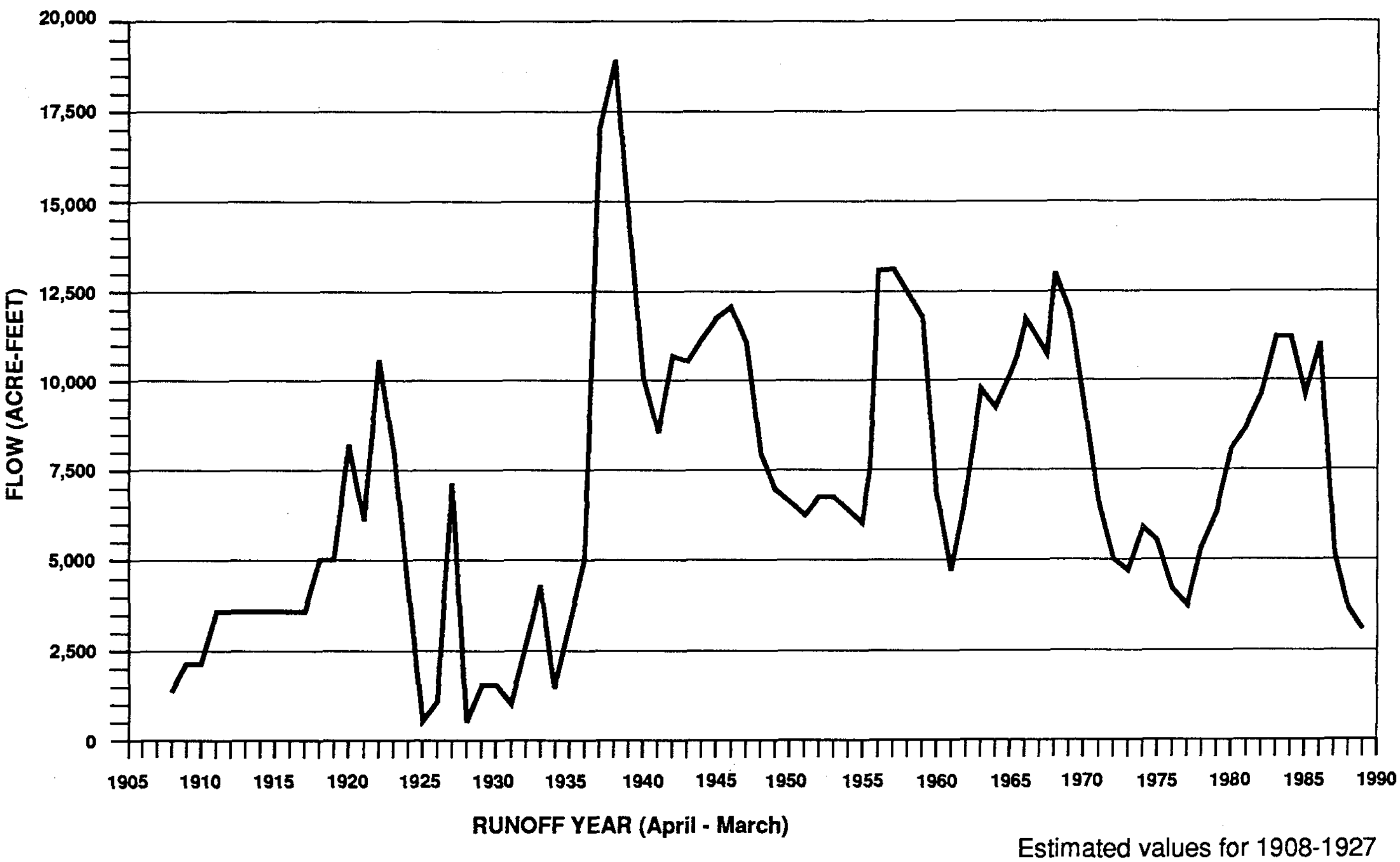

O W E N S V A L L E Y

FIGURE 9-16

OWENS VALLEY FLOWING WELLS, RUNOFF YEARS 1908-1989

SOURCE: LADWP, AQUEDUCT DIVISION

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can be seen, groundwater pumping during the 1930s and 1960s resulted in a significant reduction in spring flow. However, in areas where LADWP's groundwater pumping ceased, the spring flow returned to pre-pumping levels.

Groundwater Pumping

In the 1960s, Los Angeles had approximately 200 wells (pumping and deep observation) and test holes on City-owned land in the Owens Valley. Of these wells, 141 were pump-equipped at some time prior to 1970. The total historic combined capacity of these wells was 494.1 cfs (358,000 AFY); 80 of these were pump-equipped during the 1960's drought, with a capacity of 297.6 cfs (215,000 AFY). These Los Angeles production wells are located in nine well field areas of the Owens Valley: Laws, Bishop, Big Pine, Taboose-Aberdeen, Thibaut-Sawmill, Independence-Oak, Symmes-Shepherd, Bairs-Georges, and Lone Pine. The locations of these production wells are shown in Appendix E. The production well capacities for these wells are given in Table 9-5. In addition, there were approximately 15 domestic and small standby unequipped wells.

Groundwater production from the Owens Valley groundwater basin began prior to construction of the first aqueduct. During his 1906 survey of the groundwater resources in the Valley, W. T. Lee (Lee, 1906) reported that while no pump equipped wells had been installed in the Valley, several flowing wells were being used for domestic supply and irrigation purposes.[7] Between 1908 and 1911, LADWP completed several flowing wells in the Independence area to provide water for the dredges used in the construction of the first aqueduct. These wells were capable of producing a combined total flow of approximately 3,600 acre-feet per year.

During the 1920s, drought conditions reduced the flow in the Owens River, and LADWP installed additional wells to compensate for this loss. Pumps were installed in the Independence well field around 1924. During these drought conditions, which extended from 1928 to 1931, LADWP's average annual groundwater pumping was 34,250 acre-feet, with a maximum production of 136,163 acre-feet (188 cfs) from October 1930 to September 1931 (water year 1930-31).

From 1936 to 1958, groundwater pumping by LADWP was discontinued. During a drought period from 1958 to 1962, groundwater pumping was again an important source of water for the aqueduct

TABLE 9-5

OWENS VALLEY
PRODUCTION WELLS AND CAPACITIES
Pre-1970

Well No. (1)	Well Field (2)	Historic Capacity cfs (3)	Well No. (1)	Well Field (2)	Historic Capacity (cfs)
1	I.O.	0.8	103*	T.S.	1.8
2*	I.O.	1.3	104*	T.S.	1.4
14	I.O.	1.2	106*	T.A.	4.4
15*	I.O.	3.5	108*	T.A.	4.6
16*	I.O.	1.7	109*	T.A.	5.5
25	S.S.	1.2	110*	T.A.	5.6
27*	S.S.	1.5	111*	T.A.	6.5
28*	I.O.	1.9	112*	T.A.	4.0
31*	S.S.	1.6	113*	T.A.	2.4
32	S.S.	1.3	114*	T.A.	4.5
33	I.O.	1.5	116*	T.A.	3.2
38	S.S.	1.3	117	T.A.	1.3
39*	I.O.	1.0	118*	T.A.	3.2
42	S.S.	1.0	121	B.	0.6
43	S.S	1.2	122	B.	3.2
44	I.O.	0.8	123	B.	5.0
48	I.O.	0.6	125	B.	8.7
53	T.S.	0.4	126	B.	6.0
54	T.S.	1.7	127	B.	3.3
57*	I.O.	4.6	128	B.	4.1
58	T.S.	1.0	129	B.	4.4
59*	I.O.	3.4	130	B.	3.4
60*	I.O.	3.8	131	B.	4.4
61*	I.O.	2.4	132	B.	5.9
63*	I.O.	2.3	133	B.	4.2
65*	I.O.	5.2	134	B.	4.7
66*	S.S.	4.2	135	B.	3.7
67*	S.S.	3.9	136	B.	5.1
68*	S.S.	2.3	137	B.	3.1
69*	S.S.	4.2	138	B.	4.0
73*	S.S.	3.9	139*	B.	0.6
74*	S.S.	3.5	140	B.	4.5
75*	S.S.	3.2	141	B.	4.4
76*	B.G.	3.8	147	B.	4.0
77*	I.O.	3.1	148	B.	3.9
82	B.G.	1.0	149	B.	2.7
86*	B.G.	1.3	155*	T.S	2.5
87*	B.G.	1.2	156	T.S	1.1
89*	B.G.	3.5	158	T.S.	0.6
90*	B.G.	1.1	159*	T.S.	1.6
92*	S.S.	3.3	201	B.	2.2
95*	B.G.	1.3	203*	B.P.	3.0
96*	S.S.	4.4	206	B.P.	4.0
97	B.G.	0.8			
98	B.G.	3.0			
99*	S.S.	4.5			

TABLE 9-5 (Continued)

Well No. (1)	Well Field (2)	Historic Capacity cfs (3)	Well No. (1)	Well Field (2)	Historic Capacity cfs (3)
207	B.	3.8	245	L.	3.5
208	B.	2.0	246*	L.	3.8
210*	B.P.	2.6	247*	L.	5.6
211	B.P.	3.0	248*	L.	5.4
212*	B.P.	1.6	249*	L.	5.2
216	B.P.	4.0	250*	L.	0.1
217	B.P.	4.0	251*	L.	3.1
218*	B.P.	4.5	252	L	1.6
219*	B.P.	6.9	253	L	1.8
220*	B.P.	4.0	278*	B.	1.0
221	B.P.	4.0	330*	B.P.	20.0
222*	B.P.	4.4	331	B.P.	12.9
223*	B.P.	6.0	332*	B.P.	20.0
224	B.P.	3.0	333	I.O.	1.8
227	B.P.	4.0	341*	B.P.	1.8
228*	B.P.	4.0	342**	T.A.	
229*	B.P.	4.0	343**	B.G.	
230*	B.P.	3.4	344	L.P.	2.1
231*	B.P.	5.6	345**	S.S	
232*	B.P.	4.0	346**	L.P.	
233*	B.P.	1.8			
235*	B.	3.3			
236*	L.	4.0			
237*	B.	0.8			
238*	B.	4.3			
239*	L.	3.7			
240*	L.	3.4			
241*	L.	3.2			
242*	L.	3.8			
243*	L.	3.6			
244*	L.	3.5			
				TOTAL 466.9 cfs	

L.P. = Lone Pine
B.G. = Bairs-Georges
S.S. = Symmes-Shephard
I.O. = Independence-Oak
T.S. = Thibaut-Sawmill
T.A. = Taboose-Aberdeen
B.P. = Big Pine
B. = Bishop
L. = Laws

* Wells pumped equipped between 1960 and 1970 (capacity 297.6cfs)
** Drilled, but not pump equipped, prior to 1970.

Source: LADWP Aqueduct Division, August 1990 system. Average annual groundwater pumping for water years 1960-61 and 1961-62 was 81,253 acre-feet. After the early 1960s drought, groundwater pumping continued until 1970, but in lesser quantities. Up to the startup of operation of the second aqueduct, groundwater pumping by LADWP averaged 9,900 acre-feet per year (1945-1946 and 1969-1970). Groundwater pumping for the period 1945 to 1970 is presented on Figure 9-17.

Groundwater Budget

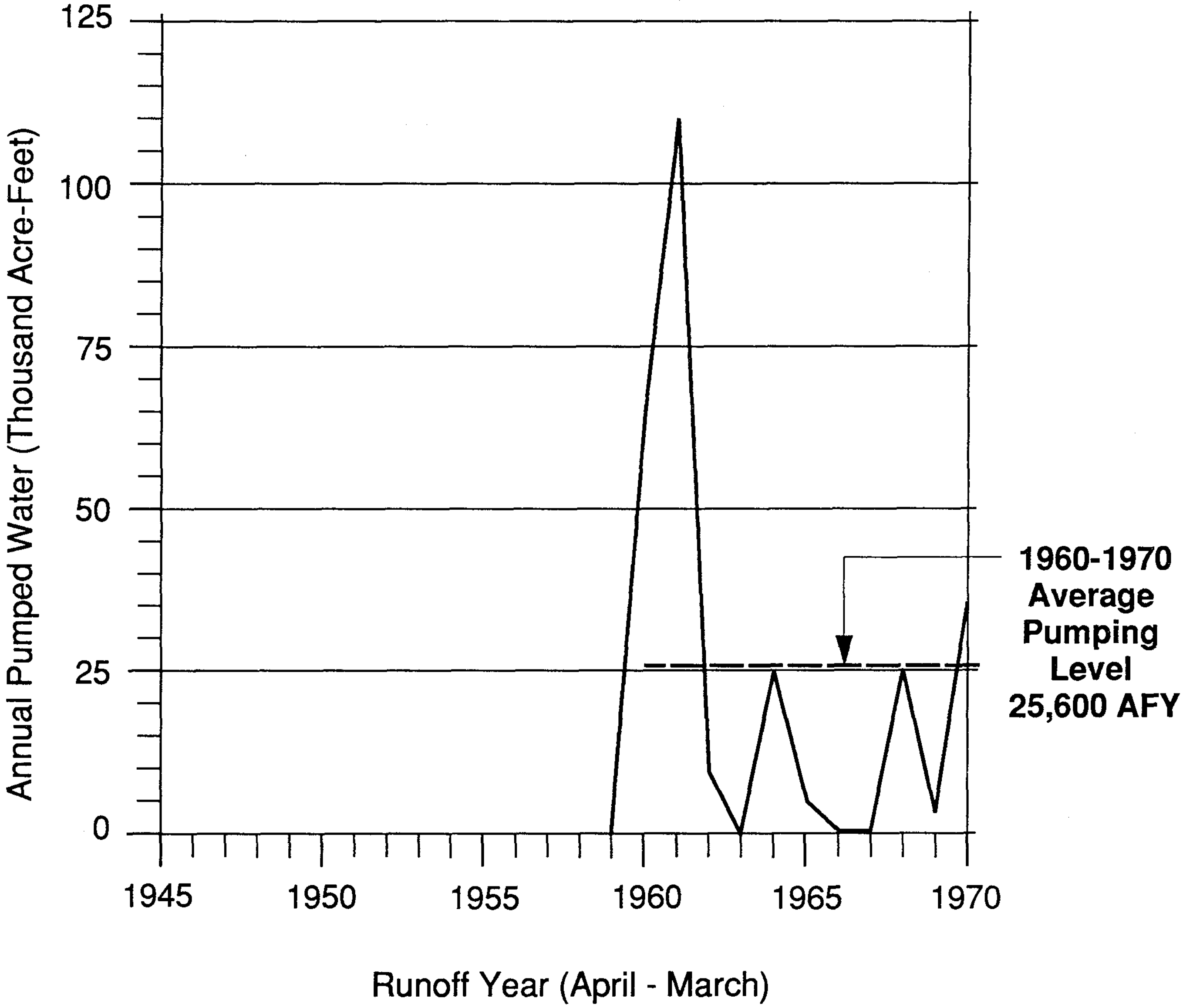
The most accurate and recent Owens Valley groundwater budget was developed by the USGS.[8] The major inflow component of the groundwater budget is recharge from runoff. This water infiltrates into the groundwater basin from creeks crossing the alluvial fans. The major components of outflow are evapotranspiration, flowing groundwater (seeps and springs), and pumped groundwater. The USGS budget is presented in Table 9-6, and is used as the basis for comparison for impact analysis later in this chapter. Other minor components of inflow and outflow are also presented in Table 6 that depicts the budget.

The pre-1970 USGS groundwater budget estimated recharge at 196,000 acre-feet per year and evapotranspiration of 112,000 acre-feet per year.[9] The evapotranspiration estimate was based on detailed vegetation data and is considered superior to the earlier estimates. The total recharge estimate is also considered more appropriate given the detail of data analysis used in the estimate.

Since groundwater pumping between 1913 and 1970 was limited to two brief drought periods, pumping did not substantially affect the groundwater budget during this period. However, changes in surface water management practices probably did have an impact on the groundwater budget. While streams continued to flow across the Valley floor in the area north of Tinemaha Reservoir, streams south of the reservoir were diverted to the aqueduct before reaching the Valley floor, and flow in the lower Owens River only occurred in high runoff years. Therefore, these sources were no longer available to recharge the upper aquifer on the Valley floor.

VADOSE ZONE

The vadose zone, or unsaturated zone, extends from the land surface to the water table. In simple terms, water exists in the vadose zone by adhering to soil particles. The strength of the adhesion to the soil particles allows for classification of the soil water into three categories: (1) water that



O W E N S V A L L E Y

FIGURE 9-17
OWENS VALLEY
GROUNDWATER PUMPING
1945-1970

SOURCE: LADWP, AQUEDUCT DIVISION

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TABLE 9-6

SUMMARY OF PRE-1970 OWENS VALLEY GROUNDWATER BUDGET
Water Years (October-September)
(AFY)

	1963-1969
INFLOW (Acre-feet/YR)	
Precipitation Percolation	2,000
Runoff Percolation	133,000
Subsurface Inflow	4,000
Conveyance Loss	57,000
Total Inflow	196,000
OUTFLOW	
Well Production (pumped and flowing wells)	20,000
Subsurface Outflow	10,000
Evapotranspiration	112,000
Flowing Groundwater (springs)	26,000
Conveyance Gain	21,000
Total Outflow	189,000
Change in Storage	+7,000

Source: Modified from Hollett and others, 1989.

can move downward in response to gravity or upward in response to capillarity, (2) water that cannot move in response to gravity, but can be extracted by plant roots, and (3) water that is so strongly held by the soil that it cannot move nor be extracted by plant roots. In general, the first two types of soil water are of interest.

Infiltration of precipitation or surface water causes an increase in soil water. The infiltrated water moves in response to soil conditions, and, in simple terms, moves from wetter areas of the soil to drier areas of the soil and in a generally downward direction. The soil water content is also increased by the upward movement of water from the water table into the vadose zone. The loss of water from the vadose zone is caused by uptake of water by plant roots, and by evaporation.

In terms of a simple water budget approach, inflow to the vadose zone is from precipitation and the groundwater system, and the outflow is to plant roots, evaporation and movement into the saturated zone below. No quantitative water budget of the vadose zone prior to 1970 is possible because of a complete lack of data; however, it is possible to qualitatively describe the conditions of the pre-1970 vadose zone water budget.

Water management practices alter inflow to and outflow from the vadose zone. A reduction in the application of irrigation water, and the reduction in infiltration from surface water courses (streams, canals, ditches etc.) diminishes soil water replenishment. Groundwater pumping that causes lowering of the water table can result in the removal of the water table from the root zone of the vegetation. Capillarity still exists, but, depending on soil conditions, the upward movement may not be sufficient to supply adequate water in the root zone.

WATER QUALITY

The State Water Resources Control Board discusses water quality in their Interim Water Quality Control Plan for the South Lahontan Basin as follows:

> "Surface waters of the Owens River Sub-basin are of excellent quality for virtually all existing and potential beneficial uses. In localized areas quality of surface waters is affected by discharges of highly mineralized water from naturally occurring warm springs. Such influences is seen from springs in the Hot and Mammoth creek areas in the north portion of the sub-basin and from the Keough Hot Springs south of Bishop. Surface waters not affected by warm springs activity are generally a moderately soft bicarbonate type with low dissolved mineral content and near neutral pH."[10]

Table 9-7 shows some characteristics of surface water quality from various locations in the Owens Valley, representative of pre-1970 conditions. Total dissolved solids contents provides an indications of the suitability of water for potable water uses or irrigation supply. It is recommended that drinking water have a maximum total dissolved solids content of 500 mg/l. Most crops require water with a total dissolved solids contents of less than 1,000 mg/l. Surface waters from the Owens Valley have total dissolved solids contents ranging from 30 to 270 mg/l. Corresponding values for groundwater are 100 to 470 mg/l.

9.3 IMPACTS OF THE PROJECT

The proposed project consists of all water management practices that were implemented or constructed in the Owens Valley to supply the second Los Angeles Aqueduct (including increased groundwater pumping), together with the water management practices and projects, contained in the Agreement.

In 1970, the second Los Angeles Aqueduct was completed, and its operation commenced. The total maximum export capacity from the Haiwee Reservoir was increased from about 480 cubic feet per second (cfs) (347,500 acre-feet per year) to about 780 cfs (564,700 acre-feet per year). As described in Chapter 4, the three sources of water to supply the second aqueduct were: (1) increased diversions from the Mono Basin, (2) increased surface diversion from the Owens Valley, and (3) increased groundwater pumping from the Owens Valley.

Environmental impacts to the water resources in Owens Valley due to the project are described if there has been or likely will be a significant adverse change from pre-project conditions. The impacts to the surface water system, the groundwater system, and the vadose zone are described. The project's impacts on vegetation, wildlife, air quality, and other resources, and the required mitigation measures are described in other chapters.

The impacts of the project on water resources can be viewed in terms of the elements of the proposed project, or in terms of each system as previously described. In order to place the impacts in perspective with regard to the pre-project setting, the detailed impact analysis that follows is organized in terms of each system.

TABLE 9-7

WATER QUALITY OF SURFACE STREAMS IN THE OWENS VALLEY

Area	Average Total Dissolved Solids (mg/l)	Average Hardness (mg/l)	Average Alkalinity (mg/l)
Lone Pine	40	20	30
Bairs-Georges	30	10	10
Symmes-Shepherd	40	20	20
Independence	50	20	20
Thibaut-Sawmill	120	50	60
Taboose-Aberdeen	50	20	30
Big Pine	30	10	20
Bishop	170	60	50
Laws	270	110	130

Source: Final EIR, Increased Groundwater Pumping of the Owens Valley Groundwater Basin, LADWP, 1979.

Described are changes to surface water flows in the Owens River, natural creeks, and in canals and ditches, greater fluctuations of groundwater levels, changes in amounts and sources of groundwater recharge, alteration of groundwater flow patterns, reduced evapotranspiration and a reduction in spring flow and seep areas due to increased pumping.

Table 9-8 presents an outline of potential impacts in the context of project elements. This format assists in checking the impact of any particular element.

The CEQA guidelines provide that a project will normally be considered to have significant adverse affects on water resources if it substantially degrades or depletes surface water or groundwater resources, interferes substantially with groundwater recharge, causes substantial flooding, or substantially degrades water quality either through pollutants or siltation.

Because this is a unique EIR, in that it describes a project that began more than 20 years ago, the analysis of the impacts of the project will be presented in two components. The first will describe the impacts of the project in the period from 1970 to 1990. The second component will describe any future impacts of the project resulting from the implementation of the Agreement. If a significant effect on the environment is identified under either component, the mitigation that will be implemented to reduce the impacts to less than significant is also described. Unless explicitly identified as significant, all impacts described are less than significant.

SURFACE WATER SYSTEM

Owens River and Los Angeles Aqueduct - 1970 to 1990

The flow in the Owens River has been, and will be altered as part of the project. Also, the channel geometry of the Owens River has been, and will be altered.

Impact

9-1 **The project has resulted in increased flow in the Owens River between Pleasant Valley and the Intake between 1970 and 1990. In the future, flows are expected to be less than those between 1970 and 1990.**

TABLE 9-8

OUTLINE OF POTENTIAL WATER RESOURCE IMPACTS
IN CONTEXT OF PROJECT ELEMENTS

Elements of the Project	Water Resources Impacts
The Agreement	System by system discussion
Increased Pumping (1970-1990)	9-10 through 9-17
15 New Wells	Chapter 16
Increased Pumping in the Bishop Cove	Chapter 16
Reduction in Irrigated Acreage	Chapter 10
Increased Surface Water Export	9-1, 9-5, 9-7, 9-8, 9-9
Decreased Operational Releases	9-2
New Groundwater Recharge Facilities	Chapter 16
Continuation of Environmental Projects	9-6, 9-8
Continuation of E/M Projects	9-3, 9-4, 9-6, 9-8

Between 1970 and 1990, flows in the river between Pleasant Valley and the Intake were generally greater due to increased import of water from the Mono Basin, and increased groundwater pumping north of the Intake. Long Valley outflow from 1970 to 1990 as compared to pre-project flow rates is depicted in Figure 9-18. The increased flows in this reach may be reduced in the future if Mono Basin exports are reduced. Between 1970 and 1990, the increase in flow as a result of increased export from the Mono Basin averaged 24,000 acre feet per year.

Insufficient information is available to determine if the increased flow rate from 1970 to 1990 has affected sediment transport rates, channel geometry, stream bank erosion, riparian vegetation or aquatic life. However, it is believed that increased flow rates have not resulted in a significant adverse impact in comparison to pre-project conditions. After 1990, flow rates will be less than occurred from 1970 to 1990 because of loss of Mono water.

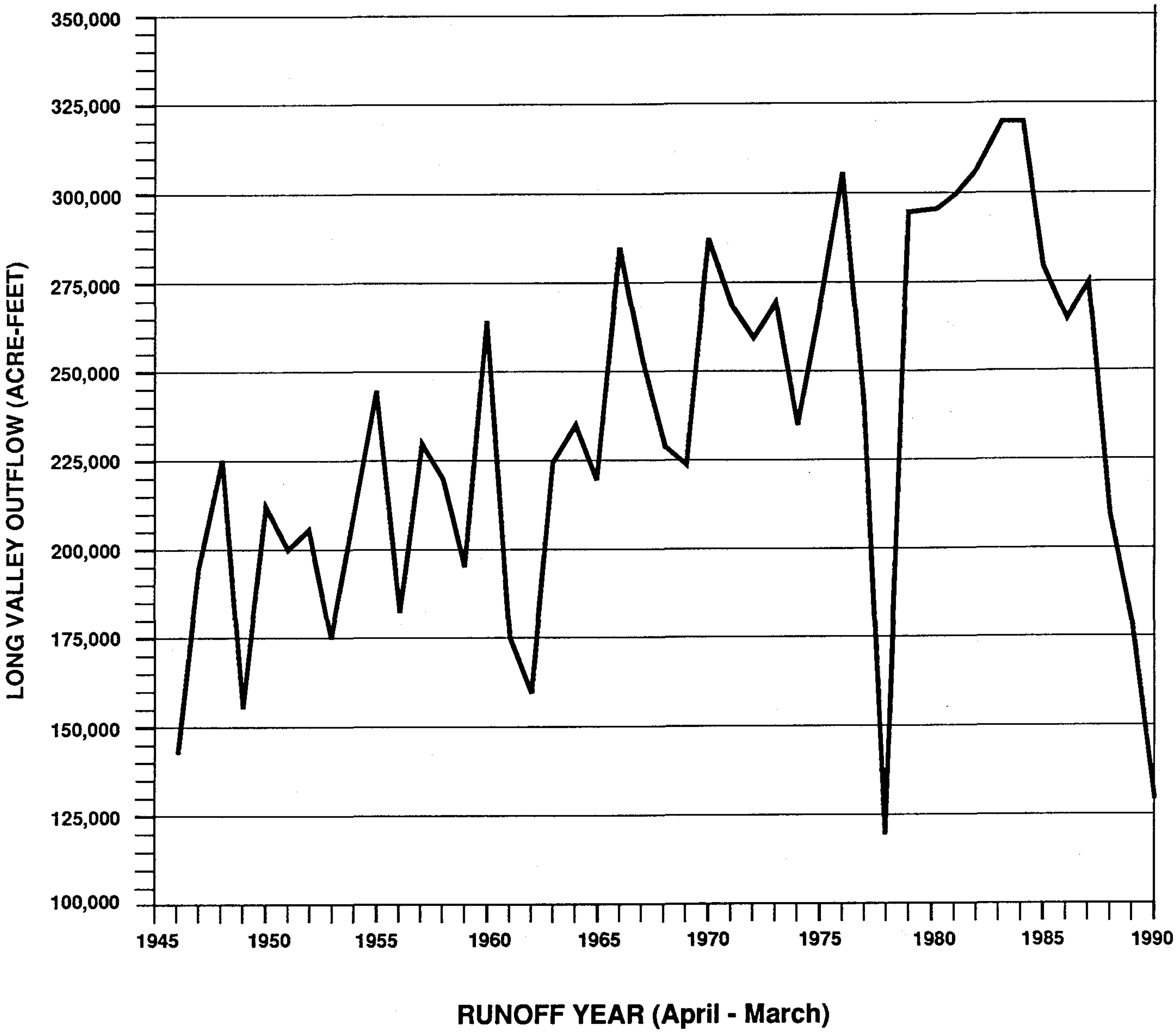
Mitigation Measures

9-1 *None required.*

Impact

9-2 **Reduction in operational releases and reduced baseflow caused slightly less flow in Owens River below the Intake from 1970 to 1986.**

Between 1970 and 1986, flows in the Owens River below the Intake were slightly reduced from pre-project flows because of reduced operational spreading during high runoff periods (due to increased export capacity), and by reduced groundwater baseflow due to groundwater pumping. Flows in the Owens River at Keeler Bridge averaged 13,100 AFY during the 1970 to 1986 period, and 14,000 AFY during the pre-project period. Beginning in 1978, flows in a portion of the lower Owens River below the Intake were increased because of releases from the aqueduct by LADWP, as part of an effort to enhance the fishery, and improve waterfowl habitat. Beginning in 1978, LADWP began releasing water from various aqueduct gates into the Owens River. The average annual amount released from 1978 to 1986 was 3,700 AFY for fishery and waterfowl habitat. This has not resulted in a significant impact on water resources.



O W E N S V A L L E Y

FIGURE 9-18

OWENS RIVER FLOW AT LONG VALLEY, 1946-1990

SOURCE: LADWP, AQUEDUCT DIVISION

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Mitigation Measures

9-2 *None required.*

Impact

9-3 The Lower Owens River project caused increased flow in Owens River between 1986 and 1990.

In 1986, the Lower Owens River Enhancement/Mitigation project was commenced. As more fully described in Chapter 5, the objective of this project was to increase flows in the river and in certain ponds and lakes by a release of water from the Blackrock, Thibaut, Independence, and Locust Gates. The water supply for this project (up to 18,000 acre-feet per year) was replaced by the construction and operation of new wells, except in 1986, when surplus surface water was available because of an above average runoff year. The average annual use on the project between 1986 and 1990 is 13,600 acre-feet per year. This has not resulted in a significant impact on water resources.

Mitigation Measures

9-3 *None required.*

Owens River and Los Angeles Aqueduct – Agreement

Implementation of the provisions of the Agreement will not affect the flow in the Owens River between Pleasant Valley Reservoir and the Intake dam.

As described in Chapter 5, a pump-back station will be constructed from the River near Keeler Bridge to the aqueduct. Flow rates in the river in the reach between the Intake and the pump-back station will be increased. The increased flow will promote restoration of wetlands along that section of the river. Continued release of a predetermined flow below the pumpback station will maintain the productive and beneficial habitat area on the Owens River Delta. A separate CEQA document will be prepared on this project prior to implementation of this element of the project.

Mitigation Measures

None required.

Owens Lake - 1970 to 1990

Impact

9-4 **Flow into Owens Lake was not and will not be substantially changed from pre-project conditions by the project.**

Implementation of the lower Owens River element of the proposed project in the future will not increase ponding on the lake as compared to pre-1970 to 1990 conditions, because the increased flow in the river will be pumped from the river to the aqueduct upstream of the lake.

Mitigation Measures

9-4 *None required.*

Owens Lake – Agreement

Under the Agreement, flow into Owens Lake will not be changed from the 1970 to 1990 condition.

Tributary Streams

Impact

9-5 **Between 1970 and 1990, no stream channels were lined, or the stream flow diverted into pipelines by LADWP.**

Mitigation Measures

9-5 *None required.*

Tributary Streams – Agreement

Under the Agreement, there will be no significant alteration of flow in the tributary streams. In addition, no stream beds will be lined and no new diversions will be made.

Mitigation Measures

None required.

Ponds, Lakes and Reservoirs – 1970 to 1990

Impact

9-6 **Between 1970 and 1990, the project resulted in beneficial changes to existing lakes and ponds, and the creation of new lakes and ponds, with no significant impact on water resources.**

As described in Chapter 5, between 1970 and 1984, LADWP commenced certain environmental projects that altered the levels of existing ponds and lakes, and created new ponds. Also, as described in Chapter 5, between 1985 and the present LADWP and Inyo County implemented the McNally Ponds, Klondike Lake, and Lower Owens River enhancement/mitigation projects that affected the levels of existing ponds and lakes. No significant adverse impacts were caused by the changes in the ponds and lakes; however, the impact of replacing some of the water supply for some of these projects with groundwater is discussed below. Under the Agreement, these projects would continue without substantial change in the future.

Mitigation Measures

9-6 *None required.*

Impact

9-7 **Reservoir levels between 1970 and 1990 varied slightly from pre-project conditions due to operation of the second aqueduct, with no significant impact on water resources.**

The reservoir storage levels in Pleasant Valley, Tinemaha, and North and South Haiwee Reservoirs from 1970 to 1990, as compared to pre-project levels, have varied slightly due to operation of the second aqueduct. Fluctuations in reservoir levels are impacted mostly by the degree and duration of spring runoff and periodically by tropical storm activity. Figure 9-3 shows fluctuations in April 1 storage at Tinemaha Reservoir. Under the Agreement, reservoir levels would continue to fluctuate seasonally and annually as they have since 1970.

Exceptions to this have been — or will be — reservoir operation modifications associated with dam safety constraints. Pleasant Valley is operated under reduced level set by the State Department of Water Resources, Division of Dam Safety, since 1980. South Haiwee was operated under reduced levels set by the State until its State-ordered removal from service in 1989. (In 1990, the State Division of Dam Safety permitted the storage of up to 15,000 acre-feet for a period of one year. This permits storage of part of the water conserved by Los Angeles residents during the current drought period for use next year.) Tinemaha Reservoir is currently being evaluated for seismic stability and may be reduced in size or removed from service.

Mitigation Measures

9-7 *None required.*

Ponds, Lakes and Reservoirs — Agreement

Under the provisions of the Agreement, new ponds and wetlands will be created by the Lower Owens River project and existing ponds will continue in existence. This will have a beneficial effect on vegetation in these areas. Spreading in the area east of Independence will not be affected by the provisions of the Agreement, but a salt cedar control program as described in Chapter 5 will be implemented.

Studies will be made on South Haiwee Reservoir to determine whether it can be returned to partial or full service. Either South Haiwee Reservoir or North Haiwee Reservoir may be used for recreation.

Mitigation Measures

None required.

Canals and Ditches — 1970 to 1990

Impact

9-8 **Flows in certain canals and ditches supplying irrigated Los Angeles-owned lands were increased as part of the project, with no significant impact on water resources.**

Between 1970 and 1990, the flow rate in certain canals and ditches was increased as a result of the provision of "firm" irrigation water supplies, and increased groundwater pumping. Under the Agreement, flow rates in these canals and ditches should not be substantially altered in the future. However, flow rates in the McNally Canals and the Big Pine Canal could be increased during future wet years to supply the new groundwater recharge facilities described in Chapter 16. The increased flow rates have not caused, and will not cause, significant effects on the environment.

Mitigation Measures

9-8 *None required.*

Ditches and Canals – Agreement

Under the provisions of the Agreement, LADWP will continue to operate canals in accordance with its practices from 1970 (past practices have included taking canals out of service for maintenance and for operational purposes). However, any permanent change in canal operations, compared to past practices, must be approved in advance by the Inyo/Los Angeles Standing Committee. Also, LADWP will continue maintenance activities to control aquatic weeds and ditch bank vegetation in order to maintain canals in a clean and efficient manner.

Mitigation Measures

None required.

Surface Water Budget – 1970 to 1990

Impact

9-9 **The surface water budget during 1970 to 1990 has been altered as compared to the pre-project conditions.**

Table 9-9 depicts the surface water system budgets for the pre-project period (1945 to 1969) and the 1970 to 1990 period. Major changes include the increased outflow from Long Valley, increased groundwater pumping and the associated decrease in flowing groundwater, and increase in Haiwee inflow (export to Los Angeles).

TABLE 9-9

SURFACE WATER BUDGET
PRE-PROJECT AND 1970-1990

Acre-Feet (1000s)	45-46 to 69-70	70-71 to 89-90
Long Valley Outflow	210	255
Runoff (Long Valley to Haiwee)	292	313
Flowing Groundwater	44	17
Pumped Groundwater	10	105
Total Inflow	556	690
Uses and Losses[1]	189	173
Pumping Loss in Creeks	0	2
Operational Spreading	29	28
Transit Loss	-3	16
Tinemaha Evaporation (Net)	2	5
Haiwee Inflow	342	468
Total Outflow	559	692
Error	-3	-2

[1]Includes uses on LADWP land and natural and artificial groundwater recharge.

Mitigation Measures

9-9 *None required.*

Surface Water Budget – Agreement

The future surface water budget under the Agreement is not expected to be significantly different from the 1970 to 1990 period, except for the possible change associated with reductions in Long Valley outflow due to decreased Mono Basin exports.

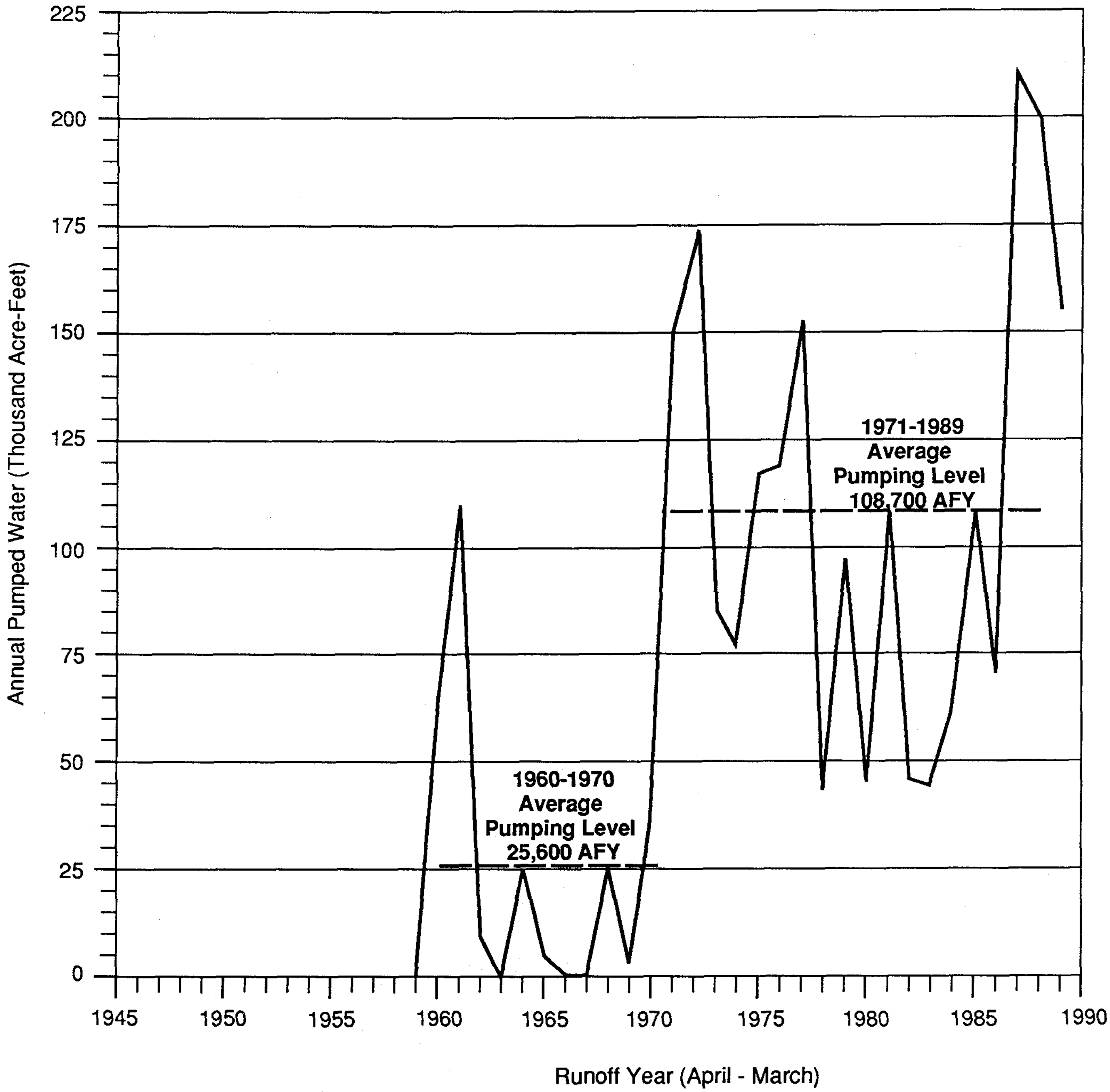
GROUNDWATER SYSTEM

Pumping

Between 1970 and 1990, groundwater pumping increased from an average of 14 cfs (9,900 acre-feet per year) during the pre-project period, to 145 cfs (105,000 acre-feet per year). Figure 9-19 shows annual groundwater pumping from 1970 to the present as compared to pre-project levels. This pumping has resulted in large fluctuations in groundwater levels, and extensive drawdown over extended periods of time in well field areas.

Los Angeles currently has over 800 wells (pumping and deep observation) and test holes on City owned land in the Owens Valley. Of these, 111 wells are pump equipped, 64 wells are designated for aqueduct supply, 17 wells for E/M supply, 9 wells for irrigation on the Bishop Cone (including one well at the Bishop Golf Course), 6 wells for town supply and 15 wells for domestic supply. The domestic supply wells are located on various LADWP leases throughout the Owens Valley. The approximate long-term combined capacity of these wells are: 376 cfs (272,000 AFY), 269 cfs (195,000 AFY), 71 cfs (51,000 AFY), 26 cfs (19,000 AFY) and 10 cfs (7,000 AFY) respectively. Domestic supply wells pump a minimal amount of water annually and are unmeasured.

Los Angeles constructed 36 new and replacement production wells between 1970 and 1990. A list of these wells, locations, and production rates is given in Table 9-10. These well locations are plotted on maps in Appendix E. Fifteen wells were taken out of service during this period. These discontinued wells are also listed on the above table and figures. Four wells, 342, 343, 345, and 346 were constructed during the 1960s, but were not activated until the 1970s.



O W E N S V A L L E Y

FIGURE 9-19

OWENS VALLEY
GROUNDWATER PUMPING
1945-1989 [1]

[1] Groundwater pumping figures for the period 1984 to 1989 include pumping to supply enhancement / mitigation projects.

SOURCE: LADWP, AQUEDUCT DIVISION

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TABLE 9-10

LADWP PUMP EQUIPPED WELLS AND PUMPING CAPACITIES IN OWENS VALLEY
1970 - 1990

Well Number	Well Field	Production Rate, CFS[1]
2N D	Big Pine	--
3N D	Big Pine	--
5N D	Big Pine	--
6N D	Independence Oak	--
7N D	Independence Oak	--
9N D	Independence Oak	--
12N D	Big Pine	--
13N D	Independence Oak	--
25N D	Big Pine	--
057	Independence-Oak	4.0
059	Independence-Oak	2.9
060	Independence-Oak	4.4
061	Independence-Oak	2.3
063	Independence-Oak	2.5
065	Independence-Oak	4.6
069	Symmes-Shepard	3.9
074	Symmes-Shepard	1.7
075	Symmes-Shepard	3.0
076	Bairs-Georges	2.6
077	Independence-Oak	3.0
088 D	Independence Oak	--
092	Symmes-Shepard	3.1
095	Bairs-Georges	1.1
099EM	Symmes-Shepard	3.3
103	Thibaut-Sawmill	1.6
104	Thibaut-Sawmill	1.1
106	Taboose-Aberdeen	2.4
109	Taboose-Aberdeen	3.9
110	Taboose-Aberdeen	5.0
111	Taboose-Aberdeen	3.2
114	Taboose-Aberdeen	3.2
118	Taboose-Aberdeen	2.9
137I	Bishop-Cone	1.9
138I	Bishop Cone	3.8
139I	Bishop Cone (Golf Course)	--
140I	Bishop Cone	4.0
141I	Bishop Cone	3.8
148D	Bishop Cone	--
155	Thibaut-Sawmill	1.1
159	Taboose-Aberdeen	1.4
207I	Bishop Cone	3.7
210	Big Pine	2.4
218	Big Pine	3.5

Table 9-10 (Continued)

219	Big Pine	4.1
220	Big Pine	3.1
222	Big Pine	1.3
223	Big Pine	2.8
229	Big Pine	1.5
231	Big Pine	2.0
232	Big Pine	1.9
235I	Bishop Cone	2.1
236	Laws	4.6
238I	Bishop Cone	3.9
239	Laws	3.2
240	Laws	2.3
241	Laws	1.3
242	Laws	1.2
243	Laws	2.3
244	Laws	2.6
245	Laws	1.4
246	Laws	2.2
247	Laws	5.3
248	Laws	4.4
249	Laws	4.0
278D	Bishop Cone	--
324D	Bishop Cone	--
330	Big Pine - Crater Mt.	16.1
331	Big Pine - Crater Mt.	10.4
332	Big Pine - Crater Mt.	16.1
333D	Independence Oak	--
341T	Big Pine - Crater Mt.	1.1
342	Big Pine	11.8
343	Bairs-Georges	1.5
344T	Long Pine	1.4
345	Symmes-Shepard	5.0
346T	Lone Pine	3.0
347	Taboose-Aberdeen	12.8
348	Bairs-Georges	3.1
349	Taboose-Aberdeen	13.6
351	Thibaut-Sawmill	17.4
352T	Big Pine - Crater Mt.	3.0
354T	Laws	2.0
356	Thibaut-Sawmill	9.3
357T	Independence-Oak	0.2
365	Laws	1.6
370	Taboose-Aberdeen	2.9
371I	Bishop Cone	2.5
374	Big Pine	5.4
375EM	Big Pine	5.6
376EM	Laws	3.0
377EM	Laws	2.7
378EM	Big Pine	5.0
379EM	Big Pine	4.3
380EM	Thibaut-Sawmill	3.2

Table 9-10 (Continued)

381EM	Thibaut-Sawmill	3.4
382EM	Thibaut-Sawmill	1.8
383EM	Independence-Oak	2.4
384EM	Independence-Oak	1.7
385EM	Laws	10.1
386EM	Laws	6.2
387EM	Laws	4.5
388EM	Laws	5.6
389EM	Big Pine	4.2
390EM	Lone Pine	**4.1**
391	Independence-Oak	4.3
392	Symmes-Shepard	2.1
393	Symmes-Shepard	3.1
394	Symmes-Shepard	3.3
395	Symmes-Shepard	3.4
396	Symmes-Shepard	3.1
	TOTAL LONG-TERM PRODUCTION RATE	376.1 cfs

D - Domestic Supply Well
I - Irrigation Well
EM - Enhancement/Mitigation Well
T - Town Supply
[1]Dashes indicate no record, flows small.

Source: LADWP, Aqueduct Division, August 1990.

Under the Agreement, future groundwater pumping would be managed to avoid certain significant decreases and changes in Valley floor vegetation, and to avoid groundwater mining. Because groundwater pumping would be governed by these goals, and not regulated by a pre-established level of pumping, it is not possible to project the amount of future pumping.

Groundwater Occurrence – 1970 to 1990

Impact

9-10 **No loss of groundwater storage capacity has occurred due to subsidence.**

Based on available data, the project has not caused a significant change in the physical ability of the aquifer to store or transmit water. Land subsidence is not believed to have occurred between 1920 and 1990 due to LADWP pumping.

Mitigation Measures

9-10 *None required.*

Groundwater Occurrence – Agreement

Under the Agreement, due to the constraints on groundwater pumping to protect vegetation and to avoid groundwater mining, subsidence related impacts are not expected to occur. No mitigation measures are required.

Groundwater Movement and Groundwater Levels

Impact

9-11 **Increased pumping between 1970 and 1990 caused alterations of groundwater flow patterns with no significant impact on water resources.**

Figures 9-20, 9-21, 9-22 and 9-23 depict generalized Spring 1978 and Spring 1984 groundwater flow patterns in the shallow and deep aquifers of the Owens Valley. The 1978 flow patterns reflect lowered water levels during the 1976-77 drought and the associated heavy pumping, whereas, the 1984 flow map depicts a recovered aquifer during the high runoff minimal pumping period of the early 1980s. In general, groundwater flow directions in 1978 and 1984 were the same as during the pre-project period with slightly shallower or steeper gradients. There appeared to have been a shift in groundwater flow direction compared to the pre-1970 period in the area south of Blackrock Springs. Continuous fish hatchery pumping has shifted the flow direction from southerly, south of the hatchery, to northerly; it is estimated that approximately one-half of the recharge from Oak Creek now flows north towards the area of depression caused by the hatchery pumping. This shift is a change from pre-project conditions.

Also, reduced irrigation from the pre-project period has likely affected localized groundwater flow patterns in the immediate areas due to reduced recharge. See Chapter 10, Vegetation.

Mitigation Measures

9-11 *None required.*

Impact

9-12 **Increased groundwater pumping caused greater fluctuations in groundwater levels between 1970 and 1990, with no significant impacts on water resources.**

A review of monitoring well hydrographs for each of the Owens Valley well fields indicates that from 1970 to 1979 there was a general decline in the shallow water table in each of the Owens Valley well fields. This decline was due to below normal runoff, increased pumping and water levels being near the highest on record in 1970 as a result of the much above normal runoff years occurring in 1967 and 1969. When the drought period that extended from runoff years 1975-76 to 1977-78 ended, groundwater pumping decreased, and natural recharge increased; consequently, the water table started to recover.

After an extremely wet period from 1982 to 1986, the water table recovered to pre-1970 levels in every well field, except in the areas around the Fish Springs and Blackrock fish hatcheries, and in the Laws area. Beginning in 1987, when ground water production was increased to supplement decreased surface water diversion associated with the low runoff and low precipitation, water levels began to decline again. At present, water levels are near their lowest levels observed during the

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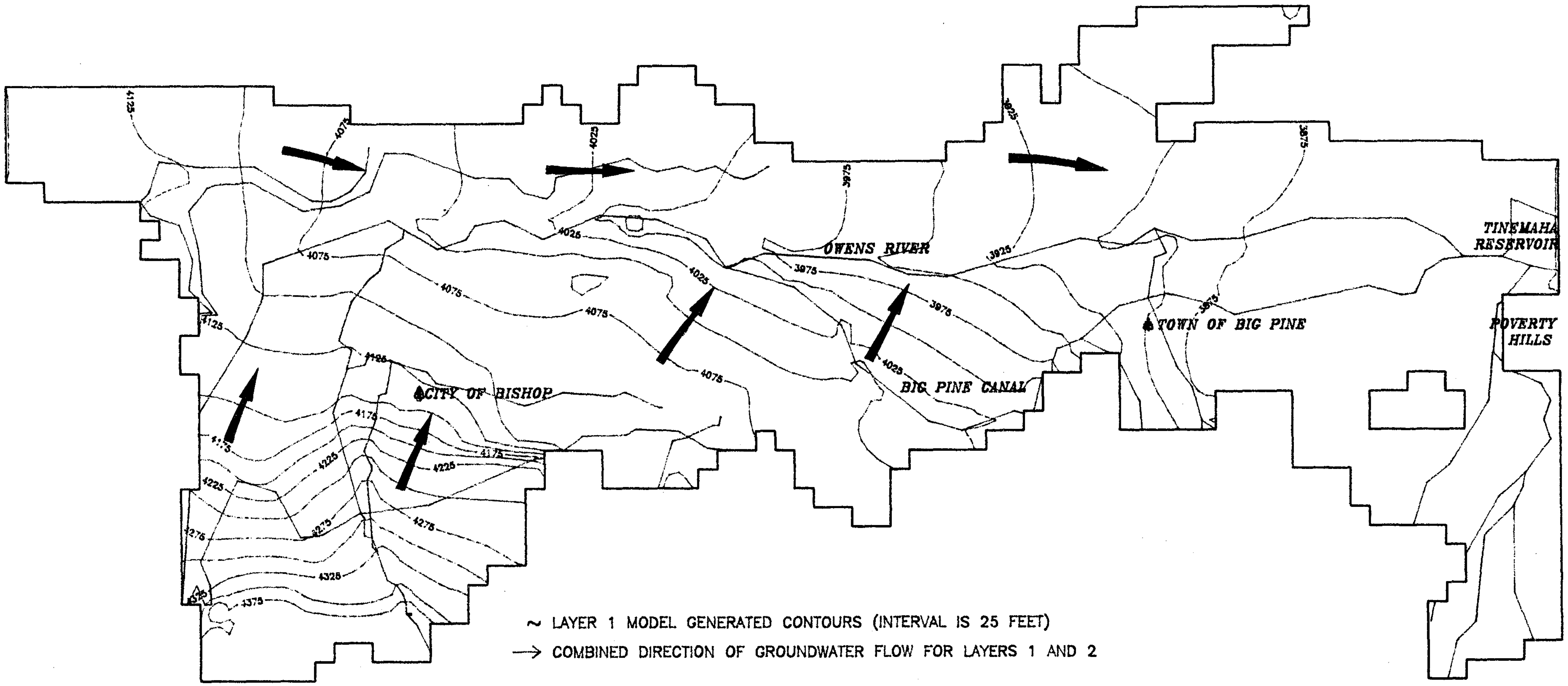
FIGURE 9-20

BISHOP BASIN, GENERALIZED GROUNDWATER FLOW PATTERNS, SPRING 1978



SOURCE: HUTCHISON, 1988

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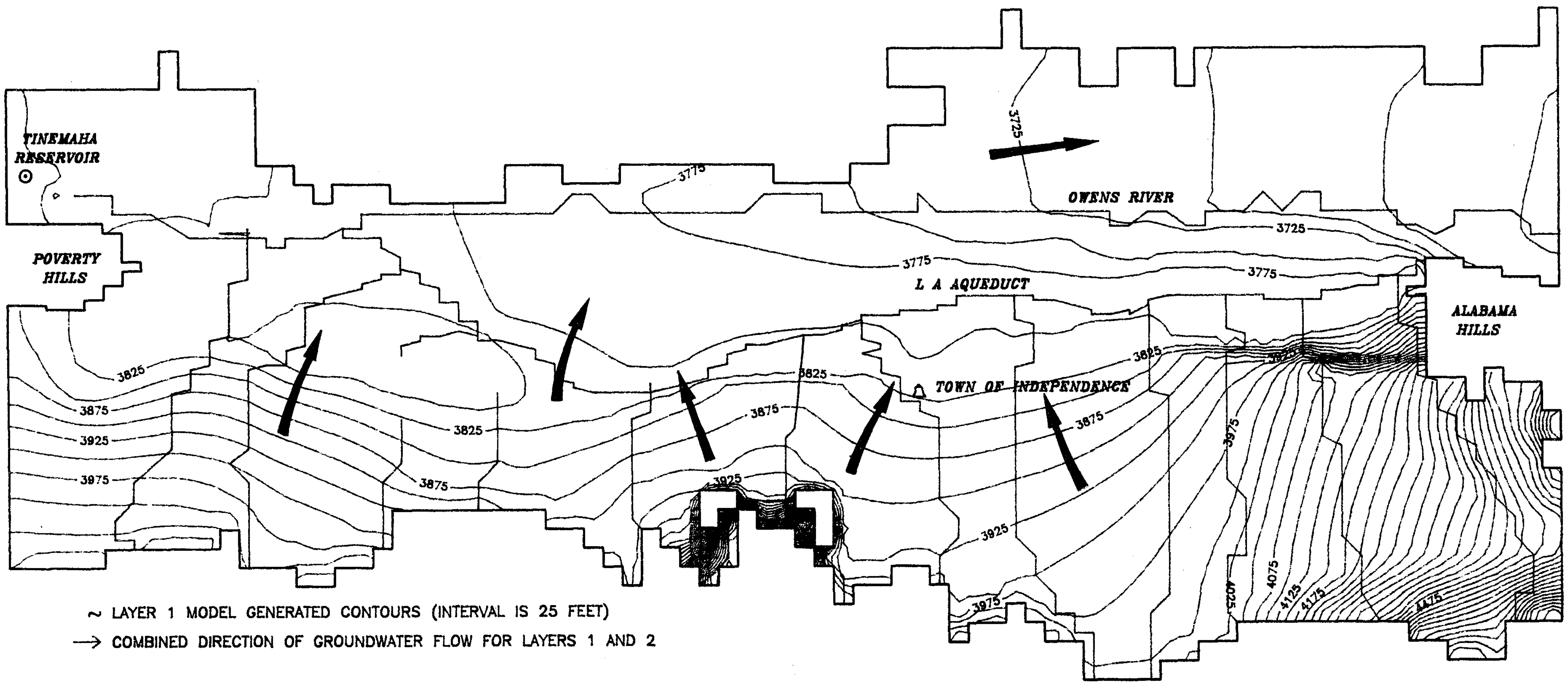
FIGURE 9-21

OWENS LAKE BASIN, GENERALIZED GROUNDWATER FLOW PATTERNS, SPRING 1978



SOURCE: LADWP, 1988

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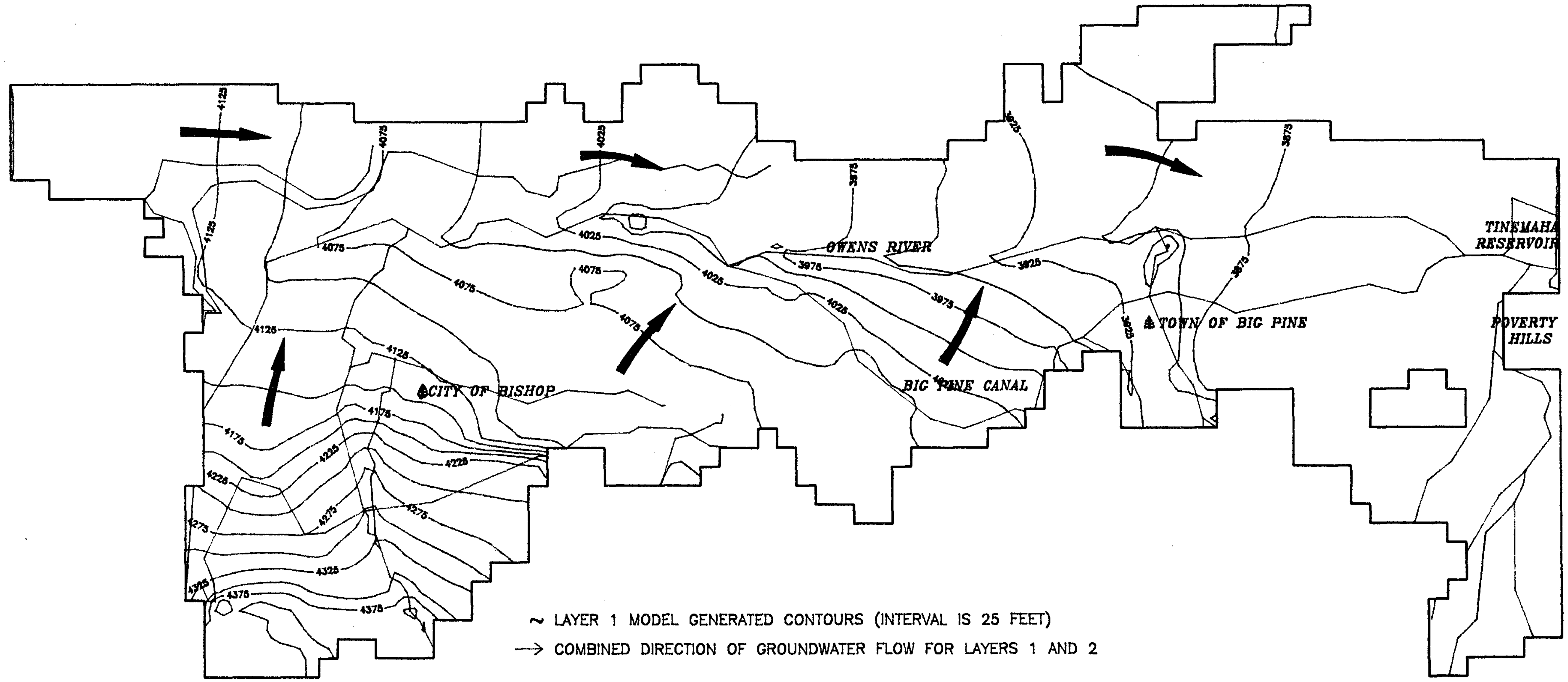
FIGURE 9-22

BISHOP BASIN, GENERALIZED GROUNDWATER FLOW PATTERNS, SPRING 1984



SOURCE: HUTCHISON, 1988

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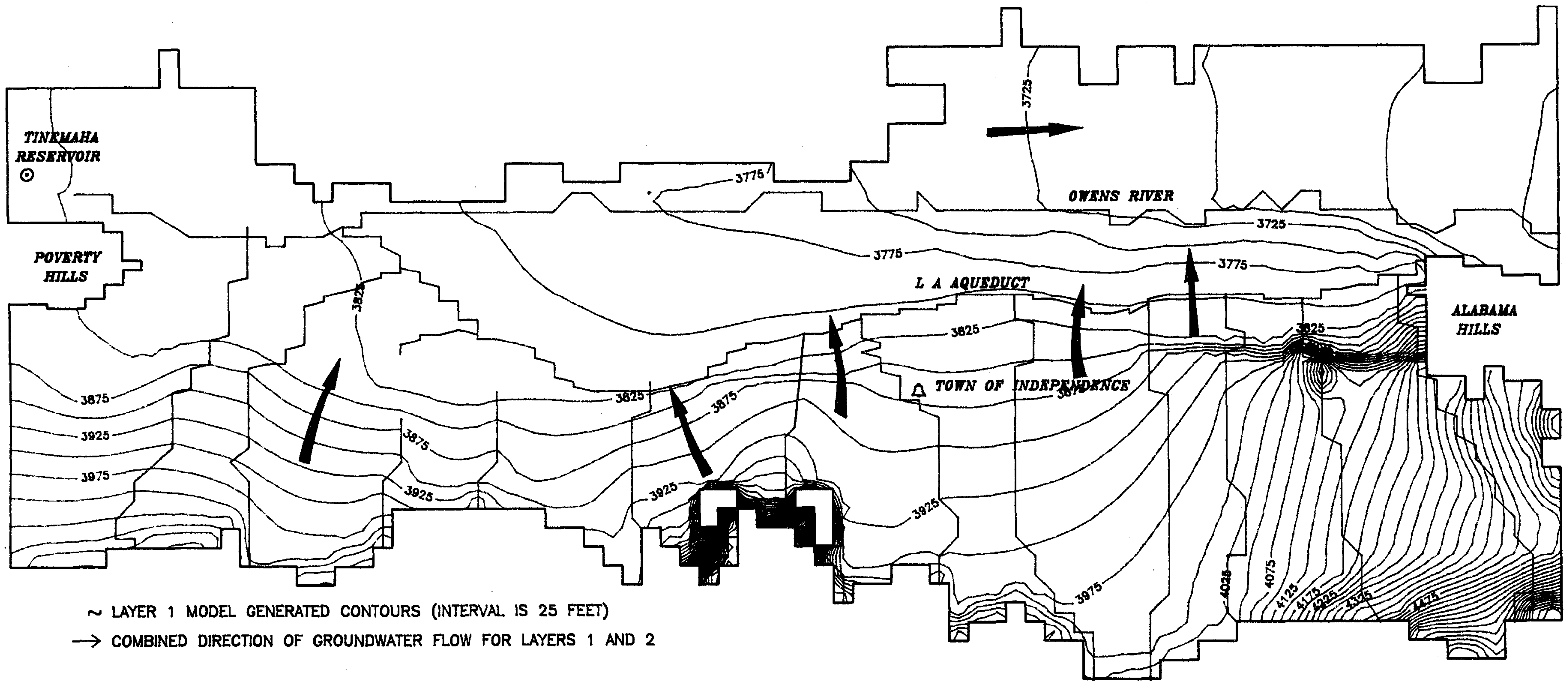
OWENS VALLEY

FIGURE 9-23

OWENS LAKE BASIN, GENERALIZED GROUNDWATER FLOW PATTERNS, SPRING 1984



SOURCE: LADWP, 1988

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drought of the mid-1970s due to high amounts of groundwater pumping and low runoff associated with the current drought.

The ten-foot drawdown level at the end of three consecutive dry years (runoff year 1977-78 repeated three times) and maximum pumping during those three dry years (the assumed worst-case scenario) are depicted in Appendix B (Exhibit A). These drawdown contours were estimated through the use of the groundwater models that were developed by Inyo County and LADWP. These contours were used as the basis for the selection of the monitoring sites that are more fully described in Chapter 10, Vegetation.

The lowering of water tables due to groundwater pumping and drought conditions reduced or eliminated movement of groundwater into the rooting zone for extended periods of time in many areas of the Valley. A comparison of pre- and post-1970 well hydrographs indicates similar magnitudes of groundwater level fluctuations in both periods, but a much greater frequency of fluctuations in the 1970 to 1990 period. Groundwater pumping during this period also reduced or eliminated flows in several springs, seeps and flowing wells. These impacts are described below.

Additionally, associated impacts caused by groundwater pumping and corresponding mitigation measures are described in Chapter 10, Vegetation; Chapter 11, Wildlife; and Chapter 12, Air Quality.

Mitigation Measures

9-12 *None required.*

Impact

9-13 **Continuous pumping between 1970 and 1990 for fish hatchery supply has lowered groundwater levels and eliminated spring flow, with no significant impact on water resources.**

Figures 9-24 and 9-25 show hydrographs of deep wells 224 and 339 which are in the vicinity of the Fish Springs and Blackrock hatcheries respectively. It can be seen that the continuous pumping to supply the hatcheries, even in above average runoff years, has caused a lowering of water levels. The recovery in wet years that is observed elsewhere in the Valley has not occurred in these areas because of the continuous pumping. Only a partial recovery of groundwater levels was seen in these two areas. The continuous groundwater pumping to supply these hatcheries has lowered groundwater levels and eliminated flow in Fish Springs, and Little and Big Blackrock Springs. The changes to water levels themselves are not judged to be significant, although the consequences to vegetation could be significant. This issue is addressed in Chapter 10, Vegetation.

The hydrographs indicate that wet year (early 1980s) groundwater level recovery in the Fish Springs area was 10 to 15 feet less than pre-1970 levels. In the Blackrock Springs area, water level recovery was one to five feet less.

Mitigation Measures

9-13 *None required.*

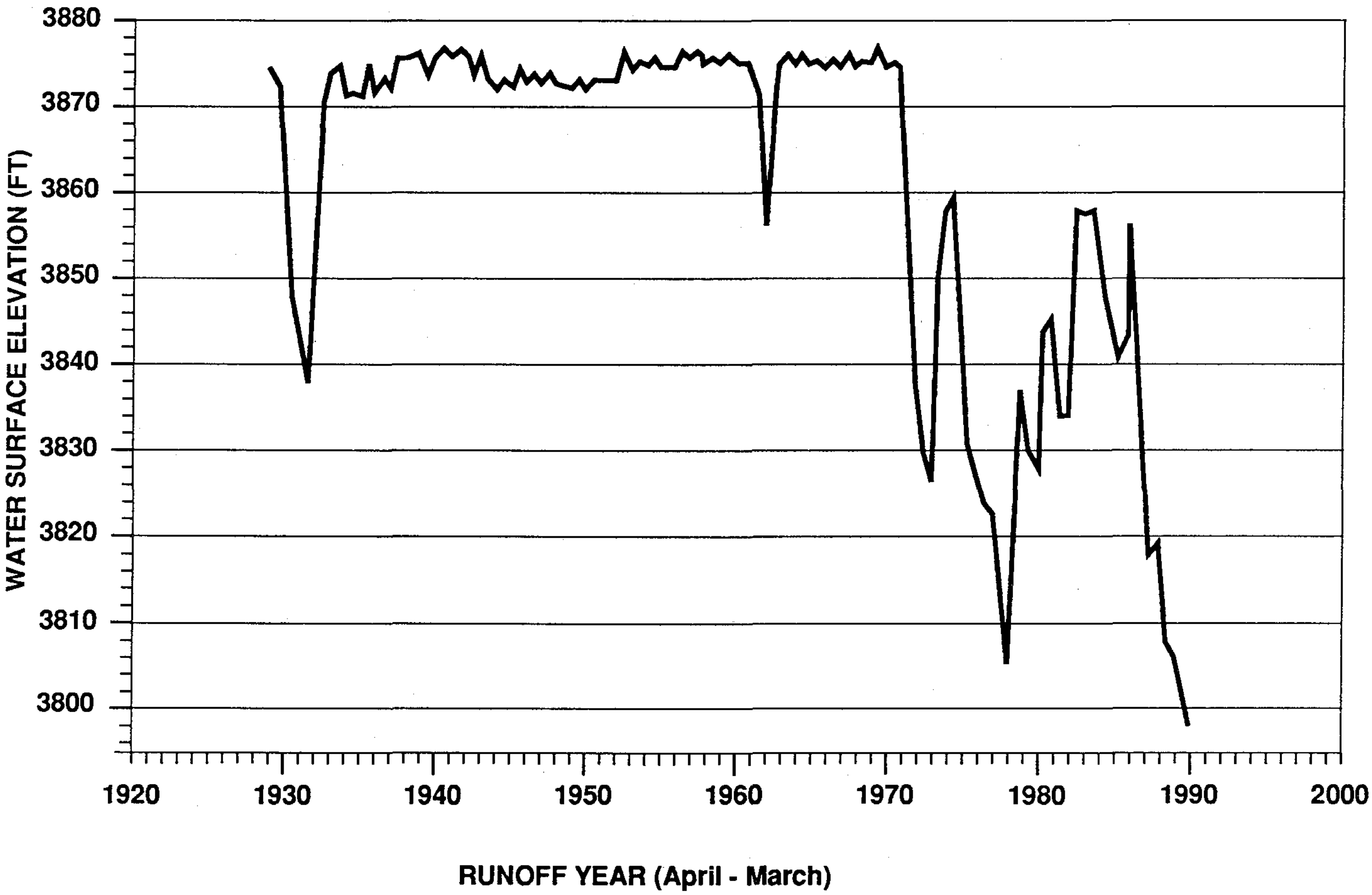
Impact

9-14 **LADWP pumping between 1970 and 1990 in the Big Pine area contributed to lowered water levels in the wells of Steward Ranch and resulted in an adverse economic effect. It is expected that LADWP will continue to pump from this area in the future. The proposed mitigation measure would reduce this impact to less-than-significant.**

Beginning in 1970, the increased pumping in the Big Pine well field has contributed to the lowering of groundwater levels under the Steward Ranch. Groundwater pumping from a production well and four enhancement/mitigation wells that were constructed in the Big Pine well field in 1986 has further contributed to the lowering of the groundwater levels. Other pumping by the Steward Ranch and drought conditions have also contributed to lowered groundwater levels.

Mitigation Measures

9-14 *Because groundwater pumping in the Big Pine well field was contributing to a lowering of groundwater levels at Steward Ranch that resulted in one of two wells being inoperable, the ranch owners have been fully compensated by LADWP on an annual basis for all reduced alfalfa production caused by a loss of well water, and for future costs of re-establishing any lost alfalfa. LADWP has also lowered the pump in the domestic well at the ranch at no cost to the ranch owners. LADWP has made the following offer (previously made public) to the ranch owners, to permanently mitigate the lowered groundwater levels that have existed since 1972:*



O W E N S V A L L E Y

FIGURE 9-24
GROUNDWATER LEVEL FLUCTUATIONS,
WELL 224, 1929-1990

SOURCE: LADWP, AQUEDUCT DIVISION

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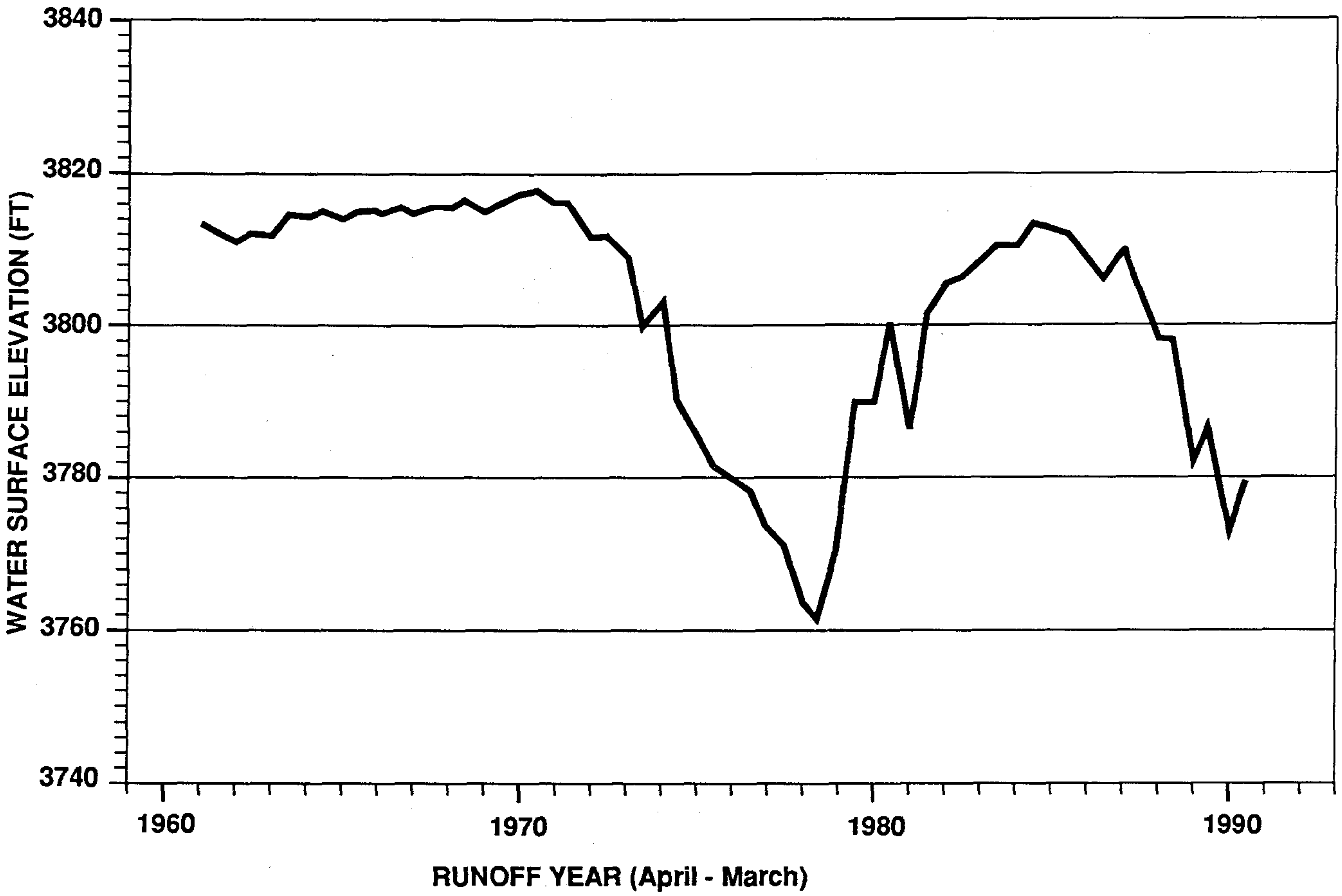

O W E N S V A L L E Y

FIGURE 9-25
GROUNDWATER LEVEL FLUCTUATIONS, WELL 339, 1960-1990

SOURCE: LADWP, AQUEDUCT DIVISION

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- *A new well would be drilled, equipped with a pump and motor, and connected to the ranch's reservoir at no cost to the ranch owner.*

- *Power bills for this well, and for the second irrigation supply well on the ranch would be adjusted in the future so that the ranch does not pay the cost of lifting water from a depth greater than the depth that existed in the wells in 1972. The ranch would pay the cost of lifting the water from a depth equal to or less than 1972 levels.*

- *The power adjustment would apply to a quantity of water sufficient to irrigate alfalfa on the ranch.*

- *The power adjustment would apply to future owners of the ranch.*

The ranch owner has not accepted this offer.

Under the Agreement, future groundwater pumping would be managed to avoid causing significant adverse impacts on water levels or water quality of non-LADWP owned wells. Should any such adverse impacts occur, they must be promptly mitigated by LADWP. The Green Book contains the management practices that would be implemented to avoid such impacts.

Impact

9-15 **The increased fluctuations in groundwater levels observed between 1970 and 1990, and the extensive drawdown over extended periods of time, have reduced the amount of water that moves from the groundwater system to the vadose zone as compared to pre-project conditions. This has resulted in reduced evapotranspiration, but has otherwise had no significant impact on water resources.**

As described above, groundwater pumping increased substantially between 1970 and the present as compared to pre-project conditions. During periods when the water table was lowered because of groundwater pumping, there was a reduction or elimination of groundwater movement from the water table to the portion of vadose zone in which the roots of Valley vegetation exist. When precipitation was inadequate to replenish the vadose zone during these periods, vegetation was adversely affected. The U.S. Geological Survey has determined that evapotranspiration from groundwater in the project area was reduced from an average of 112,000 acre-feet per year (1963 to 1969) to an average of 72,000 acre-feet per year (1970 to 1984) because of reduced vegetation (a 36 percent reduction in evapotranspiration).[11] It should be noted that water years 1963 to 1969 were very wet (runoff was 109 percent of long-term average) and vegetation reflected the wet conditions.

Mitigation Measures

9-15 *Under the terms of the Agreement, groundwater pumping would be managed to avoid causing significant decreases and changes in vegetation. Any such decreases or changes that do occur would be mitigated. Also see Chapters 10, 11, and 12.*

Groundwater Movement – Agreement

The goals of the Agreement are to avoid significant decreases in the live cover of groundwater-dependent vegetation (management Types B, C, and D), as described in Chapter 10, Vegetation and to avoid a change of a significant amount of such vegetation from one management type to vegetation in another management type which precedes it alphabetically. The plant-soil-water balance provisions in the Agreement is one of the tools to be used to prevent the vegetation decreases and changes described above from occurring.

In addition, a goal of the Agreement is to avoid groundwater pumping so that the total pumping from any well field over a 20-year period (the then current year plus the 19 previous years) does not exceed the total recharge to same well field area over the same 20-year period.

It is expected that the provisions of the Agreement described above will result in groundwater flow directions similar to those observed in the 1970 to 1990 period. Also, the average evapotranspiration is not expected to change significantly as compared to the 1970 to 1990 period.

Another goal of the Agreement is to manage groundwater pumping to avoid causing significant adverse impacts on private (non Los Angeles owned) wells, and to mitigate any significant impacts (see pages 94-97 of the Green Book).

Springs, Seeps, and Flowing Wells – 1970 to 1990

Impact

9-16 **Increased groundwater pumping from 1970 to 1990 caused significant reductions and/or cessation in the flow of springs, seeps, and flowing wells.**

Increased groundwater pumping, and the subsequent decline in groundwater levels has resulted, and would result, in a decrease in discharge from flowing wells and springs, as compared to pre-project conditions. The average discharge of flowing wells and springs from 1945 to 1969 was 44,000 acre-feet per year. From 1970 to 1988, average discharge was reduced to 17,000 acre-feet per year. By 1972, flow in some of the major springs had ceased. Drying up of some springs and some seeps resulted in significant impact on surrounding vegetation, which is addressed in Chapter 10, Vegetation.

Table 9-11 presents average flow data for this period, and Figure 9-15 and 9-16 (shown previously) present annual data for individual springs and for the two recognized groups of flowing wells for the entire period of record. Figures 9-26 and 9-27 present the flow of two springs (Fish Springs and Big Seeley Springs), and their relation to the pumping from the Big-Pine and Taboose and Taboose-Aberdeen well fields, respectively. It can be readily seen that increases in pumping are coincident with, and cause a reduction or cessation of spring flow. When pumping is reduced, spring flow returns unless the spring vent has become sealed. Timing and quantity of the return of flow depends on the rate of recharge to the area.

The pumping in the Independence and Symmes-Shepherd well fields caused a reduction in spring and seep flow in these areas. The most significant impact occurred in the Independence Springfield, located east of Independence. Historically, groundwater rose to land surface in this area due to faulting and other geological factors, and created a unique wetland area characterized by histosols (a soil type commonly found in bogs). Increased groundwater pumping in the 1930s, 1960s, 1970s and late 1980s caused a reduction and cessation of spring and seep flow. Reduction of pumping following each of the above pumping periods, however, did cause a return of spring and seep flow. Details of the impacts and mitigative measures for this area are more fully described in Chapter 10, Vegetation, and Chapter 11, Wildlife.

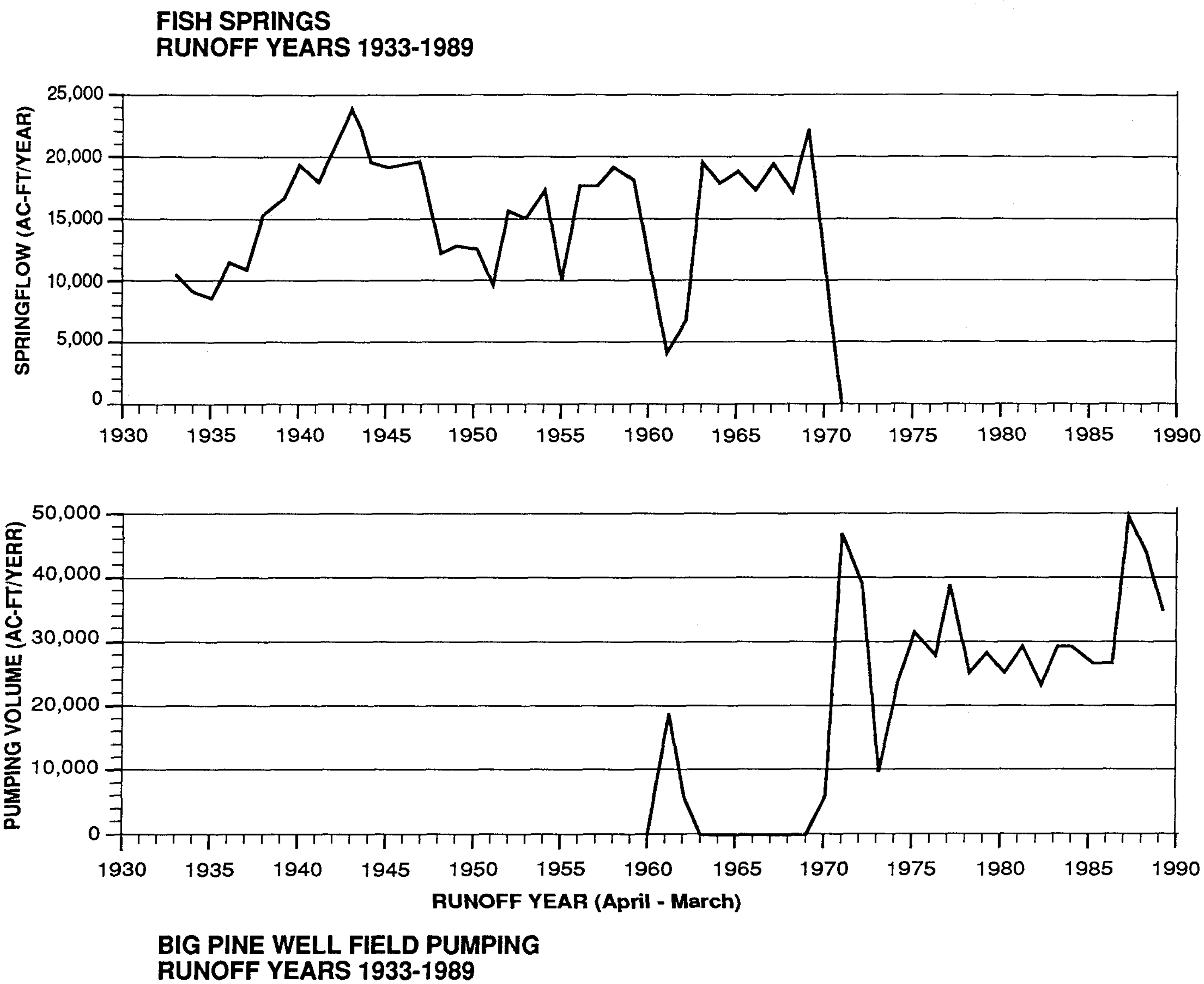
Other springs where there was a reduction or cessation of flow are Fish Springs, Big and Little Seeley, Hines, Big and Little Blackrock, and Reinhackle Spring.

TABLE 9-11

SUMMARY OF OWENS VALLEY GROUNDWATER BUDGET
Water Years (October-September)
(AFY)

	1963-1969	1970-1984
INFLOW (Acre-feet/YR)		
Precipitation Percolation	2,000	2,000
Runoff Percolation	133,000	130,000
Subsurface Inflow	4,000	4,000
Conveyance Loss	57,000	48,000
Total Inflow	196,000	184,000
OUTFLOW		
Well Production (pumped and flowing wells)	20,000	98,000
Subsurface Outflow	10,000	10,000
Evapotranspiration	112,000	72,000
Flowing Groundwater (springs)	26,000	6,000
Conveyance Gain	21,000	6,000
Total Outflow	189,000	192,000
Change in Storage	+7,000	-8,000

Source: Modified from Hollett and others, 1989.



O W E N S V A L L E Y

FIGURE 9-26
RESPONSE OF FISH SPRINGS
TO PUMPING AT
BIG PINE WELL FIELD

SOURCE: LADWP, AQUEDUCT DIVISION

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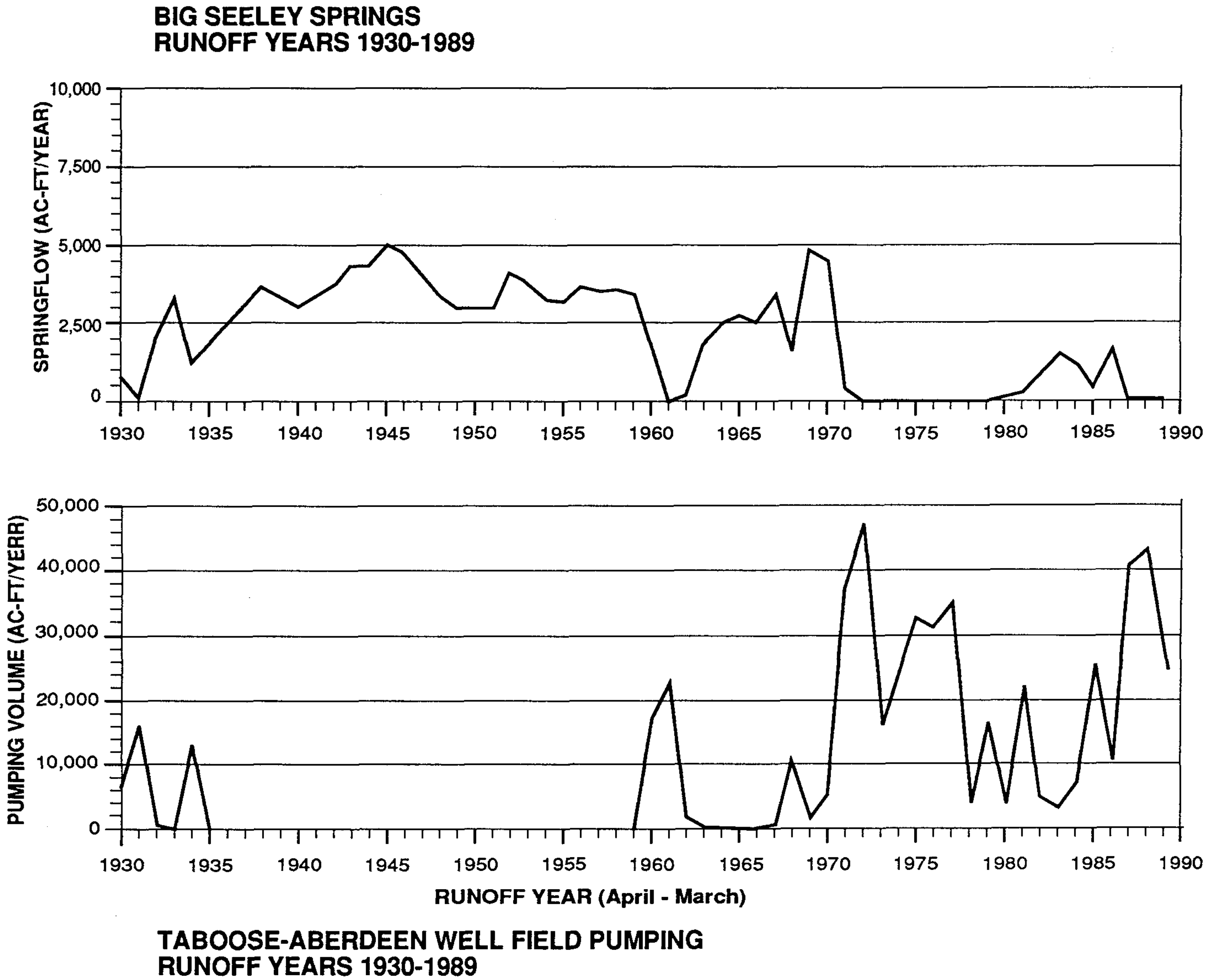

O W E N S V A L L E Y

FIGURE 9-27

RESPONSE OF BIG SEELEY SPRINGS TO PUMPING OF THE TABOOSE-ABERDEEN WELL FIELD

SOURCE: LADWP, AQUEDUCT DIVISION

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Mitigation Measures

9-16 *No mitigation measures are required for impacts to water resources; for mitigation of vegetation impacts, see discussion in Chapter 10, Vegetation.*

Groundwater Pumping – Springs and Seeps – Agreement

Under the provisions of the Agreement and the Green Book, vegetation and spring flows will be carefully monitored. The Green Book contains procedures for determining the effects of groundwater pumping and surface water management practices on spring flow. Groundwater pumping will be managed to avoid causing reductions in spring flow that would cause significant decreases or changes in associated vegetation, or surface water would be supplied if necessary to avoid such decreases or changes. No further mitigation measures are required.

Groundwater Budget

The USGS groundwater budget estimate is considered to be the most accurate, and will be used as the basis for evaluation of the impacts of increased groundwater pumping.

Impact

9-17 **The post-1970 groundwater budget was altered as a result of increased groundwater pumping, and reduced recharge as compared to the pre-project conditions.**

Table 9-11 (shown previously) presents the USGS groundwater budgets for both the 1963 to 1969 and 1970 to 1984 periods. A comparison of the groundwater budgets before and after operation of the second aqueduct shows that as a result of increased groundwater extractions of 78,000 acre-feet and reduced recharge associated with decreased irrigation of 8,000 acre-feet, evapotranspiration decreased by 40,000 acre-feet, spring and seep flow decreased by 20,000 acre-feet, and natural discharge to the Owens River decreased by 15,000 acre-feet. Because certain canals and ditches were removed from service, and the flow rates in other canals and ditches were reduced, recharge from canals and ditches was reduced by 1,000 acre-feet.

In addition, because of continuous pumping for fish hatchery supply at Blackrock and Fish Springs, and due to the lack of complete recovery in the Laws area, groundwater storage was depleted in these areas by 8,000 acre-feet. This depletion in storage is a response to the high and continuous pumping and is distinct from the concept of groundwater mining. The hydrographs of deep wells in the areas, wells 224, 339 and 271, (Figures 9-24 and 9-25 (shown previously) and 9-28) show groundwater level fluctuations.

The decreases in evapotranspiration and spring and seep flow are associated with a reduction of vegetation cover in some areas, and die-off of vegetation in other areas. Details of these impacts are covered in Chapter 10, Vegetation.

Mitigation Measures

9-17 *None required. Impacts to vegetation are discussed in Chapter 10.*

Groundwater Budget – Agreement

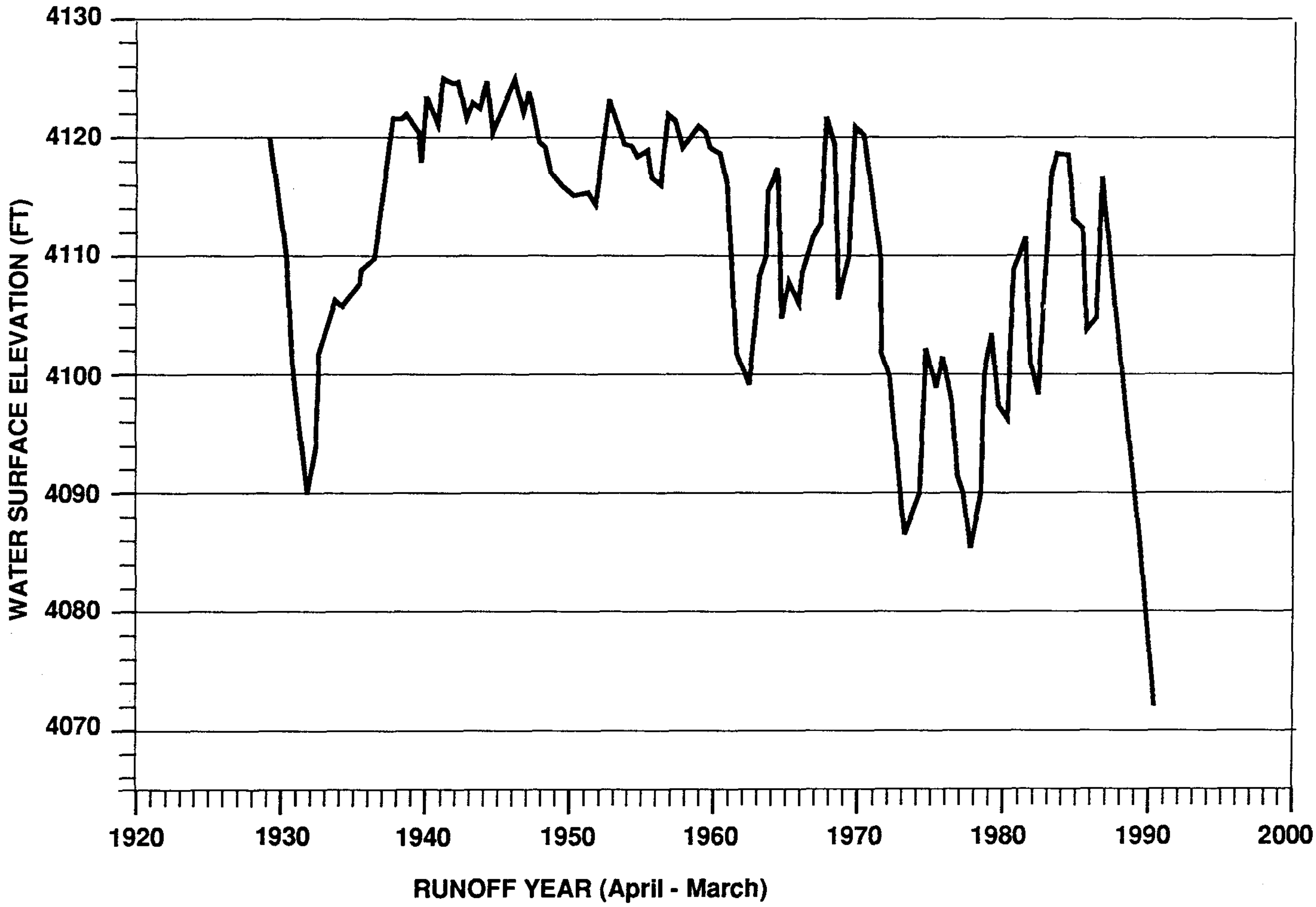
Because of the extensive use of monitoring data as a guide to management of groundwater pumping, and because environmental conditions in the Owens Valley are heavily reliant on precipitation, it is neither possible nor appropriate to accurately forecast the amount of groundwater pumping that will occur on an annual basis in the future. It is believed that average groundwater pumping in the future will not change significantly as compared to the 1970 to 1990 period. Factors that could affect future pumping include environmental protection provisions of the Agreement, effects of rotational pumping, effectiveness of groundwater recharge, and changes in pumping on the Bishop Cone.

WATER QUALITY – 1970 TO 1990

Impact

9-18 **Surface water quality was changed slightly between 1970 and 1990 as compared to pre-project conditions, with no significant impacts.**

Water quality of the Owens River was monitored as part of the U.S. Geological Survey's National Stream Quality Accounting Network from 1974 to 1985. Table 9-12 shows the chemical constituents analyzed under the program. Water in the river/aqueduct system between 1974 and 1985 has a dissolved solids level that averaged about 181 mg/l, with a range of 66 to 274 mg/l. Sodium, sulfate, calcium and bicarbonate are the principal ions.



OWENS VALLEY

FIGURE 9-28
GROUNDWATER LEVEL FLUCTUATIONS, WELL 271, 1928-1990

SOURCE: LADWP, AQUEDUCT DIVISION

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TABLE 9-12

CHEMICAL CONSTITUENTS AND PHYSICAL PROPERTIES OF WATER IN OWENS RIVER DOWNSTREAM FROM TINEMAHA RESERVOIR, WATER YEARS 1974-85

Property or Constituent	Number of Samples	Mean	Standard Deviation	Range
Discharge, instantaneous (ft^3/s)	766	476.3	200.0	5-951
Specific conductance	766	295.0	43.0	158-422
pH, field	109	8.1	0.5	7.1-9.6
Oxygen, dissolved	73	9.4	1.9	7.0-18.2
Hardness, total ($CaCo^3$)	102	70.3	13.8	5.7-106
Hardness, non-carbonate	79	0.2	1.4	0.0-12
Calcium, dissolved (Ca)	102	21.6	4.1	0.8-32
Magnesium, dissolve (Mg)	101	4.0	1.0	0.9-6.3
Sodium, dissolved (Na)	101	31.9	8.2	5.5-54
Potassium, dissolved (K)	102	3.9	0.8	1.8-5.9
Alkalinity, field ($CaCO^3$)	89	99.7	20.1	39-140
Sulfate, dissolved (SO^4)	100	22.6	7.6	5-46
Chloride, dissolved (Cl)	102	13.0	4.2	4.2-25
Fluoride, dissolved (F)	102	0.6	0.1	0.4-0.9
Silica, dissolved (SiO^2)	102	23.4	5.0	13-35
Solids, dissolved calculated	101	181.0	37.1	66-274
Nitrogen, nitrate plus nitrite (N)	81	0.1	0.1	0.0-0.9
Phosphorous, total (P)	101	0.09	0.05	0.03-0.44
Arsenic, total recoverable (As)	30	0.028	0.008	0.01-0.046
Barium, total recoverable (Ba)	17	0.115	0.12	0.050-0.5
Cadmium, total recoverable (Cd)	31	0.005	0.004	0.0-0.01
Chromium, total recoverable (Cr)	32	0.006	0.008	0.0-0.03
Cobalt, total recoverable (Co)	32	0.019	0.025	0.0-0.05
Copper, total recoverable (Cu)	32	0.023	0.021	0.0-0.11
Iron, total recoverable (Fe)	32	0.7	0.43	0.17-1.7
Lead, total recoverable (Pb)	29	0.064	0.052	0.0-0.2
Manganese, total recoverable (Mn)	31	0.048	0.038	0.005-0.2
Mercury, total recoverable (Hg)	28	0.0003	0.0004	0.0-0.002
Selenium, total recoverable (Se)	31	0.0004	0.0002	0.0-0.001
Silver, total recoverable (Ag)	23	0.0007	0.0021	0.0-0.01
Zinc, total recoverable (Zn)	30	0.062	0.146	0.01-0.83

Source: U.S. Geologic Survey Open File Report 88-715.

Biological constituents measured included both phytoplankton, fecal coliform and fecal streptococci bacteria. The most numerous phytoplankton organisms identified include diatoms, green algae and blue-green algae. The location of the sampling station, was directly downstream of the Tinemaha Reservoir.

Water samples were analyzed for both fecal coliform and fecal streptococci bacteria. Fecal coliform bacteria ranged from 1 to 50 colonies per 100 ml of water, whereas fecal streptococci bacteria ranged from one to greater than 1,000 colonies per 100 ml. The fecal streptococci bacteria is generally an indicator of livestock activities, rather than human activities, and no standards exist for streptococci. The number of colonies of both coliform and streptococci bacterial increased steadily during the period of measurement.

Mitigation Measures

9-18 *None required.*

Water Quality – Agreement

Under the provisions of the Agreement, it is not expected that there will be any changes in surface or groundwater quality.

Mitigation Measures

None required.

9.4 IMPACTS ASSOCIATED WITH NEW WELLS, INCREASED PUMPING ON THE BISHOP CONE, AND RECHARGE FACILITIES

The impacts to water resources caused by the 15 new wells and the new recharge facilities which are elements of the Proposed Project, are described in Chapter 16, Impacts of Ancillary Facilities.

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1. Williams, R. P. 1975. Erosion and Sediment Transport in the Owens River Near Bishop, California. USGS Water Resource Supply Paper 49-75.

2. Lopes, P. J. 1988. Hydrology and Water Budget of Owens Lake, California. Publication No. 41107, Water Resources Center, Desert Research Institute, University of Nevada, Reno.

3. Hollett, K. J., W.R. Danskin, W.F. McCaffrey, and C.L. Walti. 1989. Geology and Water Resources of Owens Valley, California. USGS Open-File Report 88-715.

4. Ibid.

5. California State Department of Water Resources. 1975. California's Groundwater. Bull. 118.

6. Hollett et al., op. cit.

7. Lee, W.T. 1906. Geology and Water Resources of Owens Valley, California. USGS Water Supply and Irrigation Paper No. 181.

8. Hollett et al., op. cit.

9. Ibid.

10. California State Water Resources Control Board. 1975. Water Quality Control Plan, South Lahontan Basin (6B). May, 1975.

11. Hollett et al., op. cit.

10. VEGETATION

10.1 INTRODUCTION

This chapter describes the impacts of the proposed project on Owens Valley vegetation. The chapter is divided into three sections: Vegetation Characteristics, Pre-Project Conditions, and Impacts of the Proposed Project.

The Vegetation Characteristics section establishes a frame of reference for the analysis of the pre-project conditions and the impacts of the proposed project. The section describes the Owens Valley environment and its effect on vegetation. It provides a description of the vegetation as documented during an inventory performed from 1984 through 1987. It then describes the influence of water on vegetation and how the vegetation communities identified during the inventory were grouped according to source of the plants' water supply and water requirements to produce the vegetation management types recognized by the Agreement.

The Pre-Project Conditions section describes the conditions of Owens Valley vegetation as they were prior to the commencement of the operational changes that were made to supply water to the second Los Angeles aqueduct. The pre-project conditions are the basis of comparison used in determining whether or not significant impacts have occurred, or will occur due to the proposed project.

The final section of this chapter describes the changes in vegetation that have occurred and that may occur as a result of the proposed project. This section analyzes the impacts of such changes and describes the mitigation measures that have been or will be implemented.

10.2 VEGETATION CHARACTERISTICS

The vegetation of Owens Valley has changed considerably since man entered the Valley and probably all habitats have been altered; however, it is unlikely that any one plant community has been eliminated. Therefore, the description of plant communities in this section can serve as a model for historic vegetation, providing a frame of reference for the pre-project setting and the impacts sections which follow.

This section describes the Owens Valley environment and its effect upon vegetation. It describes the existing vegetation as documented during a vegetation inventory performed in Owens Valley during 1984 through 1987. It also discusses the influence of water upon vegetation, and the establishment of the five vegetation management types recognized by the Agreement.

ENVIRONMENT AND ITS EFFECT ON OWENS VALLEY VEGETATION

Owens Valley is a deep narrow valley located some 10,000 feet below the crests of two parallel 14,000 foot mountain ranges, the Sierra Nevada and the White/Inyo Range in a geographical region known as the Great Basin. The Sierra Nevada blocks precipitation from westerly winds creating a rain shadow effect on the Valley floor. The Sierra snowpack, however, provides relatively large amounts of runoff and groundwater recharge to the Valley, that has created areas of vegetation such as meadow, marsh, and riparian habitats that require relatively large amounts of water in an otherwise arid environment.

The water that recharges the groundwater basin enters the Valley primarily as runoff in numerous creeks that flow from the Sierra Nevada on the west. Prior to the first Los Angeles aqueduct, the seasonally variable streamflows spread out in numerous channels on the Valley floor and were tributaries to the Owens River. As a result of the groundwater recharge from this runoff, vast areas of the Owens Valley floor have a shallow water table. In contrast, beneath the alluvial fans that border the Valley floor, the groundwater tables are well below the depth of plant roots.

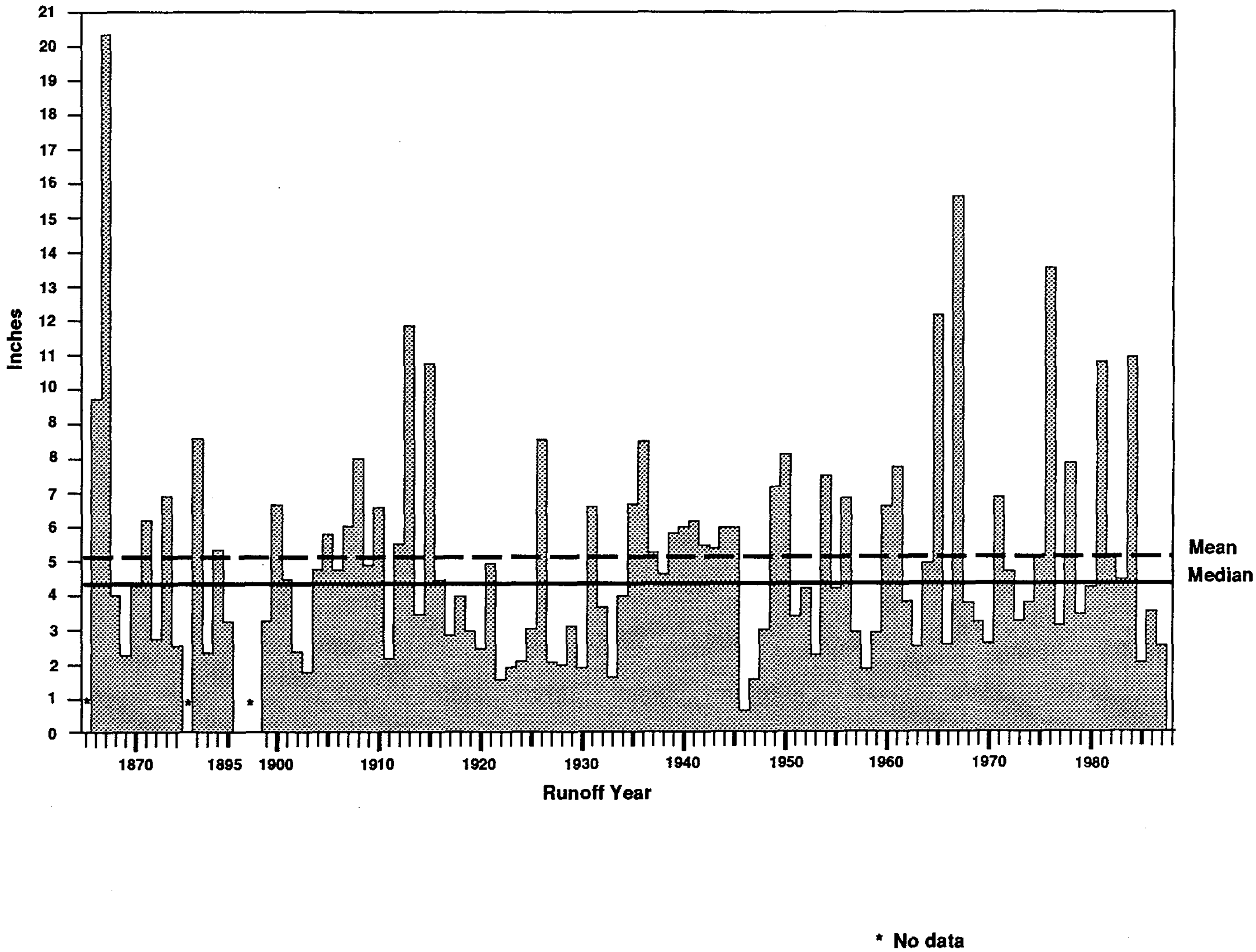
In addition to recharging the Valley's aquifers, the mountain streams carry alluvial material from the Sierra Nevada and deposit it along the lower slopes and onto the Valley floor. This process has created large alluvial fans along the base of the Sierra Nevada that have caused the Owens River to flow along the eastern side of the Valley. Since the larger soil particles are deposited more quickly by the runoff, soils of the alluvial fans found between the Valley floor and adjacent mountain ranges (bajadas) tend to be composed of coarser material as elevation increases. The soils at the break in slope where the bajadas meet the Valley floor are generally coarse sand, and the deposits on the Valley floor tend to be finer textured, but may range from gravels near active stream courses to clays derived from prehistoric lakebeds.

The differences in soil characteristics and water availability between the bajadas and the Valley floor provide habitat for plant species with different needs. Because the bajada vegetation is adapted to the physical and hydrologic conditions of the bajadas, these species generally do not grow on the Valley floor in soils affected by shallow water tables and salt.

As is common in arid or semiarid climates, where there are areas of shallow water tables there is high soil salinity. This high soil salinity occurs because evapotranspiration causes groundwater-borne ions to concentrate in the upper reaches of the soil profile.[1] For this reason, most of the soils in the floor of Owens Valley can be classified as saline, sodic, or both according to recognized criteria.[2] The salinity of Valley floor soils is a strong deterrent to the growth of many plant species, and limits the number of species that can grow successfully. The majority of plant species inhabiting the Valley floor are salt and sodium tolerant and many of these species also appear to be adapted to wet soils and poor soil aeration.

The Owens Valley climate is arid. During the summer months, relative humidity falls to 10 percent or less, and southerly winds of up to 15 or 20 miles per hour increase the effect of this dryness. Like many of the Valleys in the Great Basin, temperatures are high in summer (mean July maximum, 95 degrees F) and cool in winter (January low, 21 degrees F). Absolute maximums range from 109 degrees F in August to -8 degrees F in January.[3]

Typical of arid environments, the Valley floor receives highly variable precipitation from year to year. One hundred seven years of precipitation data for Independence, located at the approximate north/south center of the Valley, is presented in Figure 10-1. Dotted and dashed lines represent mean (5.1 inches) and median (3.3 inches), respectively. Figure 10-1 illustrates that precipitation on the Valley floor may vary from very high to very low from year to year, and that years with high precipitation skew mean precipitation upward. The graph also shows that there have been several



O W E N S V A L L E Y

FIGURE 10-1
ANNUAL PRECIPITATION AT INDEPENDENCE

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periods with precipitation approximately equal to the current four-year period of regional drought (for example, the periods beginning 1916, 1922, and 1926).

On average, approximately 80 percent of the annual precipitation falls in the Valley during the period November through March. Very little recharge from precipitation takes place during the growing season, which extends through the remaining seven months. For example, precipitation exceeding one inch, which occurred during a week-long series of summer storms, was removed from the soil by scrubby native vegetation in a matter of days.[4] Because the summer storms occur so rarely, and the water provided is removed so rapidly, the importance of such precipitation to the long-term health of Valley floor vegetation is probably minimum, although it can have an immediate beneficial effect upon the growth and vigor of this vegetation. This has been illustrated by the use of photography to document the response to summer rainfall of plants growing within the various plant communities in the Valley.[5]

In Owens Valley, vegetation consists of a transitional mosaic between the flora typical of the Mojavean Floristic Province at the southern end of the Valley and lower elevations of the alluvial fans, and the Great Basin Floristic Province located toward the north and along the upper elevations of the alluvial fans. Mojavean flora is dominated by such species as Mormon tea, spiny sage, cheesebush, blackbrush, and species of horsebush. Typical species of the Great Basin flora include big sage, hopsage, and winterfat. (Scientific names for plants are provided within the section describing plant communities.)

When two or more floristic provinces interact across an area with varied hydrology such as Owens Valley, a species-rich (highly diverse) vegetation results. Approximately 700 species of plants are known to occur within the area. Because the Valley is surrounded by mountains and has been geographically isolated since the Pleistocene Epoch, Owens Valley developed a number of endemic animal and plant species within its meadows, sloughs, and marshes.[6]

The majority of the vegetation of the Valley floor is not unique to any specific floristic province, but rather is often associated with the shallow water tables and saline and alkaline conditions found in areas throughout the western United States. These include species such as greasewood, pickleweed, seepweed, alkali sacaton, and saltgrass. Shallow groundwater zones of the Owens Valley floor also host two dominant shrubs that are found only in the far-western Great Basin and far-northern region of the Mojave desert: a shallow groundwater subspecies of rubber rabbitbrush (*C. nauseousus* ssp. *consimilis*) and Nevada saltbush. The distribution of Mojavean and Great Basin floras in the Valley is due to a slightly longer growing season and slightly hotter and dryer climate at lower elevations in the southern Owens Valley. The Great Basin flora is much less tolerant of drought periods than the Mojavean species.[7]

VEGETATION INVENTORY

Plant Communities

Between 1984 and 1987, LADWP inventoried and mapped the dominant vegetation of a total of 227,160 acres of Los Angeles-owned land in Owens Valley. A description of the maps and the mapping techniques can be found in the technical supplement to this EIR and to the Agreement.

The basis of the vegetation mapping is a classification system originally developed by Cheatham and Haller as adopted by the California Department of Fish and Game and further modified by LADWP to better fit the vegetation of Owens Valley.[8,9,10] The classification system is "floristic" in that major dominant plant species are used to differentiate vegetation types.

Based on the plant community classification system, Owens Valley vegetation is grouped into six major cover types: (1) non-native vegetation and miscellaneous lands; (2) scrub; (3) grasslands and meadows; (4) bogs and marshes; (5) riparian and bottomland habitat; and (6) woodland. Since the Cheatham and Haller Classification System is specific to natural plant communities, a "non-native vegetation and miscellaneous lands" category was added to adapt the classification system specifically for the Owens Valley.

The following are brief descriptions of vegetation types. The descriptions are summarized from data provided by LADWP.[11] The estimated acreages were derived during the 1984-87 inventory.

Non-Native Vegetation and Miscellaneous Lands

This type is specific to Owens Valley and, as indicated above, is not included in the Natural Community Classification developed by Cheatham and Haller. The type includes lands that are presently irrigated and used for alfalfa production, or as permanent native and seeded pasture for livestock. Native pasture is mostly rush (*Juncus* spp.), alkali sacaton (*Sporobolus airoides*), and salt grass (*Distichlis spicata* ssp. *stricta*). Non-native vegetation and miscellaneous lands occupy about 22,312 acres. Of those acres, roughly 11,218 are devoted to irrigated agriculture, while 6,333 are barren. The remaining miscellaneous acres that are not used for alfalfa or pasture are comprised of bodies of water and urban development. Figure 10-2 shows typical vegetation for this type.

Scrub

For defining shrub-dominated plant communities, the term "scrub" is often used. Scrub communities in Owens Valley include approximately eleven variants. These appear to be differentiated by habitat characteristics such as soil aeration, salinity, alkalinity, and water holding capacity. Figure 10-3 shows a typical scrub community.

The eleven communities of scrub vegetation in the Valley include: (1) Mojave Creosote Bush Scrub, (2) Mojave Mixed Woody Scrub, (3) Blackbush Scrub, (4) Great Basin Mixed Scrub, (5) Big Sagebrush Scrub, (6) Rabbitbrush Scrub, (7) Desert Saltbush Scrub, (8) Desert Sink Scrub, (9) Desert Greasewood Scrub, (10) Shadscale Scrub, and (11) Nevada Saltbush Scrub.

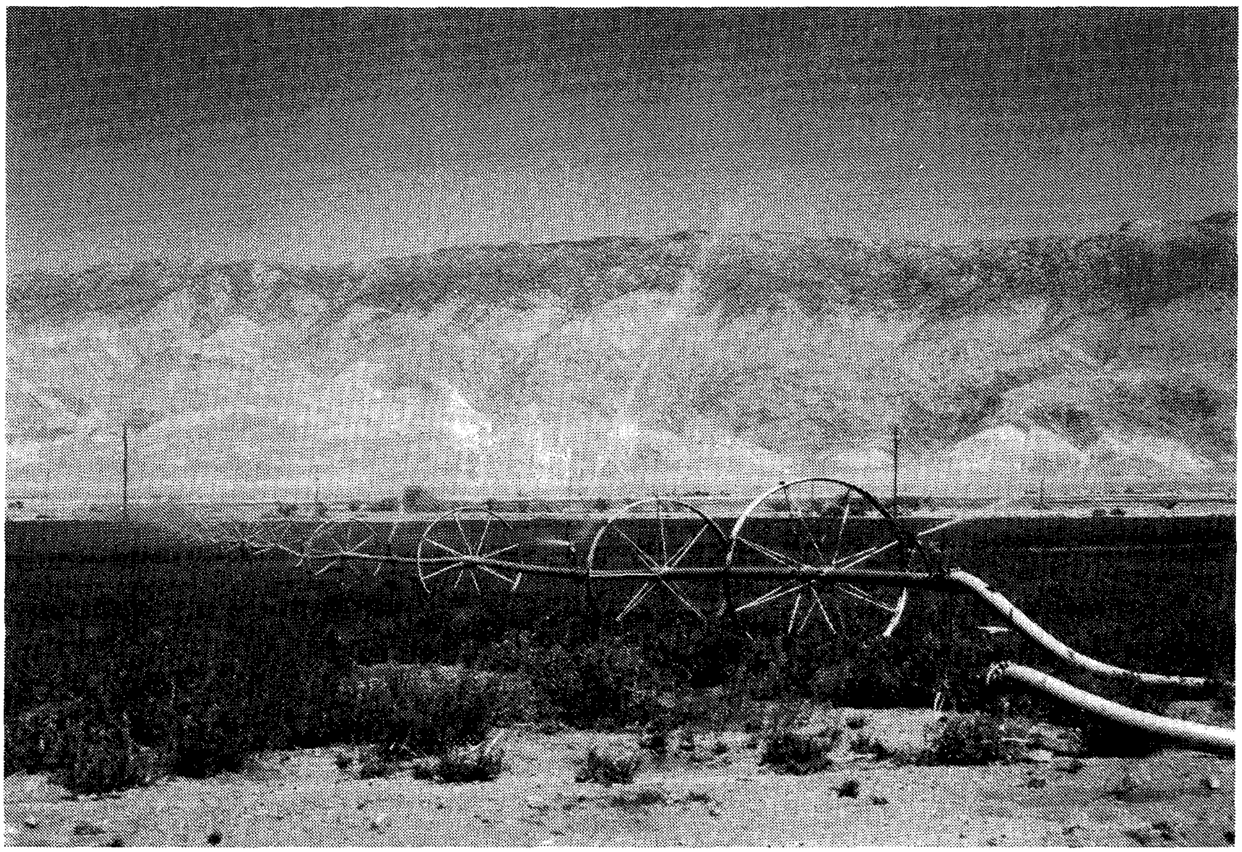
Shrubs are the dominant plant forms defining each scrub type; however, each type is dominated by different species of shrubs. In addition, the types are further differentiated by pattern of distribution within the Valley based on soil factors found at the site. The following is a summary of the characteristics that define each scrub type.

- Mojave Creosote Bush Scrub (549 acres)

  This type is defined by widely spaced shrubs dominated by creosote bush (*Larrea divaricata*) and burro weed (*Ambrosia dumosa*). The type is usually associated with well-drained soils with very low available water holding capacity. It is the dominant plant community between 3,000 and 4,000 feet elevation.

- Mojave Mixed Woody Scrub (9,124 acres)

  This complex, open plant community is characterized by a wide variety of species including Joshua tree (*Yucca brevifolia* ssp. *herbertii*), California buckwheat (*Eriogonum fasciculatum* var. *polifolium*), and bladderpod (*Isomeris arborea* ssp. *arborea*), cheesebush (*Hymenoclea salsola*), and a number of other species. The community is associated with very shallow, overly-drained, often rolling to steep slopes, usually derived from granitic rocks. The sites have extremely low water holding capacity. It is widely scattered below 5,000 feet elevation in the southwestern portion of Owens Valley.



O W E N S V A L L E Y

FIGURE 10-2
NON-NATIVE VEGETATION

SOURCE: EIP ASSOCIATES

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OWENS VALLEY

FIGURE 10-3A
ALLUVIAL FAN SCRUB

SOURCE: EIP ASSOCIATES

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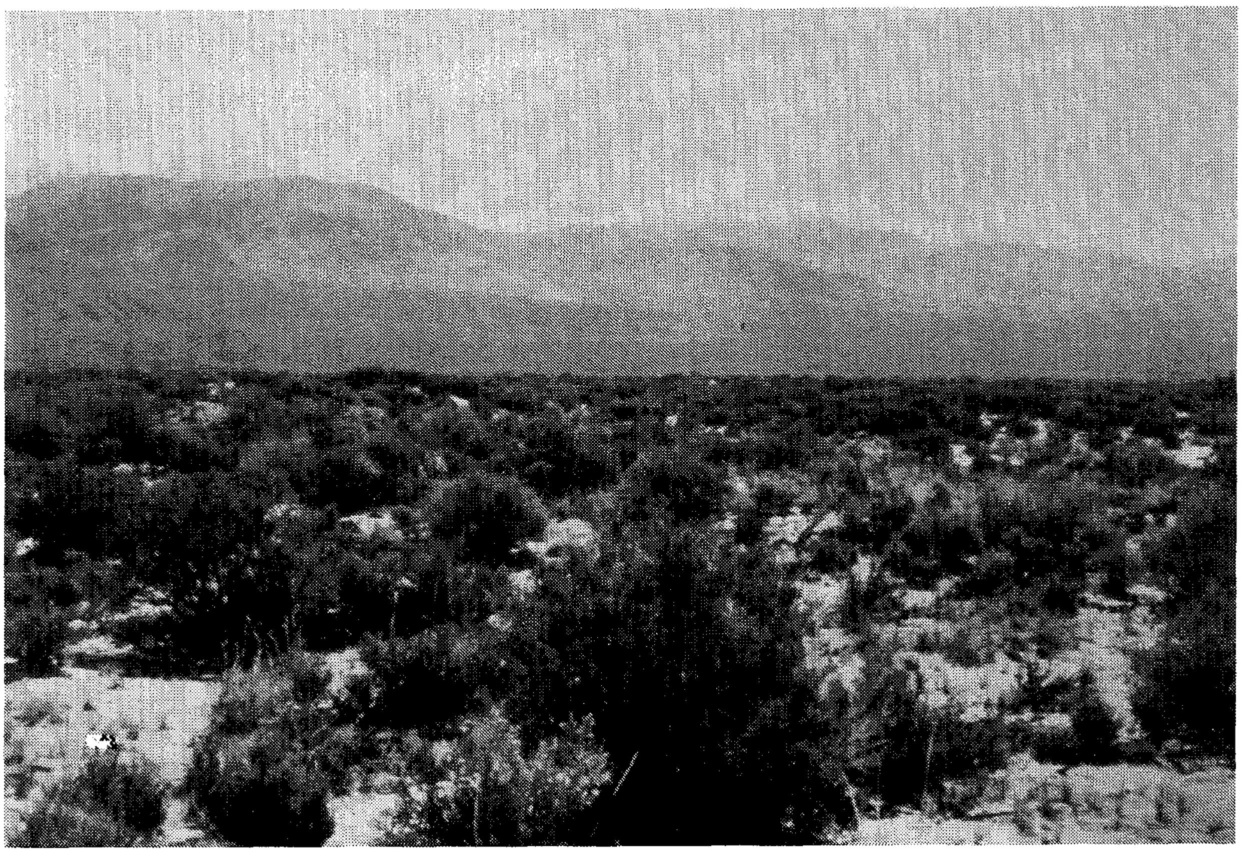

O W E N S V A L L E Y

FIGURE 10-3B
VALLEY BOTTOM SCRUB

SOURCE: EIP ASSOCIATES

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- Blackbush Scrub (3,963 acres)

  This is a low shrub community characterized by blackbush (*Coleogyne ramosissima*), terete-leaved rabbitbrush (*Chrysothamnus teretifolius*), California buckwheat, and Nevada ephedra (*Ephedra nevadensis*). It is found on dry, well-drained slopes and flat areas having calcareous soils of very low water holding capacity. The type occurs typically between 4,000 and 7,000 feet elevation from the Owens Valley region to the Mojave Desert.

- Great Basin Mixed Scrub (27,647 acres)

  The characteristic species of this low, open shrub community include Nevada ephedra (*Ephedra nevdensis*), Mojave dalea (*Psorothamnus arborescens* var. *minutifolius*), shadscale (*Atriplex confertifolia*), and cottonthorn (*Tetradymia axillaris*). The vegetation type is associated with coarse textured soils, on slopes and alluvial fans, with low available water holding capacity. It is a commonly occurring plant community throughout the Valley.

- Big Sagebrush Scrub (10,670 acres)

  This community consists mostly of soft-woody shrubs dominated by big sagebrush (*Artemesia tridentata*). It occurs on a wide variety of soils and terrain, from rocky, well-drained slopes to fine-textured Valley soils with a high water table. It is widely distributed between 4,000 and 9,000 feet elevation.

- Rabbitbrush Scrub (9,675 acres)

  This community is dominated by rubber rabbitbrush (*Chrysothamnus nauseosus*). It is usually found on sites disturbed by fire or agriculture.

- Desert Saltbush Scrub (3,364 acres)

  This low, widely-spaced, small-leaved plant community is usually dominated by a single species of saltbush (*Atriplex* spp. including allscale, fourwing saltbush, shadscale, etc.). It is found on fine-textured soils with high alkalinity or salinity on higher ground. These sites are, therefore, drier than the sites for Desert Sink Scrub identified below.

- Desert Sink Scrub (23,711 acres)

  This is similar to the Desert Saltbush Scrub, but plants often are more widely spaced. In addition to saltbush and greasewood, the community contains succulent plants such as iodine bush (*Allenrolfea occidentalis*), wild heliotrope (*Heliotropium curassavicum* ssp. *oculatum*), and nitrophila (*Nitrophila occidentalis*), as well as alkali sacaton, salt grass, and others. The community is associated with poorly drained soils, extremely high alkalinity or salinity, a high water table and salt crusts. The community occurs on moist valley bottoms and lakebeds at about 4,000 feet elevation throughout Owens Valley and is often associated with a relatively shallow water table.

- Desert Greasewood Scrub (25,694 acres)

  This community consists of low shrubs with some succulent species. Dominant species include greasewood (*Sarcobatus vermiculatus*) and shadscale. The community is associated with valley bottoms, and the margins of playas on coarse textured soils. The water table is usually in excess of ten feet.

- Shadscale Scrub (20,810 acres)

  The dominant species of this low, spiny shrub community are shadscale and bud sage (*Artemisia spinescens*). It is often associated with poorly-drained flats with heavy, somewhat alkaline soil. It may also occur on well-drained slopes at higher elevations. It is usually found at elevations between 3,000 and 6,000 feet.

- Nevada Saltbush Scrub (8,163 acres)

  This moderately tall shrubland, with total cover around 30 to 35 percent is dominated by Nevada saltbush (*Atriplex torreyi*). It is usually associated with fine-textured soils with high available water holding capacity. The high water table and salty surface crusts are also identifying physical features. The community is widely distributed on the valley bottom of Owens Valley.

Grasslands and Meadows

Grassland communities are defined by most ecologists as areas dominated by grasses or grasses and forbs that are dependent solely on precipitation which is usually in excess of 8 to 10 inches annually. Desert grasslands do exist, but they are most commonly found in areas that receive two peak periods of rainfall per year. As such, grassland is not considered a community of Owens Valley, even though precipitation dependent grasses may be common components of other valley communities.

The meadow vegetation type is associated with conditions of more or less permanently moist soils. Meadow communities in Owens Valley include approximately seven variants. These appear to be differentiated by degree of soil salinity or alkalinity, flooding frequency, soil moisture, and other environmental factors. Typical meadows of Owens Valley are shown on Figure 10-4.

The seven meadow communities in the Valley include: (1) Alkali Meadow, (2) Alkali Seep, (3) Rush and Sedge Meadow, (4) Rabbitbrush Meadow, (5) Nevada Saltbush Meadow, (6) Non-Native Meadow, and (7) Alkali Playa.

With the exception of the Alkali Playa, vegetation within the Grassland and Meadow classification consists primarily of perennial grasses and other "grass-like" plants such as rush and sedge. The following is a summary of the defining characteristics of each grassland and meadow type.

O W E N S V A L L E Y

FIGURE 10-4
TYPICAL MEADOW VEGETATION

SOURCE: EIP ASSOCIATES

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- Alkali Meadow (45,141 acres)

  This variant consists of dense to fairly open stands of perennial grasses and sedges. Relatively few plant species form the community and grass species such as alkali sacaton (*Sporobolus airoides*) and saltgrass (*Distichlis spicata*) are dominant. The type is associated with fine-textured, permanently moist, alkaline soils on valley bottoms or the lower portions of alluvial slopes. It occurs at elevations of 3,500 to 7,000 feet.

- Alkali Seep (20 acres)

  This type may be found near Alkali Meadows, but it usually has a more complete cover of grasses, broad-leaved plants, and shrubs. It is found scattered in permanently moist alkaline seeps. Characteristic species include sedge (*Carex* sp.), salt grass, rush (*Juncus* sp.), common reed (*Phragmites australis*), and nitrophila.

- Rush/Sedge Meadow (3,728 acres)

  A dense growth of perennial grasses (some resulting from the introduction of pasture crops), sedges, and broad-leaved plants characterize the plant cover. These species occur on fine-textured, permanently moist, alkaline soils throughout the Valley. On some sites, supplemental irrigation maintains the growth of the grasses. Characteristic species include sedge, salt grass, bermudagrass (*Cynodon dactylon*), meadow fescue (*Festuca arundinacea*), rush, and alkali sacaton.

- Rabbitbrush Meadow (1,848 acres)

  This type is described as a moderate stand of perennial grasses with rubber rabbitbrush, often the shallow groundwater subspecies, as a dominant. The type is scattered throughout Owens Valley on fine-textured, moist, alkaline soils.

- Nevada Saltbush Meadow (3,269 acres)

  A plant community which is dominated by Nevada saltbush and perennial grasses, is generally formed on fine-textured, usually permanently moist, alkaline soils. Other species include iodine bush, rubber rabbitbrush, salt grass, ashy wild rye (*Leymus cinereus*), and alkali sacaton.

- Non-Native Meadow (517 acres)

  This classification, which consists of a dense stand of introduced perennial grasses, but may include native grasses, sedges, and forbs, usually results from irrigation and an attempt to create a commercial pasture. Wheatgrass (*Agropyron intermedium*), bermudagrass, tall fescue, various clovers (*Trifolium* sp.), and bird's foot trefoil (*Lotus corniculatus*) are common members of the community. This community occurs on more or less permanently moist, alkaline soil and intergrades with both Alkali Meadow and Rush/Sedge Meadow.

- Alkali Playa (384 acres)

  A community of poorly drained soils with high salinity and/or alkalinity, alkali playa often has a surface salt crust. Dominants are usually low, small-leaved shrubs with wide spacing between them and includes iodine bush, salt grass, shadscale, Parry's saltbush (*A. parryi*), and greasewood.

Bogs and Marshes

Bogs and marshes are ecosystems of more or less permanently water-logged soil dominated by emergent herbaceous vegetation. Both Transmontane Alkali Marsh and Transmontane Freshwater Marsh occur in the Valley, but they are often difficult to separate. Typical marsh vegetation is shown in Figure 10-5.

- Transmontane Alkali Marsh (711 acres)

  Occurs in areas of standing, more or less permanent water, and differs from cis-montane alkali marshes that have a shorter growing season and colder winter temperatures. The dominant vegetation consists of herbaceous plants, although shrubs may be found at the margins. Common species include yerba mansa (*Anemopsis californica*), salt grass, sedges, rushes, cattails (*Typha* spp.), and bulrushes (*Scirpus* spp.).

- Transmontane Freshwater Marsh (acreage included in Transmontane Alkali Marsh)

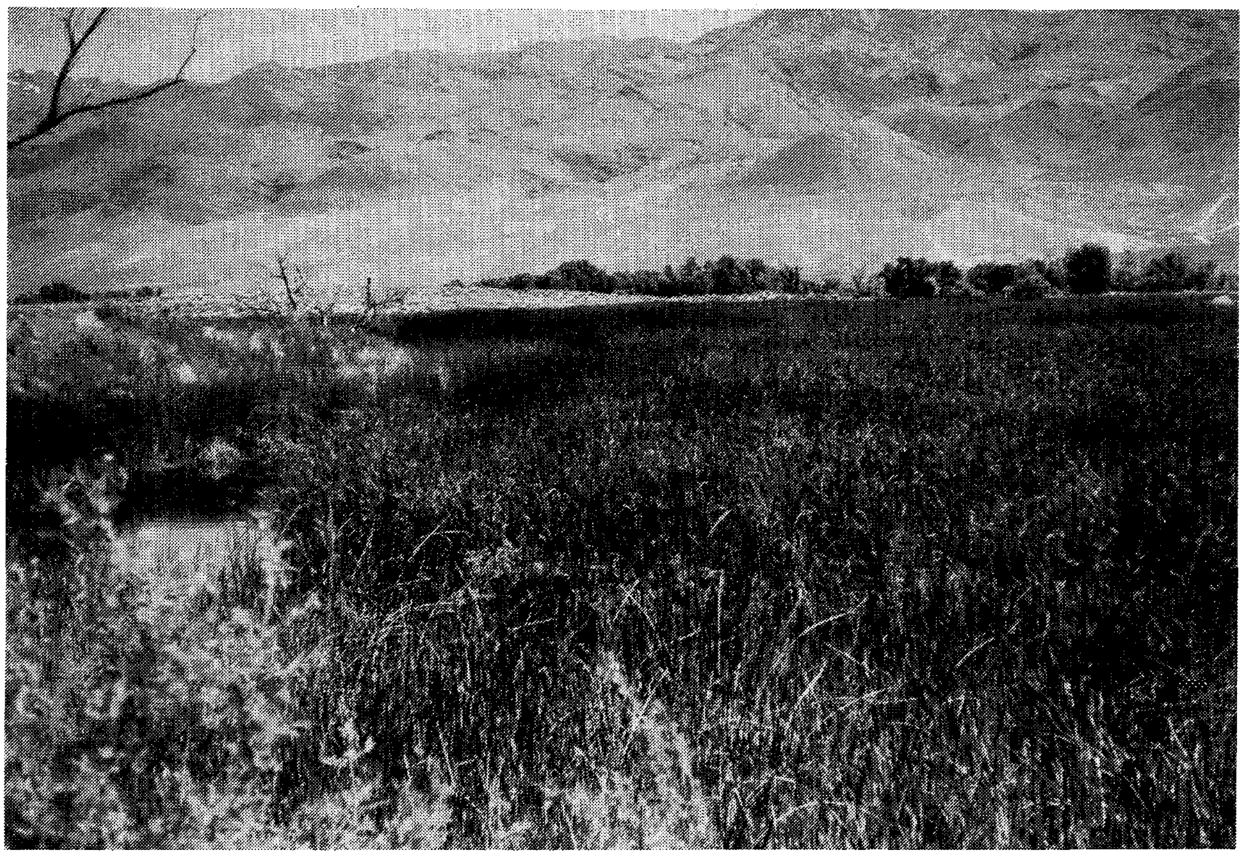
  The freshwater marsh usually occurs where the water flow provides more freshwater than in the Transmontane Alkali Marsh, although the two can be very difficult to separate. The species composition is often the same, except that a number of the alkaline species such as yerba mansa and salt grass are missing from this community. Freshwater marsh often occupies a place along moving streams and rivers while alkali marsh is farther removed from the freshwater source.

Riparian and Bottomland Habitat

Riparian communities are those that occur along permanent, intermittent, or ephemeral streams. Bottomland communities are those found on the alluvial plains associated with streams and rivers. Plants, especially trees and shrubs, of both habitats have access to water all year. Figure 10-6 shows representative riparian and bottomland habitat. Four communities occur within the Riparian/Bottomland Habitat in Owens Valley: (1) Cottonwood/Willow Riparian Forest, (2) Mojave Riparian Forest, (3) Great Basin Riparian Scrub, and (4) Tamarisk Scrub.

- Cottonwood/Willow Riparian Forest (1,989 acres)

  A riparian forest consisting of broad-leaved, deciduous trees, dominated by Fremont's cottonwood (*Populus fremontii*) and red willow (*Salix laevigata*). Widely scattered rubber rabbitbrush may also be found as an understory shrub along with wheat-like wildrye (*Leymus triticoides*), common reed (*Phragmites australis*), and alkali sacaton.



O W E N S VALLEY

FIGURE 10-5
MARSH VEGETATION

SOURCE: EIP ASSOCIATES

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O W E N S V A L L E Y

FIGURE 10-6A
RIPARIAN VEGETATION

SOURCE: EIP ASSOCIATES

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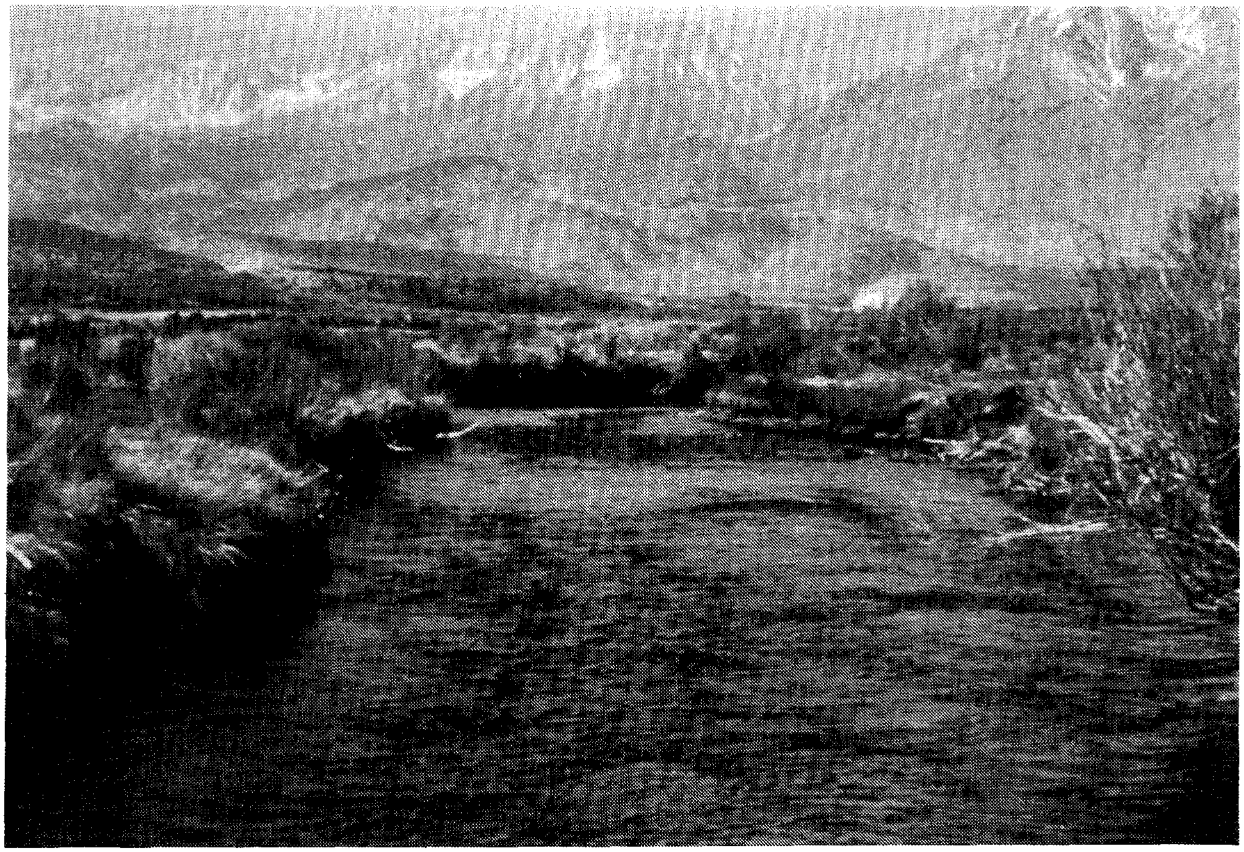

O W E N S V A L L E Y

FIGURE 10-6B
RIPARIAN VEGETATION

SOURCE: EIP ASSOCIATES

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- o Mojave Riparian Forest (1,104 acres)

  This habitat is similar in many respects to the cottonwood/willow riparian forest, but occurs at somewhat lower elevations and usually supports a denser shrub layer. Fremont's cottonwood, red willow, and Goodding's willow (*Salix gooddingii*) dominate, and the shrub layer includes Nevada saltbush and rubber rabbitbrush. Grasses and sedges form an herb layer.

- o Great Basin Riparian Scrub (2,098 acres)

  A dense community dominated by deciduous shrubby willows, among them mountain willow (*Salix commutata*), narrow leaf willow (*S. exigua*), yellow willow (*S. lutea* and *S. lutea watsonii*, and dusky willow (*S. melanopsis*). This particular scrub is most common on the fine-grained sand and gravel bars that occur along alluvial terraces of perennial and intermittent streams.

- o Tamarisk Scrub (648 acres)

  A weedy community dominated by tamarisk (*Tamarix chinensis* and *T. ramosissima*). Tamarisk is an introduced plant that is rapidly spreading to the drier parts of California along rivers and streams where it can receive summer water. Saltgrass and species of Atriplex are commonly associated with tamarisk.

Woodland Vegetation

This is dominated by tree species. No figure showing this vegetation has been provided due to the limited distribution of this non-native species.

- o Black Locust Woodland (21 acres)

  The only woodland listed by LADWP is dominated by the introduced black locust (*Robinia psuedoacacia*). This plant is usually found only where it receives water in excess of precipitation, such as on the edge of irrigated fields, or in spring or riparian habitats. The understory usually consists of native and introduced shrubs and herbs, depending on the nature of the surrounding area.

Plants and Habitats of Concern

One habitat and 15 plant species of concern occur in Owens Valley. In November 1989, EIP Associates produced a printout of the California Natural Diversity Data Base (CNDDB) for the Owens Valley floor.[12] This list includes plants and habitats listed as rare, threatened, or endangered by the State and federal governments. Listings for the same plants by the California Native Plant Society (CNPS) are also included below.[13] Species not yet included on the CNDDB list or that have been reported in other documents will be noted.

The following codes will be used in the discussion of plants and habitats of concern.

Federal:

C1 - Unlisted, but enough data are on file to support federal listing.
C2 - Unlisted, data are insufficient to support federal listing.
C3c - Unlisted, too widespread and/or not threatened.

State:

R - State listed, rare.
E - State listed, endangered.

CNPS:

1B - Plants rare, threatened, or endangered in California and elsewhere.
2 - Plants rare, threatened, or endangered in California, but more common elsewhere.
3 - Plants about which more information is needed, a review list.
4 - Plants of limited distribution, a watch list.

STATUS: Indicated as Federal/State/CNPS.

Information regarding plants of concern was obtained from the CNDDB, the CNPS, and other sources.

The only Valley-floor species recognized as rare, threatened, or endangered by State or federal agencies is the Owens Valley checkerbloom. Other species that have similar requirements, such as the Inyo County mariposa lily, are federal candidate species or are recognized by the CNPS; however, they have no legal status at this time.

In general, wetland habitats are habitats of concern in California. Wetlands are broadly described as habitats where there is a shallow water table, where the soil is often water-logged, or where the land is covered occasionally periodically, or permanently by shallow fresh or saltwater. More specific definitions for wetlands are available from various State and federal agencies, but for the purpose of this EIR, the highly specific nature of those definitions is not required.

Amelanchier utahensis ssp. *covillei* - serviceberry

NOTES: A member of the sage scrub communities that occurs widely outside of California. Listed in the 1978 DEIR and the 1982 DEIR on the Owens Valley Water Management Plan.[14,15]

STATUS: -/-/-.

Astragalus geyeri var. *geyeri* - Geyer's milk vetch

NOTES: Rare in Owens Valley, but widespread in other western states.

STATUS: -/-/2.

Astragalus lentiginosus var. *piscinensis* - Fish Slough milk vetch

NOTES: Occurs in the alkaline meadows and marshes of Fish Slough. This population has been impacted by pupfish recovery work in the past.

STATUS: C1/-/1B.

Calochortus excavatus - Inyo County Mariposa lily

NOTES: Occurs on a number of sites, usually within alkali meadows and grasslands throughout the Valley.

STATUS: C2/-/1B.

Celtis reticulata - Western Hackberry

NOTES: Member of the sage scrub. Rejected as too common by the CNPS, 1988 edition, but rare in Owens Valley near Independence.[16] Included in the 1978 DEIR and the 1982 DEIR for the Owens Valley Water Management Plan.[17,18]

STATUS: -/-/-.

Cordylanthus eremicus ssp. *eremicus* (syn. = *C. ramosus*) - Desert bird's beak

NOTES: Found in desert scrub and perhaps extirpated in the area around Blackrock Springs.

STATUS: C2/-/4.

Eriogonum ampullaceum - Mono buckwheat

NOTES: Found in desert chenopod scrub at several sites throughout the Valley.

STATUS: C2/-/1B.

Fimbristylis spadicea (syn. = *F. thermalis*) - hot springs fimbristylis

NOTES: Occurs in alkaline meadows, usually around hot springs.

STATUS: C3c/-/2.

Loeflingia squarrosa ssp. *artemisiarum* - sage-like loeflingia

NOTES: A low annual that is known from the Big Pine area in alkali scrub. There are some problems with its taxonomic status.

STATUS: C3c/-/3.

Oryctes nevadensis - Nevada oryctes

NOTES: Found in desert scrub at widely scattered locations throughout the Valley.

STATUS: C2/-/2.

Ranunculus hydracharoides - Frog's-bit buttercup

NOTES: Reported from freshwater areas of Oak Creek.

STATUS: -/-/2.

Sidalcea covillei - Owens Valley checkerbloom

NOTES: Occurs in alkaline meadows and grasslands throughout the Valley.

STATUS: C2/E/1B.

Thelypodium crispum

NOTES: Known from the alkali meadows around Klondike Lake. Not listed by the CNPS, 1988 edition, but included in the 1978 DEIR and the 1982 DEIR of the Owens Valley Water Management Plan.[19,20]

STATUS: -/-/-.

Theylpodium integrifolium ssp. *complanatum* - plain-leaved thelypodium

NOTES: Restricted to freshwater marsh habitats and rare in Owens Valley. Included in the 1978 DEIR and the 1982 DEIR for the Owens Valley Water Management Plan.[21,22]

STATUS: -/-/.

Viola nephrophylla - bog violet

NOTES: Uncommon south of Bishop on moist sites of Lower Hogback Creek. Host plant for the Apache silverspot butterfly. Included in the 1978 DEIR and the 1982 DEIR for the Owens Valley Water Management Plan.[23,24]

STATUS: -/-/-.

WATER AND ITS INFLUENCE UPON VEGETATION

In general, the more water available, the greater numbers of Owens Valley vegetation species and the greater the productivity. With greater water availability, photosynthesis increases, nutrients are transferred from soil to plant more readily, and more rapid organic decay results in increased nutrient availability.

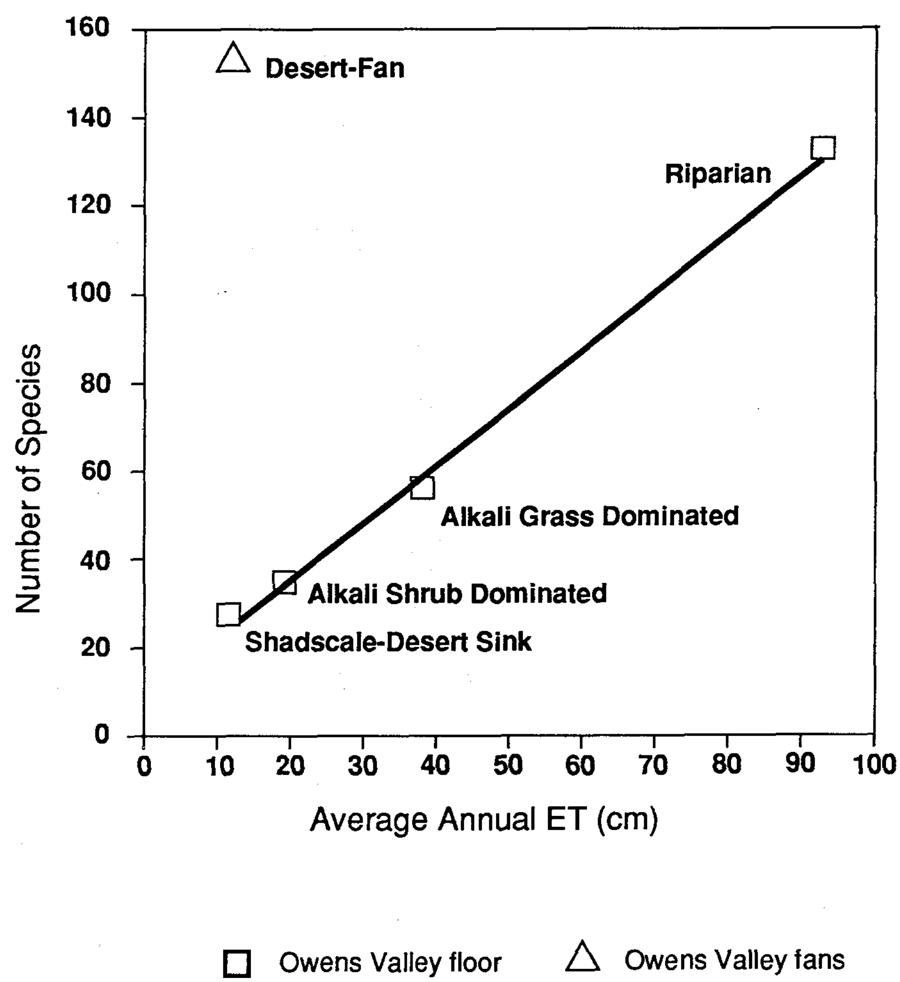
Figure 10-7 shows that, in terms of the number of species of vascular plants, species richness directly relates to water use on the Owens Valley floor.[25,26] The aligned points on the Figure 10-7 graph represent a hydrologic continuum between very wet habitats classified as riparian, to very dry habitats of the shadscale-desert sink vegetation type. The majority of the species associated with each of these vegetation types are perennials. (The desert fan habitats indicated on the graph are an exception, because the majority of the species associated with these habitats are annuals, which occur only in high precipitation years.)

VEGETATION MANAGEMENT TYPES

For purposes of management, Inyo County and LADWP grouped Owens Valley plant communities into five different vegetation "types" (A, B, C, D, and E).[27] The first step in this process was the dividing of vegetation into three categories based upon water supply. In doing this, it was recognized that the distinction between categories is not always clear-cut and that there is some overlap in both individual species and community structure.

Vegetation Not Dependent Upon Groundwater

This category consists primarily of shrubs and scattered grasses and is dependent upon water from precipitation and runoff. Such vegetation occurs mostly on the alluvial fans, but may also be found on the Valley floor in areas where the soil is better aerated and has lower



O W E N S V A L L E Y

FIGURE 10-7

VASCULAR PLANT SPECIES RICHNESS BY HABITAT

SOURCE: DAVID P. GROENEVELD, PH.D., INYO COUNTY WATER DEPARTMENT

eip 88041

salt and alkali content. This category contains a number of different plant communities comprised of different species.

Vegetation Dependent Upon Groundwater and/or Capillary Rise From the Water Table

This vegetation is located on the Valley floor and consists of both shrubs and grasses. These plants are adapted to large fluctuations in water supply and many species will tolerate considerable dry periods. However, individual species within this group vary from one another in tolerance to drought, tolerance to flooding or root inundation, and responsiveness to summer rainfall and other factors. These plant communities are adapted to the saline/alkaline conditions on the Valley floor. Plants such as these which depend on groundwater for a portion of their water supply are often termed "facultative phreatophytes." Some of these plants are dependent on a permanent groundwater supply, and are often termed "obligate phreatophytes."

Vegetation Dependent Upon Standing and/or Running Water

This category includes vegetation species found in marsh and riparian areas. These plants require a constant supply of water and their presence indicates that water, if not observable on the surface, probably is available just beneath the surface.

The second step in establishing vegetation management types was to combine the vegetation communities identified during the 1984-87 inventory with the categorization of plants according to their water supply described above. Data on plant cover obtained during the vegetation inventory was used to calculate plant water use in terms of evapotranspiration (ET), using factors developed through cooperative studies conducted by Inyo County, USGS, and LADWP.[28] The ET estimate for the vegetation cover within each parcel mapped during the inventory was used to classify the vegetation by parcel as to management type. (The estimation of water use -- as ET -- and the classification of vegetation into one of the five management types are described in greater detail within the technical supplement to this EIR and the Agreement -- a document called the Green Book.)[29]

Type A - Vegetation Not Dependent Upon Groundwater.

This type consists of vegetation which has an estimated rate of average annual water use equal to or less than the average annual precipitation in the USGS 7.5 minute quadrangle in which the vegetation is located. This vegetation is dependent for its water supply solely upon precipitation and runoff. Precipitation has a direct effect upon Type A vegetation because it is unbuffered by groundwater and tends to experience near complete exhaustion of soil water reserves annually.[30] The vigor and annual growth of Type A vegetation may, therefore, vary widely from year to year according to precipitation.

The vegetation of the bajadas is primarily Type A. Soils of the bajada are of low salinity and are well drained. The vegetation communities growing on the bajadas do not grow on the Valley floor where there are soils with high salinity because bajada species are intolerant of low soil aeration or salinity.[31]

Examples of species in management Type A which inhabit well drained soils with low soil salinity are the shrubs cheesebush, terete-leaved rabbitbrush, ephedra, and the showy stipa. Other vegetation, such as shadscale scrub, which is found in drier habitats throughout the Valley, was also classified as Type A.

Vegetation that Uses Groundwater: Shrub Dominated - Type B; or Grass Dominated - Type C.

Vegetation Type B requires at least some water from a shallow water table and/or from capillary rise from the water table, and is dominated by shrubs rather than grasses. The dominant species are Nevada saltbush, rubber rabbitbrush, and greasewood.

Vegetation growing at sufficient density to require some groundwater, but dominated by grasses, is Type C. The two grasses that dominate this vegetation are alkali sacaton and saltgrass. Vegetation cover of Type B intergrades with that of Type C distinguished only by the relative amount of grass cover versus shrub cover.

The grasses and shrubs that comprise Types B and C have relatively high tolerance for drought and soil salinity. Many of these species, including several grasses, Nevada saltbush, and the shallow-groundwater subspecies of rubber rabbitbrush exhibit tolerance to flooding.[32] These species are found primarily on the Valley floor in areas with shallow groundwater. As much as one half of their annual water use is provided by precipitation.

Type D - Vegetation Dependent Upon Surface Water or Near-Surface Groundwater.

This vegetation type consists of plant species that require readily available water. It is typically found around springs, seeps, water courses, sloughs, or ponds. The species comprising Type D have low tolerance to fluctuations in water supply. The dominant species of this type include tule, cattail, cottonwood, and willows.

Type E - Irrigated Plant Cover That Requires Relatively Large Amounts of Water.

Vegetation classified as Type E ranges from irrigated crops such as alfalfa to irrigated meadowlands. In some locations, the vegetation has been improved for cattle grazing by introducing non-native species, but most areas of this vegetation type are dominated by the species of Type C vegetation which are irrigated.

10.3 PRE-PROJECT ENVIRONMENTAL SETTING

This section describes the pre-project vegetation conditions. Since the availability of water is the single most important factor affecting Owens Valley vegetation, the pre-project conditions will be described in the context of the Valley's surface water system, its groundwater system, and its irrigated lands. This method of analysis is similar to that used in Chapter 9 to describe the Valley's water resources.

It must be noted that the description of groundwater dependent vegetation on the Valley floor in the pre-project period is complicated by the fact that no surveys or inventories exist that document the vegetation conditions during this period. Therefore, the pre-project conditions are based upon the best available information, including several studies conducted after 1970. While this is true for groundwater dependent vegetation, a more accurate description can be provided for vegetation whose source of water supply was precipitation, the river or its tributaries, lakes and ponds, canals and ditches, springs and seeps, and irrigation because relatively good records exist concerning such water supply sources in the pre-project period.

The information sources used in the pre-project setting and the impact analyses include: (1) reports and letters supplied by both LADWP and the Water Department of Inyo County; (2) past environmental impact reports filed by the City of Los Angeles;[33,34] (3) field surveys conducted by EIP Associates personnel; (4) conversations with noted experts and knowledgeable residents; (5) aerial photographs taken in 1968, 1973, 1981, and 1988; (6) herbarium and library research at both the California Academy of Sciences, San Francisco, and the University of California at Berkeley; (7) a vegetation cover map compiled in 1973, by Earth Sat, Inc., and associated report;[35] and, (8) a comparison of Owens Valley vegetation on 1968 and 1981 air photos conducted by Equisat Geobotanical Surveys, Inc.[36] Citations are placed in the body of the text where appropriate.

Although a number of aerial surveys of the Valley have been done, it has been difficult to get total agreement on the interpretation of air photography for the following reasons: (1) differences in the quality of photography and photographic materials; (2) differences in color and tone in the photographs, with some in black and white and others in color; (3) differences in scale, ranging from 1:7200 to 1:1200; and (4) differences in rainfall and runoff prior to the time the photographs were taken.

Aerial photos represent a good tool for analysis when combined with other data, such as vegetation surveys collected in the field, ground level photo monitoring sites, and well field monitoring sites. While some findings in this analysis are based in part on review of aerial photos, it should be noted that aerial photos alone are not adequate to base conclusions regarding cause and effect of vegetation changes. Changes in land use, quality and timing of the photographs, and antecedent and actual conditions during the year of the photographs, such as precipitation, groundwater levels, and the amount of water released and spread in the areas photographed also need to be considered. For example, for the timeframes used in this analysis, 1967-68 was a year of high runoff and water surplus, and two to three times the normal amount of water was spread on the Valley floor. Runoff year 1981 was a slightly below normal runoff year with about half the normal water releases from the aqueduct, and lower than normal water tables. Runoff year 1988 was greatly below normal with near normal water releases from the aqueduct, and with water tables greatly below normal.

Field surveys performed by EIP Associates in November 1989 and June 1990, combined with the vegetation surveying done by LADWP between 1984 to 1987, indicate that the vegetation types occurring in the Valley prior to 1970, are much the same as the vegetation that occurs there today. There have been instances where habitat or vegetation has been altered at specific sites in the Valley, but it is unlikely that there has been a complete loss of any community or vegetation type between the years 1970 and 1990.

SURFACE WATER

As is done in Chapter 9 - Water Resources, the surface water system has been divided for the purposes of this section into the Owens River, its tributary streams, ponds and lakes, and ditches and canals.

Owens Valley is a closed hydrologic system. Water enters the system only through runoff from the mountains or as precipitation falling on the Valley floor, and water leaves only through evapotranspiration or, historically, as flow into Owens Lake where it ultimately evaporated.

Owens River

Owens River naturally experiences highly variable seasonal flows; the highest flows occur during the spring and early summer as the result of runoff from the Sierra Nevada. Unregulated river flows normally were lowest in the fall and winter before the start of the winter rains. River flows also varied from year to year, depending on the amount of mountain snowfall. Plants adapted to this fluctuating pattern of water movement, such as cottonwoods and tree willows, formed stands along the river's banks. Flows in the river, and the vegetation along the river had been substantially altered by 1970, when the second Los Angeles aqueduct began operation.

Owens River flows were diverted to the first Los Angeles Aqueduct starting in 1913. The flows were diverted at an Intake dam east of Aberdeen. This diversion affected approximately 50 stream miles of the Lower Owens River channel. In wet years, when the aqueduct was full, LADWP released the excess flow from gates on the aqueduct. Other than in locations where flows from springs, groundwater seepage, or irrigation returns entered the river channel, riparian vegetation died out or was severely degraded along much of the channel below the Intake dam. Prior to 1970, saltcedar, an invasive species from Eurasia, became established along much of the Owens River channel below the Intake dam where the original riparian vegetation had died out or was reduced.

The construction of dams by LADWP along the river above the Intake created Tinemaha Reservoir in 1928, Long Valley Reservoir (Crowley Lake) in 1941, and Pleasant Valley Reservoir in 1954, inundating the river channel and surrounding areas at these sites.

The impoundment behind Tinemaha Reservoir resulted in the loss of riparian vegetation on the lands that were inundated. An additional effect of this reservoir, was the growth of saltcedar in the reservoir area. By 1970, this weedy species covered many acres adjacent to the reservoir bed between the high and low water storage levels.

Along the length of Owens River below the Aqueduct Intake is an extensive system of relic meander channels. By 1970, due to the diversion of the river at the Intake, most of these meander channels were dry. These meanders at one time contained marsh and riparian vegetation.

Disruption of the natural river flows, resulted in the loss of most of the marsh and riparian vegetation along this reach of Owens River.

Tributary Streams

Before completion of the first Los Angeles aqueduct, numerous tributary streams flowed from the Sierra Nevada, across the alluvial fans, onto the Valley floor and into the Owens River or Owens Lake. With the completion of the aqueduct in 1913, all of the streams south of the Aqueduct Intake were diverted into the aqueduct. This diversion resulted in the loss of riparian vegetation along these streams on the east side of the aqueduct.

These diversions led to reduction of meadow areas documented by Lee that were fed by Taboose, Goodale, Sawmill, and Thibaut creeks, among others.[37,38] Additionally, prior to 1970, to reduce the amount of water lost due to percolation and recharge from the streambeds upstream of the aqueduct, approximately ten miles of these streams were lined or were diverted into pipes and concrete-lined channels. This action eliminated or severely impacted the riparian vegetation long these sections of the streams. By 1970, a total of ten percent of the Owens River and its tributaries (in terms of miles) had been diverted out of the natural channels and the vegetation along these diverted sections had died off or had been greatly reduced.

Ponds and Lakes

Collection of water in topographic depressions on the Valley floor created natural small ponds and lakes in areas of Owens Valley. The most notable of these are Klondike Lake and Warren Lake near Big Pine, several small ponds in the center of the Valley from east of Aberdeen to east of Independence along the 1872 Earthquake Fault, and Diaz Lake near Lone Pine. Figure 9-2 (shown previously), depicts the location of these features. By 1970, these lakes and ponds were still in existence, but diversion of water from streams for irrigation, and into the aqueduct system in prior years had caused large fluctuations in the levels in these ponds and lakes. In some years, these surface water features and the associated wetlands dried up as a result of such diversions; however, by 1970, riparian and meadow vegetation were still associated with these ponds and lakes.

In response to a court decision in 1945, which was modified and affirmed by the California Supreme Court in 1950, requiring LADWP to prevent water from ponding in Owens Lake, LADWP constructed dikes on the Valley floor east of Independence. In years when runoff was in excess of the export capacity of the aqueduct, water that was released from or bypassed, the aqueduct ponded behind these 3- to 6- foot high dikes. Such ponding occurred in wet years such as 1967 and 1969. A result of this practice was the loss of vegetation not tolerant of the periodic flooding and drying. Another result was the spread of saltcedar throughout the impoundment areas.

Canals and Ditches

A network of canals and ditches was constructed in the latter half of the 19th century to convey water for irrigation, livestock, drainage, and other purposes. As Los Angeles purchased and removed lands from irrigation, many of these canals and ditches were removed from service. These activities occurred primarily between 1924 and 1935. Prior to 1970, these abandoned canals and ditches did not support riparian vegetation.

GROUNDWATER

As described above, a large quantity of vegetation on the Valley floor is dependent on a shallow water table and/or on capillary rise from the water table. Prior to 1970, water levels in Owens Valley had been affected by a reduction in groundwater recharge and by groundwater pumping. Also, prior to 1970, flows from springs and seeps had been affected by groundwater pumping which caused some changes in vegetation dependent on such flows.

Groundwater Dependent Vegetation

Diversion of tributary streams into the first aqueduct reduced the level of recharge to areas of native vegetation east of the aqueduct. This caused the periodic lowering of water tables, which contributed to the alteration of vegetation in the Valley during the pre-project period. As documented by Lee for the southern one-half of the Valley, shallow groundwater maintained meadowlands over much of the Valley floor.

Numerous marshes existed southeast of Bishop during the first two decades of the century according to the USGS map of 1913. These large expanses of vegetation were probably dominated by Types C and D vegetation. By the time the 1913 map was produced, the supply of water for some of these areas may have also been augmented by irrigation tailwater. Ditches were constructed by farmers to drain areas in the Bishop region for farmland development. This, in turn, reduced groundwater levels in localized zones to further affect the vegetation cover. These marshes were largely gone by 1970.

In addition to a reduction in recharge, groundwater pumping prior to 1970, also periodically lowered water tables in the Valley. Groundwater production from the Owens Valley groundwater basin began prior to construction of the first aqueduct. During his 1906 survey of the groundwater resources in the Valley, W.T. Lee reported that while no pump equipped wells had been installed in the Valley, several flowing wells were being used for domestic supply and irrigation purposes.[39] Between 1908 and 1911, LADWP installed several flowing wells in the Independence area to provide water for the dredges used in the construction of the first aqueduct. These wells were capable of producing a combined total flow of approximately 9,500 acre-feet per year.

During the 1920s, drought conditions reduced the flow in the Owens River, and LADWP installed additional wells to compensate this loss. During these drought conditions, which extended from 1928 to 1931, LADWP's average annual groundwater pumping was 34,250 acre-feet, with a maximum production of 136,163 acre-feet (188 cfs) from October 1930 to September 1931 (water year 1930-31).

From 1936 to 1958, little groundwater was pumped by LADWP. During a drought period from 1958 to 1962, groundwater pumping was again an important source of water for the aqueduct system. Average annual groundwater pumping for water years 1960-61 and 1961-62 was 81,253 acre-feet. After the early 1960s drought, groundwater pumping continued until 1970, but in lesser quantities. In the 1930s, and again in the 1960s, water levels in the areas of the wells significantly declined due to groundwater pumping by LADWP, but recovered shortly after pumping ceased. Although groundwater pumping prior to 1970, had caused decreases and changes in groundwater dependent vegetation, these decreases and changes were limited in area.

Springs and Seeps

Due to the limited duration of groundwater pumping, the vegetation dependent on the flow from springs and seeps had not been greatly reduced during the period prior to 1970. Springs such as Fish Springs, Big and Little Seely Springs, Blackrock and Little Blackrock Springs, and numerous unnamed springs in the Valley were flowing in 1968, as can be seen on aerial photographs. It is not known whether Hines Spring was flowing at this time because the spring is an ungauged channel. These springs supported primarily Types C and D vegetation. All of the above springs ceased to flow due to regional groundwater pumping during the early 1960s (LADWP, gauge records); however, once groundwater pumping ceased, spring flows returned.

Irrigated Lands

European man's influence on Owens Valley vegetation began in the 1850s and 1860s. Homesteads proliferated in the Valley around the turn of the century. Like all later agriculture in the Valley, these early ranches required irrigation. Water use gradually increased as more land was brought under cultivation.

Tailwater from irrigation and water spreading also resulted in an extension of riparian cover in areas downgradient from irrigated lands.

Irrigated acreage continued to increase to a maximum of approximately 75,000 acres during the mid-to-late twenties.[40] Between 1924 and 1935, Los Angeles purchased the majority of the private lands in the Valley. As Los Angeles removed lands from irrigation, not only were the irrigated lands abandoned, but also less water was then available to support vegetation in areas downgradient from the formerly irrigated lands.

Prior to operations to supply the second aqueduct, the lands that received irrigation water totaled around 21,800 acres. These lands are shown on Figure 10-8A-L. For convenience, lands irrigated under the project are also shown on that map.

10.4 IMPACTS AND MITIGATION MEASURES

INTRODUCTION

The proposed project consists of all water management practices that were implemented or constructed in Owens Valley to supply the second Los Angeles aqueduct which was completed in 1970, together with the water management practices and projects contained in the Agreement. As in the pre-project setting section, the impacts of the project will be described in the context of the Valley's surface water system, its groundwater system, and its irrigated lands.

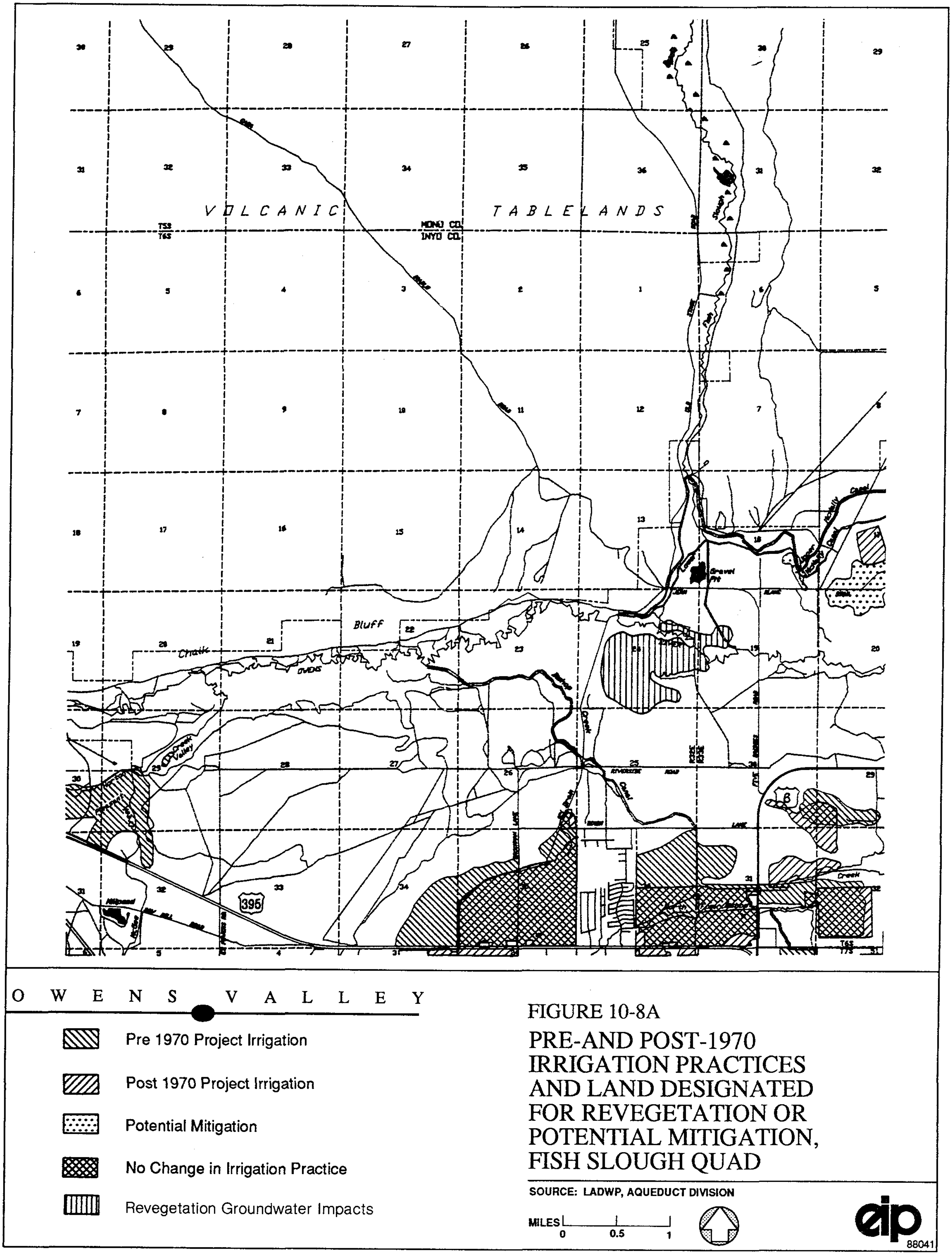
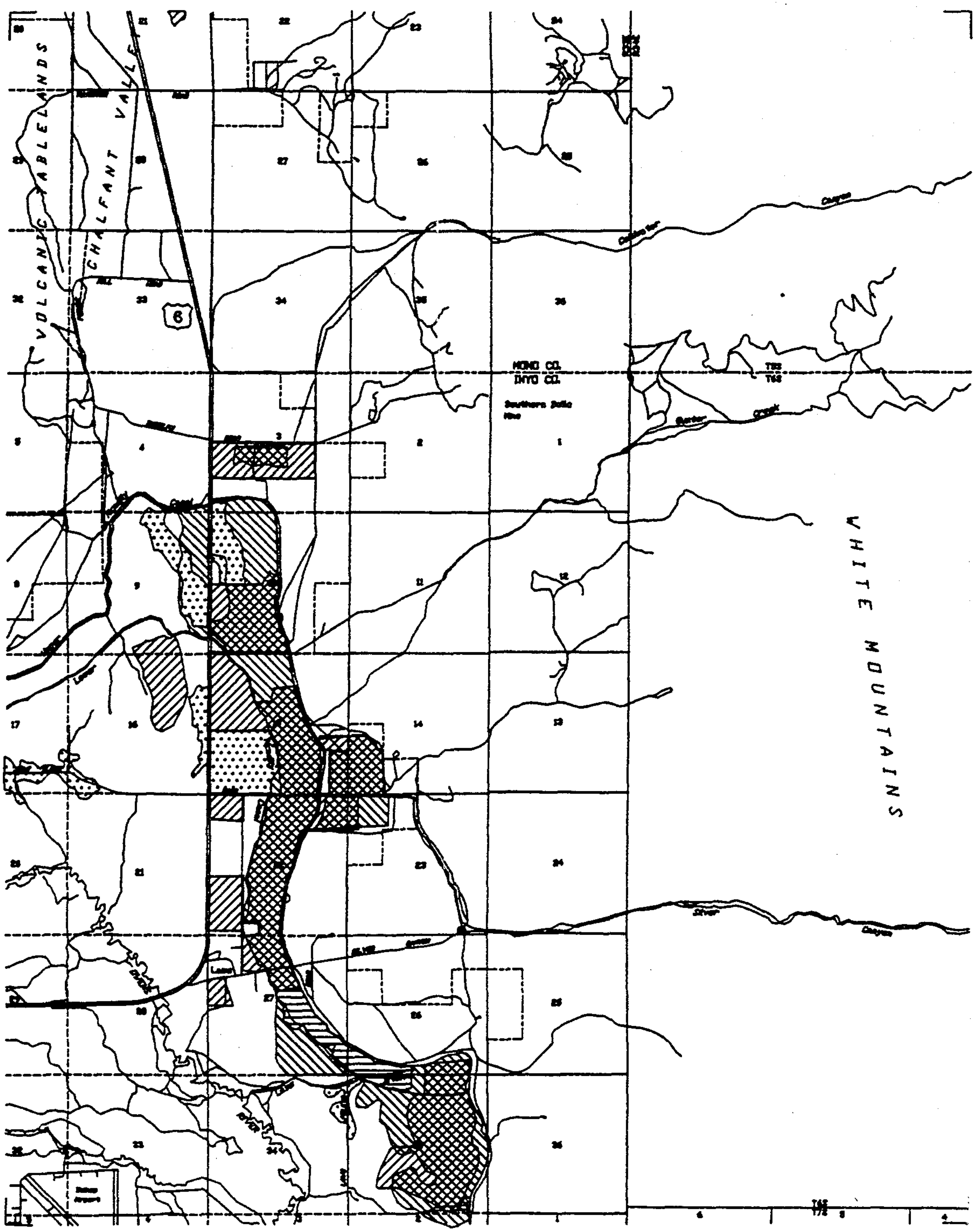


FIGURE 10-8A
PRE-AND POST-1970 IRRIGATION PRACTICES AND LAND DESIGNATED FOR REVEGETATION OR POTENTIAL MITIGATION, FISH SLOUGH QUAD



OWENS VALLEY

Pre 1970 Project Irrigation

Post 1970 Project Irrigation

No Change in Irrigation Practice

Revegetation-Surface Water Impacts

Potential Mitigation

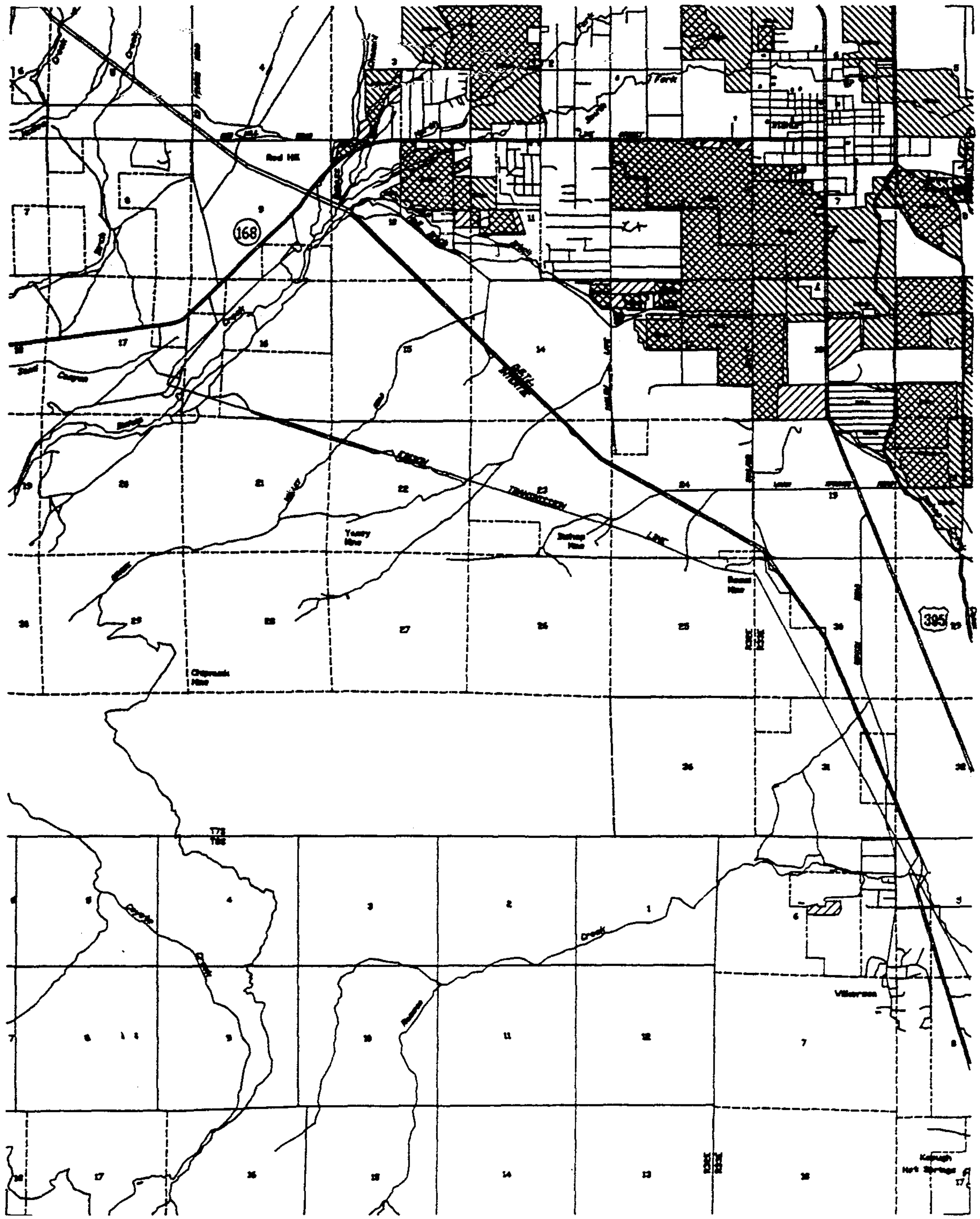
FIGURE 10-8B

PRE-AND POST-1970 IRRIGATION PRACTICES AND LAND DESIGNATED FOR REVEGETATION OR POTENTIAL MITIGATION, LAWS QUAD

SOURCE: LADWP, AQUEDUCT DIVISION

MILES 0 0.5 1

eip 88041



O W E N S V A L L E Y

- Pre 1970 Project Irrigation
- Post 1970 Project Irrigation
- No Change in Irrigation Practice
- Surface Water Impacts

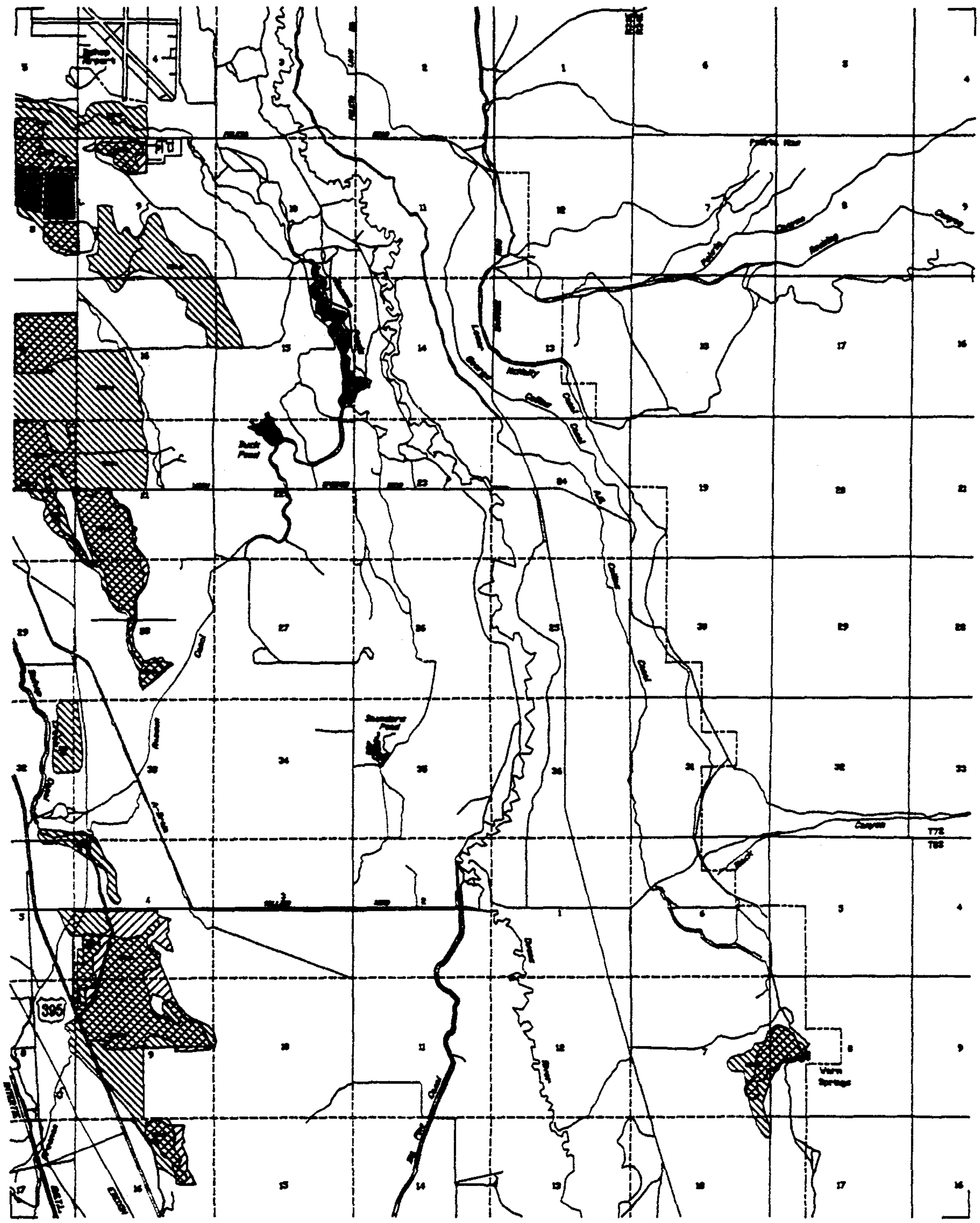
FIGURE 10-8C

PRE-AND POST-1970 IRRIGATION PRACTICES AND LAND DESIGNATED FOR REVEGETATION OR POTENTIAL MITIGATION, BISHOP QUAD

SOURCE: LADWP, AQUEDUCT DIVISION

MILES 0 0.5 1

eip 88041



O W E N S V A L L E Y

Pre 1970 Project Irrigation

Post 1970 Project Irrigation

No Change in Irrigation Practice

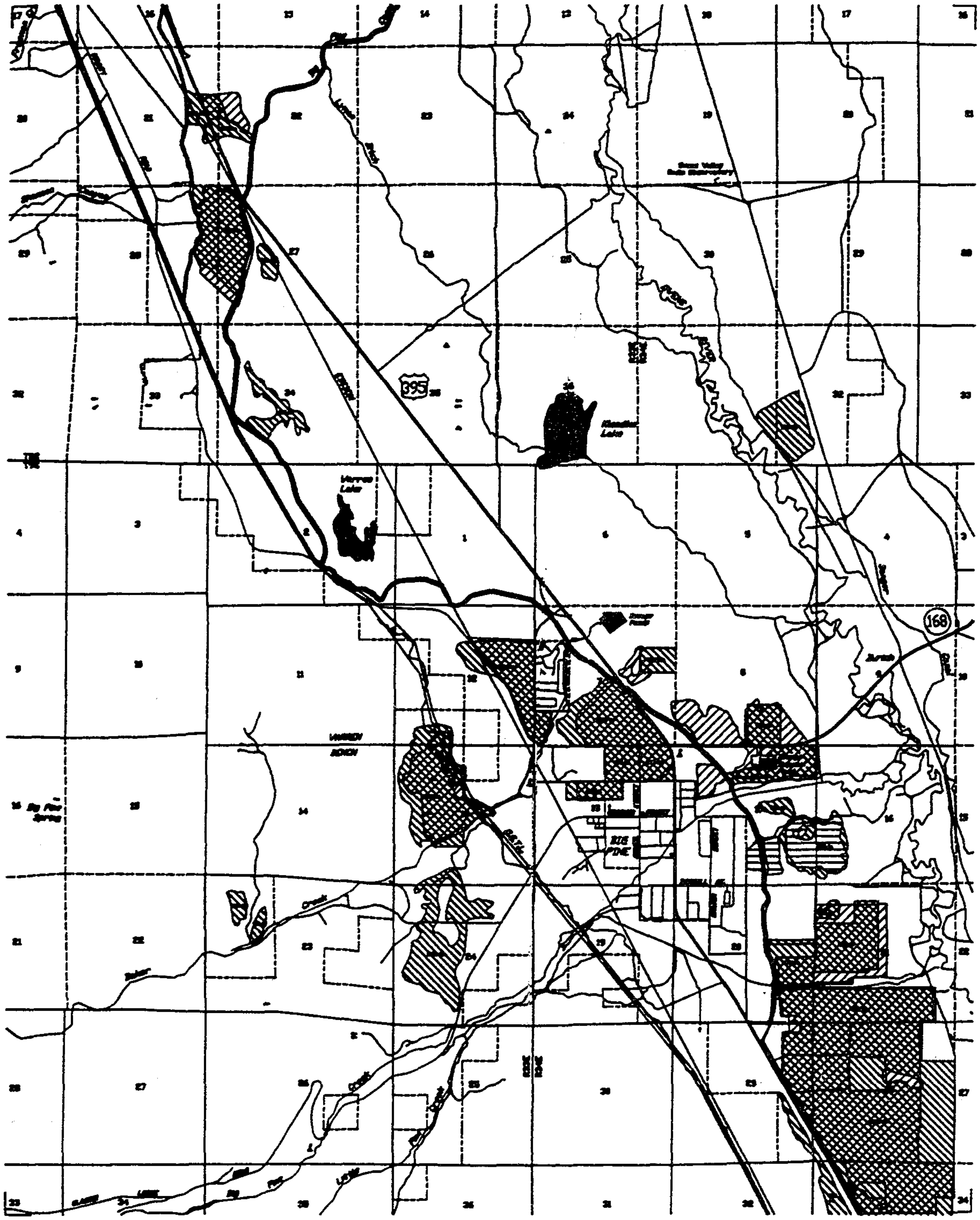
FIGURE 10-8D

PRE-AND POST-1970 IRRIGATION PRACTICES AND LAND DESIGNATED FOR REVEGETATION OR POTENTIAL MITIGATION, POLETA QUAD

SOURCE: USGS; EIP ASSOCIATES

MILE 0 0.5 1

eip 88041



O W E N S V A L L E Y

- Pre 1970 Project Irrigation
- Post 1970 Project Irrigation
- No Change in Irrigation Practice
- Surface Water Impacts

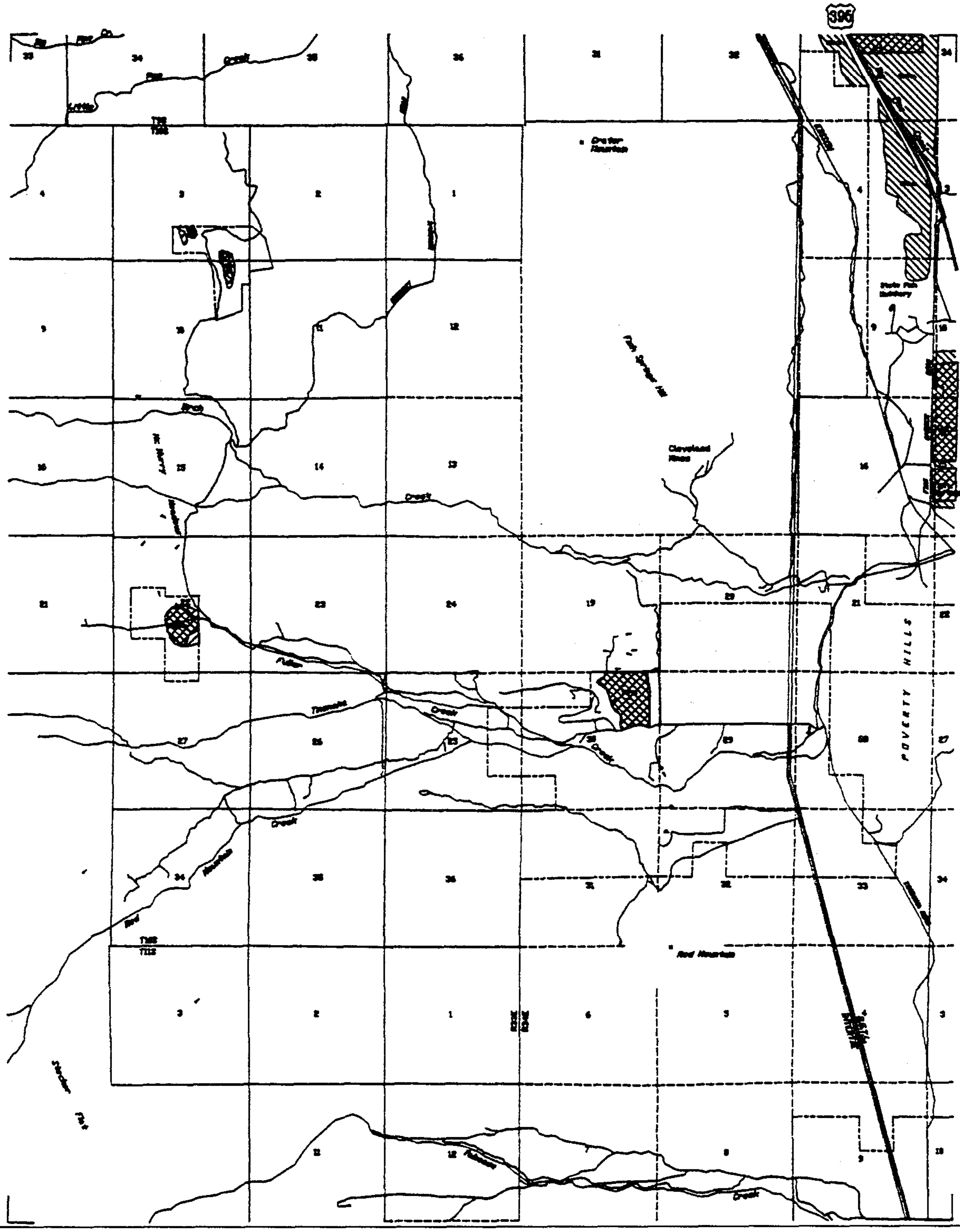
FIGURE 10-8E

PRE-AND POST-1970 IRRIGATION PRACTICES AND LAND DESIGNATED FOR REVEGETATION OR POTENTIAL MITIGATION, BIG PINE QUAD

SOURCE: LADWP, AQUEDUCT DIVISION

MILES 0 0.5 1

eip 88041



O W E N S V A L L E Y

Pre 1970 Project Irrigation

Post 1970 Project Irrigation

No Change in Irrigation Practice

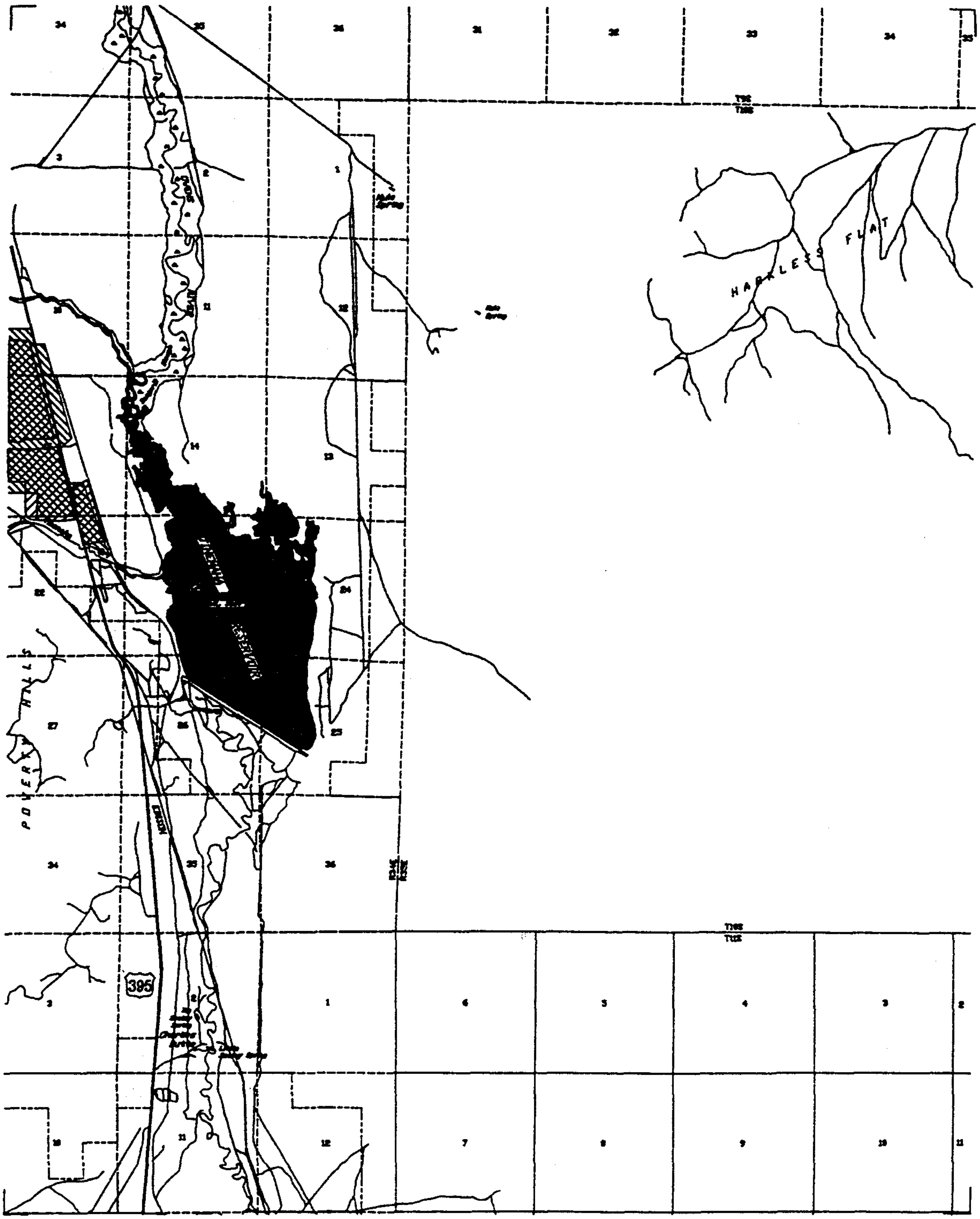
FIGURE 10-8F

PRE-AND POST-1970 IRRIGATION PRACTICES AND LAND DESIGNATED FOR REVEGETATION OR POTENTIAL MITIGATION, FISH SPRINGS QUAD

SOURCE: LADWP, AQUEDUCT DIVISION

MILE 0 0.5 1

eip 88041



OWENS VALLEY

- Pre 1970 Project Irrigation
- Post 1970 Project Irrigation
- No Change in Irrigation Practice
- Revegetation Groundwater Impacts

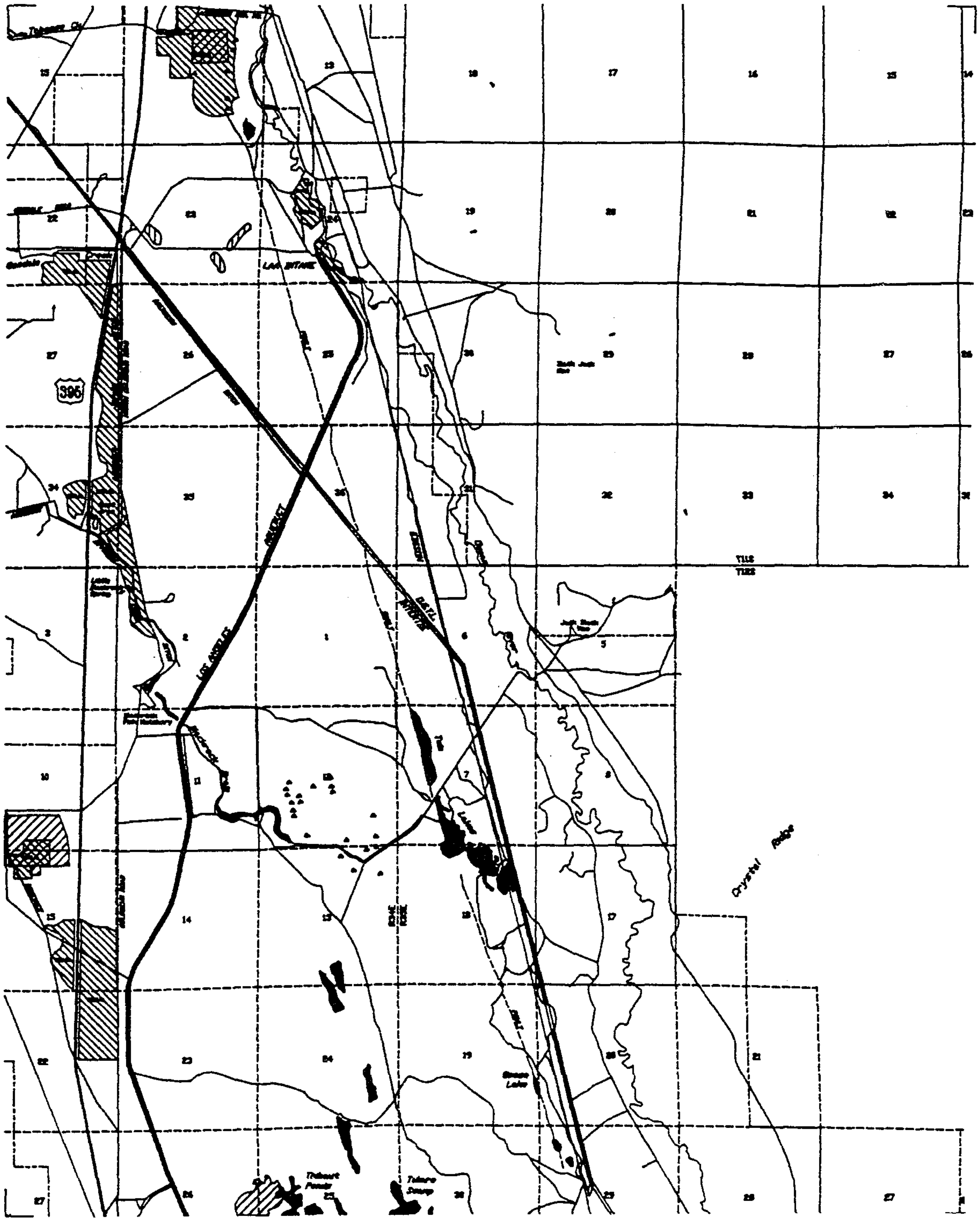
FIGURE 10-8G

PRE-AND POST-1970 IRRIGATION PRACTICES AND LAND DESIGNATED FOR REVEGETATION OR POTENTIAL MITIGATION, TINEMAHA RESERVOIR QUAD

SOURCE: LADWP, AQUEDUCT DIVISION

MILES 0 0.5 1

eip 88041



O W E N S V A L L E Y

Pre 1970 Project Irrigation

Post 1970 Project Irrigation

No Change in Irrigation Practice

Revegetation Groundwater Impacts

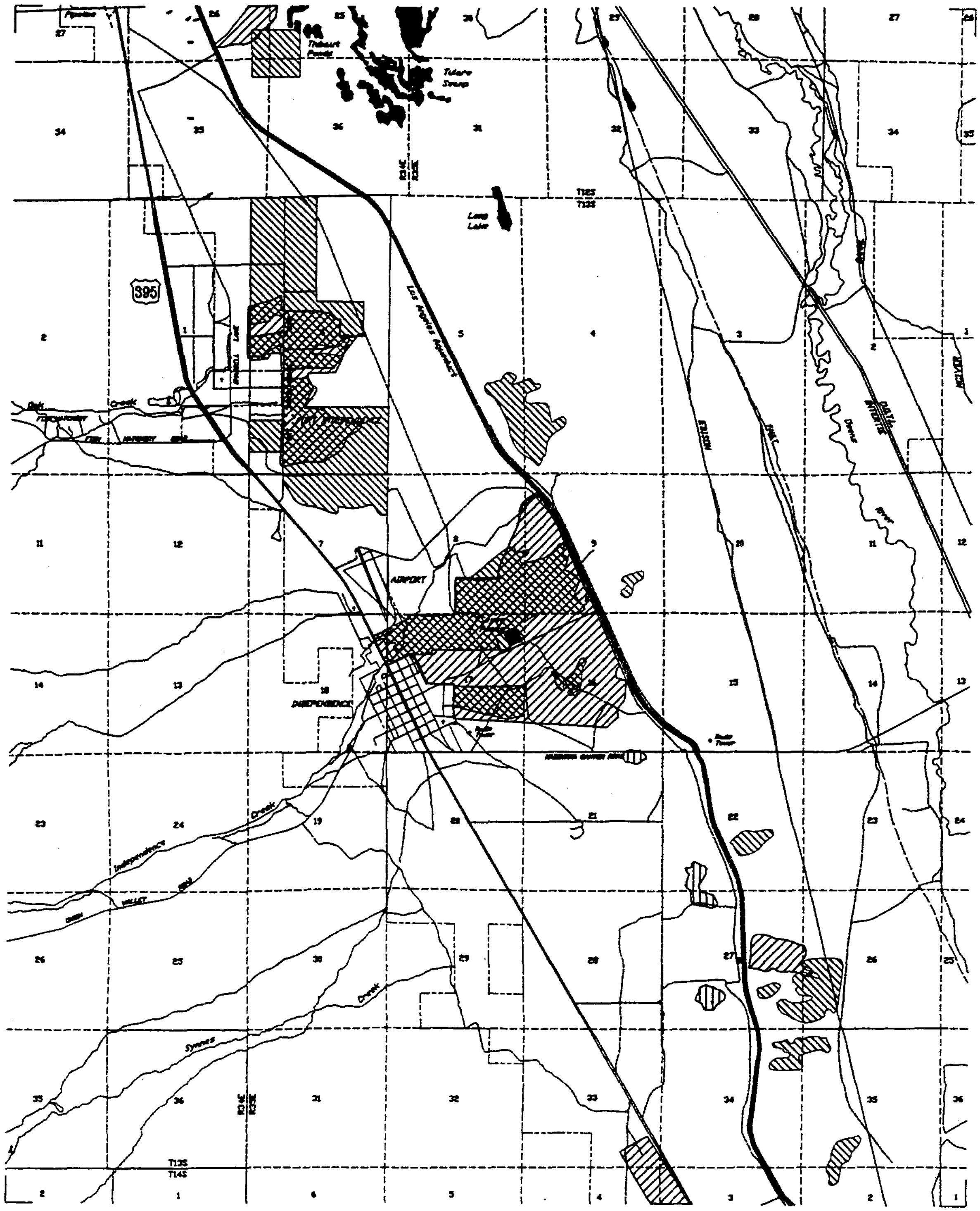
FIGURE 10-8H

PRE-AND POST-1970 IRRIGATION PRACTICES AND LAND DESIGNATED FOR REVEGETATION OR POTENTIAL MITIGATION, BLACKROCK QUAD

SOURCE: LADWP, AQUEDUCT DIVISION

MILES 0 0.5 1

eip 88041



O W E N S VALLEY

- Pre 1970 Project Irrigation
- Post 1970 Project Irrigation
- No Change in Irrigation Practice
- Revegetation Groundwater Impacts

FIGURE 10-8I

PRE-AND POST-1970 IRRIGATION PRACTICES AND LAND DESIGNATED FOR REVEGETATION OR POTENTIAL MITIGATION, INDEPENDENCE QUAD

SOURCE: LADWP, AQUEDUCT DIVISION

MILES 0 0.5 1

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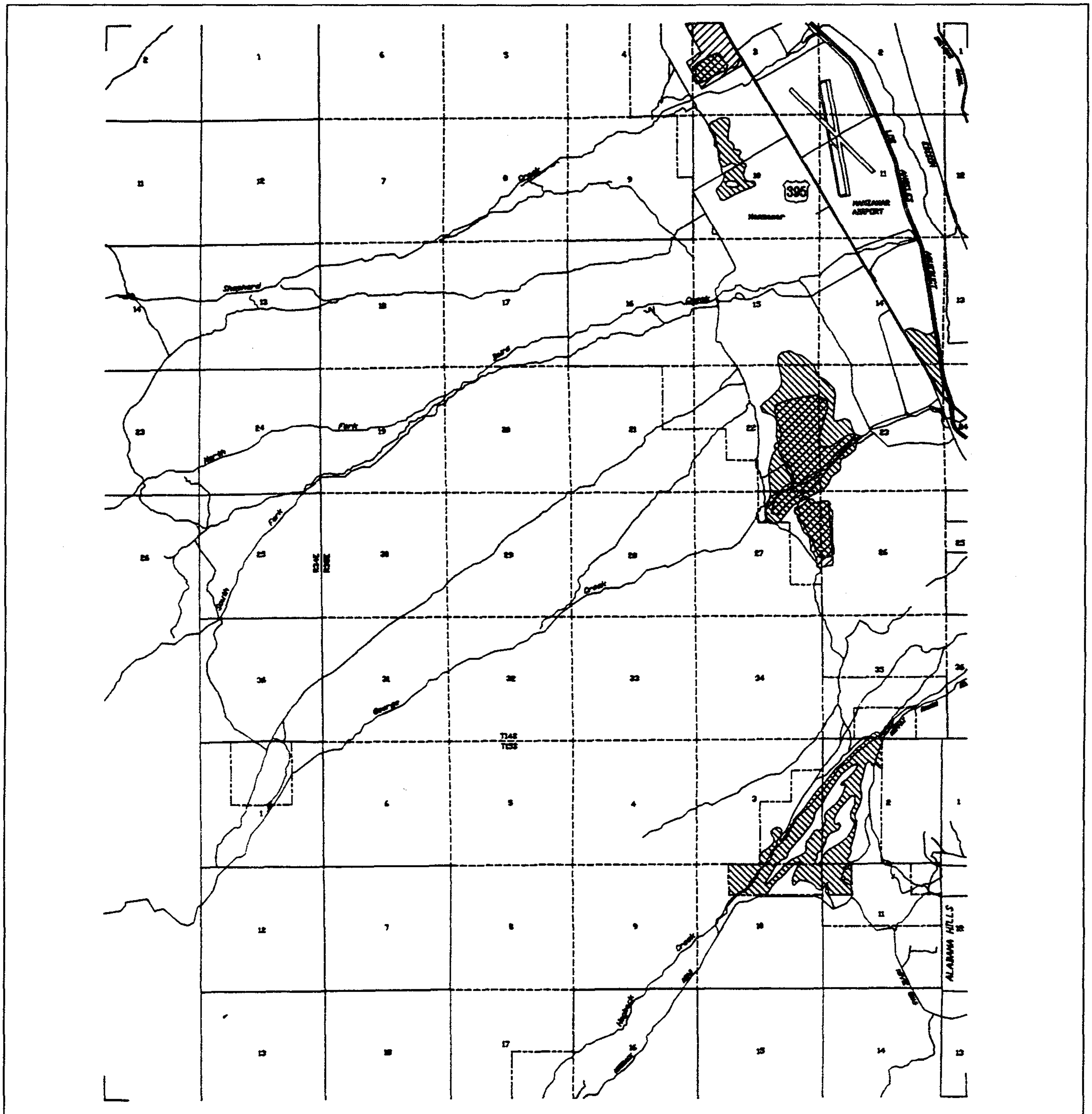


O W E N S • V A L L E Y

- Pre 1970 Project Irrigation
- Post 1970 Project Irrigation
- No Change in Irrigation Practice

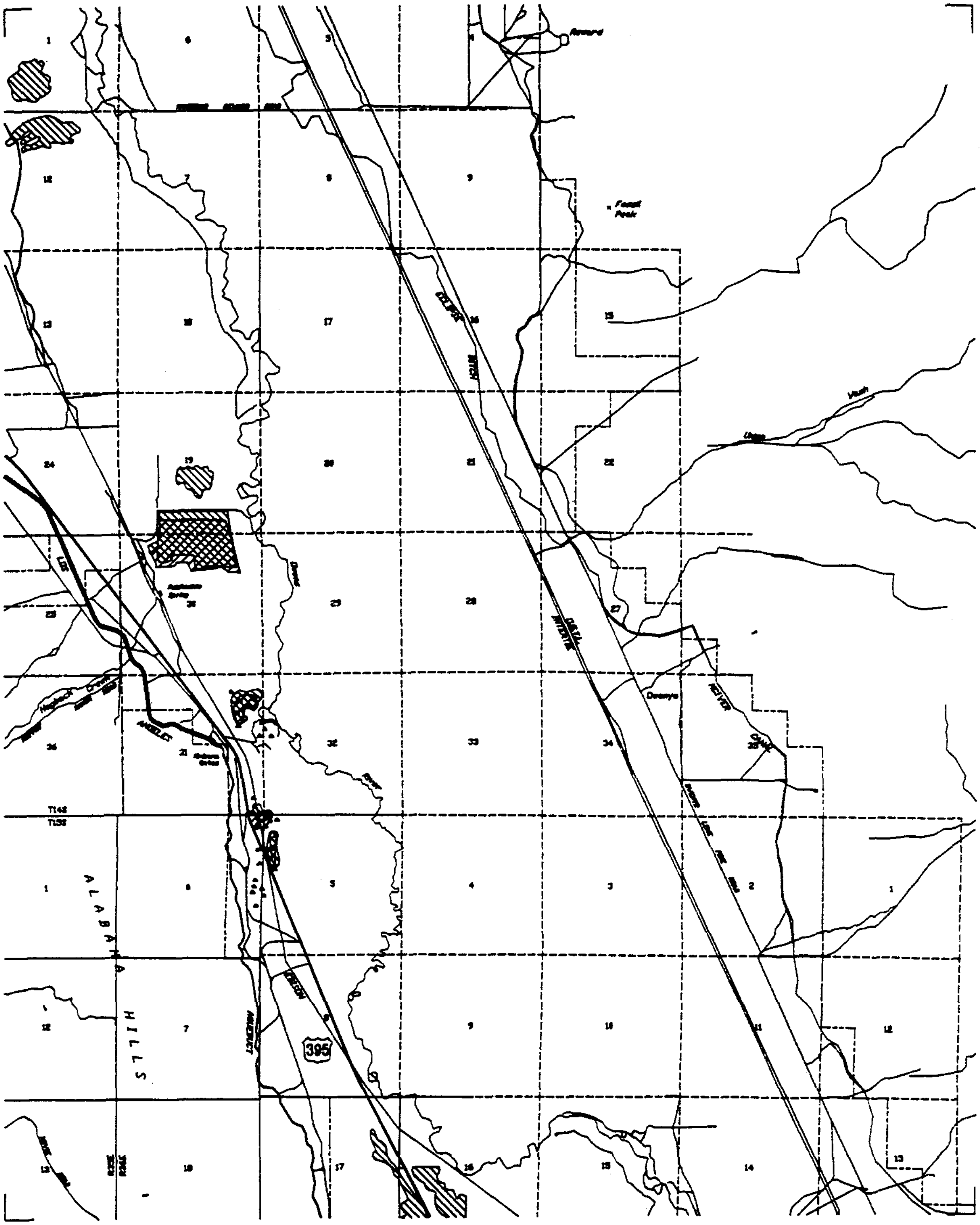
FIGURE 10-8J

PRE-AND POST-1970 IRRIGATION PRACTICES AND LAND DESIGNATED FOR REVEGETATION OR POTENTIAL MITIGATION, MANZANAR QUAD

SOURCE: LADWP, AQUEDUCT DIVISION

MILE 0 0.5 1

eip 88041



OWENS VALLEY

Pre 1970 Project Irrigation

Post 1970 Project Irrigation

No Change in Irrigation Practice

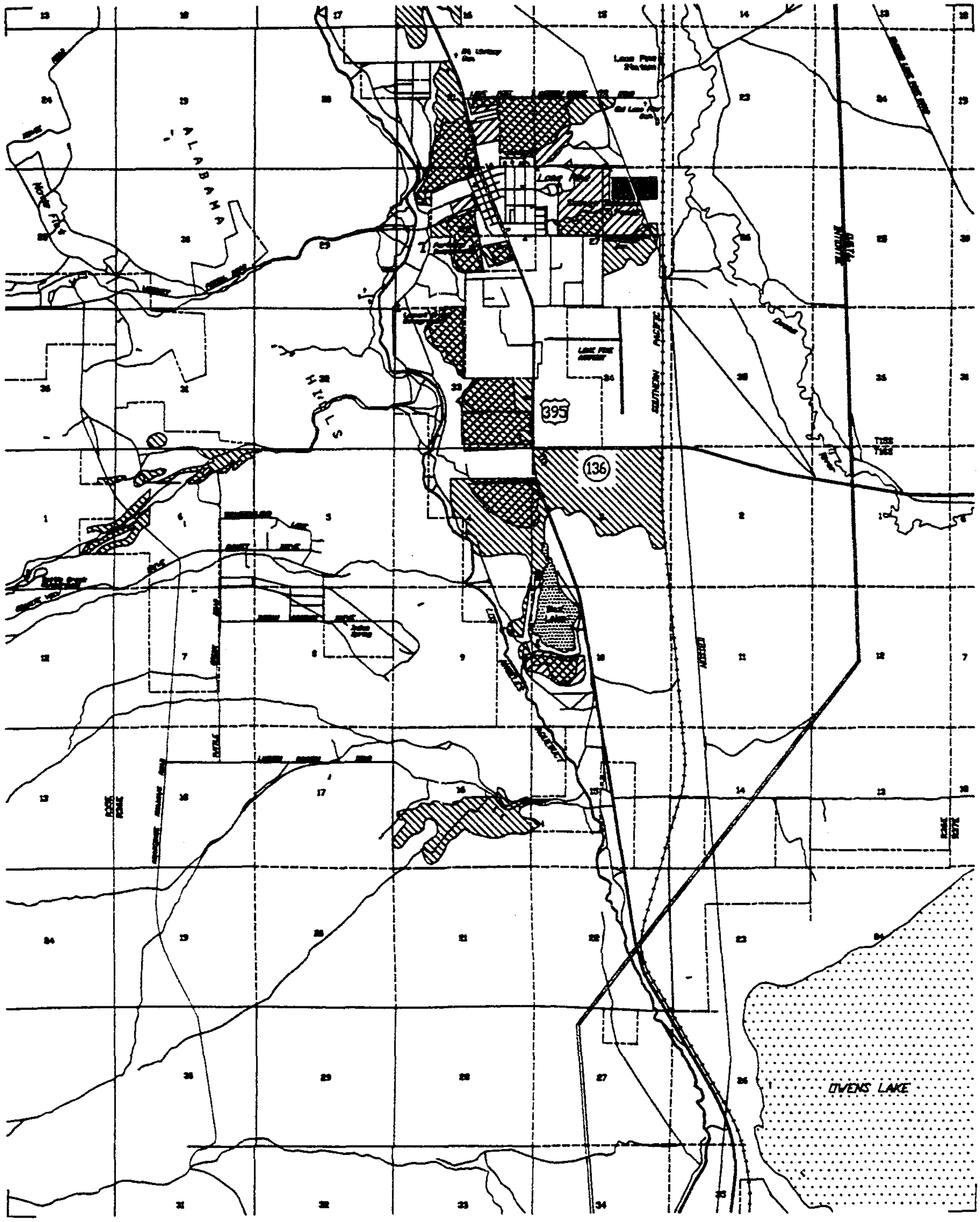
FIGURE 10-8K

PRE-AND POST-1970 IRRIGATION PRACTICES AND LAND DESIGNATED FOR REVEGETATION OR POTENTIAL MITIGATION, UNION WASH QUAD

SOURCE: LADWP, AQUEDUCT DIVISION

MILE 0 0.5 1

88041



O W E N S V A L L E Y

Pre 1970 Project Irrigation

Post 1970 Project Irrigation

No Change in Irrigation Practice

FIGURE 10-8L

PRE-AND POST-1970 IRRIGATION PRACTICES AND LAND DESIGNATED FOR REVEGETATION OR POTENTIAL MITIGATION, LONE PINE QUAD

SOURCE: LADWP, AQUEDUCT DIVISION

MILE 0 0.5 1

88041

Because this is a unique EIR in that it describes a project that began more than 20 years ago, the analysis of the impacts of the project will be presented in two parts. The first describes the impacts of the project in the period from 1970 to 1990. The second component describes future impacts of the project resulting from the implementation of the Agreement. If a significant effect on the environment is identified under either time frame, the mitigation measures that will be implemented to reduce the impact to less than significant are also described. Unless explicitly identified as significant, all impacts described are less than significant.

In 1970, the second Los Angeles aqueduct was completed and became operational. The total maximum capacity to export surface water and groundwater from Owens Valley increased from an average annual amount of about 347,500 acre feet (480 cfs) to about 564,700 acre feet (780 cfs).

Vegetation in Owens Valley is known to have changed due to water exportation. No vegetation map was prepared prior to 1970 documenting pre-project conditions in the Owens Valley; however two vegetation maps of Owens Valley have been produced in a time sequence that could be used to make an evaluation of the impacts of the proposed project. These maps reflect conditions during 1973-74 and 1984-87.[41,42] However, the quantity of data and level of detail of the 1973-74 map limits its usefulness in determining vegetation change.

Several studies have attempted to evaluate the vegetation changes that have occurred in Owens Valley due to the increased diversion or export of surface water and groundwater due to the project. Griepentrog and Groeneveld observed vegetation to determine the degree of vegetation change as indicated by the vigor and condition of living plants versus remnant dead plant material at locations throughout the Valley. This very qualitative analysis produced a map of vegetation change corresponding to changes in depth to the water table due to groundwater pumping.[43] In addition, several of the areas with vegetation change are known to have experienced such changes due to decreases in the amount of surplus surface water released during wet years. Their analysis concluded that more than 25,000 acres of vegetation had been affected by water gathering activities, and that most of the effects had been caused by increased export after 1970.

A second indication of vegetation decrease and/or change can be found in a comparison of the groundwater budgets developed by USGS for the pre-1970 period and the post-1970 period. Such a comparison shows that as a result of increased groundwater pumping of 95,000 acre feet after

1970, and reduced recharge associated with the operation of the second aqueduct, ET from groundwater decreased by 40,000 acre feet per year. The decrease in ET is associated with a reduction of vegetation cover in some areas and die-off of vegetation in other areas.

Jacques, through a comparison of the 1968 and 1981 air photography concluded that there had been a reduction in vegetation cover between 1970 and 1990 on Owens Valley floor areas within well fields.[44]

The studies described above conclude that there has been a reduction in vegetation cover or a change in the species composition of vegetation since 1970. As stated in the pre-project setting section, a baseline survey of vegetation of sufficient detail to document vegetation conditions in the pre-project period does not exist.

However, because relatively good records exist concerning precipitation, the Owens River, its tributaries, lakes and ponds, canals and ditches, springs and seeps, and irrigation in the pre-project period, the pre-project condition of vegetation dependent on such sources has been described relatively accurately in the pre-project setting section. A determination of whether or not vegetation dependent on these sources has been significantly affected by the project has been made by a comparison of the pre-project conditions to existing conditions, and to anticipated changes to these conditions that may occur because of the implementation of the Agreement.

A determination of whether or not groundwater dependent vegetation and vegetation dependent on the release of surplus waters has been significantly adversely impacted by the project has been made using the above described studies, the data sources described in Table 10-1, and the best judgment of the authors. No original scientific field studies were conducted as part of this EIR.

In considering the significance of impacts from the proposed project on vegetation, an impact on vegetation was considered to be significant based on the following factors:

TABLE 10-1

SOURCE LIST FOR IDENTIFICATION OF VEGETATION IMPACTS

- LADWP EIR's on Impacts of Groundwater Pumping, 1976 and 1979.[1,2]
- Inyo County Water Management Report and Impact Assessment, 1981.[3]
- Inyo County Groundwater Management Ordinance Draft EIR, 1982.[4]
- D. Jacques Survey of Owens Valley Vegetation Changes, 1990.[5]
- USGS Open File Report (88-715), Owens Valley Water Resources, 1989.[6]
- LADWP Data on Groundwater Pumping by Well and Well Field, Water Spreading, and Existing and Historical Irrigation Practices.[7]
- LADWP Vegetation Map Circa 1973, Revised 1989.[8]
- LADWP Vegetation Field Survey Data and Map (1984-87).[9]
- Review of 1968, 1973, 1981, and 1988 Aerial Photos
- Review of Historical/Existing Land Uses (Grazing, Crop Production, Fire).
- Review of Historical Precipitation Records.

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[1] Los Angeles Department of Water and Power. 1976, op. cit.
[2] Los Angeles Department of Water and Power. 1979, op. cit.
[3] Griepentrog and Groeneveld. 1981, op. cit.
[4] Inyo County Water Department. 1981. Draft EIR on the Owens Valley Water Management Plan. County of Inyo, California.
[5] Jaques, D. 1990, op. cit.
[6] Hollett, K. J., W. R. Danskin, W. F. McCaffrey, and C. L. Walti. 1989. Geology and Water Resources of Owens Valley, California. U. S. Geological Survey Open-file Report 88-715.
[7] Los Angeles Department of Water and Power. Various documents.
[8] This map is a revision of the map produced by the Earth Satellite Corporation.
[9] Los Angeles Department of Water and Power. 1989. Green Book.

- o The size, location, and use of the area that has been affected.
- o The degree of the decrease, change, or effect within the affected area.
- o The permanency of the decrease, change, or effect.
- o Whether the decrease, change, or effect causes a violation of air quality standards.
- o The cumulative effect of the impact when judged in relation to all such areas of Owens Valley.
- o The value of existing enhancement and mitigation projects in addressing the environmental consequences of similar impacts.
- o The impact, if any, on rare or endangered species and on other vegetation of concern.
- o Whether the decrease, change, or effect affects human health.

Finally, it should be noted that centuries and perhaps millennia were required to produce the habitats and species diversity in Owens Valley that have been affected during the almost 90-year history of water export. For practical purposes such changes must be regarded as permanent. Even if water management were to revert to pre-project operations, the affected vegetation could require a time period of many decades to return to the pre-1970 conditions.

SURFACE WATER

As was done in the pre-project setting section, for the purposes of this impact analysis the Owens Valley surface water system has been divided into the Owens River, its tributary streams, ponds and lakes, and ditches and canals.

Owens River - 1970 to 1990

Between 1970 and 1990, flows in the river between Pleasant Valley and the Intake were generally greater due to increased import of water from the Mono Basin and increased groundwater pumping north of the Intake. Long Valley Reservoir outflow averaged 290 cfs for the 1945 to 1970 period, and 311 cfs for the 1960 to 1970 period. Reservoir outflows for the 1970 to 1990 period averaged 360 cfs, which is 24 percent more than the 1945 to 1970 flows and 15 percent more than the 1960-1970 flows.

Insufficient information is available to determine if the increased flow rate from 1970 to 1990 has affected sediment transport rates, channel geometry, streambank erosion, riparian vegetation, or aquatic life. However, it is believed that increased flow rates have not resulted in a significant adverse impact in comparison to pre-project conditions. After 1990, flow rates will be less than occurred from 1970 to 1990, because Mono Basin diversions will be reduced in connection with recent court decisions requiring fish flow releases down streams tributary to Mono Lake and expected modifications in the City's licenses to divert water.

Impact

10-1 **Flows in Owens River below the Intake were altered, with no significant impact on vegetation.**

Between 1970 and 1990, flows in the Owens River below the Intake were slightly reduced from pre-project flows because of reduced operational spreading during high runoff periods (due to increased export capacity), and by reduced groundwater baseflow due to groundwater pumping. Flows in the Owens River at Keeler Bridge averaged 13,100 AFY during the 1970 to 1986 period, and 14,000 AFY during the pre-project period. Flows in a portion of the Lower Owens River below the Intake were increased because of releases from the aqueduct by LADWP, as part of an effort to enhance the fishery, and improve waterfowl habitat. Beginning in 1978, LADWP began releasing water from various aqueduct gates via various ditches into the Owens River.

In 1986, the Lower Owens River enhancement/mitigation project was commenced. As more fully described in Chapter 5, the objective of this project was to increase flows in the river and in certain ponds and lakes by a release of water from the Blackrock, Thibaut, Independence, and Locust Gates. The water supply for this project (up to 18,000 acre feet per year) was provided by the construction and operation of new wells, except in 1986, when surplus surface water was available because of an above average runoff year. Flow releases to the Owens River has resulted in a beneficial impact to riparian vegetation and wildlife, as compared to pre-project conditions.

Mitigation Measures

10-1 *None required.*

Owens River - Agreement

Impact

10-2 **Implementation of the Agreement will not affect the flow in the Owens River between Pleasant Valley Reservoir and the Intake dam, and will not result in a significant decrease or change in vegetation along this reach of the river, but flow in the river below the Intake dam will increase, which will increase vegetation along this reach of the channel.**

As described in Chapter 5, a pump-back station and a pipeline will be constructed from the River near Keeler Bridge to convey water from the river to the aqueduct. Flow rates in the river in the reach between the Intake and the pump-back station will be increased. The increased flow will promote restoration of riparian vegetation and the restoration of wetlands and its associated vegetation along that section of the river. Continued release of a flow below the pump-back station will maintain the productive and beneficial habitat area on the Owens River Delta. A separate CEQA document will be prepared prior to implementation of this element of the project.

Mitigation Measures

10-2 *None required.*

Tributary Streams - 1970 to 1990

Impact

10-3 **Between 1970 and 1990, no stream channels were lined, or the stream flow diverted into pipelines by LADWP.**

Mitigation Measures

10-3 *None required.*

Tributary Streams - Agreement

Impact

10-4 **Provisions of the Agreement will have no effect on flow in the existing tributary streams, and will not result in a significant decrease or change in vegetation along these streams.**

Mitigation Measures

10-4 *None required.*

Ponds, Lakes, and Reservoirs 1970 to 1990

Impact

10-5 **Between 1970 and 1990, the project resulted in beneficial changes to lakes and ponds, and the creation of new lakes and ponds, with no significant adverse impact on vegetation.**

As described in Chapter 5, between 1970 and 1990, LADWP commenced several environmental projects that altered the levels of existing ponds and lakes, and created new ponds. Ponds that were created or restored were Farmer's Pond, Buckley Ponds, Saunders Pond, Mill Pond, Klondike Lake, Calvert Slough Pond, Little Blackrock Spring Pond, and Lone Pine Pond. During this same period, LADWP water management practices resulted in the elimination of ponds at Fish Springs and Blackrock Springs that existed during the pre-project period. The net result was an increase of 491 acres of surface water and several hundred acres of associated riparian habitat.

Also, as described in Chapter 5, LADWP and Inyo County implemented the McNally Ponds, Klondike Lake, and Lower Owens River enhancement/mitigation projects that further benefited and affected the levels of ponds and lakes. No significant adverse impacts to vegetation were caused by the changes in the ponds and lakes; however, the impact of replacing some of the water supply for some of these projects with groundwater is discussed below.

Mitigation Measures

10-5 *None required.*

Impact

10-6 **Between 1970 and 1990, LADWP continued to spread surplus water in wet years in the spreading areas created by the dikes east of Independence between the aqueduct and the river. This activity increased soil moisture and water tables, but also fostered conditions favorable to the spread of salt cedar, which was established prior to 1970.**

Mitigation Measures

10-6 *A saltcedar eradication and control program will be started as described in Chapter 5.*

Impact

10-7 **Reservoir levels varied slightly due to operation of the second aqueduct, with no significant impact on vegetation.**

Mitigation Measures

10-7 *None required.*

Ponds and Lakes - Agreement

Impact

10-8 **Under the provisions of the Agreement, new ponds and wetlands will be created by the Lower Owens River project and existing ponds will continue in existence. This will have a beneficial effect on vegetation in these areas.**

Spreading in the area east of Independence will not be affected by the provisions of the Agreement, but a saltcedar control program as described above will be implemented. As described above, studies will be made on South Haiwee Reservoir to determine whether it can be returned to partial or full service. Either South Haiwee Reservoir or North Haiwee Reservoir may be used for recreational use in the future.

Mitigation Measures

10-8 *None required.*

Ditches and Canals - 1970 to 1990

Impact

10-9 **No large ditches and no canals were removed from operation between 1970 and 1990.**

No significant impacts have occurred to vegetation along these segments of the aqueduct system.

Mitigation Measures

10-9 *None required.*

Ditches and Canals - Agreement

Impact

10-10 **Under the provisions of the Agreement, LADWP will continue to operate canals in accordance with its practices from 1970 (past practices have included taking canals out of service for maintenance and for operational purposes with the requirement that no significant impacts to vegetation would be allowed to occur).**

However, any permanent change in canal operations, compared to past practices, must be approved in advance by the Inyo/Los Angeles Standing Committee. Also, LADWP will continue maintenance activities to control aquatic weeds and ditch bank vegetation in order to maintain canals in a clean and efficient manner. Under the Agreement, vegetation along the canals and ditches will be maintained in approximately the conditions documented during the 1984-88 vegetation inventory.

Mitigation Measure

10-10 *None required.*

GROUNDWATER SYSTEM

Introduction

Between 1970 and 1990, groundwater pumping increased from an average of 14 cfs (9,900 acre feet per year) during the pre-project, to 145 cfs (105,000 acre feet per year). This pumping caused large fluctuations in groundwater levels, and extensive drawdown in certain areas over extended periods of time. The groundwater fluctuations have adversely affected groundwater dependent vegetation within these areas.

From 1970 to 1979, there was a general decline in the shallow water table in well field areas in the Valley. When the drought period that extended from runoff years 1975-76 to 1977-78 ended, groundwater pumping decreased and recharge increased; consequently, the water table in the well field areas started to recover.

After an extremely wet period from 1982 to 1986, the water table recovered to pre-1970 levels in every well field, except in areas around the Fish Springs and Blackrock fish hatcheries, and in portions of the Laws area. Beginning in 1987, groundwater production was increased to supplement decreased surface water availability due to low runoff and low precipitation caused by the current drought, water levels began to decline again. In 1990, water levels were near the lowest levels observed during the drought of the mid-1970s.

Mathematical groundwater models of Owens Valley (and each of its well field areas) developed by USGS, Inyo County, and LADWP, were used to identify the area in each well field where water levels would be drawn down ten feet or more by maximum amounts of groundwater pumping during three consecutive critically dry years (runoff year of 54 percent, which occurred in runoff year 1977-78, repeated three times with annual pumping of 275,287 acre feet, 247,758 acre feet, and 222,942 acres feet). This "worst case" scenario assisted in identifying the areas where groundwater pumping could affect groundwater dependent vegetation. (See Chapter 9.) It should be noted that from 1987 to 1990, the actual runoff each year has been more than the runoff assumed in the "worst case" scenario and the actual total groundwater pumping has been less than that assumed in the worst case scenario.

The maps described above show that not all areas of the Valley floor have been affected, or have been identified as having the potential to be affected, by groundwater pumping. Table 10-2 shows Owens Valley vegetation by management type within the ten-foot drawdown areas. From an analysis of Table 10-2, it can be seen that of the 227,160 acres mapped during the vegetation inventory conducted between 1984 and 1987, a total of more than 58,000 acres have vegetation that is partially or fully dependent on groundwater (management types B, C, and D). (The exact total acreage of vegetation that uses groundwater is the subject of a study described in Chapter V of

TABLE 10-2
AREA OF PREDICTED DRAWNDOWN/TOTAL VEGETATION CLASSIFICATION - MANAGEMENT AREA

Quad Name	Type A AC	Draw-down >10'	Type B AC	Draw-down >10'	Type C AC	Draw-down >10'	Type D AC	Draw-down >10'	Type E AC	Draw-down >10	TOTALS AC	TOTALS >10'
Dolomite	3,512	-	-	-	152	-	-	-	91	-	3,755	-
Union Wash	18,189	14	504	-	3,871	9	47	-	792	-	23,403	23
Manzanar	6,093	1,539	1,180	363	1,225	123	381	-	388	248	9,267	2,273
Lone Pine	12,716	-	713	-	1,538	-	442	-	1,137	-	16,546	-
Blackrock	13,913	3,953	410	222	6,851	2,289	340	93	861	206	22,375	6,763
Independence	11,164	1,408	1,097	140	11,328	1,180	405	137	2,726	1,374	26,720	4,239
Bee Springs	6,134	-	25	-	446	-	51	-	95	-	6,751	-
Aberdeen	4,517	11	0	-	-	-	-	-	-	-	4,517	11
SOUTH 1/2 TOTALS	76,238	6,925	3,929	725	25,411	3,601	1,666	230	6,090	1,828	113,334	13,309
Tinemaha	7,880	1,124	325	110	1,493	508	478	13	1,629	78	11,805	1,833
Fish Springs	5,074	584	680	296	195	171	163	-	296	97	6,408	1,148
Ulymeyer	3,868	83	280	48	72	8	143	-	0	-	4,363	139
Big Pine	14,842	1,250	1,515	154	4,226	1,088	750	64	2,761	616	24,094	3,172
Poleta	15,202	720	2,906	414	5,196	168	799	35	1,307	174	25,410	1,511
Bishop	10,603	2,454	319	252	623	611	216	63	2,664	1,960	14,425	5,340
Laws	7,553	2,279	243	132	2,468	1,406	304	206	2,180	1,398	12,748	5,421
Fish Slough	9,087	2,060	193	65	2,329	1,237	1,061	130	1,903	1,343	14,573	4,835
NORTH 1/2 TOTALS	74,109	10,554	6,461	1,471	16,602	5,197	3,914	511	12,740	5,666	113,826	23,399
OWENS VALLEY TOTALS	**150,347**	**17,479**	**10,390**	**2,196**	**42,013**	**8,798**	**5,580**	**741**	**18,830**	**7,494**	**227,160**	**36,708**

the Green Book. The final acreage may be somewhat greater than 58,000.) Of this groundwater dependent vegetation, 11,735 acres are located within the ten-foot drawdown areas of the worst case scenario. This analysis reveals that of the 227,160 acres of Owens Valley that were mapped, approximately five percent of the overall area may have experienced impacts to vegetation due to groundwater pumping, or such impacts potentially could occur under the worst case scenario.

The areas identified above are not the only areas within which adverse vegetation impacts have occurred due to the operation of the second aqueduct. These are only the areas that have been identified as having the potential for adverse impact due to groundwater pumping. As such, they are the areas that have been intensively studied for such impacts. However, as previously described in this EIR, an attempt has been made to identify all adverse impacts in Owens Valley due to groundwater pumping or to other elements of the proposed project, both within and outside of these areas.

Groundwater Pumping - Lowering of Water Table 1970 to 1990

Increased groundwater pumping has significantly adversely affected approximately 1,015 acres of vegetation throughout Owens Valley.

Impact

10-11 **Fluctuations in water tables due to groundwater pumping has caused approximately 655 acres of groundwater dependent vegetation to die-off. Loss of vegetation cover has occurred on these lands.**

Mitigation Measures

10-11 *As part of the Independence Springfield and woodlot enhancement/mitigation projects, approximately 317 acres of barren or near-barren ground have been revegetated with either native pasture or alfalfa. This area was affected by groundwater pumping and surface diversions of water. A map of the project area is shown in Appendix E.*

In the near future, two enhancement/mitigation projects will be initiated to mitigate areas affected by groundwater pumping adjacent to the towns of Independence (east side regreening project) and Big Pine (northeast regreening project). Each project will be approximately 30 acres and will be converted to irrigated pasture. A map of the project is shown in Appendix E.

Under the Shepherd Creek enhancement/mitigation project, approximately 198 acres of poorly vegetated land has been converted to alfalfa. This area was affected by groundwater pumping and abandonment of irrigation. In addition, an area of approximately 60 acres to the east of the existing project area on the opposite side of Highway 395 is poorly vegetated. If the density of the native cover in this area does not naturally increase, the existing enhancement/mitigation project may be expanded to include this additional area. A map of the project is shown in Appendix E.

Approximately 80 acres of land that lost a significant amount of its live native vegetation cover as a result of increased groundwater pumping will be revegetated. The techniques that will be employed to revegetate these lands will be determined through studies that will be conducted by LADWP and Inyo County. These lands will not be permanently irrigated, but will be revegetated with native Owens Valley vegetation not requiring irrigation except perhaps during its initial establishment. Depending on the amount of rainfall and runoff, successful revegetation of these lands could take a decade or longer. The goal will be to restore as full a native vegetation cover as is feasible, but at a minimum, vegetation cover sufficient to avoid blowing dust will be achieved in that area. The lands that will be revegetated are shown on Figures 10-8A through 10-8L.

Impact

10-12 **Vegetation in an area of approximately 300 acres near Five Bridges Road north of Bishop was significantly adversely affected during 1988 because of the operation of two wells, to supply water to enhancement/mitigation projects.**

Between 1987 and 1988, two wells in the Five Bridges area that were pumped to supply water to enhancement/mitigation projects contributed to a lowering of the water table under riparian and meadow areas along Owens River. Approximately 300 acres of vegetation were affected, and within this area, approximately 36 acres lost all vegetation due to a wildfire. The affected area is shown on Figure 10-8A.

Mitigation Measure

10-12 *Water has been spread over the affected area since 1988. By the summer of 1990, revegetation of native species had begun on approximately 80 percent of the affected area. LADWP and Inyo County are developing a plan to revegetate the entire affected area with riparian and meadow vegetation. This plan will be implemented when it has been completed.*

Impact

10-13 Increased groundwater pumping has significantly adversely affected approximately 60 acres of vegetation in the Symmes-Shepherd well field area.

Increased groundwater pumping from wells in the Symmes-Shepherd area has caused a substantial reduction of vegetation cover in approximately 60 acres in three areas immediately to the east of the pumping wells. The affected vegetation was previously supplied by shallow groundwater and surface seeps and is shown as three areas north of Shepherd Creek on Figure 10-8F.

Mitigation Measures

10-13 *A revegetation program will be implemented for these effected areas utilizing native vegetation of the type that has died off. Water may be spread as necessary in these areas to accomplish the revegetation.*

Groundwater Pumping - Lowering of Water Tables - Agreement

The goals of the Agreement are to manage Owens Valley groundwater and surface water resources to avoid significant decreases in the live cover of groundwater dependent vegetation (management Types B, C, and D), and to avoid a change of a significant amount of such vegetation from one management type to vegetation in another management type which precedes it alphabetically. The vegetation conditions documented during the 1984-87 vegetation inventory serve as the base for comparison for determining whether decreases and changes have occurred.

Through plant-soil-water balance provisions in the Agreement, and continuing monitoring and evaluation by the Technical Group and Standing Committee, groundwater pumping will be managed to avoid significant impacts. A more detailed description of the Agreement and of the mitigation that will be implemented should such decreases or changes occur is presented on pages 10-64.

Groundwater Pumping - Springs and Seeps - 1970 to 1990

Impact

10-14 Increased groundwater pumping has reduced or eliminated flows from Fish Springs, Big and Little Seely Springs, Hines Spring, Big and Little Blackrock Springs, and Reinhackle Spring. This has caused significant adverse impacts to vegetation at several of these spring areas.

Fish Springs

An unnamed pond approximately five acres in size and its attendant vegetation dried up due to groundwater pumping from a supply well for the CDFG Fish Springs Fish Hatchery and regional effects from other wells in the area. Aerial photos from 1968, clearly indicate a small pond and associated wetland above and to the southwest of the State's fish hatchery. By 1981, the pond was dry and no evidence of marsh vegetation was discernible. While maps do not indicate any springs in this area, it is likely that a spring supplied the water for the pond. This area is shown on Figure 9-2 (shown previously).

Big and Little Seely Springs

During droughts increased groundwater pumping has reduced and eliminated the flow from these springs, although they have and will recover during wet periods and reduced pumping. The vegetation dependent on these springs for water has been impacted. These springs are shown on Figure 9-2 (shown previously).

Hines Spring

Flow from Hines Spring was reduced or eliminated due to groundwater pumping that began as early as the 1950s. Pumping was accelerated after the second aqueduct became operational. Pumping at Aberdeen also contributed to reduced spring flow. Although the spring dried up in 1964, aerial photos taken in 1968, indicate that at that time there was still some riparian vegetation associated immediately around the spring and its drainage. This vegetation covered approximately two acres on 1968 photos. By 1981, the spring itself was devoid of any riparian vegetation and there was greatly reduced cover in the area surrounding the spring. A test well in the vicinity indicated that in 1985, the water table was at a depth of four to six feet and the spring flowed briefly during 1986. Aerial photos taken in 1988, show some vegetation recovery since 1981. By November 1989, there was no water in the spring and the remnants of large dead tree willows and scattered vegetation could be seen.

Former vegetation in the Hines Spring area was generally meadow. Today, however, much of the site is dominated by a sparse cover of shrubs. Alkali sacaton and salt grass are found here, but they appear to have been impacted by livestock grazing in several areas. A LADWP range trend plot enclosure was established just south of Hines Spring. The plant health and cover inside of the enclosure is greater than outside the enclosure, indicating the difficulty of establishing healthy vegetation in an environment that includes heavy grazing and insufficient water supply. Evidence of wind erosion of soils is seen in areas where vegetation is sparse. The area requiring revegetation is shown in Figure 10-8G.

Big and Little Blackrock Springs

Groundwater pumping from wells that supply the CDFG Blackrock Fish Hatchery, combined with increased pumping from other wells in the area, have caused the elimination of spring flow from these two springs. At Big Blackrock Springs, much of the area of the former riparian vegetation that was supplied by the spring is now occupied by the State's fish hatchery, a large pond, and several fish rearing facilities associated with the hatchery.

Prior to 1970, Little Blackrock Spring supported grasses, willows, and low rushes on its marshes. Tules, cattails, and other marsh vegetation were present, but occupied only a small area at the edges of the spring fed ditch. In 1971-72, flow from the spring ceased with the start of pumping from a nearby well for supply to the hatchery. Water was later diverted from Division Creek into the site, and a pond was established by LADWP.

Ground level photographs taken in the mid-1970s show the pond with a greatly reduced surface area, and completely surrounded by tules and cattails. Emergent vegetation such as this, typically trap additional silt and organic matter, further promoting the deposition process. By 1989, there was almost no open water remaining in the pond site. The pond had effectively been transformed into a marsh. Big and Little Blackrock Springs are shown on Figure 9-2 (shown previously).

Reinhackle Spring

Increased groundwater pumping has periodically reduced the flow from Reinhackle Spring. This spring is the source of water for a large pasture area and supports many large tree willows. The location of this spring is shown on Figure 9-2 (shown previously).

Mitigation Measures

10-14 *No on-site mitigation will be implemented at Fish Springs and Big Blackrock Springs; however, the CDFG fish hatcheries at these locations serve as mitigation of a compensatory nature by producing fish that are stocked throughout Inyo County.*

In the area of Big and Little Seely Springs, LADWP well number 349, discharges water into a pond approximately one acre in size. This pond provides a temporary resting place for waterfowl and shorebirds when the pumps are operating or Big Seely Spring is flowing. This water passes through this pond to Owens River. Riparian vegetation has become established around this pond.

The Hines Spring vent and its surroundings will receive on-site mitigation. Water will be supplied to the area from an existing, but unused, LADWP well at the site. As a result, approximately one to two acres will either have ponded water or riparian vegetation. Hines Spring will serve as a research project on how to re-establish a damaged aquatic habitat and surrounding marshland. Riparian trees and a selection of riparian herbaceous species will be planted on the banks. The area will be fenced.

LADWP will continue to supply water from Division Creek to the site of the former pond at Little Blackrock Springs. The marsh vegetation at this site will thus be maintained. When it was determined in the late 1980s that groundwater pumping was affecting the flow from Reinhackle Spring, pumping from certain wells in the area was discontinued and the spring flow increased. No significant adverse impacts on vegetation in this area have resulted from the reduced flow. In the future, either groundwater pumping in the area will be managed to avoid causing such a reduction in flow from this spring to the degree that decreases or changes in native riparian vegetation will result, or LADWP will supply surface water to the native riparian vegetation supplied by the spring to avoid any such decreases or changes due to reduced flow caused by groundwater pumping.

Although not all springs and associated riparian and meadow vegetation will receive on-site mitigation, the Lower Owens River Project will provide mitigation of a compensatory nature. This project will rewater over 50 miles of the river channel allowing for restoration of riparian vegetation along the river. This project also will result in the creation of several new ponds along the river and will provide the continuation of existing lakes associated with the project. The project will restore large areas of wetland and meadow vegetation, perhaps exceeding 1,000 acres adjacent to the river and in its delta. In comparison, the area of riparian and meadow vegetation that has been lost and will not be restored because of the elimination of spring flow due to groundwater pumping is estimated to be less than 100 acres.

In addition, vegetation dependent on a supply of water from a spring (primarily management Type D) will be maintained in order to avoid a significant change or decrease as provided in the Agreement and the Green Book.

Groundwater Pumping - Springs and Seeps - Agreement

Impact

10-15 **Under the provisions of the Agreement, and the technical appendix to this EIR and the Agreement, a document called the Green Book, vegetation dependent on springs and seeps must be maintained such that there is no significant decrease or change in vegetation from approximately the conditions as documented by the 1984-87 vegetation inventory. This vegetation and spring flows will be carefully monitored. The Green Book contains procedures for determining the affects of groundwater pumping and surface water management practices on spring flow. Groundwater pumping will be managed to avoid causing reductions in spring flow that would cause significant decreases or changes in associated vegetation, or surface water would be supplied if necessary to avoid such decreases or changes.**

Mitigation Measures

10-15 *None required.*

IRRIGATION 1970-90

Between 1963 and 1970, LADWP reduced the acreage of its land in Owens Valley that received a supply of irrigation water from a maximum of 21,800 acres to 11,600 acres. Prior to 1970, irrigation water was supplied on a "feast or famine" basis -- that is, when water was not needed to fill the aqueduct for export to Los Angeles, it was supplied for irrigation. In wet years, more than 21,800 acres received irrigation water; in dry years, fewer than 2,000 acres received water. The 11,600 acres receiving irrigation water after 1970, received firm irrigation supplies in all but the critically dry years. The lands irrigated prior to and after 1970, are shown on Figures 8A-8L.

Prior to 1970, tailwater (water running off the irrigated lands) supplied some areas of meadow type vegetation adjacent or near the irrigated lands. This vegetation was impacted when irrigation to some of these lands was discontinued as part of the operations to supply the second aqueduct.

Impact

10-16 **Approximately 1,080 acres of formerly irrigated lands, had not successfully revegetated following the abandonment of agriculture. This was a significant adverse impact because these lands had a loss of vegetation and were the source of blowing dust.**

Mitigation Measures

10-16 *As part of the enhancement/mitigation projects implemented by LADWP and Inyo County since 1985, approximately 942 acres of these abandoned agricultural lands have been revegetated with irrigated pasture or alfalfa. These areas are the Independence Pasture Lands and native pasture lands, the Van Norman and Richards fields, and the Lone Pine woodlot adjacent to Lone Pine. These areas are described further in Chapter 5 (see Appendix E, which shows the location of these projects).*

A field of approximately seven acres along the Whitney Portal Road in Lone Pine, and a field of approximately 11 acres north of Lone Pine and east of Highway 395, have been converted to irrigated pasture as part of the Lone Pine Regreening enhancement/mitigation projects. The location of these projects and their description is contained in Chapter 5, and shown in Appendix E.

In addition, 120 acres of formerly irrigated land near Bishop with a loss of vegetation cover will be revegetated. The process to successfully revegetate these lands will be determined through studies to be conducted by LADWP and Inyo County. These lands will not be permanently irrigated, but will be revegetated with native Owens Valley vegetation not requiring irrigation except perhaps during its initial establishment. Depending on the amount of rainfall and runoff, successful revegetation of these lands could take a decade or longer. The goal will be to achieve as full a vegetation cover as is feasible, but at a minimum, a vegetation cover sufficient to avoid blowing dust. The formerly irrigated lands that will be revegetated are shown on Figure 10-8C.

Finally, irrigated lands in Owens Valley (including the Olancha-Cartago area) in existence during the 1981-82 runoff year or that have been irrigated since then, will continue to be irrigated in the future, except perhaps in very dry years. (Reductions in very dry years must be agreed upon in advance by LADWP and the Inyo County Board of Supervisors).

Impact

10-17 **Meadow and riparian vegetation that were supplied by tailwater from formerly irrigated lands has been impacted.**

Mitigation Measures

10-17 *The loss of meadow or riparian vegetation that was dependent on tailwater from formerly irrigated fields will be mitigated in the form of compensation by the restoration of meadow and riparian vegetation by the Lower Owens River Project.*

Irrigation - Agreement

As stated above, no lands will be taken out of irrigation in the future. Some new lands may be irrigated as part of enhancement/mitigation projects approved by LADWP and Inyo County. No mitigative actions are required in these areas.

Mitigation Measures

None required.

IMPACTS CAUSED BY A COMBINATION OF FACTORS, INCLUDING GROUNDWATER PUMPING AND CHANGES IN SURFACE WATER MANAGEMENT PRACTICES FROM 1970 TO 1990

In many areas of Owens Valley, vegetation dependent on groundwater or surface water has decreased in cover or changed in management type due to a number of factors, including increased groundwater pumping or to changes in surface water management practices as a result of supplying water to the second Los Angeles Aqueduct. In many of these areas it is impossible to determine exactly what has caused the decrease or change.

These areas of decrease or change are found throughout the Valley, but primarily within portions of the drawdown areas of each well field identified by the worst case scenario described above. Most of these decreases or changes are not deemed significant adverse changes to vegetation, but those that are significant are identified below. Although most of these decreases and changes are not deemed significant, the Valley-wide mitigation described below applies to these decreases and changes.

Impact

10-18 **Significant adverse vegetation decrease and change have occurred in the Laws area due to a combination of factors, including abandoned agriculture, groundwater pumping, water spreading in wet years, livestock grazing, and drought.**

Between 1970 and 1990, an average of 15,213 AFY of groundwater was pumped in the Laws area. In this area, geologic and soil conditions are such that groundwater recharge is rapid. In runoff year 1968-69, about 40,000 AF of water was spread in and around the Laws area. The estimated pre-project groundwater level ranged from 6 to 24 feet. Current groundwater level is between 30 and 35 feet.

Comparison of pre-project vegetation conditions as defined by aerial photos with conditions documented during the 1970-90 period indicates significant vegetation changes. Because of the complexity of activities in this area, it is difficult to isolate one particular factor as the primary cause of vegetation change or loss. The observed lowering of the groundwater table to the existing 30- to 35-foot level is well below the root systems of the grass and shrub species, and probably induced the loss of vegetation in each of the areas of concern. In addition, water was spread in 11 different years during the period of 1968 to 1988, to increase groundwater recharge. Water spreading can affect vegetation in three ways: scarification of a spreading basin bottom results in the disturbance of top soil and removal of vegetation; alternating wet-dry cycles creates conditions favorable for the spread of salt cedar; and plants that become established in wet years later die in dry years.

Vegetation of the Laws well field area mapped in the 1984-87 period had large areas with a high percentage of weedy annuals such as Russian thistle and bassia. Aside from the present and past agricultural areas, live plant cover ranges from 8 to 70 percent. Cover estimates from the 1974 Earth Satellite report indicate the cover of meadow areas are moderate to dense (20 to 95 percent). Many of those areas which had the highest grass cover, now also have the highest percentages of weedy species. The seasonal die-off of these species in early summer can result in a high percentage of bare soil and thus, the percent cover in some areas can be misleadingly high; both cover and species diversity are low. This, along with the dominance of rubber rabbitbrush, indicates the highly disturbed nature of vegetation in the area. The long-term, multiple-use by man has made it difficult to assess the nature of the original native vegetation.

The Laws area has historically been farmed. These agricultural enterprises frequently removed native vegetation in favor of cropland development. The area is also subject to livestock grazing by LADWP ranching lessees.

Mitigation Measures

10-18 *Approximately 140 acres will be revegetated within the Laws area, which has lost all or part of its vegetation cover due to increased groundwater pumping or to* *abandonment of irrigation operations to supply the second aqueduct. (See discussion of the impacts of groundwater pumping and of irrigation reductions in irrigation above.) These areas are shown on Figure 10-8B.*

In the 1970s, LADWP commenced the Farmer's Pond environmental project. In the mid-1980s, LADWP and Inyo County implemented the Laws-Poleta Pasture Land, Laws Museum, and McNally Ponds enhancement/mitigation projects in the Laws area totalling approximately 541 acres of pasture land (see Chapter 5). The location of these projects is shown in Appendix E.

The area where it is suspected that groundwater pumping during the recent drought has caused decreases or changes in vegetation, is being monitored by Inyo County and LADWP. Groundwater pumping has been reduced in the area. Should it be determined that any significant decreases or changes have occurred, the area will be mitigated under the Agreement as described below.

Approximately 640 acres in the Laws area have a very low density of vegetation cover. The loss or reduction of vegetation cover in these areas was caused by the abandonment of agriculture following purchase of lands by Los Angeles (primarily in the 1920s and 1930s), wet year water spreading from the McNally canals by LADWP during the pre-project and project periods, wild fire, groundwater pumping, and other factors. The primary cause of the loss or reduction of vegetation is, therefore, not a result of the project. Although the conditions on these lands are not a result of the project, because of the existing sparse vegetation conditions, these lands will be considered by the Standing Committee for selective mitigation, which would be compatible with water spreading and groundwater recharge activities during wet years. The areas subject to this mitigation are shown on Figures 10-8A and 10-8B.

Impact

10-19 **Water management practices in a portion of the Big Pine Well Field have resulted in a significant adverse change and decrease of plant cover.**

The Big Pine Well Field possesses one of the highest pumping capacities of all the LADWP well fields in Owens Valley. Between the period of 1970 and 1990, an average of 28,595 AFY of groundwater was pumped from the Big Pine Well Field, second in terms of total production to the Taboose-Aberdeen Well Field. Nearly all of these wells are located along the Big Pine Canal.

The area east of Big Pine is an agricultural area, both past and present. The alluvial fan from the eastern base of the Sierra Nevada almost reaches the river at this point as evidenced by the nature of the soils. The dominant soil in this area is coarse, well-drained sandy loam and usually occurs on the alluvial fans. The SCS indicates that this soil is ideal for cropping and pasture, and supports big sagebrush, shadscale, and several species of saltbush. A reduction of shrub and grass cover is visible on 1968 and 1981 air photos within riparian habitat along Big Pine Creek east of Big Pine. There are also some areas of abandoned agriculture that show sparse vegetation, partly due to the difficulty of revegetation in well drained soils. Cattle grazing, burning and other agricultural practices have also affected the area and have severely hindered the process of natural revegetation.

Due to past and present use, the physical properties of the soil, and the type of vegetation that the soil supports in other parts of the Valley, it is difficult to differentiate between vegetation changes due to groundwater pumping and changes due to surface water practices in this area. It is probable that vegetation changes during the 1970 to 1990 period are due to a combination of factors related to land use and surface water management.

Mitigation Measures

10-19 *A revegetation program will be implemented for approximately 160 acres within the Big Pine area, which have lost all or part of its vegetation cover due to increased groundwater pumping or to abandonment of irrigation as part of operations to supply the second aqueduct, will be revegetated (see discussion of the impacts of groundwater pumping and of reductions in irrigation above). These areas are shown on Figure 10-8D.*

LADWP and Inyo County will implement the Big Pine Regreening enhancement/mitigation project by establishing irrigated pasture on approximately 30 acres to the north and east of Big Pine. The Big Pine Ditch project is planned to be implemented as provided in the Agreement. These projects are shown in Appendix E. This area will also be mitigated by the Valley-wide mitigation under the Agreement described below.

An area of approximately 20 acres directly to the east of Big Pine that is poorly vegetated as a result of pre-project activities and activities which are not a part of the project will be evaluated as a potential enhancement/mitigation project. If, in planning this project, it is determined that it is not feasible to permanently irrigate this area, a revegetation program will be implemented. This area is shown on Figure 10-8D.

Impact

10-20 A significant loss and reduction of marsh vegetation has occurred in the Thibaut-Sawmill area primarily due to surface water diversion, but also due to lowered groundwater from increased groundwater pumping.

The floor of Owens Valley that lies between the aqueduct and Owens River east of the Thibaut-Sawmill Well Field is a large flat area, which in pre-project times supported meadow and marsh vegetation. The marsh vegetation grew in the meanders. Aerial photographs taken in 1968, show large patches of vegetation in the NE quarter of Section 24. Also, data indicate that although the water table was at depth of one foot in 1986, pumping from the Thibaut-Sawmill Well Field has lowered the water table from five to nine feet. Aerial photographs taken in 1981 and 1988, indicate a significant decrease in marshland vegetation compared to the pre-project condition due to lack of surface water spreading during these two below-normal runoff years. Field surveys done as part of this EIR in November 1989, corroborate this decrease in marsh vegetation due to below-normal runoff and drought conditions resulting in reduced water supply to the area in 1988 and 1989. While marsh vegetation still exists on the site, there has been an overall reduction of vegetative cover.

Mitigation Measures

10-20 *Portions of the Lower Owens River project are in this area. Portions of the impacted area will be mitigated directly, however, for much of the impacted area. Mitigation will be in the form of compensation by restoring wetland, meadow, and riparian vegetation.*

Any significant decreases in vegetation cover or changes in vegetation composition due to groundwater pumping during the recent drought period will be mitigated under the Agreement as described below.

Overall Valley-Wide Mitigation

As described throughout this impact section, decreases and changes in Owens Valley vegetation have occurred since operations to supply the second aqueduct commenced. Many on-site and compensatory mitigation measures are discussed in this section. However, the Agreement itself serves as a Valley-wide mitigation measure.

As stated in Chapter 9 - Water Resources, because of an extremely wet period between 1982 and 1986, the water table recovered to pre-1970 levels in all areas of the Valley except around the Fish Springs and Blackrock fish hatcheries and in portions of the Laws area. During this same period, because of high runoff, precipitation and the restored water tables, vegetation recovered to its greatest vigor since 1970. Under the provisions of the Agreement, the goal is to manage groundwater and surface water to avoid significant decreases and changes from these vegetation conditions; therefore, these provisions of the Agreement are themselves a mitigation measure.

It should be emphasized that under the Agreement, mitigation is not a primary goal, but a secondary tool to be employed if the primary goals are not fully achieved. As identified in Section 5 of the Green Book, research and study will be conducted by Inyo County and Los Angeles for the purposes of improving the existing methods of managing Owens Valley's water resources and of improving upon existing mitigation techniques. Among the studies that will be conducted in the near future are those identified in Sections 5.A.1, 5.B.1, 5.B.2, and 5.B.4 of the Green Book. To assist this study effort, a research facility will be constructed in Owens Valley as determined appropriate by the Standing Committee.

Recognizing the experimental nature of some of the management and mitigation techniques, and under the severe conditions of the current drought, it has been agreed by LADWP and Inyo County to conservatively manage groundwater pumping during this drought and during a period of recovery following the drought, LADWP and Inyo County have agreed that the following policy will govern future groundwater pumping:

> "Recognizing the current extended drought, the Standing Committee establishes a policy for annual management of groundwater pumping during this drought. The goal of this policy is that soil water within the rooting zone recover to a degree sufficient so that the vegetation protection goals of the Agreement are achieved. To this end, groundwater pumping during this drought, as well as the period of recovery, will be conducted in an environmentally conservative manner, taking into consideration soil water, water table, and vegetation conditions. It is recognized that soil water in the rooting zone is naturally replenished by precipitation and from the water table. Further, soil water, water tables, and vegetation conditions will be monitored by the Technical Group to ensure that the goal of this policy is being achieved and for purposes of evaluating the effectiveness of the existing well turn-off/turn-on provisions."

IMPACTS CAUSED BY A COMBINATION OF FACTORS, INCLUDING GROUNDWATER PUMPING AND CHANGES IN SURFACE WATER MANAGEMENT PRACTICES - AGREEMENT

See immediately preceding description of Valley wide mitigation measures. No further mitigation measures are required beyond what has been prescribed in the preceding section.

IMPACTS OF THE AGREEMENT (POST-1990)

Introduction

The Agreement will continue some interim period practices, and will modify past groundwater management policies and practices. Vegetation is the primary indicator for assessing environmental effects of groundwater pumping and surface water management practices. Under the Agreement, vegetation in Owens Valley has been organized into a management system consisting of five classifications, A through E. These classifications are based on vegetation surveys conducted by LADWP between 1984 and 1987, and correspond to the estimated evapotranspiration values (ET) for each category. In addition, new wells, recharge facilities, and enhancement/mitigation (E/M) projects are also proposed. For a complete description of the goals of the management and each vegetation category, please see Chapter 5 - Proposed Project in this EIR and the Green Book.

Representatives of LADWP and Inyo County Water Department will play key roles in the implementation of the groundwater management plan. The Inyo County/Los Angeles Standing Committee and the Inyo/Los Angeles Technical Group will continue to represent the parties in implementing the goals and procedures of the Agreement. The standardized procedures for monitoring, data interpretation, and determination of effects are set forth in a technical document called the "Green Book." The Green Book is attached as a technical appendix to the final long-term agreement and this EIR. The Green Book is the instrument that sets forth the methods and techniques that will be used by the two parties to implement the goals of the Agreement.

Provisions will be included in the final long-term Agreement for increasing, decreasing, or changing the management areas, the monitoring sites, the type of monitoring, the procedures for analyzing and interpreting monitoring results, and for modifying the provisions of the Green Book as a result of information gained from ongoing research and cooperative studies, or for other reasons deemed necessary to improve the effectiveness of the monitoring and evaluation activities.

The Agreement includes a comprehensive set of management and monitoring tools for protection of Owens Valley vegetation, which were not employed during the interim period. The amount of groundwater that could be pumped in any given year is limited by the built-in requirements for environmental protection and monitoring. The health of the environment will be monitored in existing and future vegetation monitoring sites and water table monitoring wells inside and outside of each management area and Owens Valley towns. To provide sufficient data to effect informed management, the type of monitoring at each site and monitoring well will be structured as necessary by the two parties. Monitoring could include, but is not limited to, measurement of retained soil water, water levels in deep and shallow wells, analysis of vegetation, remote sensing, and the use of photographic monitoring. All monitoring, analysis, and interpretation of results will be done by the Technical Group. LADWP will fund the installation of the necessary monitoring sites and wells, and will maintain the shallow test holes. LADWP and Inyo County will jointly maintain the vegetation monitoring sites.

For purposes of the Agreement, determination of "significance" and "significant effect on the environment" will be made by the Technical Group in accordance with guidelines contained in the Agreement and the Green Book. Determinations of whether a decrease in live vegetation cover is significant, or whether a change in vegetation from one vegetation classification to another is significant, or whether a significant effect on the environment has occurred, will be made on a case-by-case basis.

The first step in the case-by-case analysis will be to determine whether the environment or vegetation change can be measurably demonstrated. The second step will involve a determination by the Technical Group as to whether such environmental or vegetation change is or is not attributable to groundwater pumping, and/or surface water management practices. The third step is to determine the degree of significance.

Decreases and changes in vegetation and other environmental effects will be considered to be attributable to groundwater pumping, or to a change in surface water management practices, if vegetation decrease, change, or environmental effect would not have occurred but for groundwater pumping and/or a change in past surface water management practices. A given site would be compared to an area of similar vegetation, soils, rainfall, and other relevant conditions where such a vegetation decrease, change, or environmental effect has not occurred, or has not occurred to the same degree (see the Green Book).

If the vegetation decrease, change, or environmental effect is determined to be attributable to groundwater pumping or to changes in past surface water management practices, the Technical Group then will determine whether the vegetation decrease, change, or environmental effect is significant. In making this determination, factors to be considered by the Technical Group will include, but not be limited to:

- The size, location, and use of the area that the vegetation change, decrease, or environmental effect has affected;
- The degree of the vegetation decrease, change, or environmental effect within the affected area;
- The permanency of the vegetation decrease, change, or environmental effect;
- Whether the vegetation decrease, change, or environmental effect causes a violation of air quality standards;
- Whether the vegetation decrease, change, or environmental effect affects human health;
- Available factual and scientific data;
- Whether effects of the vegetation decrease, change, or environmental effect are limited, but the incremental effects are substantial when viewed in connection with vegetation decreases or changes in other areas that are attributable to groundwater pumping or to changes in surface water management practices by LADWP;
- E/M projects that have been implemented by LADWP;
- The impact, if any, on rare or endangered species.

If the degree of vegetation decrease, change, or environmental effects are determined to be significant, a mitigation plan will be developed and implemented. Notwithstanding the fact that wells may be turned off due to insufficient soil moisture, any vegetation decrease or changes that are determined to be significant by the Technical Group will be mitigated as soon as a reasonable and feasible mitigation plan is developed by the Technical Group and implemented by LADWP. In developing the mitigation plan, the Technical Group shall consider the potential environmental and water supply effects of any proposed plan. Implementation of this plan would be commenced within twelve months of a determination by the Technical Group or by dispute resolution that a significant decrease or change has occurred. A mitigation plan developed by the Technical Group could include restoring perennial vegetation cover in an area where there has been a significant decrease in live perennial vegetation cover, and/or restoring vegetation in an affected area to a vegetation community that falls within the classification shown on the relevant vegetation management map, as soon as it can be reasonably restored. Mitigation actions could include, but are not limited to, surface water application or reduction in groundwater pumping (if groundwater pumping has not already been terminated in the affected area).

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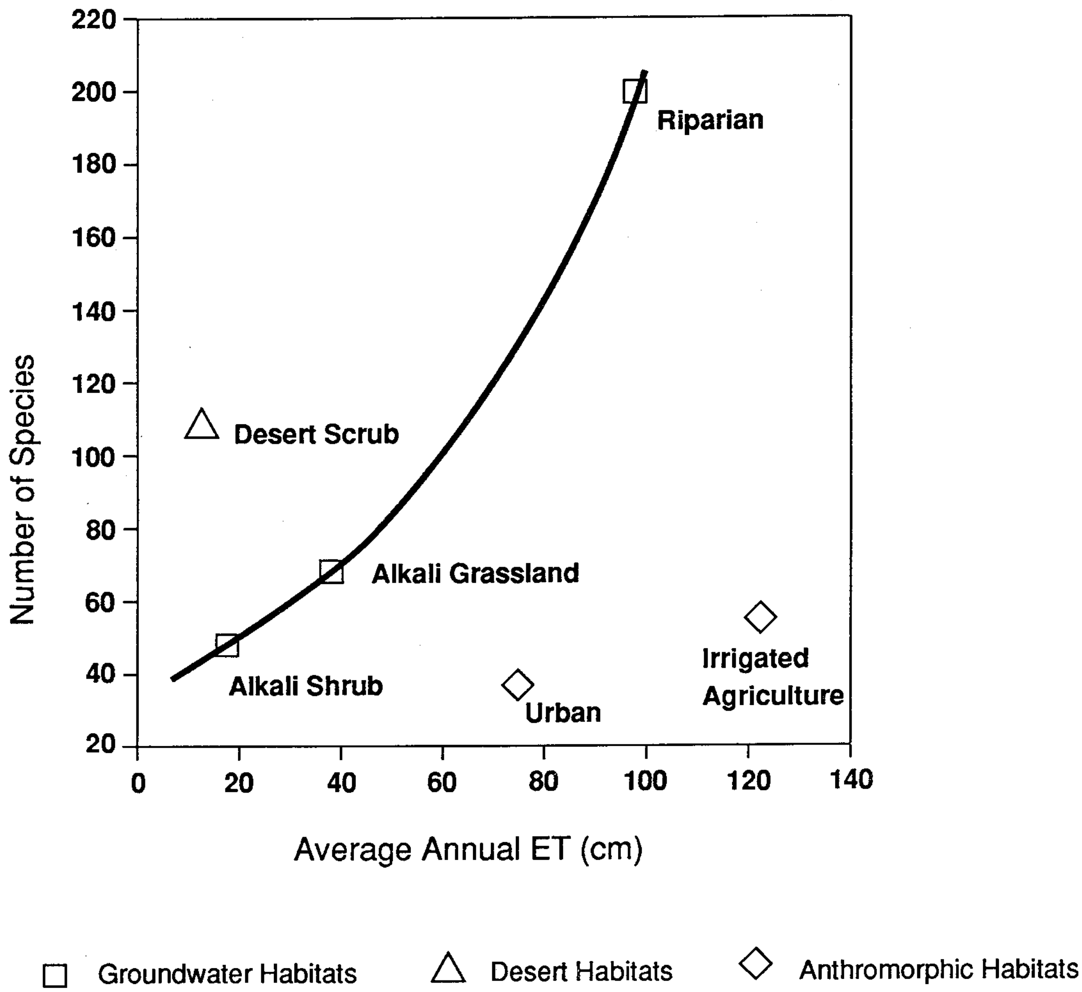
11. WILDLIFE

INTRODUCTION

Owens Valley is the southwestern-most valley in the Basin and Range complex of western North America. It lies between the White/Inyo Mountains on the east and the Sierra Nevada on the west, whose 14,000-foot peaks form an intense rain shadow. The great watershed between these two mountain ranges results in considerable wetland and riparian habitat in what is ordinarily an arid climate. The aridity and drastic fluctuations in precipitation and runoff have resulted in a restriction of trees on the Valley floor, with most native tree species confined to the extensive riparian zones along the Owens River and its main tributaries coming off the Sierra Nevada. The restriction of tree canopy was an important factor that determined the distribution of wildlife species on the Valley floor.

A common axiom among wildlife biologists is that "the more diverse the vegetation, the more diverse the wildlife," and where two different plant communities come together, the "edge" between the two will usually be more valuable for wildlife than either community considered alone. The heterogeneity of vegetation patterns in the Owens Valley provides an abundance of "edge" and, thus, an enormous variety of wildlife species.

Vegetation and water availability determine the quality of the habitat available for animals. This is shown on Figure 11-1, which also illustrates that habitats derived by man, "anthropogenic" habitats," tend to have relatively low species richness despite the amount of water that they consume. Therefore, wetter habitats tend to support many more species at greater densities. Like the vegetation species richness curve, the habitats of the Valley floor support animal species in increasing numbers as a continuum with increasing water consumption (see Figure 10-7). The



O W E N S V A L L E Y

FIGURE 11-1

ANIMAL SPECIES RICHNESS BY HABITAT

SOURCE: DAVID P. GROENEVELD, PH.D., INYO COUNTY WATER DEPARTMENT

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The animal and plant species richness graphs are not directly comparable because the animal species were categorized into habitats that were not based on floristics as was the plant list. The species totals for this plot were compiled to habitat type by the California Department of Fish and Game in the 1975 LADWP Draft EIR. Water use for each of the habitats was estimated as arithmetic averages of evapotranspiration calculated for each vegetation community that fit the habitat designation (ET calculation is described in Chapter 2 of the Green Book).

Each organism is a part of a community of living things and is partially or entirely dependent upon other species. In complex biotic communities, such as the Owens Valley, organisms whose food is obtained from plants by the same number of steps are said to belong to the same trophic level. Green plants occupy the first trophic level; plant-eaters (herbivores), the second level; carnivores which eat the herbivores, the third level; and secondary carnivores, the fourth. The transfer of food energy from the source in plants through a series of organisms with repeated eating and being eaten is referred to as the food chain. Food chains are not isolated sequences but are interconnected with one another in a food web. These chains, beginning with green plants, may be short, as with plants being eaten by songbirds that may not be prey species; or long, with plants being eaten by insects, which are eaten by the grasshopper mouse, which is consumed by the gopher snake, which is eaten by the red-tailed hawk. Of course, there are numerous variations to this cycle.

Field observations indicate that wildlife populations closely follow the vegetative pattern of cyclic high and low production. During periods of high plant productivity, wildlife populations occupy much wider ranges or habitat areas than normal. As plant production returns to normal, animal populations decline and the smaller habitats, such as springs and streamside riparian/woodlands, maintain the largest and most diverse populations. In the Owens Valley, precipitation is the most important factor in vegetation cycles and associated wildlife populations. A year of high productivity brings an increase in primary consumers (rodents, rabbits, elk, quail, grasshoppers), which later provide for an increased predator population (hawks, owls, badgers, coyotes, bobcats).

Every range is more or less out of balance in that some particular aspect of food, water, or cover is deficient. Thus, one limiting factor generally exerts control to prevent the range from supporting the populations that the other aspects would be capable of supporting.

Data provided by the California Department of Fish and Game, LADWP, and other resource agencies indicate that species richness of both plants and animals is directly related to water availability and structural complexity of the habitat. However, water availability alone is not enough to result in high species diversity. Irrigated pasture, for instance, grows in area of high water availability but supports relatively few wildlife species, in part because it is not a complex habitat. Generally, however, the availability of water tends to increase the number, diversity, and complexity of plant species, which in turn provide increased habitat for wildlife.

Owens Valley has both riparian and wetland habitats which are defined in Chapter 10, Vegetation. Two wildlife inventories were made on City of Los Angeles lands in the Valley by the California Department of Fish and Game. These surveys covered 75,000 acres and took place from October June 1974, and again from late August 1975 to November 1975. Because of the short duration of the Fish and Game studies, additional field studies inventories have been conducted by LADWP biologists between 1975 and the present. The combined inventories indicate that more than 300 species of birds, 73 species of mammals, 14 species of fish, 32 species of reptiles, six species of amphibians, and countless species of invertebrates inhabit Owens Valley. These species are listed in Appendix C. The species list includes a number of species normally found at higher elevations, outside the area of the proposed project. They are included because they periodically make use of the Valley floor habitats. This is especially true during years of low precipitation and runoff.

11.1 BACKGROUND AND HISTORY

Although historic data on population estimates and diversity are not available, records from newspapers and journals indicate that in the early days of settlement in Owens Valley there were very few species of wildlife found in any abundance. A pioneer of those days recalled that there were few varieties of birds in the mid 1860s; primarily blackbirds and meadowlarks, with mallard ducks abundant on the river and at Owens Lake when it rained (Inyo Register 1909). Only four species of native fish --- the Owens pupfish, Owens tui chub, speckled dace, and Owens River sucker --- inhabited the Owens River and its tributary streams. The presence of migratory species and their numbers varied greatly from year to year, depending primarily on climatic conditions. This was also true for quail populations.

In 1871, a naturalist with the Wheeler Expedition at Fort Independence reported that with little or no natural tree growth evident in Owens Valley, birds were not very abundant, with most being raptors nesting in the canyons and cliffs.

Settlement by Europeans brought about changes to wildlife population. Coyotes, bobcats, and rabbits were subjected to periodic extermination projects (these continued even until the 1960s) and new species of game birds and fish were introduced. Table 11-1 shows the introduced species and the dates of the introduction. By the 1890s, cultivation of land and an extensive system of irrigation canals and ditches had a beneficial impact on some species, such as quail and pheasant, but an adverse impact on other species including native fish; as diversions of the Owens River and the lower portions of many streams altered riparian areas. In many years, the Owens River was dry or flowed less than 2 cfs.

Around the turn of the century, new species such as spoonbills, gadwall, and canvasback ducks began to appear in the Valley, but intensive hunting was decimating populations of quail, bighorn, and a remnant herd of antelope in the Big Pine area. In 1905, the Inyo County Fish and Game Protective Association was formed.

Over the next few decades, the character of wildlife habitat in many parts of Owens Valley underwent changes of varying degree, and the species diversity of the Valley's wildlife continued to increase.

11.2 PRE-PROJECT SETTING

Within this EIR, pre-project conditions are those that occurred prior to 1970. In order to construct a pre-project setting for wildlife, detailed census information collected prior to 1970 would be necessary. Unfortunately, insufficient records exist upon which to accurately set forth a pre-project condition. The dependence of animal populations upon plants as the primary producers in the Owens Valley ecosystem is an important factor to consider in the evaluation of impacts on wildlife due to water gathering. Although vegetation also was not documented prior to 1970, aerial photography has served as an historical reference upon which to observe, classify and discuss the types of vegetation changes. Results from such an analysis are described in Chapter 10, and the

TABLE 11-1

OWENS VALLEY FISH AND WILDLIFE INTRODUCED GAME SPECIES

Species	Year
Rainbow Trout	1872/73
Catfish	1875
Brown Trout	1877/78
Brook Trout	1884
Pheasant	1896
Largemouth Bass	1908
Chukar	1909
Bluegill, Crappie, and Sunfish	1930
Tule Elk	1933/34

Major Non-Game Species	Carp (1881) Beaver (1946)
Other introduced species that never became established:	Bobwhite Quail (1891) Hungarian Partridge (1929) Gambel's Quail (1940)

Source: LADWP, Range and Wildlife Division, August 1990.

observed vegetation changes are then ascribed to the changes in water management in the Owens Valley.

Reductions or changes in animal populations have been driven by changes of habitat caused by reduction or relocation of water availability, decreased vegetation, and replacement with more drought-tolerant cover. Water availability, vegetation growth, and creation of habitat in the Owens Valley must be considered in the analysis of animal populations. Therefore, no real pre-project condition can be created, but can only be referred to by qualitative assumption.

Although no systematic population censuses have taken place in the Owens Valley that permit pre-project and post-project comparison, the species that occur in the Valley have been documented by species lists. Such species lists have been compiled by the California Department of Fish and Game and appeared in both of the LADWP Draft Environmental Impact Reports during the 1970s.

By the late 1960s, lists of species known to occur in the Owens Valley area were prepared by the Department of Fish and Game, BLM, and U.S. Forest Service. These lists indicated that the Valley provides habitat for some 270 species of birds, 72 species of mammals, 14 species of fish, 30 species of reptiles, 6 species of amphibians, and countless invertebrates --- both aquatic and terrestrial (see Appendix C).

Of the 20 orders of birds found in North America, 17 are represented in the Owens Valley, and these can be grouped into the following five categories: water birds, marsh and shore birds, birds of prey, upland game birds, and songbirds. A description of each category is presented below.

Water Birds

These birds tend to prefer open water aquatic habitats and include one species of loon, three species of grebes, one species of pelican, one species of crested cormorant, three species of terns and gulls, and 25 species of waterfowl. Many of the species are migratory but a few are year-round residents of the Valley. Seasonal activity and numbers of individuals present from year to year vary greatly, due to climatic conditions.

The common loon is a fairly common migrant which feeds entirely upon animal life, especially small fish. The loon also feed upon crayfish, frogs, and insects. As are all species referred to as migrants in this discussion, the loon is present in the Valley in the spring and fall, spending its summers in the northern states and wintering to the south. Loons are not important as game birds.

Of the three species of grebes found locally, the western and eared grebes are the most common, found during the summer months, while the smaller pied-billed grebe is considered a fairly common resident species. All three of these species breed in the Valley. The diets of the western and eared grebes are similar, with small fish being preferred over aquatic insects and crayfish or other small crustaceans. The pied-billed grebe, however, prefers crustaceans, especially crayfish. Grebes are also of no importance as game birds.

Migrating flocks of white pelicans are a fairly common and spectacular sight over the Valley in the fall and spring. Pelicans occasionally utilize local ponds and lakes as feeding or resting areas. Their diet consists almost entirely of fish, as does that of the double-crested cormorant, another fairly common migrant.

Four species of gulls and at least three species of terns are known to occur in the Valley. With the exception of the common California gull, all are uncommon or rarely seen. The California gull and Caspian tern are seen during the summer months and may breed in this area, although the most publicized breeding spot is Negit Island in Mono Lake, 60 miles to the north. With the possible exception of the Black tern, the gulls and terns feed upon small fish and insects. The gulls are also notorious scavengers, feeding on garbage and, to some extent, carrion. The Black tern feeds mainly on aquatic insects and spiders.

Twenty-five species of waterfowl are known to frequent the Owens Valley area at various times of the year. Owens Valley is part of the Pacific Flyway, and in certain years significant numbers of migratory waterfowl have used this region as a stopover. The larger species (geese and swans) usually spend little time locally, as California's central valley is the primary wintering area for these species. The Tundra swan is fairly common in the winter, while the Canada, white-fronted, snow, and Ross' geese are common, rare, and accidental migrants, respectively. The geese feed primarily on the seeds and vegetation of marsh and aquatic plants and weed seeds, while the swan feeds on grasses. All of these species will use the stubble of agricultural crops where available. Of the 20 species of ducks, ten are surface feeding ducks and ten are diving ducks. The mallard, ruddy duck, gadwall, and wood duck are resident species. The cinnamon teal also breeds locally but it is common during the summer months only. The lesser scaup, bufflehead, and common merganser are present during the winter months.

Migrant species present in the spring and fall include the pintail, green-winged teal, blue-winged teal, the rare European and common American wigeons, northern shoveler, redhead, ring-necked, canvasback, common goldeneye, and red-breasted merganser. Most of these ducks, like the geese, feed primarily on aquatic vegetation such as pondweed, bulrush, and sedge. Some of the surface feeding ducks also utilize stubble of agricultural plants if available. The diets of the diving ducks (redhead, ring-necked, canvasback, scaup, goldeneye, bufflehead, scouter, ruddy duck, and mergansers) include larger amounts of animal life, including crustaceans, amphibians, and small fish. The common and red-breasted mergansers feed almost entirely on fish along with crayfish, frogs, and aquatic insects.

The American coot, or mud hen, is closely related to the gallinules and rails, but is usually included in discussions of waterfowl. The coot is a very abundant year-long resident and is not regarded as a choice gamebird. Like the ducks, the coot prefers aquatic vegetation such as pondweed, sedge, and bulrush for food.

Marshbirds and Shorebirds

There are three identifiable subgroups in this category: long-legged shallow waders (herons, egrets, ibis, and bitterns); marsh dwellers (gallinules, rails, and cranes); and shorebirds (sandpipers, plovers, and stilts). Of the 38 species in this category six are year-long residents, including the great blue heron, American bittern, sora, Virginia rail, killdeer, and common snipe; the remainder are migratory. These birds prefer the margins of bodies of water, and some, such as the bitterns, soras, and rails are very secretive and are rarely seen, preferring the cover of dense marshes. Most feed on fish, crustaceans, aquatic insects, but some feed on riparian vegetation.

The herons and egrets are among the largest of the birds found in the Valley and are usually seen along the river, the Los Angeles Aqueduct, and larger canals. The great blue heron and American bittern are common or fairly common resident species which breed locally. Migrant species include the common egret, the fairly common snowy egret, and the uncommon green and black-crowned night herons, or the rarely seen least bittern and cattle egret. The white-faced ibis is an accidental visitor or transient in the area. Like many waterbirds, the great blue and black-crowned night herons prefer a diet of fish along with crustaceans and aquatic insects. They will also consume small mice and shrews as well as frogs, snakes, and snails in small amounts. In contrast, the diet of the green heron, common egret, and snowy egret is over half crustaceans, with aquatic insects, frogs, and small fish in smaller amounts. Food habits studies on herons and other waders have shown that generally they do little damage; however, the herons may invade a fish hatchery pond and consume large amounts of small fish in a fairly short time.

Of the marsh dwellers, the sora and Virginia rail are fairly common year-long residents. The Virginia rail feeds primarily on animal foods, such as insects, snails, and spiders, while the sora is distinct in the large amount of plant food it consumes (especially bulrush, sedge, and spike rush). The yellow rail and common gallinule are rare in the summer months, while the sandhill crane is a rare winter visitor.

Of the 24 species of shorebirds, only the killdeer and common snipe are considered to be year-long residents in the Valley. The killdeer is probably the most common of all the birds in this category. Common summer residents which may breed locally include the spotted sandpiper, American avocet, and Wilson's phalarope. The vast majority of the shorebirds are migrant species and are either uncommon or rarely seen, but may appear to be more abundant due to the numbers of various species seen together at any one time or place. Aquatic and/or terrestrial insects are the preferred foods of the four species of plovers, six species of sandpipers, and the black-necked stilt, avocet, willet, dunlin, and whimbrel. The long-billed curlew is especially fond of snails, while the greater yellowlegs prefers fish. The marbled godwit is the only shorebird found in this area which consumes large amounts of plant food, with pondweed comprising at least 50 percent of its diet. The marshbirds and shorebirds have little direct economic importance, either positive or negative. Except for the sandhill crane and some rails, they are not prized as gamebirds.

Birds of Prey

There are two orders of birds of prey found in Owens Valley, the hawks and their allies (falcons, eagles, ospreys, vultures, and kites), and the owls. Eighteen species of hawk and hawk allies are found in the Valley along with nine species of owls. Some species are year-round residents while others are migratory.

The hawks and owls make no direct use of plants in their diets, yet plants are vitally important to them. The local and regional distribution of these birds is largely dependent upon the flora. The character of the vegetation controls the abundance and distribution of the prey species such as mice, birds, rabbits, grasshoppers, etc. Also, the presence of large trees and shrubs influences the selection of nesting sites.

Of the hawks, the red-tailed, northern harrier, and sharp-shinned hawks are the most common year-long residents. The Cooper's hawk and goshawk are also resident species but are uncommon, with the goshawk usually found at higher elevations. The rough-legged hawk is common during the winter months, the ferruginous hawk is an uncommon winter resident, the Swainson's hawk is a common summer resident, while the red-shouldered hawk is a rare migrant. The food preferences of these hawks are about evenly divided between small mammals, preferred by the red-tailed, red-shouldered, Swainson's rough-legged, and ferruginous hawks, and small birds, preferred by the goshawk, sharp-shinned, Cooper's and marsh hawks. Actually, the diet of the marsh hawk consists of nearly half birds and half mammals. All of the hawks consume insects to some extent. The red-tailed, rough-legged, marsh, and Cooper's hawk take game birds together with some poultry.

During the summer months, the turkey vulture is common throughout the area, feeding on carrion. The golden eagle is a fairly common resident species. In some years, when populations of prey species such as small birds, rodents, and rabbits are high, the golden eagle is extremely active throughout the Valley. The southern bald eagle, on the other hand, is a rare winter visitor feeding almost entirely on fish. The bald eagle is an endangered species.

The osprey, or fish hawk, is an uncommon summer resident which feeds entirely on fish. The osprey is not on the official endangered or threatened species list; however, in many parts of the United States, it has been seriously affected by the presence of DDT in its food, which in turn affects the eggs and has caused a decline in overall production. This has never been a problem in Owens Valley as use of pesticides has been negligible. These birds migrate as far south as Argentina during the winter months.

Four species of falcons have been observed in the Valley, the most common being the American kestrel, commonly called the sparrow hawk. This is a resident species which, unlike the other birds of prey depends upon insects for food. The prairie falcon is also a resident species, less common than the sparrow hawk, that has also been observed nesting locally. The pigeon hawk and American peregrine falcon are rare winter visitors. The peregrine falcon is an endangered species.

Of the nine species of owls found in and around the Owens Valley, only four are resident species. The screech owl and great horned owl are by far the most common. While both of these species feed mostly on rodents, the screech owl is usually found only in riparian areas where it also consumes large amounts of insects. The great horned owl may be found in various habitats, from marshland to sagebrush, semi-desert scrubland. Other fairly common owls are the barn owl and long-eared owl, both year-long residents, and the burrowing owl, which is found in open brushlands during the summer months. The flammulated owl is an uncommon summer resident usually seen only at higher elevations. The pygmy and saw-whet owls are rarely seen migrants which are usually found in wooded areas at higher elevations.

In owls, as with the hawks and their allies, the size of the bird has much to do with the food habits. The smaller owls prey upon small rodents and larger insects, while the larger species, such as the great horned owl, prey upon rodents, rabbits, squirrels, gamebirds, and to some extent frogs and large insects.

Upland Game Birds

To a large group of American sportsmen, upland game birds are important above all others. Upland game birds are primarily plant feeders, but some insects are usually taken in the feeding process. Probably the most common upland game species in the Valley is the California quail, a year-long resident found in nearly all habitat types. The California quail feeds primarily on the leaves and seeds of filaree, clover, bassia, and lupine, as well as alfalfa. Quail brood counts, conducted by Department of Fish and Game in the mid-1960s, show an average brood size of 9.6 young per adult pair.

The mourning dove is very common during the summer months, and primarily a seed eater found mainly in the riparian, agricultural, and alkali grassland types. Numbers of doves vary greatly from year to year due to climatic conditions. Its larger cousin, the white-winged dove, is an accidental migrant through this area. The doves feed on the seeds of sunflower, purslane, fiddleneck, and filaree. The rock dove, or domestic pigeon, is actually a feral species that has become self-sustaining in and around the towns. It is a fairly common resident in the Valley.

The chukar is a fairly common resident of the sagebrush and semi-desert scrublands. The abundance of this species is determined by the seasonal precipitation. Examinations of chukar taken by local hunters have shown that Indian ricegrass is probably the preferred food item.

The ring-necked pheasant is introduced into various riparian areas each year as a project of the Rainbow Club and the Department of Fish and Game. Pheasant plantings are for put-and-take hunting, and of the 3,200 released annually, very few -- if any -- survive through the winter. It is reported that pheasants, which are not native to the U.S., were abundant in the Valley earlier in this century. Changing agricultural practices, especially discontinuance of grain or cereal crops have had much to do with the decline of resident pheasant populations. Resident pheasant populations have also disappeared from areas such as Round Valley, where land use practices and vegetation types have not changed drastically over the years.

Songbirds (and miscellaneous birds)

This group includes all birds not fitting into one of the above categories. Some groups, such as hummingbirds and woodpeckers, are not truly songbirds but will be discussed here. The passerine, or songbirds, constitute the largest order of birds in the world and are well represented in the Owens Valley, with 26 families (more than in all other groups combined), including hummingbirds and woodpeckers. Seventy-four species are year-round residents, six are summer residents, 32 are winter visitors, and the remainder are migratory species.

As expected with such a large group, there is a great variation in habitat preference between species. Nearly 130 species are most commonly associated with moist habitats, such as riparian vegetation, 15 prefer xeric or dry habitats, and the remainder are not habitat-specific.

Food preferences range from seeds, fruits, and insects, sometimes depending upon the season or availability. A few species may take crustaceans, small fish, or small animals. Others, like the common raven and black-billed magpie, are commonly seen along the roadsides eating carrion. The six species of hummingbird feed on nectar taken from flowers.

The roadrunner is a member of the cuckoo family and is a common resident species that may be seen throughout the Valley. Although it is seldom seen in flight, it is not uncommon to see a roadrunner perched atop a telephone pole. Roadrunners feed primarily upon lizards and insects associated with the alkali scrubland and semi-desert scrubland vegetation.

The poor-will, common nighthawk, and lesser nighthawk are nocturnal insect eaters. The poor-will is an uncommon summer resident that replaces the whip-poor-will in the western states. The nighthawks are also summer residents found in a variety of habitat types, but are most noticeable on farms and in towns around streetlights and lighted signs that attract insects.

The swifts, like the nighthawks, feed entirely on insects and are not resident species. The black and Vaux's swifts are very uncommon and found mainly in riparian habitats, while the white-throated swift frequents more open scrubland vegetation.

Hummingbirds, the smallest of the North American birds, feed almost entirely on the nectar of both wild and cultivated plants. None of the six species of hummingbirds found in this area are year-long residents, and only the black-chinned and rufous hummingbirds are very common on the Valley floor. The Costa's hummingbird may occur locally but is rarely seen. The broad-tailed, calliope, and Anna's hummingbirds are usually found only at higher elevations but may pass through the Valley during migration.

The belted kingfisher is a common resident species, usually found only near water where it feeds mainly on fish, along with some crayfish, frogs, and lizards.

The woodpecker family is represented in and around the Owens Valley by seven species of woodpeckers, two species of sapsuckers, and the red-shafted or common flicker. The flicker is a common, year-long resident of wooded areas and towns and obtains most of its food on the ground -- mainly ants and other terrestrial insects. The sapsuckers are not resident species. The yellow-bellied sapsucker is a common summer resident that feeds mainly on the wood, sap, and fleshy fruits of trees, while the Williamson's sapsucker is an uncommon migrant found mostly at higher elevations and feeds mainly on insects. With the exception of the acorn woodpecker, an accidental migrant through the Valley, the Lewis', whiteheaded, hairy, downey, ladder-backed, and Nuttall's woodpeckers are resident species. the Lewis', white-headed, and downey woodpeckers, however, are found mostly at higher elevations. The Nuttall's woodpecker is rarely seen. Insects and the fruits of woody plants are preferred food of all species.

Seven species of flycatchers, none of which are resident species, may be found in wooded areas. As the name implies, flycatchers feed entirely on insects and spiders. The ash-throated flycatcher is the only species considered common on the Valley floor. Similar species, including the Black and Say's phoebes, and the western kingbird, are common on the Valley floor and feed mainly on insects but also consume fruits of woody plants. The eastern kingbird is an oddity, as it has been observed in the Owens Valley in summer months, while its range has historically been considered limited to the east of the Rocky Mountains.

Swallows, which are represented in the Valley by six species during the summer months, are also insectivorous. Only the tree swallow, a fairly common migrant, feeds on plant material to any extent. The violet-green swallow is a western species, while the others (the tree, bank, rough-winged, barn, and cliff swallows) range all over the country.

Probably the most commonly seen birds in this area are the blackbilled magpie and the common raven. These birds may be seen throughout the year, in most vegetation types, as well as in the towns where they are considered nuisances. While insects are considered the favorite food item for these species, they are usually seen eating carrion (road-killed birds and mammals).

Three species of jays are year-long residents in the Valley and are found usually in riparian habitats or the semi-desert scrubland on the foothills, where they feed primarily on seeds or fruits of woody plants. The Stellar's and scrub jays are common, while the pinyon jay is uncommon and, in fact, is more closely related to the crows and the Clark's nutcracker.

The two subgroups which are represented in the Valley by the greatest number of species are the warblers and the sparrows. The 18 species of warblers found in the Owens Valley are insectivores and are found exclusively in the wooded, riparian habitat. While the warblers feed primarily on insects and spiders, some eat small amounts of fleshy fruits of woody plants. While the yellow-rumped, or myrtle warble, is a common resident species, the others are either migrants or summer visitors. There are six warblers (the black and white, magnolia, black-throated blue, black-throated green, golden-winged, and blue-winged warbler) along with their cousins, the ovenbird, northern waterthrush, and American redstart, which are rare or accidental migrants here in the Valley. None of these species are reported as common west of the Great Plains.

The western meadowlark is probably the most common songbird found in the Valley. Meadowlarks are found throughout the year but the greatest numbers are found in late spring and early summer. Sixteen species of sparrows and two juncos, which are technically sparrows, occur in the Valley. The house, or English sparrow, is not included with these as it is not a sparrow but a weaver finch. These birds all have heavy bills well adapted for crushing the seeds of grasses and weedy plants. Seeds make up the bulk of their diets, except during the warmer months when insects are plentiful. None of the true sparrows cause significant damage to cultivated plants and most eat destructive insects. The majority of these species are partial to open areas or fields (vesper, savannah, sage). Others such as the fox and white-throated sparrows frequent bushy areas, while still others prefer marshy habitat. The vesper, sage, chipping, white-crowned, Lincoln's, and song sparrows are permanent residents. Six species are summer residents, three are winter residents, and only the golden-crowned sparrow is considered a true migrant. Numerous other bird species have not been discussed but are known to occur in the Valley, and are listed in Appendix C.

It should be noted that the occurrence of these species is determined from past and current data furnished by local observers. As more data are received, some minor details of habitats used, food habits, or abundance of some species are revised.

Mammals

Seven of the eleven orders of mammals are represented by 72 species in the Owens Valley. An eighth order (Perissodactyla) is represented by burros, mules, and horses which are not wildlife species and will not be discussed. Mammals found in the Valley may be discussed in the following categories.

Small Animals

This category consists mainly of rodents (order Rodentia) but excludes the larger species such as the beaver and porcupine. Two other orders, namely Insectivora (moles and shrews) and Chiroptera (bats), are also included. In general, small mammals have no appreciable value as either fur or game, while some may be considered pests.

Shrews are the smallest mammals, and although considered insectivores, they also consume some plant food. All three species of shrews found in the Owens Valley area are inhabitants of damp, riparian areas. While the more common vagrant and water shrews may be found on the Valley floor, the rare Inyo shrew is found only at higher elevations in the White and Inyo Mountains. These shrews are active year-round and feed primarily on earthworms and the larvae of various insects, including beetles, caterpillars, ants, and flies. They also eat snails, grasshoppers, and spiders. The California mole, also an insectivore, is common in areas of porous soils throughout the year. The mole is found in most habitat types and feeds on grubs, earthworms, and insect larvae. In addition, the underground parts of plants, particularly the bulbous roots, are an important supplement.

Bats are the only true flying mammals, and all of the 16 species found in the Valley are nocturnal. These bats eat only insects, including flying ants, moths, flies, mosquitos, and caddisflies, which they capture on the wing. Five species, i.e., the silver-haired, red, hoary, pallid, and Mexican freetail bats, migrate. The other species are residents which hibernate in small caves or old buildings during the winter months. Except for the western big-eared bat, which frequents only the open brushlands of the foothills and canyons, all species may be found in the riparian/woodland vegetation during the summer months. The hoary bat is usually found in wooded areas at higher elevations. Spotted, silver-haired, and red bats are rare species that are normally found at higher elevations but are occasionally observed over the foothills and lower canyons.

Three species of ground squirrels occur in the Valley. The most commonly seen is the whitetailed antelope ground squirrel, which is active throughout the year in the grassland and open brushlands. The large California ground squirrel and the uncommon Townsend's ground squirrel both hibernate. While the California ground squirrel may be found in various habitats, especially riparian/woodland, the Townsend's is found only in the semi-desert scrubland. All three species are largely vegetarian, feeding on the leaves and seeds of filaree, lupine, buckwheat, and bromegrass.

Both the least and Merriam chipmunks are fairly common at the higher elevations, and both hibernate during the winter months. Nuts and fruits of woody plants are their predominant foods, but weed seeds are used extensively. Some insects are also taken.

The valley pocket gopher is common in riparian and grassland areas, and is a pest on agricultural lands. The diet of the pocket gopher is entirely vegetarian and consists of filaree, homegrass, and the roots and bulbs of woody plants. Seeds and nuts are also eaten when available near the burrow.

The pocket mice, deer mice, kangaroo mice, and larger kangaroo rats are all nocturnal and are adapted for arid or semi-arid habitats. They do not require drinking water as they obtain their water from the vegetation and seeds of weeds and woody plants. Fifteen species of these mice and rats are found throughout riparian, grassland and semi-desert scrubland habitats. The Great Basin pocket mouse and pinyon mouse are usually found only at higher elevations. For the most part, the mice are associated with woodland, grassland, and alkali scrubland, while the kangaroo rats are associated with the semi-desert scrubland. The white-footed deer mouse may be found in all vegetation types, while the canyon mouse, little pocket mouse, and kangaroo rat are usually found only in the open, semi-desert scrubland. These pocket mice and kangaroo rats are primarily seed eaters, with filaree, purslane, sunflower, ricegrass, saltbush, and creosote preferred. The diet of the deer mouse reflects the availability of both plant and animal foods at various seasons. As its name implies, the southern grasshopper mouse is primarily insectivorous, preferring grasshoppers, crickets, and spiders.

The larger wood rats, sometimes called "packrats" or "trader rats", are also nocturnal. The desert wood rat is common in the alkali and semi-desert scrublands, while the bush-tail wood rat is common on the higher alluvial slopes and forested areas. The rare dusky-footed wood rat is recorded only in the canyons near Independence. Ordinarily, wood rats do not invade human habitats and do not use farm crops to any extent. The diet of wood rats is almost entirely vegetarian, consisting mainly of seeds, foliage, fruits, and underground parts of weeds and woody plants; they rarely consume insects.

Unlike the wood rats, the house mouse is sometimes found in fields but is more common in buildings. The house mouse will eat anything edible.

The meadow mouse, or meadow (California) vole, is partial to open areas on woodlands or pasture land. It subsists on foliage, roots, and to some extent, seeds of clover, bulrush, sunflower, and alfalfa.

Fur and Game Mammals (furbearers)

Mammals included in this category are those that are large enough to be valuable as fur or game, or both. The feeding habits of these animals vary from a carnivorous diet, as in the bobcat or mountain lion, to the vegetarian diet of the beaver, porcupine, and rabbits. Others are omnivores, subsisting on both plant and animal material.

The opossum is the only marsupial found in North America. Although it is somewhat common in the Southeast, it was introduced into California some years ago and its occurrence in the Valley is accidental. It has not been reported in Owens Valley for many years.

The beaver is an introduced species; it is the largest of the rodents and is chiefly nocturnal, but is occasionally seen by day, appearing shortly after sundown. The beaver has become more common in recent years during the summer months along the Owens Rivers and many streams and canals, where it feeds on the bark and wood of twigs, branches, and trunks of trees, especially cottonwood. Next to the beaver, the porcupine is the largest native rodent and may be seen during the day, but is most active at night. During the winter months the diet of the porcupine, like that of the beaver, consists almost wholly of the inner bark of trees. In other seasons, the porcupine makes use of a wide variety of herbaceous plants, including sedge and clover.

Next to the rodent species, hares and rabbits are the most abundant mammals in the Valley, the most common being the black-tailed jackrabbit and the desert cottontail. These species are entirely vegetarian, eating any available green plants. During the mid-1960s, the Department of Fish and Game conducted road censuses of jackrabbits and cottontails on the Valley floor. Their counts showed an average of 0.55 jackrabbits and 0.37 cottontails per mile.

The uncommon long-tailed weasel and the mink, which is very rare in this area, are considered vicious predators that are seldom, if ever, interested in plant food. The prey most commonly taken are rabbits, pocket mice, birds and their eggs, snakes, frogs and fish. Both of these species are nocturnal and are seldom seen outside of the riparian/woodland habitat.

Two species of skunks are found locally, with the striped skunk common in all but the driest habitats and the uncommon spotted skunk restricted to the riparian areas. Both species are nocturnal and omnivorous, feeding on mice, small birds and eggs, insects, berries, and carrion. They are also fond of poultry, where available.

The badger is fairly common in the more open brushland habitat where it feeds mainly on small mammals (rodents), which it digs from their burrows. The burrows that the badger digs may be hazardous to livestock.

The raccoon is a common resident of the tule marsh and riparian habitats. Raccoons are chiefly nocturnal and may den in hollow trees, logs, or ground burrows during the cold spells, but do not hibernate. This species forages along streams and ponds looking for frogs, crayfish, and other aquatic organisms; they will also eat birds' eggs occasionally. In the fall, the raccoon depends more upon fruits of woody plants and even alfalfa. A relative of the raccoon, the ringtail cat is a rare resident of the Valley and inhabits rocky outcrops near streams. This nocturnal predator has been observed in the Big Pine area and feeds mainly on small mammals, insects, birds, and occasionally lizards.

Foxes are uncommon in this area and are usually found only in the woodland and semi-desert scrubland at the higher elevations and the extreme southern end of the Valley. The gray and kit foxes are nocturnal and feed primarily on rodents, insects, birds and eggs, and fruit. The very common coyote, on the other hand, is active day or night in all habitat types and has a wider range of food preferences. Coyotes are known to attack calves of both livestock and tule elk.

The bobcat is associated with the riparian/woodland habitat and preys primarily upon rabbits and rodents and sometimes game birds. The mountain lion is a high country predator that may be found in the Owens Valley during the winter and spring months. Observations of mountain lions have risen drastically in recent years. The black bear is also found at higher elevations but ranges low into the Valley area covered in the proposed project. Bear observations have also risen in recent years, especially on Independence and Big Pine Creek above the Valley floor, and at Fort Independence.

Big Game

These animals are all species in the order Artiodacyla (even-toed, hoofed mammals). All are exclusively plant eaters.

The mule deer is a most popular big game species found mainly at higher elevations, descending to the foothills during the winter months. On the winter range, bitterbrush is the staple food item. There is also a resident deer herd which inhabits the wooded, riparian habitat along the Owens River through the Valley floor. The mule deer browses extensively on trees and shrubs, especially in winter, but also consumes grasses and other herbaceous plants.

The California bighorn sheep are mostly a high mountain species, but have been reported on or near the Valley floor in years of heavy Sierra snowpack.

The most notable big game species in the Valley is the Tule Elk. The smallest of the races of elk, the Tule Elk has adapted to all habitat types from the Valley floor to elevations of over 10,000 feet in the Sierra and White/Inyo ranges. Since their introduction into the Valley in the 1930s, the elk have formed five distinct herd areas. Since the 1940s, the numbers of animals was kept below 300 through special hunts conducted by the Department of Fish and Game. Organized opposition to the hunting of Tule Elk resulted in the hunt of 1969 being the last. Like the mule deer, the Tule Elk are vegetarians that prefer browse species but also consume grasses and forbs when available. Their diet includes plant species found in all habitat types, and they appear to feed on those plants which appear the greenest at a particular time. Tables 11-2 and 11-3 show general food preferences of the Tule Elk (from Owens Valley Tule Elk Habitat Management Plan, revised February 1, 1986, and McCullough, 1969).

Fish

When white man first entered the Owens Valley, only four species of fish were present: Owens tui chub, Owens sucker, Owens pupfish, and Owens dace. Eleven species of fish, nine of which are game fish, have been introduced. Brown trout are wild residents in most flowing waterways, while rainbow trout are planted annually on a put-and-take basis with little carryover.

During the decade of the 1960s, an average of 670,000 trout, reared in Valley Hatcheries, were planted in 14 streams within the study area each year. Populations of brown trout were sampled by the Department of Fish and Game, and densities in several streams were estimated. The composition of fish populations may change in a given section of stream in different seasons. The streams are quite homogeneous at a given time of the year, but the stream character is totally different in May, during the spring floods, than in the fall. The stretch of the Owens River from Pleasant Valley to Five Bridges is one of the most heavily fished wild trout streams in the State and has been designated "Wild Trout Waters" by the Fish and Game Commission.

Warmwater fishes most common in ponds, but also found in the river and canals, include largemouth and smallmouth bass, brown bullhead and channel catfish, green and red-ear sunfish, and bluegill. The trout and bass are carnivorous, feeding mainly on insects, snails and smaller fish. The sunfish make some use of plant foods, especially algae, but live largely on insect larvae and crustaceans which feed directly on the algae. The catfish feed extensively on plants, with insects making up a minor portion of the diet.

Of the nongame fish, the carp is a large, bottom-feeding minnow that takes a good deal of plant food. The mosquito fish is a small fish that much resembles the pupfish, and as its name implies, feeds mainly on mosquito larvae.

TABLE 11-2

PLANT SPECIES PREFERRED BY TULE ELK (BY SEASON)

Herd	Spring	Summer	Fall	Winter
Bishop	Saltbush Willow Greasewood	Willow Clover Licorice	Willow Bassia Licorice	Sagebrush Saltbrush Needlegrass
Tinemaha	Alfalfa Willow Licorice	Alfalfa Juncus Willow	Alkali Sacaton Licorice Alfalfa	Sagebrush Alkali Sacaton Saltbush
Goodale	CA Buckwheat Dalea Milk Aster	CA Buckwheat Desert Trumpet Milk Aster	Needlegrass Sagebrush CA Buckwheat	Sagebrush Needlegrass Winterfat
Independence	Greasewood Annual Forbs Dalea	Bassia Clover Ricegrass	Saltbush Greasewood Alakli Sacaton	Saltbush Alakli Sacaton Shadscale
Lone Pine	Greasewood Bud Sage Dalea	Willow Juncus Ricegrass	Saltbush Grasswood Alkali Sacaton	Saltbush Alakli Sacaton Greasewood

Source: LADWP, Range and Wildlife Division, August 1990.

TABLE 11-3
ANNUAL FOOD PREFERENCES OF TULE ELK

Herd	Grasses	Forbs	Shrubs
Bishop	23.3%	36.7%	40.0%
Tinemaha	18.6%	40.7%	40.7%
Goodale	15.8%	15.8%	68.4%
Independence	18.6%	18.6%	62.8%
Lone Pine	26.7%	16.7%	56.6%
TOTALS	20.6% (15.8 - 26.7)	25.7% (15.8 - 40.7)	53.7% (40.0 - 68.4)

Source: LADWP, Range and Wildlife Division, August 1990.

Reptiles and Amphibians

Thirty species of reptiles and six amphibians are known to occur in the Valley. All species found locally either hibernate or over-winter from late fall until spring.

Over half of the lizards are associated only with the alkali scrubland or semi-desert scrubland habitats, while others are found in riparian and grassland types as well. The most common species in the Valley are the zebra-tailed, Great Basin whiptail, northern side-blotched, and sagebrush lizards. Except for the desert iguana and chuckwalla, which feed mainly on vegetation, the lizards depend upon insects and spiders for the bulk of their diet.

While the lizards are tolerant of the more hostile habits, most snakes prefer areas near water. The rubber boa, yellow-bellied racer, and aquatic garter snakes are found only in riparian habitats, while the others frequent various habitats. Only four species – the desert sidewinder, western long-nosed, Mojave patch-nosed and western ground snake – are not found in the true riparian/ woodland habitat. The red racer and Great Basin gopher snakes are the most common species in the Valley. Most snakes found locally feed primarily on lizards. The larger species, including the gopher snake and the rattlesnake, prefer rodents; garter snakes prefer fish and toads or frogs. The western ground snake, a rare nocturnal resident of the semi-desert scrubland, feeds on insects and spiders. The Sierra and Mountain garter snakes are normally found only at higher elevations.

All of the amphibians require water during at least part of their life cycle. The toads and leopard frogs may be able to breed in pools formed after heavy rains, but the larger populations occur only near permanent water. The California and Great Basin spadefoot toads are nocturnal. The bullfrog is by far the most common species found locally, and like all of the amphibians, feeds mainly on insects. The mountain yellow-legged frog is found only at higher elevations.

Invertebrates

Included here are all those animals that have no backbones and are grouped in the large artificial category known as invertebrates. Many of these animals occur in the soil or are too small to be seen by most people. Their existence is essential to the functioning of a complex ecosystem, but very little is known about most of them.

Insects and other arthropods (specially spiders and scorpions) are by far the largest group of animals on earth. They far surpass all other terrestrial animals in number and occur practically everywhere. While many species are endemic to the Valley, little or nothing is known about their life cycles and the importance they play in the overall ecology.

Certain invertebrates are associated with specific plants for all or part of their life cycles. For example, some species of gall-making wasps lay their eggs on willow plants. Even if the remainder of the wasp's life cycle is spent away from the willows, the wasp's distribution is dependent upon the presence of the host willow. It has been suggested that rabbitbrush is possibly the most important host plant in the Valley. The Department of Fish and Game's inventory centered about collections made on rabbitbrush plants, which was the only widespread species in bloom during the study period. Several species of cerambycid beetles spend their entire life cycle on rabbitbrush (the larvae feed on the roots and adults feed on the pollen).

Insects feed on an almost endless variety of foods. Thousands feed upon plants and practically every plant is fed upon by some kind of insect. Plant feeders may feed on almost any part of the plant: caterpillars, leaf beetles, and leaf hoppers feed on the leaves; aphids feed on the stems; grubs feed on the roots; certain weevil and moth larvae feed on the fruits; and so on. Some insects burrow inside the plant and feed. Thousands of insects are carnivorous, feeding on both vertebrates and other insects.

Thirty-three orders and associated families of invertebrates are known from Owens Valley. While many species of this group may be endemic to the Valley, very little is actually known about the animals, their habits or their place in the Valley's ecology. Many species of insects and spiders require one or more highly specific plant species for parts of their life cycle. But again, the extent of this complexity is unknown for many Valley species. Also, the importance of this group of animals as food for other animals should not be underestimated; they play a vital role in the ecological food web.

Endangered Species

Prior to 1970, two species of birds – the southern bald eagle and American peregrine falcon – were listed as endangered species. Both of these species are migrants, seen only seasonally.

The Owens Valley pupfish was also listed as an endangered species and was protected in refuge built under a cooperative agreement between LADWP and the Department of Fish and Game.

11.3 PRESENT SETTING

Overall, there is no significant difference between present wildlife populations in Owens Valley and pre-project populations discussed previously (Section 11-2). Except for additional information presented in this section, the discussion of pre-project wildlife populations is still applicable.

Between October 1973 and June 1974, and again in August through October 1975, two wildlife inventories were conducted by the Department of Fish and Game on 75,000 acres of City of Los Angeles-owned lands in the Valley. Because of the short duration of these studies, additional field studies have been conducted by LADWP biologists on an ongoing basis since 1976. These inventories indicate that today, some 299 species of birds, 73 species of mammals, 14 species of fish, 32 species of reptiles, and six species of amphibians, along with hundreds of species of invertebrates, inhabit Owens Valley. Table 11-4 lists the 32 species of birds, mammals and reptiles that have been added to the list since 1970.

However, while much has been added to the database in recent years, the lack of quantitative data for pre-project populations or habitat requirements prevents detailed comparisons. Factors that have influenced certain wildlife populations, to some extent, are discussed as follows:

BIRDS

It is acknowledged that many of the bird species listed in Table 11-4 may have been present, but somehow overlooked, prior to 1970; however, some species, such as the Arctic loon, parasitic jaeger, and zone-tailed hawk, may be expanding their range and are new but uncommon in the eastern Sierra.

Waterbirds

Since 1970, ten new species of waterbirds have been recorded in the Valley (Table 11-4); however, local hunters and bird watchers have reported a noticeable decline in overall numbers of waterfowl utilizing the Valley during fall migration. At the same time, local breeding populations of some ducks have been increasing. The exact nature of change in waterfowl numbers is difficult to determine because not only is there a lack of quantitative data on pre-1970 populations, but also the early Statewide waterfowl surveys begun by the Department of Fish and Game in 1952 did not include the Owens Valley. The area did not warrant the time and expense of such surveys as compared to the San Joaquin Valley region. A decrease in water spreading activity in very wet years, along with the removal of some irrigated acreage since 1968, has been suggested to be a major contributor to a decline in waterfowl numbers. These changes are discussed in Chapters 9 and 10. The data on the magnitude of such changes in water use, however, do not suggest a major change in waterfowl numbers should be expected. Also, several ponds and waterfowl habitat improvement projects were developed by LADWP between 1970 and 1984 (see Chapter 5). These projects, along with several enhancement/mitigation projects implemented in cooperation with Inyo County since 1984 (including the Lower Owens River Project), have promoted an increase in species that nest locally, as well as numbers of migratory species resting in the Valley.

Marsh and Shorebirds

Since 1970, four new species of marsh and shorebirds have been observed in the Valley (Table 11-4). These would be considered rare or uncommon species.

Birds of Prey

In recent years, the local breeding population of the Swainson's hawk has increased significantly. LADWP biologists, working in cooperation with the Department of Fish and Game, have documented each known nest site and its success. The Swainson's hawk is listed as threatened by the State of California (Table 11-5).

TABLE 11-4

SPECIES OBSERVED OR ADDED SINCE 1970

Species	Occurrence
Arctic loon (*Gavia arctica*)	Accidental
Brown pelican (*Pelicanus occidentalis*)	Accidental
Little blue heron (*Florida caerulea*)	Rare
Roseate spoonbill (*Ajaia ajaia*)	Rare
Greater scaup (*Aythya marila*)	Accidental migrant
Barrow's goldeneye (*Beucephala islandica*)	Rare
Oldsquaw (*Clangula hyemalis*)	Migrant
Hooded merganser (*Lophodytes cucullatus*)	Rare
Zone-tailed hawk (*Buteo albonotatus*)	Uncommon
Sanderling (*Crocethia alba*)	Uncommon
Semipalmated Sandpiper (*Ereunetes pusillus*)	
Parasitic jaeger (*Stercorarius parusiticus*)	Uncommon
Herring gull (*Larus argentatus*)	Uncommon
Sabine's gull (*Xema sabini*)	
Common tern (*Sterna hirundo*)	
Chimney swift (*Chaetura pelagica*)	
Vermillion flycatcher (*Procephalus rubinus*)	
Verdin (*Auriparus flaviceps*)	
Catbird (*Pumetella carolinensis*)	
Townsend's solitaire (*Myradestes townsendi*)	
Parula warbler (*Parula americana*)	
Palm warbler (*Dendroica palmarum*)	Accidental
Great-tailed grackle (*Quiscalus mexicanus*)	
Summer tanager (*Piranga rubra*)	Uncommon
Brown towhee (*Pipilo fuscus*)	
Gray-headed junco (*Junco caniceps*)	
Harris' sparrow (*Zonotrichia querula*)	
Swamp sparrow (*Melospiza georgiana*)	
McCown's longspur (*Rhynchophanes mccownii*)	Accidental
Spiny pocket mouse (*Perognathus spinatus*)	
Speckled rattlesnake (*Crotalus mitchelli*)	
Mojave rattlesnake (*Crotalus scutulatus*)	Rare

Source: LADWP, Range and Wildlife Division, August 1990.

TABLE 11-5

ENDANGERED, THREATENED, OR FULLY PROTECTED SPECIES KNOWN TO INHABIT THE OWENS VALLEY AREA

Species	Status
American peregrine falcon (*Falco peregrinus anatum*)	Endangered
Southern bald eagle (*Haliaeetus leucocephalus*)	Endangered
Owens pupfish (*Cyprinodon radiosus*)	Endangered
California bighorn sheep (*Ovix canadensis californiana*)	Rare (State of California only)
Ringtail cat (*Bassariscus astutus*)	Fully protected by State
Owens dace (*Rhinichtys osculus*)	Fully protected by State
Owens tui chub (*Gila bicolor* ssp. *snyderi*) CE/FE (Extirpated from most Owens Valley sites)	Endangered
Golden Eagle (*Aquila chrysaetos*) CSC/CFP	Fully protected by State
Swainson's hawk (*Buteo swainsoni*) CT/2 (Nests in Owens Valley)	Threatened
Prairie falcon (*Falco mexicanus*) CBC (Location information suppressed)	Species of Special Concern
Snowy plover (*Charadrius alexandrinus ssp. nivosus*) CSC/2	Species of Special Concern

TABLE 11-5 (Continued)

Species	Status
Western yellow-billed cuckoo (*Coccyzus americanus ssp. nivosus*) CE/2 (Threatened by loss of habitat)	Endangered
Long-eared owl (*Asio otus*) CSC	Species of Special Concern
Willow flycatcher (*Emidonax traillii*) CSC/FSS)	Species of Special Concern Sensitive Species
Yellow warbler (*Dendroica petechia ssp. brewsteri*) CSC	Species of Special Concern
Yellow-breasted chat (*Icteria virens*) CSC (Threatened by loss of habitat)	Species of Special Concern
Owens Valley vole (*Microtus californicus ssp. vallicola*) /2	Candidate for Federal Listing

CE Listed as endangered by the State of California
CT Listed as threatened by the State of California
CSC California Department of Fish and Game species of special concern
CFP California Department of Fish and Game fully protected species
FE Listed as endangered by the Federal Government
FSS Federal (BLM, USFS) sensitive species
2 Category 2, candidate for Federal listing

Source: California Department of Fish and Game, Natural Diversity Data Base

As mentioned previously, the American osprey is a summer visitor which nests locally. Artificial nesting platforms have been constructed at Tinemaha Reservoir as a cooperative project by members of the Interagency Committee on Owens Valley Land and Wildlife (which was formed by LADWP and the Department of Fish and Game in 1970). Nesting pairs of osprey have successfully reared young on these nest sites each summer since 1974.

Upland Game Birds

While numbers of quail observed in the Valley may vary greatly from year to year due to variations in local precipitation and irrigation activities, the overall Valley population appears to be in good condition. Brood counts, conducted by the Department of Fish and Game in the late 1970s, show the average brood size continues to be comparable to pre-project populations, 10.6 young per adult pair (as compared to 9.6 in the 1960s).

In recent years, LADWP and the Department of Fish and Game have initiated a cooperative program to reintroduce populations of "wild" pheasants in northern Owens Valley. Early results of this program look promising.

Songbirds

Since 1970, 14 new species have been added to this category (some of these, according to the literature, should not be present west of the Rocky Mountains).

The yellow-billed cuckoo is now listed as an endangered species (Table 11-5). It is a rare summer resident in the riparian woodland habitat, feeding almost entirely on insects. This species has been known to breed locally (primarily on Big Pine and Lone Pine Creeks) since 1977.

MAMMALS

Fur and Game Mammals (furbearers)

Populations of species in this category remain in healthy and stable condition. Census data, collected by LADWP and the Department of Fish and Game, on jackrabbit and cottontail populations in the late 1970s and early 1980s showed an average of 0.58 jackrabbits and 0.41 cottontails per mile, as compared to 0.55 and 0.37, respectively, in the 1960s.

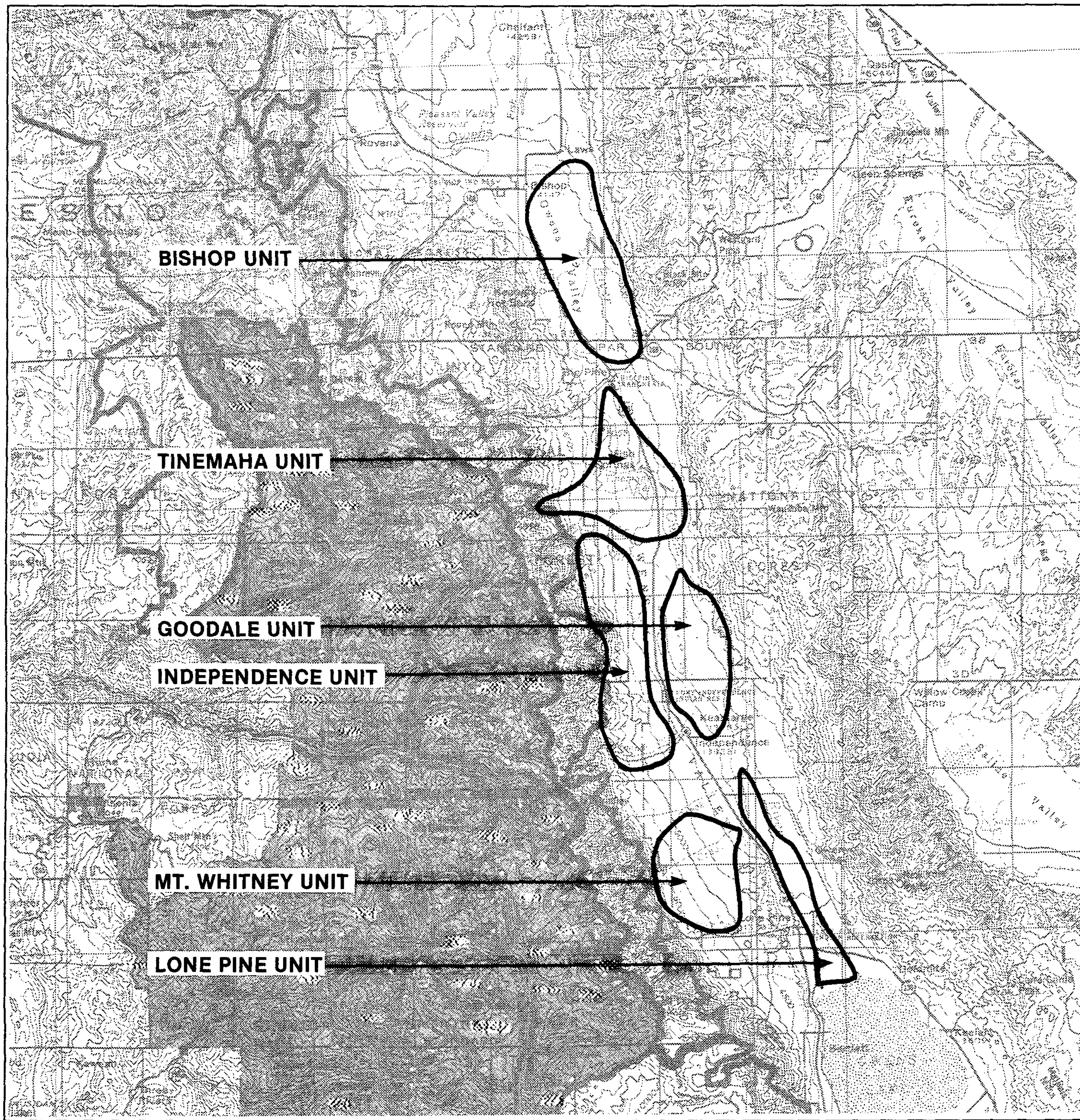
Big Game

In 1969, State law banned hunting of Tule Elk until the State-wide population reaches 2,000 animals. This law also set a limit of 490 animals for the Owens Valley. In 1972, a new herd was started by the introduction of animals from the Tupman Preserve. This herd (Mt. Whitney herd) now numbers over 60 animals. There are now six distinct herds within the Valley: Bishop, Tinemaha, Goodale, Independence, Lone Pine, and Mt. Whitney. The range and herd area boundaries are shown in Figure 11-2. In recent years, their numbers have risen to as high as 600, 110 animals more than the Fish and Game Code allows. On several occasions, surplus elk have been relocated to suitable habitats in their native range, west of the Sierras. The Department of Fish and Game conducts an aerial census by fixed-wing aircraft each year in order to monitor herd size and movements. It has been estimated that the actual herd size could be at least 15 percent greater than the figures shown in Table 11-6. Herd numbers should appear lower in years following capture and relocation of surplus elk; however, in some years, the spring calf crop may offset the number removed in the previous year. In recent years, as funding became available, an additional census was flown by helicopter, which allowed for observation of animals missed in fixed-wing census. The Interagency Tule Elk Habitat Management Plan, prepared in 1977 and updated in 1986, suggested the following numbers for each herd in the Valley:

Bishop	70 - 100
Tinemaha	80 - 100
Goodale	50 - 70
Independence	60 - 80
Lone Pine	40 - 60
Mt. Whitney	40 - 60
TOTAL	360 - 490

The Tule Elk have thrived in Owens Valley, and Valley herds are used as a source in relocation efforts in other parts of the State. Even after the removal and relocation of 167 elk in 1985, numbers recovered quickly to levels well above the 490 capacity set by the State Legislature.

Monitoring conducted as part of the Tule Elk Management Plan has shown that the habitat is in fair to good, and stable condition. Little, if any, of the Tule elk habitat lies within an area that



O W E N S V A L L E Y

FIGURE 11-2

TULE ELK RANGE AND HERD BOUNDARIES

Approximate boundary of Herd Range

SOURCE: LADWP, AQUEDUCT DIVISION

MILES 0 5 10

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TABLE 11-6

TULE ELK AERIAL CENSUS DATA - 1966-1989

YEAR		BULLS	COWS	CALVES	UNCLASSIFIED	TOTAL
1966	(August)	68	172	47	3	250
1967	(December)	64	128	54	0	246
1968	(August)	93	181	61	0	335
1969	(August)	68	209	51	2	330
1970	(August)	37	150	41	0	228
1970	(September)	59	175	58	0	292
1971	(September)	65	161	65	0	291
1972	(August)	52	194	34	0	280
1973	(August)	79	195	66	0	340
1974	(August)	65	245	65	0	375
1975	(August)	98	245	59	0	400
1976	(August)	101	300	77	0	478
1977	(August)	143	354	85	0	582
1978	(August)	124	301	89	0	514
1978	(September)	138	285	90	0	514
1979	(August)	143	262	82	0	487
1980	(August)	132	302	99	0	533
1981	(August)	121	263	92	0	476
1982	(August)	117	247	82	0	446
1983	(August)	111	269	115	0	495
1984	(August)	151	328	130	0	609
1985	(August)	158	365	77	0	600
1986	(August)	105	242	82	0	429
1986	(helicopter)	155	268	68	0	519
1987	(August)	129	268	68	0	465
1987	(helicopter)	151	302	71	0	524
1988	(August)	123	235	67	0	425
1988	(helicopter)	194	297	72	0	563
1989	(August)	104	241	54	0	399

may be affected by water gathering activities. To manage herd size, some restricted hunting by special permit only was allowed by the Department of Fish and Game in Owens Valley in 1989 -- the first such hunt since 1969.

Fish

In the early 1970s, wells were constructed at the Blackrock and Fish Spring Hatcheries to provide a more reliable water source (see Chapters 9 and 10). This firm water supply has increased hatchery production, resulting in an average annual planting of over one million fish each year in Owens Valley streams, compared to the 670,000 average each year during the 1960s.

The Owens tui chub was placed on the Endangered Species List in August 1986. This species is found in Mono County at Hot Creek; the Owens River gorge, just below the dam at Crowley Lake; and at Fish Slough. It has recently been found in Inyo County on the Cabin Bar Ranch property near Olancha. The Owens pupfish is found at the Fish Slough Native Fish Sanctuary, created by LADWP and the Department of Fish and Game in 1969; at Warm Springs, southeast of Bishop; and at several recently created habitats through the cooperative efforts of the Department of Fish and Game, LADWP, Bureau of Land Management, and the University of California. Warmwater fisheries have been enhanced by LADWP and Interagency projects as described in Chapter 5, including Buckley Ponds, Saunders Pond, and the Lower Owens River Project.

ENDANGERED, THREATENED, AND FULLY PROTECTED SPECIES

A list of the endangered, threatened, and fully protected species believed to exist in the Owens Valley is shown previously on Table 11-5. No adverse impact to the welfare of any of these species is expected as a result of the project. In fact, several of these species will continue to benefit by on-going LADWP and Interagency projects, as well as enhancement/mitigation projects.

SUMMARY

In general for the Owens Valley, the wetter the habitat the more value it has for wildlife. The riparian habitats (aquatic, marshland, and woodland communities) support more species and numbers of individuals than the other communities. The sagebrush communities are very valuable for prey species, for the larger predators, and as browse for the larger herbivores. The browse supports large numbers of deer, elk, and bighorn sheep during the winter months. The other communities, including alkali scrubland and alkali grassland, are much less productive from the wildlife standpoint. They do, however, contain unusual and valuable species.

Where two different habitat types come together, the "edge" between the two types will be more valuable as wildlife habitat than either type considered alone. The vegetative patterns in the Valley provide an abundance of "edge" and thus, an enormous variety of wildlife species.

Owens Valley plan communities, grouped into six major cover types found within the Valley floor study area, are described in detail in Chapter 10 Vegetation. Each community has unique aspects utilized by wildlife species. Different species may derive different benefits from the same habitat; likewise, individual species may utilize one or more habitats in several ways. All of the components of a community are, therefore, linked to each other and to the rest of the ecosystem in such a way that whatever may affect one component will likely affect the whole.

Any animal's environment must provide three basic requirements: food, water, and shelter. A given habitat can provide these requirements in a variety of ways. This is accomplished by differential use in both time and space. This diversified use of space can be demonstrated by water fowl in an aquatic community. Surface-feeding ducks eat plant materials and small aquatic animals from on or near the surface of the water. By diving, other kinds of ducks are able to obtain fish, mollusks, and roots that are found below the water's surface. Likewise, within the same habitat, the thin bills of the shorebirds allows them to probe in the mud and shallow waters for mollusks, crayfish, and other invertebrates, without competition with the ducks.

Wildlife species may utilize more than one community over a given period of time. For example, the great horned owl moves from the woodlands, where it roosts during the day, to open country, where it hunts at night. Another example is Tule Elk, which often feed in alfalfa fields during the night but spend the day in adjacent brushlands. They also use different parts of the Valley during different parts of the year with separate areas for calving, rutting and wintering.

Another important factor in the relationship that wildlife has to its habitat is the condition of the habitat. As an example, the fawn production of a deer herd is directly related to the condition of the range.

A number of species can be supported by a community or a combination of communities. This is possible because of the variety of ways communities can be used, both in time and space, by the animals present in them. The integrated manner in which the fauna and surroundings operate together makes it impossible to separate them and still have a functioning system.

11.4 IMPACTS AND MITIGATION MEASURES

The CEQA Guidelines indicate that a project will normally have a significant impact on vegetation and/or wildlife if it will: 1) substantially affect a rare or endangered species of animal or plant or the habitat of such species; or 2) interfere substantially with the movement of any resident of migratory fish or wildlife species. Based on these criteria, effects on the following resources were reviewed:

- Locations and/or principal concentrations of rare and/or endangered species, commercial species, or game species, and presence of suitable habitat
- Areas of permanent or seasonal concentrations of wildlife species
- Riparian habitat
- Wetlands habitat
- Native California plant communities
- Spawning and nursery stream habitat

The very factors that make the Owens Valley a particularly rich wildlife area also prohibit a detailed analysis of possible impacts to part of the Valley fauna. Habitat requirements of wildlife species are documented as they are known in the Pacific and southwest desert environments and projected for the Owens Valley. However, the overlapping of biotic provinces in the Valley provides wildlife species with a food source unlike that elsewhere in their range. The presence of a plant species may allow for the survival of some species of birds even though a plant usually utilized may be deficient. Since detailed data on the specific food requirements and energy flows are not complete for many wildlife species as they occur in the Owens Valley, it is difficult to express the impact on the fauna in actual numbers of individuals affected.

Changes in the composition and density of wildlife species will occur if man's activities cause changes in the vegetation cover and water availability. For example, if a vegetation type changed into a different type due to changes in water management practices, the wildlife occupying the site would find the changed conditions to be less than favorable for their survival. Although there may be other species for which the changed site would be ideal, because the new habitat has been created by disturbance, many years may be required for establishment of a stable, self-perpetuating vegetation cover. Even so, since such habitats would have less water available, less vegetation productivity would result and hence, the value of the habitat for supporting wildlife generally would have been degraded.

Although changes in water management have occurred on a large scale in the Owens Valley, no data exist to either determine the changes in wildlife populations in any one area, nor what species may have been displaced. Due to the lack of baseline information, the impacts from water management during the 1970 to 1990 period can only be described qualitatively.

Impact

11-1 **Changes of surface water management practices and increased groundwater pumping have altered the habitats on which wildlife depends. Vegetation changes have been significant in many locations throughout the Valley (see chapter 10). Therefore, impacts to certain species of wildlife, which were entirely dependent upon the impacted habitat, can be presumed to be significant.**

Observations by some Owens Valley residents suggest a general decrease in numbers of certain species of wildlife in the Owens Valley in response to water management. No census data exists, however, upon which to conclude the magnitude of the change nor to discern such changes from population responses to weather fluctuations. Because census data are lacking to quantify changes to wildlife populations, elements of the project, groundwater pumping, abandoned agriculture and increased diversion of runoff during wet years, cannot be used to describe the changes in wildlife populations. Therefore, by necessity, impacts to wildlife due to the second barrel must be described collectively.

It is apparent that weather patterns have a profound effect on wildlife populations both prior to 1970 and today, as well. Above normal amounts of Valley-floor precipitation and management of surplus water by spreading during wet years increase the value of the habitat for wildlife and hence populations of some species tend to rise dramatically.

Even though populations of wildlife may fluctuate with weather patterns, some Valley residents have reported that populations of wildlife species of personal interest to them have decreased and remained at lower levels after increased water export began during the early 1970s. Data are not available, however, to support this quantitatively. A long-time birder who has spent many years in the Valley has observed a general decline in riparian bird populations between 1972 and the present (Heindel, 1990).

Mitigation Measure

11-1 *The importance of riparian, marsh and aquatic habitats is recognized for mitigation of the impacts to wildlife that occurred during the 1970 to 1990 period. Wetter habitats support many more species and greater populations of wildlife; therefore, water management to create wet habitats will be used to mitigate the significant adverse impacts of the project.*

Since 1970, LADWP has worked on its own, and cooperatively with other agencies to manage water for creating, maintaining and enhancing wildlife habitat in the Owens Valley. Examples of these projects are the Farmer's Ponds and Buckley Ponds near Bishop, Klondike Lake near Big Pine, Billy Lake near Independence and the Lone Pine ponds. (These projects are shown in Table 4-1 and described in Chapter 5.) These projects will be continued under the project.

During 1981, the LADWP began releasing water to the lower Owens River through the Independence waste gate and Billy Lake. Likewise, after 1970 the LADWP provided water releases on an informal basis to the lower Owens River channel through irrigation return flows. Together, these releases augmented springflow to the river channel which maintained riparian vegetation and aquatic habitat (warm water fishery).

As part of the Agreement, a project to create and manage water flow in over 50 miles of the lower Owens River will be used to mitigate the adverse impacts upon wildlife that occurred because of water management practice between 1970 and 1990. The Lower Owens River project will be the subject of a separate CEQA evaluation, that will focus upon various management options.

In its entirety, the Lower Owens River project will create and manage over 1,000 new acres of wet habitats for wildlife. These new wet areas will be provided with water on a regular basis and, therefore, as wildlife habitat, are expected to surpass in quality the affected wet areas that received water only intermittently prior to 1970.

Additionally, since the channel of the river is a narrow strip, it will provide "edge" that will substantially increase the value for wildlife over that which would be provided by its area alone. Wildlife populations, especially birds associated with wet habitats, are expected to benefit throughout the region.

Because the Lower Owens River Project will be managed to provide benefits to wildlife that exceed the impact during the last two decades, this project will also mitigate for the reduction of wildlife populations that may have occurred because of the reduction of vegetation cover within well field areas. Additionally, this project will mitigate for the impacts on springs.

Impact

11-2 **The Agreement would protect native vegetation, improve fish and wildlife habitat, and result in beneficial impacts.**

Under the Agreement, the health and productivity of Valley vegetation is a main determinant of the amount of groundwater that could be pumped in any given hydrologic year. Adherence to the goals, principles, and management procedures provides great assurance that the native vegetation that provides habitat cover and food for wildlife would be maintained. Under the terms of the Agreement, rare or endangered species and their habitats as described at the beginning of this impact section, will be managed in a manner that is consistent with State and federal laws.

Mitigation Measures

11-2 *None required; however, LADWP would continue to conduct its program of on-going wildlife inventories, monthly wildlife censuses, raptor surveys, habitat assessments, breeding bird surveys, and other ecological studies.*

Other elements of the Agreement propose rewatering of up to 50 miles of the lower Owens River for purposes of creating improved habitat for a warmwater fishery. This proposal will be addressed in a future EIR; however, as an element of the proposed project, it will provide a beneficial impact on fish and wildlife populations. The Lower Owens River Project involves enhancement of wetland areas to improve upland game bird habitat, as well as creation of a warmwater fishery.

12. AIR QUALITY

12.1 SETTING

Air quality in the Owens Valley is generally excellent. However, during periods of high wind, dust in large quantities can be present in the air. Also, during the winter, woodsmoke can pollute the air in the vicinity of the valley towns.

REGULATORY BACKGROUND

Criteria Pollutants

The 1970 Clean Air Act gave the U.S. Environmental Protection Agency (EPA) the authority to set federal ambient air quality standards. The Act established primary standards to protect public health, and secondary standards to protect public welfare from effects such as visibility reduction, soiling, nuisance dust, etc. It also required that federal standards be designed to protect those people most susceptible to respiratory distress known as "sensitive receptors," such as asthmatics, the elderly, very young children, people already weakened by illness, and persons engaged in strenuous work or exercise. Pollutants subject to federal ambient standards are referred to as criteria pollutants.

In 1971, the EPA established federal standards for six major air pollutants: photochemical oxidants (ozone, O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), lead (Pb) and total suspended particulate (TSP). The TSP standard was changed in July 1987 to apply only to particulate matter less than 10 microns in diameter, termed PM_{10}.[1] The PM_{10} standard replaced the TSP standard because it was more easily associated with health effects resulting from inhalation into the human respiratory tract.

State ambient air quality standards, which are more restrictive than the federal standards, were established in California starting in 1969, pursuant to the Mulford-Carrell Act. The standards given in Table 12-1 represent those levels and durations estimated to be acceptable by the federal government and the State of California. Table 12-2 summarizes some of the adverse effects of major air pollutants.

AIR QUALITY AND CONTROL IN OWENS VALLEY

Air Monitoring

Air quality in Owens Valley is monitored by the Great Basin Unified Air Pollution Control District (GBUAPCD) located in Bishop, California. The airshed above Owens Valley is part of the Great Basin Valley Air Basin (GBVAB). GBVAB consists of Inyo, Mono, and Alpine Counties, which is the same as the jurisdiction of the GBUAPCD. Figure 12-1 shows the area covered by GBUAPCD and the locations of its monitoring sites.

Spot monitoring in the GBVAB, conducted by the California Air Resources Board (CARB) in 1972, identified particulates as the most likely air quality problem. Monitoring for particulates by the GBUAPCD began in 1979 with up to 18 monitoring sites. Currently there are 12 sites in the GBVAB monitoring particulates. All of these sites have been modified to monitor PM_{10}. Appendix E contains a history of the air monitoring sites in Owens Valley.

Sources of PM_{10}

One month after the EPA promulgated the PM_{10} standard, the Owens Valley between Tinemaha Reservoir and Haiwee Reservoir was designated as a Group I non-attainment area for the PM_{10} standard. The Group I designation indicates that the area has either a greater than 95 percent chance of violating the standard or, as is the case with the southern Owens Valley, has violated the standard. The entire Owens Valley has been designated non-attainment for the State PM_{10} standard. Under the federal Clean Air Act, the State of California was required to prepare a SIP to verify exceedances of the PM_{10} standard, identify the sources of the exceedances, and develop a plan to bring the sources into compliance within three to five years. A SIP was prepared by the GBUAPCD in December 1988. In the SIP the GBUAPCD reported exceedances of both federal and State PM_{10} standards. The federal PM_{10} 24-hour standard is 150 ug/m^3 (micrograms per cubic

TABLE 12-1

FEDERAL AND STATE AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	Federal Primary Standard	Federal Secondary Standard	California Standard
Ozone	1-hour	0.12 ppm	0.12 ppm	0.10 ppm
Carbon Monoxide	1-hour	35.0 ppm	35.0 ppm	20.0 ppm
	8-hour	9.0 ppm	9.0 ppm	9.0 ppm
Nitrogen Dioxide	1-hour	---	---	0.25 ppm
	Annual	0.053 ppm	0.053 ppm	---
Sulfur Dioxide	1-hour	---	---	0.25 ppm
	3-hour	---	0.5ppm	---
	24-hour	0.14 ppm	---	0.05 ppm
	Annual	0.03 ppm	---	---
PM_{10}	24-hour	150 ug/m^3	150 ug/m^3	50 ug/m^3
	Annual	50 ug/m^3	50 ug/m^3	30 ug/m^3
Lead	30-Day Avg.	---	---	1.5 ug/m^3
	Calendar Quarter	1.5 ug/m^3	1.5 ug/m^3	---

Notes:

Annual values for PM_{10} differ in that the Federal Primary and Secondary Standards are based on the annual Arithmetic Mean. The California Standard for PM_{10} is based on the Geometric Mean. All other annual values are for the average annual.

ppm = parts per million

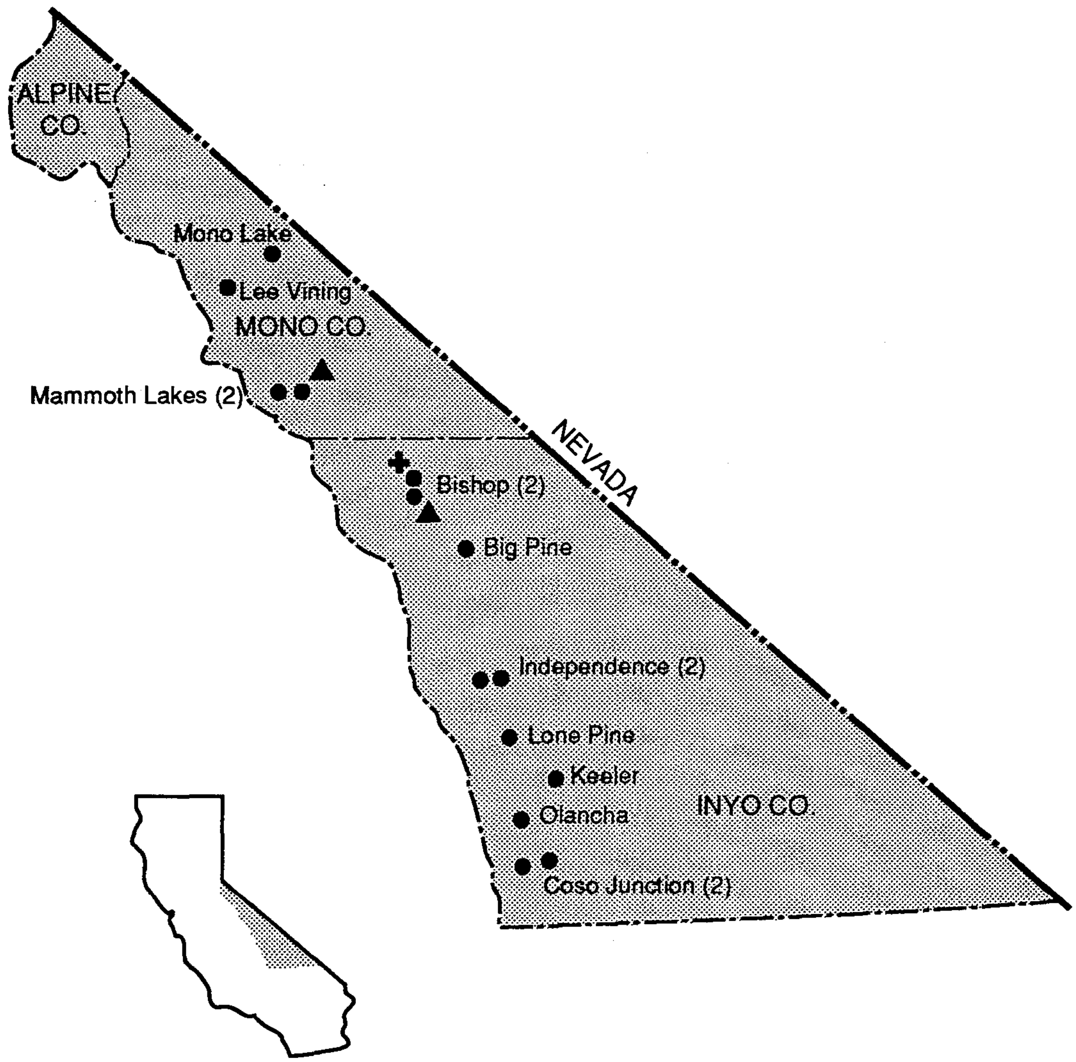
ug/m^3 = micrograms per cubic meter.

Source: California Air Resources Board.

TABLE 12-2

HEALTH EFFECTS SUMMARY OF THE CRITERIA AIR POLLUTANTS

Air Pollutant	Adverse Effects
Ozone	o eye irritation o respiratory function impairment
Carbon Monoxide	o impairment of oxygen transport in the bloodstream, increase of carboxyhemoglobin o aggravation of cardiovascular disease o impairment of central nervous system function o fatigue, headache, confusion, dizziness o can be fatal in the case of very high concentrations in enclosed places
Sulfur Dioxide	o aggravation of chronic obstruction lung disease o increased risk of acute and chronic respiratory illness
Nitrogen Dioxide	o risk of acute and chronic respiratory illness
Total Suspended Particulates and PM_{10}	o increased risk of chronic respiratory illness with long exposure o altered lung function in children o with SO_2, may produce acute illness o particulate matter 10 microns or less in size (PM_{10}) may be inhaled and lodge in the lungs. Children, the elderly and those with cardiovascular and respiratory problems are especially susceptible to increased respiratory problems and illnesses due to high levels of PM_{10}.
Lead	o impairment of blood function and nerve construction o behavioral and learning problems in children



O W E N S V A L L E Y

● Particulate Sampling Only

▲ Discontinued During Year

✚ Site Relocated

FIGURE 12-1

GREAT BASIN VALLEY AIR BASIN MONITORING STATIONS OPERATING DURING 1988

SOURCE:

MILES 0 20 40

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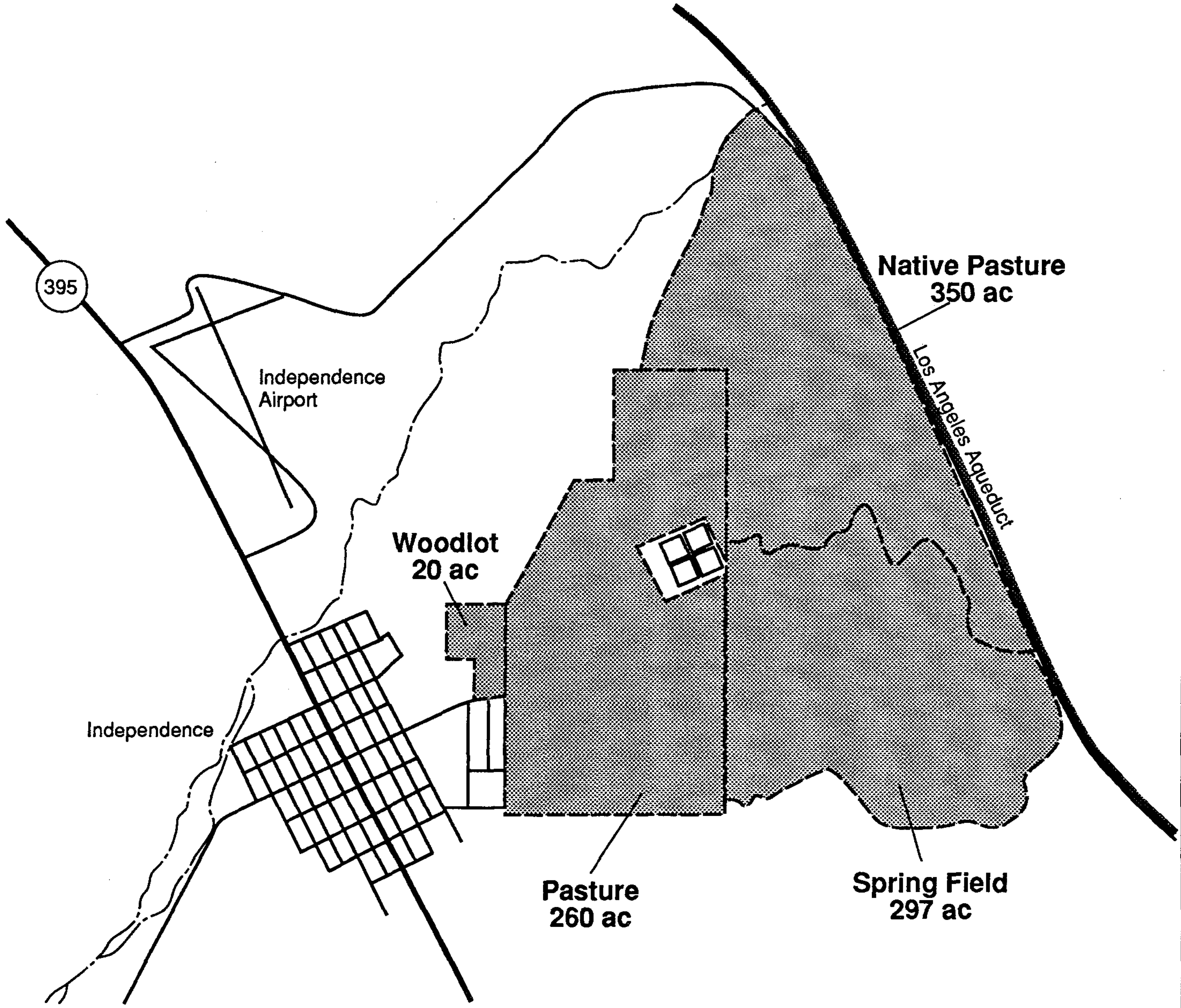
meter) and the State standard is 50 ug/m^3. A federal significant harm to health level also exists for PM_{10} which is 600 ug/m^3. A list of TSP values exceeding 100 ug/m^3, the old State standard through 1983, and PM_{10} values exceeding 50 ug/m^3, the State standard from 1984 to the present, for Owens Valley may be found in Appendix E. Sampling of TSP and PM_{10} at most monitoring sites typically occurs once every six days and therefore exceedances actually recorded may underestimate actual exceedances.

PM_{10} monitoring sites in the Owens Valley have verified Owens Lake as the predominant source of federal PM_{10} exceedances. Approximately 90 percent of the federal standard exceedances in the Owens Valley are caused by the dry lake bed of Owens Lake. A concentration of PM_{10} measured near Owens Lake was the highest measured in the U.S. (1,860 micrograms/m^3 at Keeler). Three other major contributors in addition to smaller open area sources constitute the remaining identified sources of PM_{10} in the valley. The two largest sources of PM_{10} after Owens Lake are the area east of the Owens River from Mazourka Canyon to Lone Pine and the dry shoreline of the Tinemaha Reservoir exposed when water levels in the reservoir are low. The area located just east of Independence has been a source of fugitive dust but has been mitigated by enhancement/mitigation projects. These areas are shown in Figure 12-2. According to the SIP, Owens Lake is the single major source causing violations of the federal and state standards with other major sources contributing to PM_{10} violations but not directly causing exceedances. Other sources, including dirt roads, barren land, and community emissions, could cause exceedances of the California PM_{10} standards.

Significant Contribution to Ambient Particulate Concentrations

It is not known if any single dust source, besides Owens (Dry) Lake, can itself cause a violation of the federal 24-hour PM_{10} standard. However, monitoring and visual evidence indicates that other sources could contribute significantly to a violation of either the federal or State PM10 standards.

For example, an area east of Independence has been a significant dust source. Approximately 700 acres in an area known as the Independence Springfield became barren as a result of groundwater pumping to supply the second aqueduct. On March 31, 1982, GBUAPCD documented a dust event at this site that contributed significantly to the ambient PM_{10} concentration. The area has



O W E N S V A L L E Y

FIGURE 12-2

E/M PROJECTS RELATED TO FUGITIVE DUST, INDEPENDENCE AREA

SOURCE: LADWP, AQUEDUCT DIVISION

FEET 0 1,000 2,000

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been mitigated by the establishment of alfalfa and native pasture under the Independence Pasture Lands and Springfield enhancement/mitigation projects described in Chapter 5.

It should be noted that this example is the only non-Owens (Dry) Lake dust event in the valley that has been documented in detail, although the particulate contribution estimate for this event is not necessarily a worst-case value for this type of source. This example can be used as a guide in understanding the effects on air quality that adverse impacts to vegetation can have in the valley.

Mitigation of the Owens (Dry) Lake Dust Problem

Mitigation of the Owens Lake problem is currently the subject of a separate multi-agency study headed by the GBUAPCD, with financial support from the State Lands Commission and LADWP. While information on the dry Owens Lake bed PM_{10} problems is presented below for general information, the mitigative actions to control PM_{10} are outside the scope of this EIR.

As required by the SIP, the GBUAPCD is investigating possible PM_{10} mitigation measures. A literature review of research conducted on the mechanisms and possible mitigation measures of PM_{10} generation at Owens Lake resulted in 13 potential mitigation concepts. These concepts can be condensed into three modes of action: 1) interfere with wind, 2) interfere with the production of alkali salts on the surface, and 3) flood or wet surface.

From these concepts, a plan was developed to investigate the technical and economic feasibility of various mitigation measures, including covering specified areas of the Owens Lake bed with gravel, flooding, leaching, sprinklers, compaction, crust modification, fence barriers, and tree rows. The final mitigation strategy will be based on the feasibility of implementing these controls.

Federal and State Attainment Requirements

Under the present federal clean air acts the Owens Valley must attain the PM_{10} standard as "expeditiously as practicable," or for the Group I area in the southern Owens Valley, within five years from the date the State Implementation Plan (SIP) is approved by EPA. The Owens Valley Group I SIP, which identifies a control strategy to bring the southern Owens Valley into attainment, is presently being reviewed by EPA. All federal requirements under the present federal Clean Air Act may be subject to change as a result of the present Clean Air bills going through Congress.

There is no specific deadline for the attainment of the California PM_{10} standards. However, among the many bills enacted during the closing days of the 1987-88 biennial session of the California Legislature was AB 2595 (Sher), the California Clean Air Act. AB 2595 was signed into law by Governor Deukmejian and became effective January 2, 1989. The legislation requires the CARB to report to the legislature by 1991 on the prospects for achieving the State standard for PM_{10}. Areas which exceed State standards are required to plan for attainment as soon as practicable. By 1991, the State is expected to determine the severity of the PM_{10} problem in all areas.

Additional Requirements Under California Health and Safety Code 42316

In 1983, the State legislature passed SB 270, which contains language allowing the GBUAPCD to require the City of Los Angeles to undertake and fund reasonable measures to mitigate the air quality impacts associated with the City's water-gathering operations. The law that went into effect in January 1984 under section 42316 of the California Health and Safety Code states:

> 42316. (a) The Great Basin Air Pollution Control District 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 and may require the City to pay, on an annual basis, reasonable fees, based on an estimate of the actual costs to the District of its activities associated with the development of the mitigation measures and related air quality analysis with respect to those activities of the City. The mitigation measures shall not affect the right of the City to produce, divert, store, or convey water and except for studies and monitoring activities, the mitigation measures may only be required or amended on the basis of substantial evidence establishing that water production, diversion, storage, or conveyance by the City causes or contributes to violations of State or federal ambient air quality standards.

12.2 PRE-PROJECT SETTING

Except for the short-term monitoring conducted by the California ARB in 1972, the air quality in the Owens Valley was not monitored until 1979, when GBUAPCD established monitoring sites at the locations shown on Figure 12-1. Quantitative data for pre-project air quality conditions are, therefore, not available for this analysis. However, anecdotal and other information regarding the conditions in the valley prior to 1970 may be used to make a qualitative assumption of air quality at that time.

Based on this information, it can be assumed that the following areas have been sources of blowing dust before the project was implemented: the area east of Owens River, from Big Pine to Lone Pine; the dry shoreline of Tinemaha Reservoir when exposed due to low water levels; the spillway area on the east side of Tinemaha Dam; some poorly vegetated lands that were formerly cultivated and irrigated; and Owens (Dry) Lake, which is the largest single source of dust in the valley. These sources of dust are, therefore, assumed to represent the background air quality for comparison with changes in air quality caused by the project.

12.3 IMPACTS OF THE PROJECT

Impacts on air quality in the Owens Valley resulting from the proposed project will be assessed for two time periods. The first analysis will address the effects of the project during the period from 1970 to 1990. The second analysis will begin in 1990 and assess any future air quality impacts resulting from implementation of the Agreement.

Air quality impacts have been divided into two categories: impacts due to increased groundwater pumping and impacts due to a reduction in irrigated acres. The CEQA Guidelines indicate that a project will normally have a significant effect if it would violate any air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentrations. For the purposes of this EIR, the CEQA Guidelines are used to determine whether a significant impact has occurred.

Not all impacts identified below are significant impacts. Significant adverse impacts are explicitly identified as such. The corresponding mitigation measures, unless otherwise noted, would be sufficient to reduce impacts to a less-than-significant level.

GROUNDWATER PUMPING 1970-1990

Impact

12-1 **Significant impacts on air quality resulting form groundwater pumping during the period 1970 to 1990 have occurred due to vegetation losses.**

The amount of vegetative cover and soil moisture play a significant role in the determination of whether or not winds are capable of lifting particulates from the soil into the air. Vegetative cover plays a dual role in reducing the probability that soil particulates will be suspended in the air by reducing ground shear and entrapping particulates in the air.

Soil moisture in the Owens Valley has varied significantly between 1970 and 1990. While some of this variation may be attributed to natural events, some may also be attributed to increased groundwater pumping. The best historical indicator of soil moisture conditions in Owens Valley is vegetative cover. As discussed in Chapter 10, Vegetation, the extent and distribution of plant species dependent on soils with higher moisture content have been reduced since implementation of the project in 1970. This reduction has primarily occurred in riparian, wetland and groundwater dependent shrub and meadow areas in the central portion of the valley. The loss of vegetation at the Independence Springfield, for example, contributed to generation of dust before the area was mitigated. Soils in many areas on the valley floor have a high silt content and release particulates when disrupted either mechanically or by the wind. While it is difficult to precisely quantify the amount of air pollutants that have been generated due to groundwater pumping during the period from 1970 to 1990, it can be qualitatively assumed that air quality has been adversely affected in those areas with soils susceptible to wind erosion that have experienced significant vegetation loss.

Mitigation Measures

12-1 *As part of the Independence Pasture Lands and Springfield enhancement/mitigation projects, approximately 730 acres of barren or near-barren ground have been revegetated with either native pasture or alfalfa. This area was affected by groundwater pumping and surface diversions of water. Approximately 40 acres remain barren and will be revegetated with native pasture. Under the Shepherd Creek enhancement/mitigation project, approximately 200 acres of poorly vegetated land has been converted to alfalfa. In addition, other areas that have the potential to cause significant adverse impacts to air quality have been identified in Chapter 10 and will be mitigated as set forth in that chapter.*

GROUNDWATER PUMPING -- AGREEMENT

Impact

12-2 **Increased groundwater pumping could result in elevated PM_{10} levels due to vegetation loss.**

The Agreement's primary goal is to protect vegetation in the Owens Valley while supplying water to the second aqueduct. The provisions of the Agreement require monitoring of vegetation, soil moisture and groundwater levels. If the goals of the Agreement are achieved, vegetation damage and any resulting significant air quality impacts from wind erosion of the exposed soil would be avoided.

Mitigation Measures

12-2 *See Mitigation Measure 12-1 above.*

IRRIGATED ACREAGE -- 1970-1990

Impact

12-3 **Significant impacts to air quality have resulted from the abandonment of irrigated lands to supply the second aqueduct.**

Some formerly irrigated lands have not successfully revegetated following abandonment of agriculture. The lands that have a complete, or near complete, lack of vegetation cover and have soils susceptible to wind erosion are the source of blowing dust.

Mitigation Measures

12-3 *Approximately 1,240 acres of formerly irrigated agricultural lands that had not successfully revegetated have been planted with pasture or alfalfa (see Chapter 10, mitigation measure 10-11). In addition, other areas that have the potential to cause significant adverse impacts on air quality have been identified in Chapter 10, Vegetation, and will be mitigated as set forth in that chapter.*

IRRIGATED ACREAGE -- AGREEMENT

Irrigated lands in the Owens Valley (including the Olancha-Cartago area) in existence during the 1981-82 runoff year or that have been irrigated since then, will continue to be irrigated in the future. This will not result in significant adverse impacts to air quality.

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1. Micron is defined as one-millionth of a meter.

13. ENERGY

13.1 INTRODUCTION

This chapter will describe the power plants that generate electricity using water from Owens Valley (see Table 13.1). It presents a discussion on power generation during the pre-project period, and the amounts of power generated by increased exports of water from Owens Valley during the period 1970-1990 with projections for the future project (1990 onwards) under the Agreement. The impacts of power production and consumption patterns resulting from the interim and future project are then presented.

13.2 SETTING

The City of Los Angeles was one of the first municipalities to operate a public power system in the western United States. The electric power system supplying Los Angeles began as an outgrowth of the development of Los Angeles' water system. Los Angeles's first power plants were built to aid in the construction of the first Los Angeles Aqueduct, commencing with the Division Creek and Cottonwood power plants in 1909. As Los Angeles grew and thrived, the demand for electrical energy was met through the creation of a sophisticated and efficient network of hydroelectric, fossil fuel, and nuclear generating plants as well as the purchase of power from other utility companies in western North America. Los Angeles presently serves its more than 3 million customers roughly 24 billion kilowatt-hours (KWH) of electricity per year. LADWP expects this rate of consumption to grow at a rate of 2.06 percent per year through the year 2007.

Water flowing through the Los Angeles Aqueduct system is used to generate electricity at a total of 12 hydroelectric plants. Seven of these plants (Upper Gorge, Lower Gorge, Control Gorge, Pleasant Valley, Big Pine, Division Creek, and Cottonwood Creek) use waters flowing towards or into the Owens Valley, one plant (Haiwee) uses water as it leaves the valley, and the remaining

TABLE 13-1

POWER PLANTS ALONG LOS ANGELES AQUEDUCT SYSTEM

POWER PLANT	DATE ON LINE	PLANT CAPACITY (Megawatts)	AVERAGE GENERATION (KWH/AF)
SUPPLIED BY WATER FROM MONO COUNTY			
Upper Gorge	1953	37.5	620
Middle Gorge	1952	37.5	635
Control Gorge	1952	37.5	640
SUPPLIED BY CREEKS IN OWENS VALLEY			
Big Pine	1925	3.2	860
Division Creek	1909	0.6	1000
Cottonwood Creek	1909	2.0	880
SUPPLIED BY WATER FROM MONO COUNTY AND OWENS VALLEY			
Pleasant Valley	1958	2.7	45
Haiwee	1927	5.4	100*
San Francisquito 1	1917-87	75.5	700* **
San Francisquito 2	1920-32	47.0	440*
Foothill	1971	10.0	400**
San Fernando	1922	6.4	170*
TOTAL ALL PLANTS		267.9	

* 1410 KWH/AF via 1st LAA
** 1100 KWH/AF via 2nd LAA

Source: Los Angeles Department of Water and Power, August 1990.

four (San Francisquito No. 1 and No. 2, Foothill, and San Fernando) use the aqueduct flow enroute between Owens Valley and Los Angeles. Only San Francisquito No. 1 and Foothill receive water directly from the second aqueduct.

13.3 PRE-PROJECT

Prior to completion and operation of the second aqueduct, Los Angeles had a generating capacity of about 180 megawatts at its power plants operating along the aqueduct system. At that time, these plants produced about eight percent of the Los Angeles's power supply.

As described in Chapter 4, the water exported from the Owens Valley during the pre-project period was primarily from surface water sources. Under normal runoff conditions, 132,000 AFY of water was exported from Owens Valley while another 202,000 AFY was derived from Long Valley and the Mono Basin. Long Valley and Mono waters generated power at the Upper Gorge, Middle Gorge, Control Gorge and Pleasant Valley plants while Owens Valley runoff powered the Big Pine, Division Creek and Cottonwood Creek plants. Combined flows were used at Haiwee, San Francisquito No. 1 and No. 2 and San Fernando. According to records of LADWP power production for the years 1960-1969, an average of 936,600 MWH of electrical energy was produced annually by hydroelectric plants operating along the aqueduct system. Of this, 723,500 MWH (77 percent) was produced from waters exported from Long Valley and the Mono Basin while 213,100 MWH (23 percent) was produced from Owens Valley waters.

During the six years prior to completion of the second aqueduct, Los Angeles purchased an average of 96,300 AFY of water from the Metropolitan Water District of Southern California (MWD). MWD delivered water to Southern California via the Colorado River Aqueduct, which was completed in 1941. Approximately 2,000 KWH/AF was consumed for each acre-foot delivered to Southern California. Los Angeles's purchases accounted for the annual consumption of 192,600 MWH of electrical energy.

13.4 IMPACTS AND MITIGATION MEASURES

The second aqueduct addition to the Los Angeles aqueduct system increased the flow of water into Los Angeles and presented opportunities for additional power generation. Subsequently, LADWP increased the efficiency of San Francisquito No. 1 plant and constructed a new hydroelectric generating plant at Foothill. These additions boosted the total generating capacity of the aqueduct system to 265.3 MW.

Based on normal year flow volumes, the changes in water gathering activities implemented by LADWP between 1970 and 1990 resulted in an increased average export from Long Valley/Mono Basin and from the Owens Valley watersheds. During this period, an average of 1,201,900 MWH of electrical energy was generated annually along the aqueduct system. This represented approximately five percent of total power production. Water exported from Long Valley and the Mono Basin produce 900,400 MWH (75 percent) while Owens Valley water generated 301,500 MWH (25 percent). The overall increase over the pre-project power production was approximately 28 percent. The 88,400 MWH increase in electrical power generation from the Owens Valley as compared with the pre-project, however, was partially offset by the power consumption occurring at the wells used to extract groundwater from the basin. During 1970-1990 period, this amounted to 220 KWH/AF or 20,900 MWH annually. The net increase in electrical energy derived from the increased extraction of water from the Owens Valley was, therefore, 88,400 MWH - 20,900 MWH which equals about 67,500 MWH. This amounts to an approximate 32 percent increase in average annual power production from the use of Owens Valley water.

If this electricity generated from the increase in Owens Valley diversions were unavailable, Los Angeles would have to obtain it from some other source to accommodate demand. According to LADWP officials, the most likely source of electricity to make up for power generated from the project would be fossil fuel plants, either coal or fuel oil.

Even with the increased flow of water through the aqueduct system afforded by the second aqueduct, LADWP has had to continue to make purchases of water from MWD. Water deliveries made from the State Water Project (SWP) through the MWD to Los Angeles involve a large net consumption of hydroelectric power to pump water uphill in southern San Joaquin Valley and over the Tehachapi Mountains into the San Fernando Valley. According to LADWP's 1979 Final EIR on the increased pumping of the Owens Valley groundwater basin, the SWP's pumping plants consumed 4,150 KWH/AF lifting water from the Sacramento-San Joaquin Delta to Southern California. Power generated at Castaic Power Plant in San Fernando Valley is about 980 KWH/AF for a net consumption by the SWP of about 3,170 KWH per acre-foot of water delivered.

Between 1970 and 1990, purchases from MWD have averaged 63,400 acre-feet per year. Since MWD's Colorado River supply consumes 2,000 KWH/AF of water delivered and it's SWP supply consumes 3,170 KWH/AF of water delivered, the water purchased by LADWP from MWD required an average annual energy expenditure of from 127,000 MWH to 200,000 MWH.

In the future, the export of Owens Valley water will be governed by the terms of the Agreement. These terms include provisions for new wells and the pumping of water for enhancement/mitigation projects. Although this will cause a slight increase in the energy consumption within the Valley, the pattern of uses is not expected to change substantially; however, the Agreement also imposes environmental constraints on future pumping volumes. These constraints could curtail exports of Owens Valley water to the extent that power generation is reduced. Since the resultant deficit in water supply would have to be made up from other sources, it could result in additional expenditures of energy for the production of the replacement water.

The primary impact on energy resources due to the increased extraction of water from the Owens Valley was the generation of an annual average of 88,400 MWH of energy from the increased aqueduct flows. Although the energy production was partially offset due to the 20,900 MWH expended in pumping groundwater from the Owens Valley groundwater basin, there remained 67,500 MWH per year of increased energy available to Los Angeles. This energy contributed to the climate of opportunity that has permitted growth and prosperity within Los Angeles.

The CEQA guidelines indicate that a project will normally have a significant adverse impact on energy resources if it would use energy in a wasteful manner or if it would encourage activities that result in the use of large amounts of energy. For purposes of this EIR, the net increase in electrical power generated by the increased water exported from Owens Valley would not be considered as constituting a significant adverse impact. Applying this criteria, no significant adverse impacts related to energy have been identified.

Although discussion of adverse impacts that are less than significant is not required by CEQA, increased availability of energy is discussed below as a less than significant impact. No mitigation measures are required.

Energy Produced Due To Pumping - 1970 to 1990

Impact

13-1 **The development of wells and pumping of groundwater for the second aqueduct resulted in an increase in the net energy balance of the overall aqueduct power system, with no significant impact on regional energy systems.**

Figure 13-1 presents a schematic diagram of the power generation system along the aqueduct system, illustrating the locations of power plants along each aqueduct. The region of groundwater pumping, and its associated consumption of electrical power begins in the north end of Owens Valley in the Bishop Cone and Laws well fields, extends south to the Lone Pine well field, and ends north of the Cottonwood Power Plant. Water pumped from this region, along with some surface water diversions, flows only through the second Los Angeles Aqueduct, where it generates power in the San Francisquito No. 1 (75.5-MW capacity), and Foothill (10.0-MW capacity) power plants.

An acre-foot (AF) of water passing through these plants created an annual average of about 1,100 KWH of power during the period following the construction of the second aqueduct. The annual average consumption of electricity by the wells in Owens Valley was about 220 KWH/AF. The estimated net energy balance for the second aqueduct was about 880 KWH/AF (1,100 minus 220 = 880 KWH/AF per acre foot pumped). Thus, there is a net gain of electrical power even with groundwater pumping. This is not considered a significant impact.

Mitigation Measure

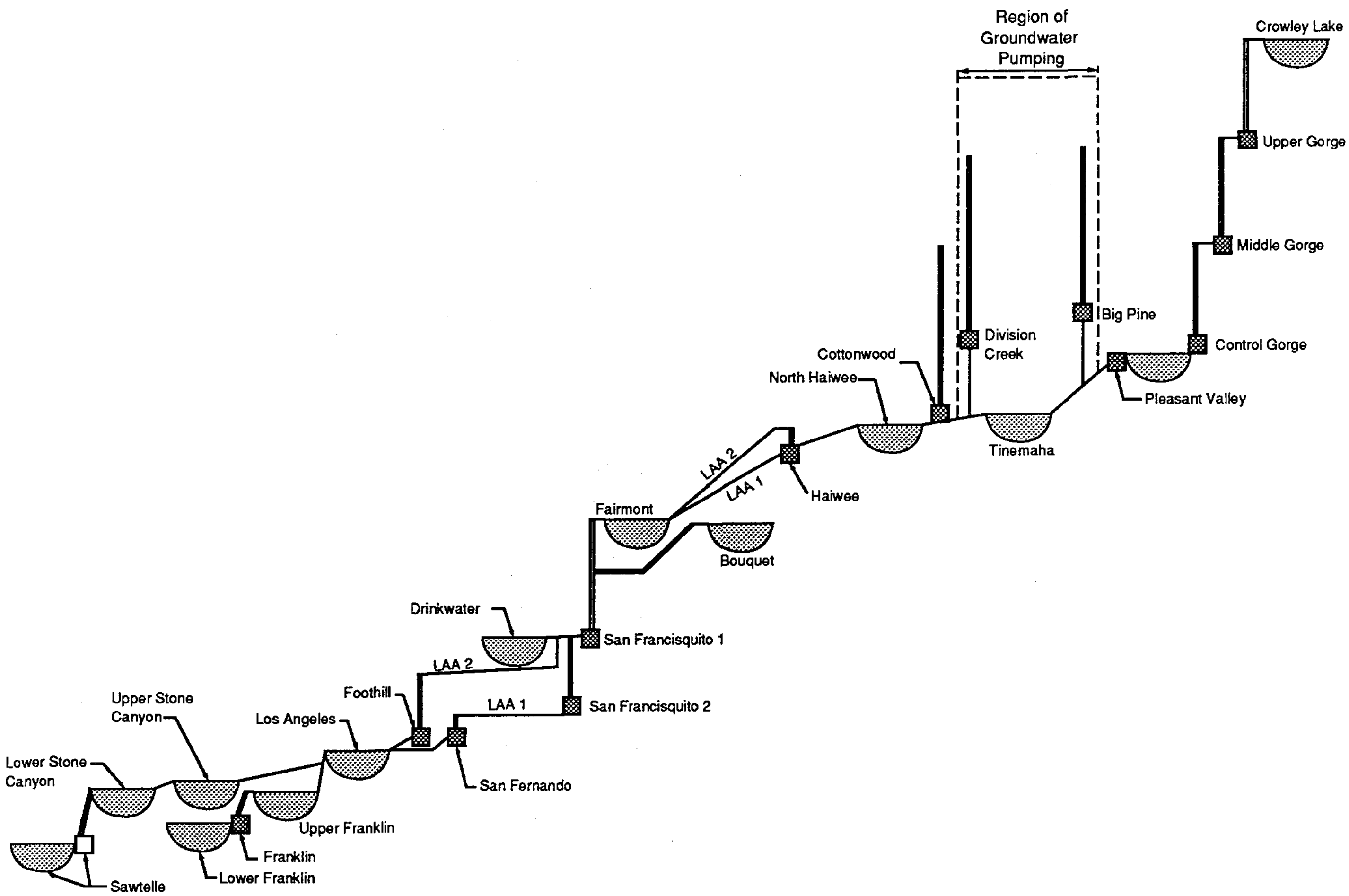
13-1 *None required.*

Energy Produced Due to Pumping - Agreement

Impact

13-2 **Less energy may be created due to environmental constraints.**

An impact of the future project stems from the need to replace lost generating capacity during future periods when environmental constraints cause reductions in Owens Valley water exports.



O W E N S V A L L E Y

LEGEND

Penstock
Power Plant (On Line)
Power Plant (Proposed)
Reservoir (In Service)

FIGURE 13-1

DIAGRAM OF POWER GENERATION ALONG LOS ANGELES AQUEDUCT SYSTEM

SOURCE: LOS ANGELES DEPARTMENT OF WATER AND POWER

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The more environmentally conscious policies of the Agreement may cause such short falls in generating capacity to be more frequent than has been the case in the past. However, since the power generated from Owens Valley waters during the interim period amounted to only about 1.3 percent of Los Angeles's energy supply, future reductions will not hold significant consequences.[1]

Mitigation Measure

13-2 *None Required.*

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1. LADWP, Statistical Report FY 1979-1988.

14. LAND USE AND ECONOMIC DEVELOPMENT

14.1 INTRODUCTION

This chapter describes the land use patterns and economy of Owens Valley preceding and following implementation of the proposed project, and it evaluates land use and economic impacts of the proposed project, including the Agreement. Data from a variety of sources, including LADWP, Inyo County, the City of Bishop, the State Board of Equalization, and other private and public data sources are presented to assist the analysis. Effort has been made to obtain data that is readily available from these agencies' historical records, including certain archival materials. The most current data on land use patterns and economic development were gathered from published sources. Where relevant, published sources are supplemented with information obtained through interviews with local officials.

14.2 BACKGROUND

Historical land use practices in Owens Valley revolved around agriculture. The agricultural economy grew steadily from the mid-1860s until the mid-1920s, when Los Angeles increased its purchase of Owens Valley land and its export of water from the Valley. As a result of these actions, the number of farms in the valley declined from 482 in 1925, to 218 in 1930, and 173 in 1945. Irrigated acreage declined from 74,958 in 1920, to 27,488 in 1930, and 23,625 in 1940.

By the early 1930s, Los Angeles owned about 211,665 acres, or approximately 82 percent of the valley floor. From this time onward, Los Angeles' land use policies determined the course of physical and economic development in Owens Valley.

The predominant land uses in Owens Valley are recreation and ranching. Recreational uses are focused primarily at the Owens River and its tributary streams, while most of the valley floor is used as rangeland for cattle and livestock and alfalfa production.

INYO COUNTY LAND USE POLICIES

Inyo County's 1990 General Plan (hereafter, the 1990 Plan) completed in 1984, assumed that Inyo County's population would grow to 26,000 persons in 1990, and that economic growth would occur primarily in the services sector as recreation activities continued to expand in response to heightened societal awareness of the environment.

The 1990 Plan set forth the following relevant land use policies
for Owens Valley stressing:

- Community expansion through the development of vacant parcels within and contiguous to the towns;
- Encourage public agencies to trade or sell land within or adjacent to the towns to stimulate planned and logical development;
- Support programs that seek to improve the condition of rangeland vegetation and maintain it at desired levels of quality, quantity, and diversity. Seek to minimize short-term disruptions and insure the long-term stability and health of the livestock industry on rangeland and improvement programs;
- Promote recreation and a diverse tourist industry; and
- Management of groundwater basins to assure quality and quantity of water for beneficial uses.

The goals articulated in Inyo County's General Plan form the broad outline of the County's position regarding the second Los Angeles Aqueduct. Inyo County stated in the 1990 Plan that there should be comprehensive water basin planning in Owens Valley that would determine a balanced approach to supplying Los Angeles with water for equitable economic development of both regions and protection of the environment. Enhanced coordination for planning by the various public agencies and private interests in the Valley would achieve this balanced approach.

LAND OWNERSHIP

Land ownership is divided between the federal government and the City of Los Angeles. Only a small amount of land outside of the towns is privately owned. In general, Los Angeles' land holdings are located on the valley floor and in Round Valley, to the northwest of Bishop. The intermediate slopes of the Sierra Nevada and Inyo/White mountains are managed by the U.S. Bureau of Land Management, and the mountain ranges themselves are part of the Inyo National Forest. Table 14-1 shows the pre-1970 land ownership in Owens Valley.

LADWP LAND USE POLICIES

LADWP's policies on permissible uses for its Owens Valley properties are implemented through its leases. LADWP has two types of leases which implement its land use policies: ranch leases and commercial leases.

Ranch Leases

Most of the acreage LADWP owns in Owens Valley is regulated through its ranch leases. LADWP is charged with managing its lands in a manner which will protect Los Angeles' water rights and the quality of its water supply. LADWP's basic land use policy in leasing or renting Los Angeles' properties in Inyo County is "to allow only such uses which are compatible with the reason for the ownership of these lands." These uses include non-polluting agriculture and the raising of sheep, cattle, and horses. The production of alfalfa is permitted on a smaller scale. Other permitted passive uses of Los Angeles-owned lands include: fishing, hiking, photography, horseback riding, and other such low-impact uses. Camping is not allowed (except in designated areas), and off-road vehicles are prohibited (except on existing roads and trails). These land use policies effectively limit agricultural development and other forms of economic development. However, these policies also have a beneficial effect by protecting the visual and aesthetic values in Owens Valley, and creating unique recreational areas for tourists.

Under the ranch lease system, some Los Angeles-owned lands are classified for irrigation. When lands so classified are not irrigated due to drought conditions, the lessee receives a rent reduction or "dry finding" adjustment credit.

The provisions of ranch leases also contain specific conditions governing land use and land management. The standard ranch lease includes specific requirements of the lessee such as obtaining permission of LADWP before conducting any controlled burnings, constructing buildings, or making improvements. Lease provisions also require cooperation in the protection of Tule Elk and compliance with the existing State Department of Fish and Game Tule Elk Management Plan.

TABLE 14-1

LAND OWNERSHIP IN INYO COUNTY (PRE-1970)
(1,000s of Acres)

Agency	Acreage	Percent of Total
U.S. Federal Government	5,261.1	81.5
Forest Service	767.9	11.9
Bureau of Land Management	2,325.0	36.0
Death Valley National Monument	1,710.0	26.5
Department of Defense	458.2	7.1
State of California	117.3	1.8
Department of Conservation	0.4	0.0
Department of Finance	101.9	1.6
Department of Public Works	5.3	0.1
State Controller	9.7	0.2
Cities (including Los Angeles)	245.0	3.8
County	6.0	0.1
School Districts and Special Purpose Districts	NA	NA
Withdrawn from Entry	395.0	6.1
Total Governmental	6,024.4	93.3
Private	433.8	6.7
Total Land Area	6,458.2	100.0

Source: Inyo County, 1990 General Plan for Development, 1965; EIP Associates.

Commercial Leases

After Los Angeles had purchased most of the land on the Owens Valley floor, the businesses began to decline and valley merchants demanded reparations. In 1929, the Board of Water and Power Commissioners (which sets policy for LADWP) announced that Los Angeles would purchase any remaining private property in the valley offered to Los Angeles, including town lots.

By 1933, Los Angeles owned 85 percent of the residential and commercial town properties. The commercial properties were then leased to the valley's merchants. The terms of the leases were five years maximum length.

LADWP Sale of Town Properties

In response to Owens Valley residents' requests, Los Angeles began selling its town properties in late 1938. In disposing of these properties, the Board of Water and Power Commissioners determined that Los Angeles could sell town properties while retaining the water rights, thereby safeguarding its interests. Resolution No. 179, which set forth the Board's policy on disposition of Owens Valley town properties also declared that the policy of LADWP "is and shall be to offer for sale and to sell ... lands and improvements ... at such prices as shall constitute the reasonable market value of" the town properties. By 1944, approximately 750 parcels of the town properties owned by LADWP had been sold on a direct sale basis.

In 1945, the Los Angeles City Attorney rendered a new interpretation of the City Charter, which stated that all future sales and leases were to be put up for competitive bid for town properties. Local citizens resisted this ruling, fearing that their businesses or homes would be sold out from under them, or leased to someone else. In 1945, their state senator, Charles Brown, sponsored a bill, later known as "The Brown Act," which stated, in effect that Los Angeles had to give the right of first refusal in selling or leasing its property to the person who had rented it for two out of the preceding three years. This policy effectively limited Los Angeles' disposition of town properties to the sale of vacant properties only. However, between 1945 and 1967, a series of public auctions were held and 505 parcels were sold. After that, however, no additional auctions of surplus properties were held for several years.

ECONOMIC DEVELOPMENT

Regional economies are considered to have two essential components: "basic industries" (sometimes called export industries), which export products or services to areas external to the region and bring income into the region from outside; and "non-basic industries" (sometimes called local-serving industries), which provide goods and services to local residents who live and work in the region.

In economic terms, demand for indigenous exports (exported goods or services produced by local businesses) from the Owens Valley economy are concentrated in tourism (retail trade sectors, including gas stations, restaurants, recreation services, and lodging services), agriculture, manufacturing, and mining activities.

There are two sources of demand for Owens Valley exports, the U.S. economy as a whole, and the Los Angeles region. LADWP's water export from Owens Valley does not represent a locally controlled export. Los Angeles' land ownership and management practices serve to restrict development in Owens Valley as a means of protecting the watershed and ultimately Los Angeles' water supply in the Valley. Put another way, because of Los Angeles' land ownership, it exports not only water from the Valley, but also restricts development in the Valley, thereby effectively "importing" economic development constraints. In the absence of Los Angeles' prevalence in land ownership, such constraints would not exist.

Both components of Owens Valley export employment (goods and services) create demand for the local-serving sectors in the region. These sectors include: business and personal services, local-serving retail trade (food, drugs, apparel, and other merchandise for residential living), financial, insurance and real estate services (FIRE), and local government services.

14.3 PRE-PROJECT SETTING

LADWP LAND OWNERSHIP

By the 1960s most of the land on the floor Owens Valley was owned by Los Angeles, which also acquired the accompanying water rights. This meant Owens Valley towns could not expand onto adjacent lands, developers could not acquire lands for building, and industries could not locate in the Valley because of constrained labor and housing markets. According to the 1990 Plan, in 1968, Los Angeles owned about 241,834 acres of land in Inyo County, all of it on, or adjacent to, the floor of Owens Valley.

LADWP LAND USE POLICIES

Ranch Leases

Prior to 1968, LADWP leased 192,000-acres for agricultural purposes. Of this total, 21,800 acres were classified as irrigated, 2,200 acres of which were used for production of alfalfa or other crops. During the ten year period preceding 1963, livestock production in the Valley averaged 24,600 head of cattle. Table 14-2 shows the pre-1970 land uses.

As early as 1948, LADWP began granting five-year ranch leases to local cattle ranchers, that were re-issued without competitive bidding. Approximately 89 percent of the lands for lease would receive no water. On the remaining 11 percent of the lands leased, rents would be prorated according to the amount of water actually delivered on a strictly annual basis, depending on how much excess runoff water was available after deliveries to Los Angeles. According to a 1966 report by LADWP to the State Legislature, surplus water available in wet years could be used to irrigate about 30,000 acres within Inyo and Mono Counties. During dry years, the irrigated acreage was reduced to about 3,000 acres (see Figure 14-1).

Commercial Leases

Prior to 1970, LADWP leased most of the commercial properties it owned in the Owens Valley towns. The terms of these leases were five years maximum.

LADWP Sale of Town Properties

As stated earlier, between 1945 and 1967, Los Angeles sold 505 parcels through a series of public auctions, resulting in a substantial reduction of the percentage of urban lands owned by Los Angeles in Owens Valley.

ECONOMIC DEVELOPMENT

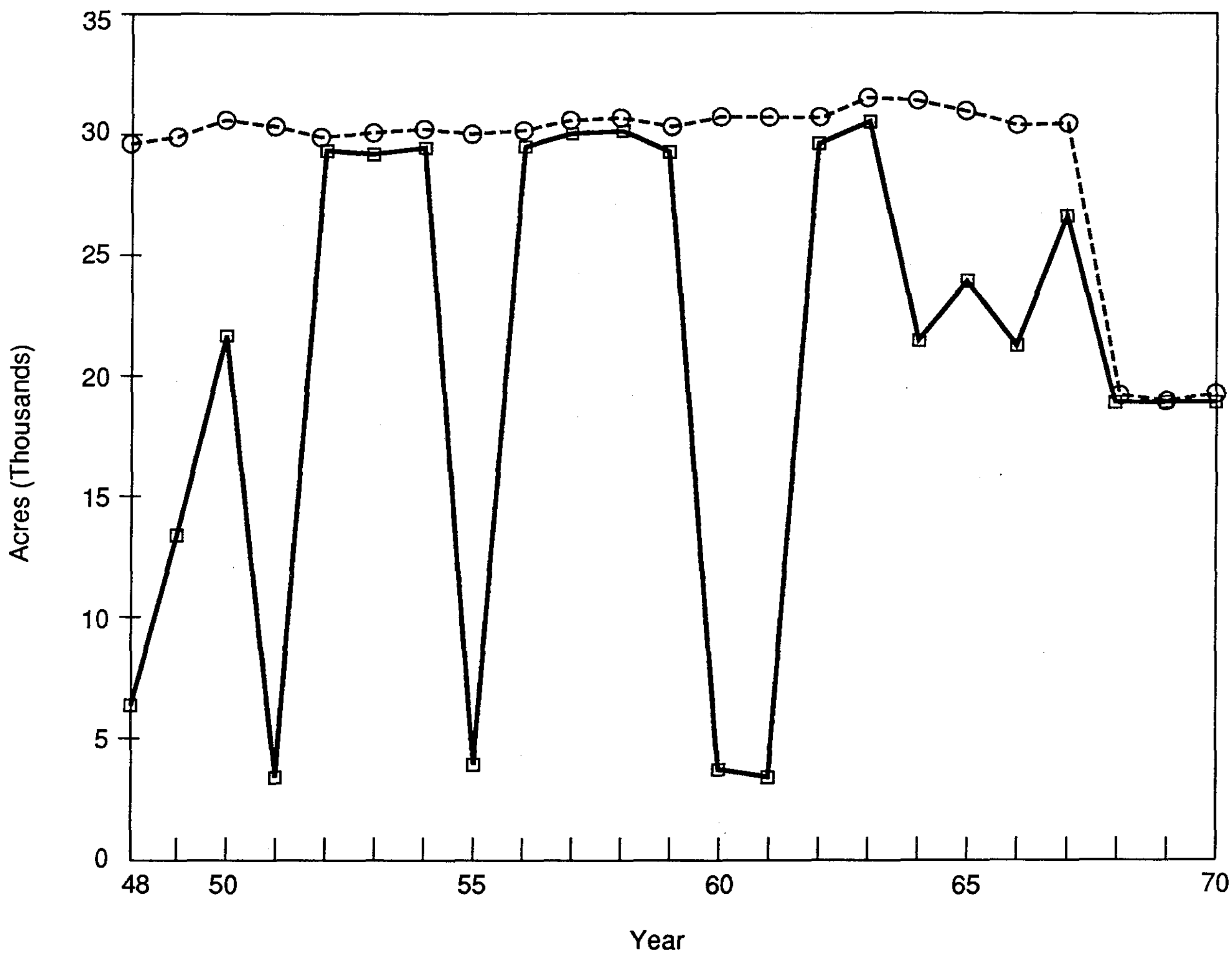
Employment trends in the export sectors of the Owens Valley economy between 1960 and 1970, reflect the economic dependence of the Valley on recreation and retail trade, and constrained

TABLE 14-2

LAND USES IN INYO COUNTY (PRE-1970)
(1,000s of Acres)

Use	Acreage	Percent of Total Land Area	Percent of Used Land Area
Agriculture	371.0	5.7	11.28
Military	458.2	7.1	13.8
Recreation	2,460.4	38.1	74.3
Inyo National Forest	767.9	11.9	23.2
Death Valley National Monument	1,690.1	26.2	51.1
Other	2.4	0.0	0.1
Transportation	12.8	0.2	0.4
State Roads	5.3	0.1	0.2
County Roads	5.6	0.1	0.2
Airports	1.9	0.0	0.1
Urban Uses	8.2	0.1	0.2
Total Used Land Area	3,310.6	51.3	100.0
Vacant Land Area	3,147.6	48.7	NA
Total Land Area	6,458.2	100.0	NA

Source: Inyo County, 1990 General Plan for Development, prepared by Herman D. Ruth + Associates; EIP Associates.



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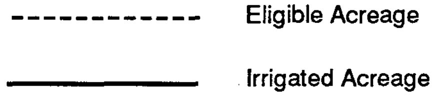

FIGURE 14-1

ACRES OF IRRIGATED LADWP LANDS IN INYO AND MONO COUNTIES PRE-1970

SOURCE: LOS ANGELES DEPARTMENT OF WATER AND POWER

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urban development. In keeping with general national trends, the region saw strong population growth between 1960 and 1970. Inyo County grew by nearly 4,100 new residents during the decade, as shown in Table 14-3. By 1960, the distribution of employment by sector in the Inyo-Mono region was already oriented toward recreation and lodging activities (see Figure 14-2). Inyo County gained over 1,000 net housing units, and the vacancy rate appeared to be high at around 20 percent. In the City of Bishop, housing demand increased with a net gain of over 330 units and a vacancy rate of about 9 percent. During this period, the Bishop area continued its role as a center of employment and residence for the region.

Recreation and Retail Trade

The significance of recreation and tourist activity in the Inyo County economy is also apparent in taxable retail sales data covering the period 1960 to 1970. The data presented in Figure 14-3 show that Inyo County experienced real growth in total retail activity between 1960 and 1970, of about 45 percent, after adjustment for the effects of inflation.

Retail trade typically is subject to the same cyclic effects experienced in employment and household income trends; however, taxable retail sales show significant growth in most retail sectors during the 1960s in real terms. Figure 14-3 illustrates the relative growth in most retail sectors in Inyo County, including eating and drinking (restaurants and bars) , auto-related outlets (primarily service station taxable retail sales) and other retail (which includes sporting goods and specialty retail stores). Real taxable retail sales in restaurants increased by 75 percent from 1960 to 1970; in auto-related businesses by ten percent; in other retail by 149 percent.

Construction and Urban Development

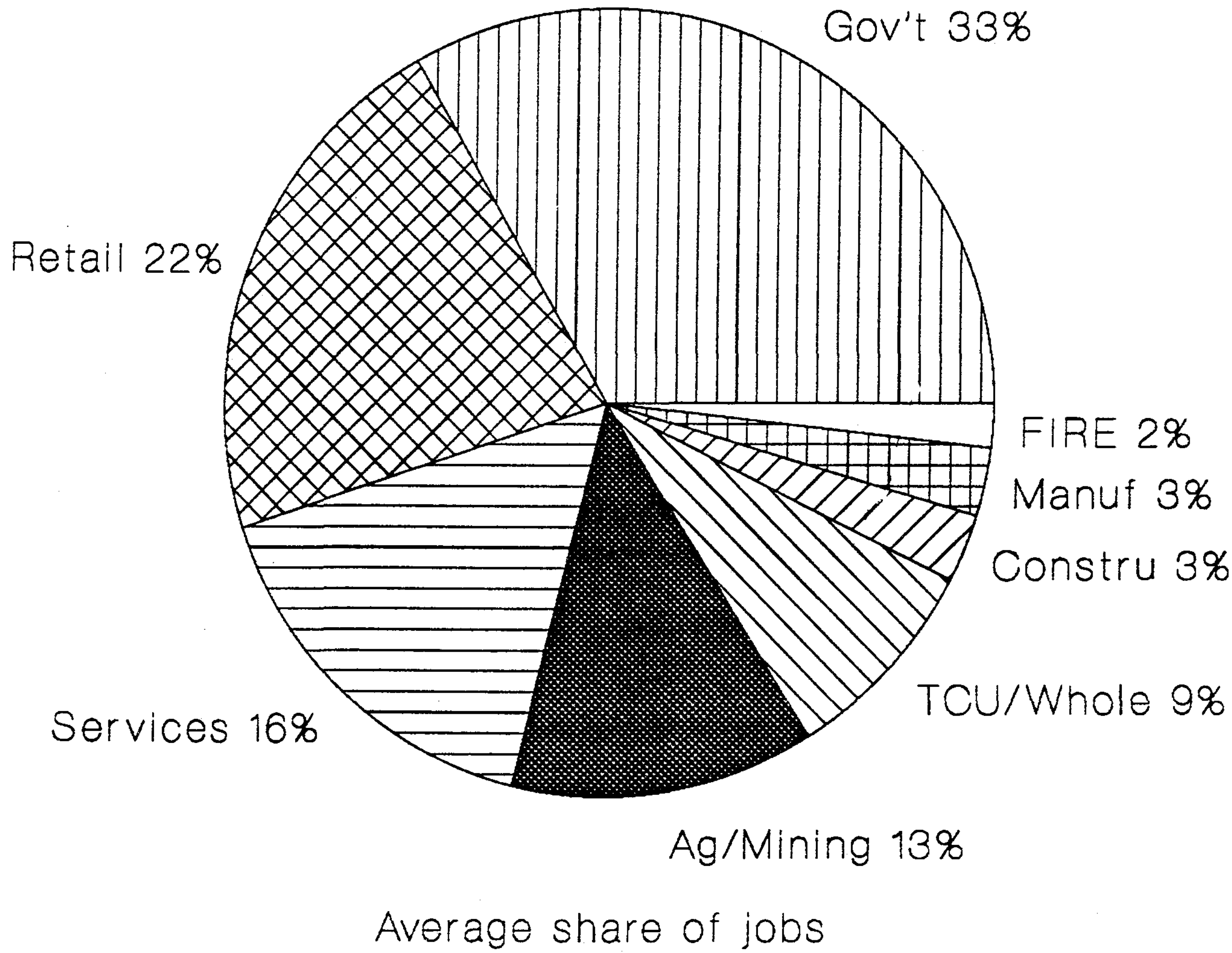
As noted earlier, since 1938, Los Angeles has had a policy of selling off town lots acquired originally as part of earlier Owens Valley residents' demands for economic reparations in the 1930s. Lot sales by LADWP fluctuate, but over time Los Angeles has released urban land for commercial and residential development. Despite this policy, however, urban development has been constrained in Owens Valley due to Los Angeles' ownership of lands on the urban fringe of the Valley's towns.

TABLE 14-3

POPULATION AND HOUSING SUMMARY, 1960-1990
CITY OF BISHOP AND INYO COUNTY

Population	City of Bishop	Unincorp. County	Total County
1960	2,875	8,809	11,684
1970	3,498	12,073	15,571
1980	3,333	14,562	17,895
1990	3,715	14,726	18,441
Percent Change, 1960-70	21.67%	37.05%	33.27%
Percent Change, 1970-80	-4.72%	20.62%	14.93%
Percent Change, 1980-90	11.46%	1.13%	3.05%
Total Housing Units			
1960	1,129	3,975	5,104
1970	1,450	4,685	6,135
1980	1,712	6,772	8,484
1990	1,883	7,573	9,456
Percent Change, 1960-70	28.43%	17.86%	20.20%
Percent Change, 1970-80	18.07%	44.55%	38.29%
Percent Change, 1980-90	10.00%	11.83%	11.46%
Occupied Housing Units			
1960	1,028	3,034	4,062
1970	1,388	4,148	3,536
1980	1,560	5,654	7,214
1990	1,777	5,965	7,742
Percent Change, 1960-70	35.02%	36.72%	36.29%
Percent Change, 1970-80	12.39%	36.30%	30.31%
Percent Change, 1980-90	13.91%	5.50%	7.32%
Vacancy Rate			
1960	8.9%	23.7%	20.4%
1970	4.3%	11.5%	9.8%
1980	8.9%	16.5%	15.0%
1990	5.6%	21.2%	18.1%
Household Size			
1960	2.80	2.90	2.88
1970	2.52	2.91	2.81
1980	2.14	2.58	2.48
1990	2.03	2.43	2.33
Percent Change, 1960-70	-9.89%	0.34%	-2.43%
Percent Change, 1970-80	-15.22%	-39.95%	-33.04%
Percent Change, 1980-90	-5.14%	-5.82%	-6.05%

Source: U.S. Censuses of Population and Housing, 1960, 1970 and 1980; California Department of Finance, Report E-5, January 1990.



O W E N S V A L L E Y

FIGURE 14-2
INYO-MONO REGIONAL EMPLOYMENT STRUCTURE, PRE-1970

SOURCE: STATE BOARD OF EQUALIZATION

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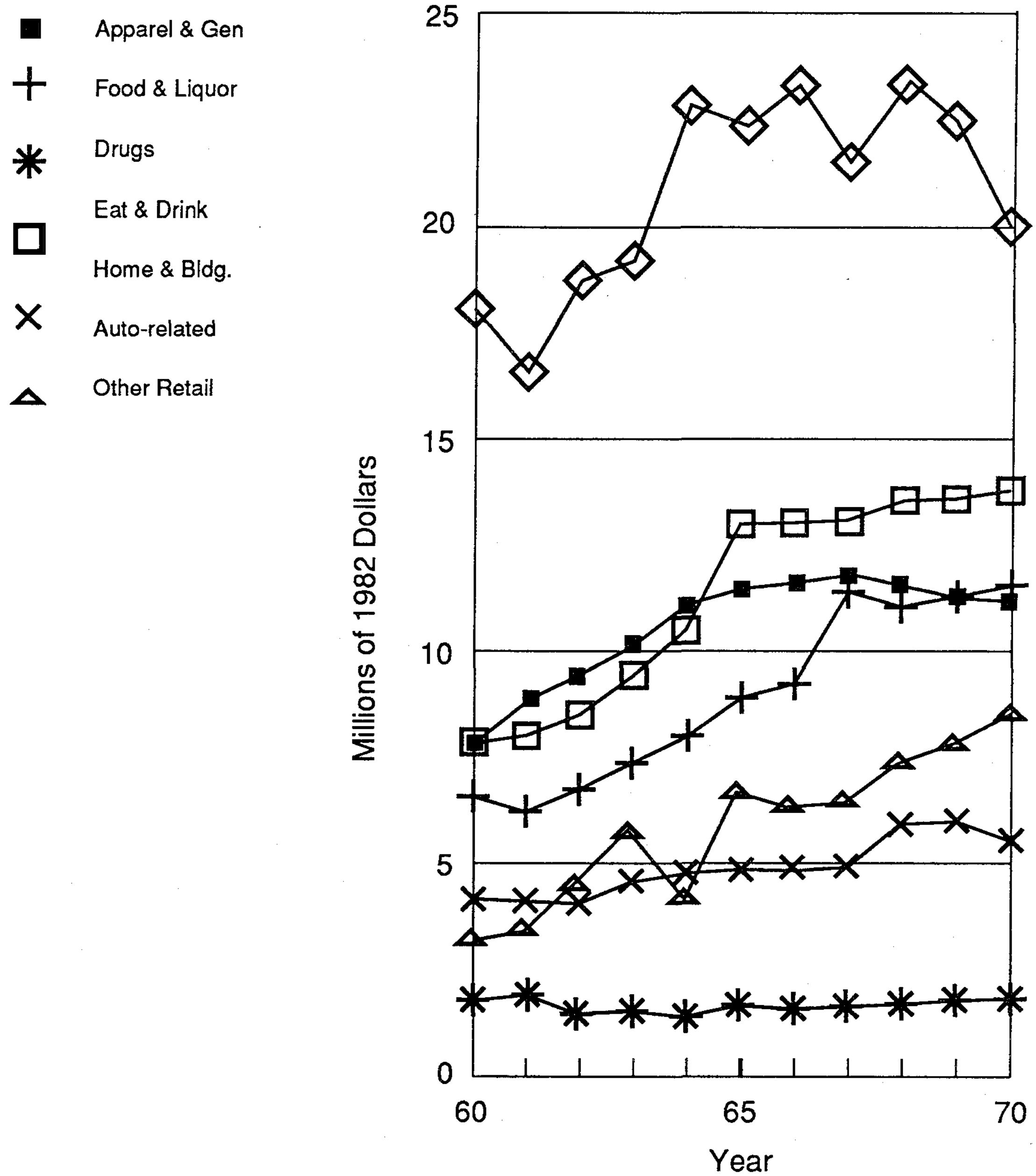

O W E N S V A L L E Y

FIGURE 14-3

TAXABLE RETAIL SALES IN INYO COUNTY, PRE-1970

SOURCE: LADWP, AQUEDUCT DIVISION

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Data on the number of building permits issued annually in Inyo County from 1967 to 1970 indicate a low level of building activity. Over that period, seven single family housing units were added to Bishop's housing stock, while just over 220 single family units were added to Inyo County as a whole. Twenty multi-family units were added in Bishop (also the total for Inyo County) over the same period.

Commercial construction was steady, if not significant, between 1967 and 1970. The value of industrial building permits made up about nine percent of total non-residential building permit valuation during this period, reflecting both the trend in Owens Valley toward retail and service activity, as well as the constraints on industrial development posed by a lack of land on the urban fringes of Valley towns.

14.4 IMPACTS OF THE PROJECT

In this section, LADWP's land use and ownership policies following 1970, are examined to determine whether the proposed project resulted or will result in significant land use or economic effects to Owens Valley. The impacts of the project are discussed in the context of LADWP's land use policies and economic development in Owens Valley.

Since the proposed project consists of practices and facilities that began more than 20 years ago, together with the Agreement, the analysis of the impacts of the proposed project will be presented in two components. The first will describe the impacts of the project in the period from 1970 to 1990. The second component will describe future impacts of the project resulting from the implementation of the Agreement.

If a significant land use or economic impact is identified under either component, the mitigation that will be implemented to reduce the impact to less than significant is also described. Unless explicitly identified as significant, all impacts described are less than significant.

Irrigated Lands - 1970 to 1990

Impact

14-1 **In anticipation of the proposed project, by 1968 LADWP reduced the amount of land classified as irrigated in Owens Valley from 21,800 to 11,600 acres.**

As part of the proposed project, LADWP irrigated acreage was reduced and ranch leases were modified to provide a firm allocation of five acre-feet of water per acre. Irrigated leased lands solely dependent on diversions from a creek for irrigation water would receive the full allotment only when sufficient water was available from the natural flow in the creek. Other irrigated leased lands would receive pumped groundwater, where available, to stabilize water supply during drought years.

Figure 14-4 shows that as a result of the modification of ranch leases, water deliveries to ranchers were stabilized. The land that was removed from irrigation was mainly poor quality pasture and the higher quality lands that remained irrigated benefited from the firm allotment of water. Alfalfa production in the Valley also increased as a result of the consistent water supply.

Mitigation Measure

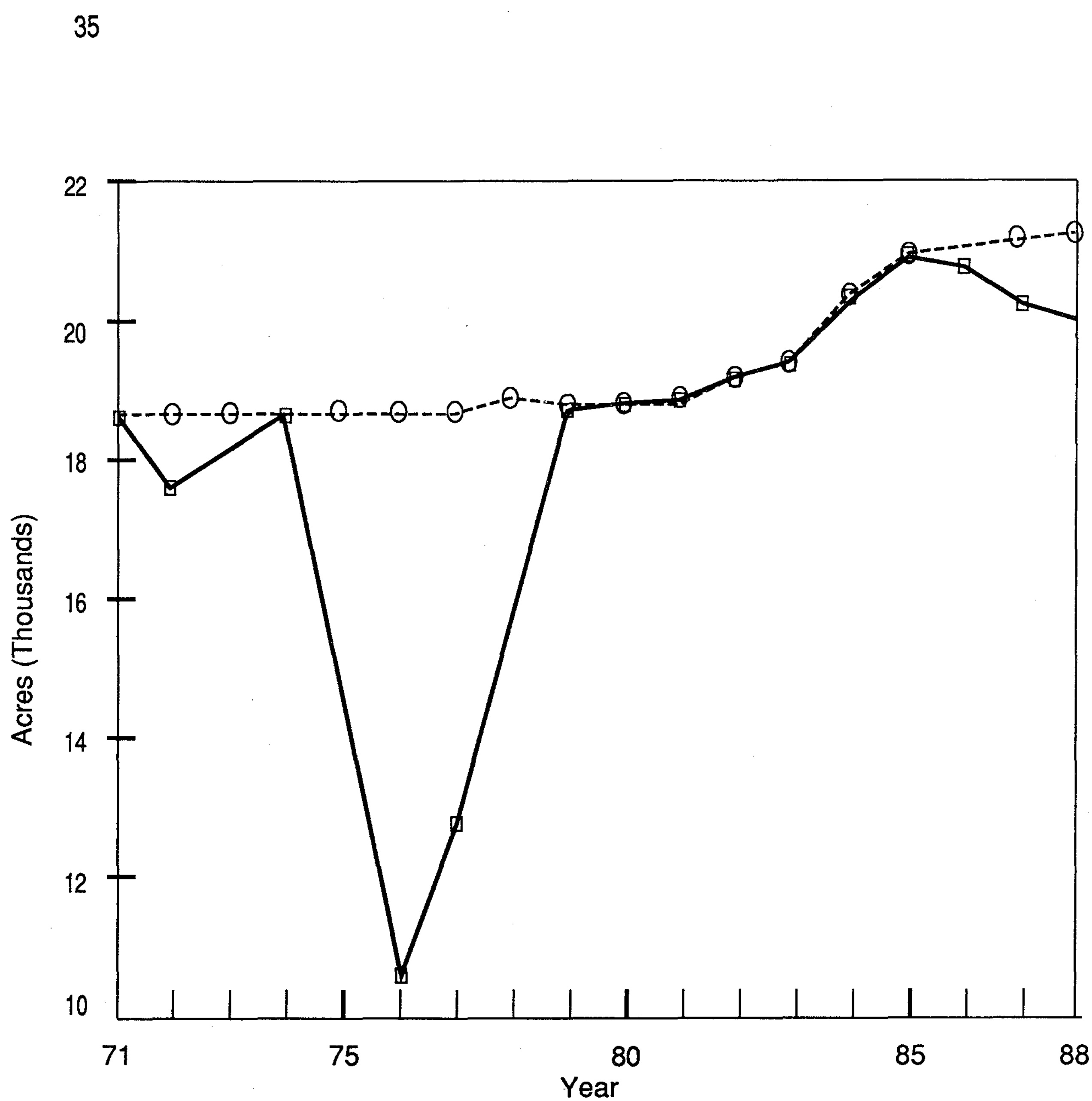
14-1 *None required.*

Irrigated Lands - Agreement

Impact

14-2 **LADWP will continue to provide water for irrigation of Los Angeles-owned land in Inyo County.**

Under the terms of the Agreement, LADWP will provide water to irrigate Los Angeles-owned lands that were irrigated during the 1981-82 runoff year. LADWP will continue to provide water for irrigation of Los Angeles-owned lands in the Olancha/Cartago area in accordance with past practices. In addition, water will continue to be provided to any enhancement/mitigation projects implemented since 1981-82. This will result in a total of 14,200 irrigated acres under the Agreement; however, in the event of successive dry years, a program providing for reasonable reductions in irrigation water supply for Los Angeles-owned lands and for enhancement/mitigation projects may be implemented if such a program is approved by LADWP and the Inyo County Board of Supervisors.



OWENS VALLEY

FIGURE 14-4

IRRIGATION DELIVERIES BY LADWP IN INYO AND MONO BASINS, 1971-1988

------------ Eligible Acreage

———— Irrigated Acreage

SOURCE: LOS ANGELES DEPARTMENT OF WATER AND POWER

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Mitigation Measure

14-2 *None required.*

Livestock Production - 1970 to 1990

Impact

14-3 **Changes in irrigation and leasing practices of the proposed project had little effect on overall livestock production in Owens Valley.**

LADWP's program to stabilize irrigation deliveries appears to have primarily stabilized cattle production. A consistent water supply meant that ranchers did not have to liquidate their herds because of a water reduction.

Mitigation Measure

14-3 *None required.*

Livestock Production - Agreement

Impact

14-4 **The irrigation provisions of the Agreement will assure a stable ranching economy. Chapter 17, CEQA Considerations, describes LADWP's grazing management policy.**

Under the terms of the Agreement, water will continue to be supplied as in past years, and grazing management policies will be enforced. No impacts to livestock production are anticipated from the Agreement.

Mitigation Measure

14-4 *None required.*

Ranch Leases - 1970 to 1990

Impact

14-5 **Ranch leases in Owens Valley were modified as a result of the project.**

When LADWP reduced the amount of land it classified as irrigated in Owens Valley, it modified the leases to provide a firm allocation of water. The term of the leases, however, continued to be five years, as it was prior to the modification. The number of LADWP lessees also remained the same, while the number of leases decreased slightly so that there were fewer leases of larger acreage.

In 1978, LADWP reduced the term of the leases to one, two, or three years in response to the litigation filed by Inyo County against Los Angeles. All other conditions of the leases remained the same.

Mitigation Measure

14-5 *None required.*

Ranch Leases - Agreement

LADWP's ranch leasing policies will remain as they have been during 1970-90.

Commercial Leases - 1970 to 1990

Commercial leases were not modified between 1970 and 1990 as compared with pre-project conditions.

Commercial Leases - Agreement

Commercial leases will not be affected by the Agreement.

LADWP Land Acquisition Policies - 1970 to 1990

LADWP's land acquisition policies did not change between 1970 and 1990 as compared with pre-project conditions.

Between 1970 and 1990, LADWP purchased several hundred acres in Inyo and Mono counties. These purchases were in accordance with LADWP's policy since 1929, to purchase undeveloped property with its associated water rights in Owens Valley, to expand and protect its existing water rights as well as to protect water quality in the Valley.

LADWP Land Acquisition Policies - Agreement

LADWP's land acquisition policies will continue as they have since 1929. The Agreement does not modify these policies.

LADWP Town Lot Sales Policy - 1970 to 1990

Between 1970 and 1990, LADWP's policy on the sale of town lots remained as it was prior to 1970. LADWP's policy regarding sale of town lots is described earlier in this chapter.

LADWP Town Lot Sales Policy - Agreement

The Agreement will not alter LADWP's policy on the sale of town lots. (The land releases that could occur under the Agreement are described later in this chapter.)

Economic Development - 1970 to 1990

Between 1970 and 1990, LADWP's ownership of urban fringe lands did not change.

The Owens Valley regional economy exemplifies the effects of a constrained land market on a recreation-dependent regional economy. As the supply of land for new development is constrained, land prices rise as buyers compete for scarce developable land. Land uses having the greatest competitive advantage in the bidding are those with low overhead and high rates of return on investments.

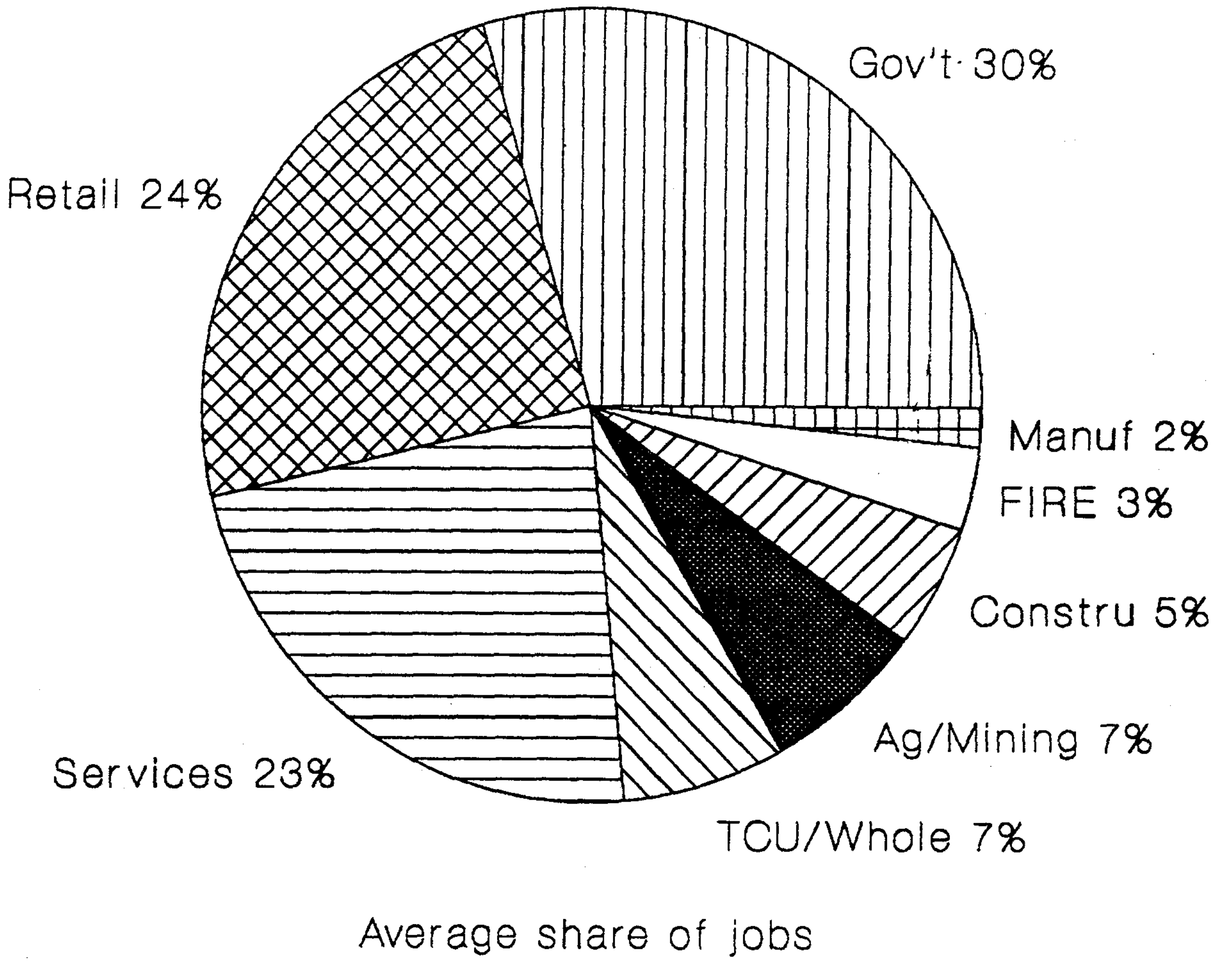
With little private land available for industrial development, there is little opportunity for economic diversification. Employment trends in the Inyo-Mono region over the period 1971 to 1988, show this lack of diversification. The only sectors that continued to grow during this period include retail trade, services, construction, and government. The lack of available industrial land is suggested in the relatively stagnant behavior of manufacturing and wholesale trade employment: the lack of a trained workforce and distance to population centers are also factors. The lack of land in general results in a low rate of growth of finance, insurance, and real estate (FIRE) employment, as job growth in these categories depends significantly on urban development and population growth.

The two-fastest growing industry sectors in terms of employment in the Inyo-Mono region between 1971 and 1988, are retail trade and services. They have increased their share of overall employment in the Inyo-Mono region, as Figure 14-5 shows (compare with Figure 14-2 above). These two sectors are also the lower paying sectors in the region. The two other growth sectors, government and construction, pay higher wages, but account for a smaller share of the overall economy than retail trade and services.

Any regional economy dependent primarily upon tourism or recreation activities earns its "export" income by selling products or services to tourists. The primary transportation mode to the eastern sierra region is the automobile, and taxable retail sales reflect this. As Figure 14-6 illustrates, once inflation is factored out, taxable retail sales in Owens Valley were essentially flat between 1971 and 1988. The only exception is auto-related sales, which includes both auto dealer sales, auto parts, and service station taxable sales. The latter, service station taxable sales, accounts for the bulk of the growth during the period. Most of this growth is due less to growth in tourist activity and more to the price of gasoline.

Because of slow population growth in Owens Valley (see Table 14-3), construction rates for new residential units and nonresidential buildings have also been quite low. Most of the recent population growth in Inyo County comes from in-migrating older people, many of whom are retirees from Southern California. These people are no longer raising families, and typically have sold their equity-rich homes, and can afford, in many instances, to pay cash for homes in Owens Valley. Since the volume of sales is quite low in the Eastern Sierra, it is difficult for prospective buyers without this kind of equity to compete for housing.

Growth in low wage occupations, constrained housing supplies, and a lack of available land for new construction for both employment and residential opportunities force a divergence between the incomes earned by (generally younger) residents and the houses they might afford. Table 14-4



O W E N S VALLEY

FIGURE 14-5
INYO-MONO REGIONAL EMPLOYMENT STRUCTURE 1971-1988

SOURCE: CALIFORNIA EMPLOYMENT DEVELOPMENT DEPARTMENT

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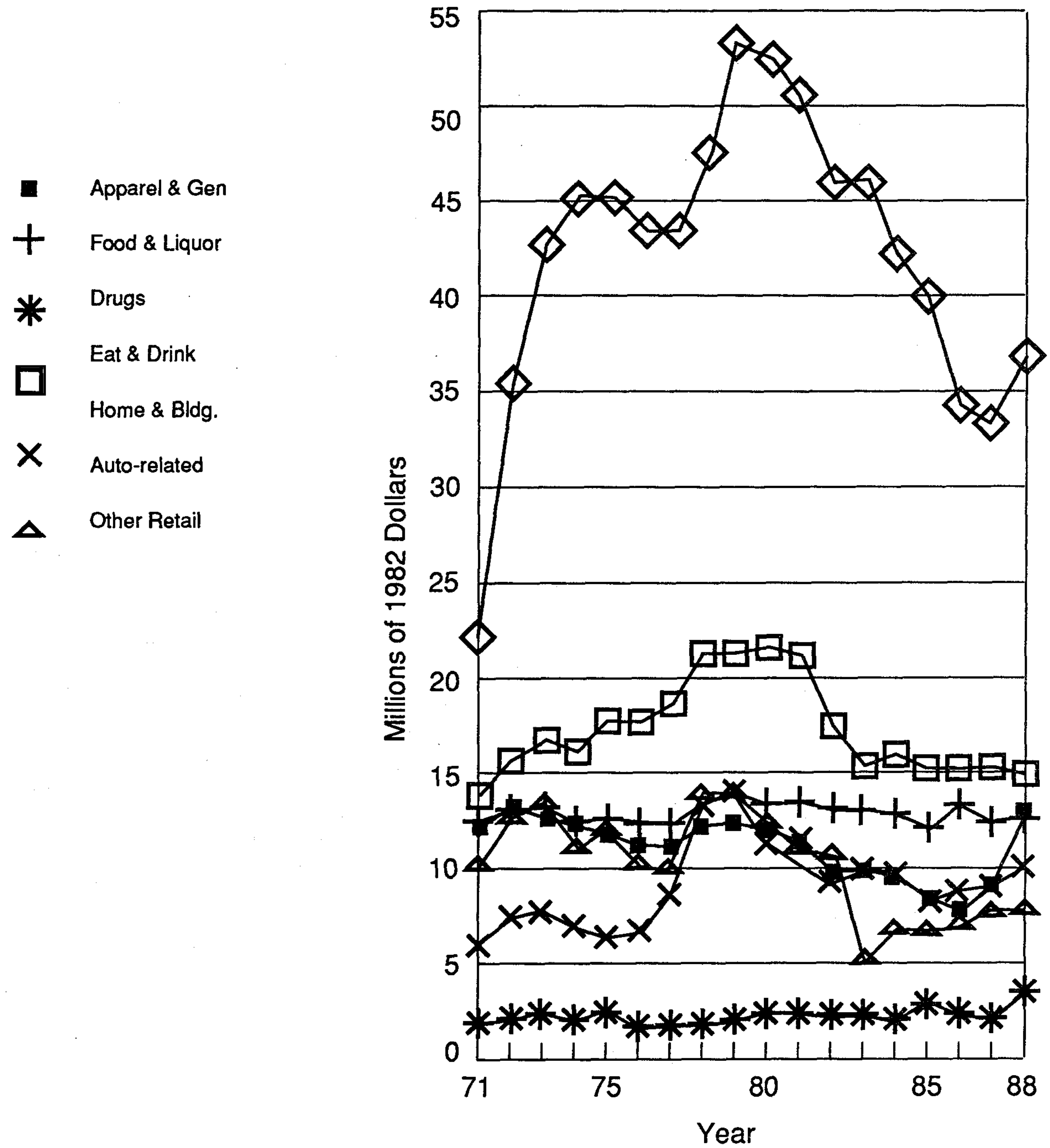

O W E N S V A L L E Y

FIGURE 14-6

TAXABLE RETAIL SALES
IN INYO COUNTY
1971 - 1988

SOURCE: STATE BOARD OF EQUILIZATION

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TABLE 14-4

HOUSING AFFORDABILITY IN OWENS VALLEY
1980 AND 1989

	1980	1989
Average Home Price[1]	$ 80,000	$ 110,000
Monthly Mortgage Payment[2]	$ 683	$ 772
Required Annual Household Income[3]	$ 29,150	$ 33,100
Mean Annual Household Income[4]	$ 17,693	$ 24,050

1. 1980 home price is the median value from 1980 Census of Housing, Table 48. 1989 home price is based on interviews with area real estate brokers, December 1989.

2. Monthly mortgage payment for 30-year, fixed-rate loan at 12.5% interest in 1980, 10% interest in 1989.

3. Required household income is the household income necessary to support the monthly mortgage payment over a year's time.

4. 1980 mean annual household income is obtained from 1980 Census of Population. 1989 mean annual household income was calculated for Inyo County by dividing 1986 adjusted gross income from the Franchise Tax Board for Inyo County by the county population. After inflating the result ($8,935 per capita in 1986) to 1989 dollars at 5 percent a year, per capita income was multiplied by Department of Finance persons per household (2.325) to derive a 1989 mean household income figure of $24,050.

Source: EIP Associates, February 1990.

illustrates this point for the years 1980 and 1989. In 1980, the median price of a house in Inyo County, according to the U. S. Census of Population, was $80,000. The average annual household income for Inyo County residents was $17,693. In order to afford a mortgage on the house at an interest (at the time) of 12.5 percent, the average household would have to earn $29,150. This gap between actual average household income and the income needed to purchase a home narrowed only $200 by 1989, due mostly to a decline in mortgage rates.

Economic Development - Agreement

Los Angeles will offer for sale, either at public auction or to Inyo County, the City of Bishop, or the Bishop Community Redevelopment Agency, a total of 101 acres adjacent to or within the Owens Valley towns. These sales are to provide for the future orderly growth of the towns within the Valley. Los Angeles and either Inyo County or the City of Bishop will agree upon the location and schedule for release of the land. The land must be located within the general areas designated by the boundaries noted on maps attached to the Agreement. Urban expansion on these designated lands conforms with Inyo County's General Plan. Each sale will be subject to a CEQA review.

In addition, the Agreement provides that upon request of the Inyo County Board of Supervisors or the Bishop City council, Los Angeles will negotiate in good faith for the sale at public auction of additional surplus Los Angeles-owned land in or near Owens Valley towns for specific identified needs. Any such sales would occur subsequent to those described above and would be subject to a CEQA review.

Los Angeles will also negotiate in good faith for the sale or lease to Inyo County of Los Angeles-owned land adjacent to Valley towns for use as a public park or for other public purposes in conformance with the Inyo County Parks Master Plan. The Agreement provides for the rehabilitation of existing county parks and campgrounds, and for the development of new County parks, campgrounds, and recreational facilities and programs. Any such sale or lease and development of new parks would be subject to a CEQA review.

15. CULTURAL AND HISTORICAL RESOURCES

15.1 SETTING

ETHNOGRAPHY

Prior to historic contact, the Owens Valley was occupied by the Owens Valley Paiute. They were bordered on the north and east by other Paiute groups, and Shoshone and Monache tribes to the south and west, respectively. Nearly all of these bordering groups in the western Great Basin and eastern California spoke related Numic languages, part of the Northern Uto-Aztecan linguistic stock.[1] Knowledge of the ethnography of the Owens Valley Paiute comes largely from the studies of Steward, although accounts from military and survey expeditions and other sources offer additional insight into their cultural system.[2,3]

The Owens Valley Paiute differed in many ways from neighboring indigenous peoples. Because of their agricultural endeavors in the Valley, including the irrigation of about 7,000 acres of land, they were able to occupy permanent villages on the valley floor, with smaller temporary living sites located in areas of seasonal resource exploitation.[4] These villages, located along the Owens River or adjacent desert scrub areas, formed the basis of their sociopolitical and economic system; the nuclear family was not the principal societal unit in Owens Valley as it was among all the surrounding precontact groups.

Traditional resource gathering among the Owens Valley Paiute was tied to the seasonal distribution, abundance, and breeding or ripening cycles of the various plants and animals exploited for food. As mentioned above, a system of canals was established to transport Sierran stream water to alluvial slopes and the valley floor to irrigate desirable crops. Some diversion ditches reached eight miles in length.[5] Foodstuffs (seeds, nuts, roots) were stored for consumption in winter, while animal trapping, fishing, and plant gathering were undertaken the remainder of the year, the summer and fall being the time of greatest exploitation.

The village system of the Owens Valley Paiute was divided into "districts," each of which had a leader or "head man" responsible for organizing communal activities such as food gathering and group festivals. An annual festival, the "fandango," was held after the fall harvests and was a time for socializing, gambling, celebrating and planning activities for the upcoming year. When sponsored by a large district, the gathering would draw groups from far away and last as long as a week.[6]

The Bishop district, known as "Pitana Patu," held large celebrations in the Five Bridges area, and in the "sand hills" southwest of Laws adjacent to the Owens River.[7] The latter site, known as "Pawona Witu," is listed on the National Register of Historic Places as a historic district. Fandangos were held throughout Owens Valley, and fall festivals were common throughout much of the Great Basin.

According to Steward, there were probably at least 30 permanent villages clustered into a lesser number of land-owning districts between Round Valley to the north and Owens Lake to the south, making Owens Valley one of the most densely settled regions of the entire Great Basin.[8] The aboriginal population of Owens Valley was probably at least 2,000.[9] The aboriginals of the Valley were originally gatherers and hunters. Many plant foods were collected in season in recognized territories, including a section of the valley floor and the adjoining mountain slopes. Especially important were pine nuts and the seeds of Indian rice-grass, wild-rye and love grass. Many other plant foods also were sought. Hunting for mountain sheep, deer, and jackrabbits, and fishing in both the Owens River and its tributaries were also very important subsistence activities. The Native Americans of Owens Valley did become farmers and even irrigated their land "upon a considerable scale," with the greatest development occurring at the northern end of the valley near the present town of Bishop, where population would be the densest and the natural facilities the greatest.[10] There are petroglyphs near the valley, numerous clusters of mortars worn in the bedrock, and ancient burial grounds established by these early Indians still in use by their descendants.[11]

Currently there are approximately 1,500 Paiute and Shoshone Indians living on four reservations within the Owens Valley Groundwater Basin. These reservations, located near Bishop, Big Pine, Fort Independence and Lone Pine, cover 1,500 acres, approximately 1,000 of which are cultivable.[12]

PREHISTORY

Archaeological investigation in Owens Valley was scant until the 1960s, although some prehistoric sites and petroglyphs were recovered in the area (at Cottonwood Creek and Little Lake, respectively). Scores of researchers have conducted both academic and regulatory-driven cultural resource studies in the Valley in the past decade or more.[13]

Although archaeological sites in the Great Basin have been found to date from as early as 10,000 years ago, sites in the Owens Valley have not been firmly dated beyond about 3,500 years old. Artifacts associated with earlier occupation (i.e., Paleo-Indian and Archaic forms) have been found in very small numbers, but none in a context that will allow an acceptable dating technique to be applied. Although there is evidence to suggest the area was occupied as early as 10,000 years ago, there have been no sites discovered to substantiate this.

The archaeological evidence at present supports the theory that the Owens Valley began to experience an increase in human population during the Late Prehistoric Period about 2,000 years ago, and was sparsely occupied for about 2,000 years prior to that time. There is ample evidence of the use of the bow-and-arrow beginning about 1,400 years ago, with the majority of the sites in the region dating from about this time or later. It has been theorized that changes in regional adaptive strategies that can be seen in the archaeological record at about 1,000 years ago may indicate the spread of Numic-speaking people (ancestral Paiutes) into the area.[14]

Excluding rock-art sites, prehistoric sites in the Owens Valley can be grouped into three primary categories: 1) long-term habitation sites, 2) short-term seasonal camps, and 3) temporary camps. The latter category comprises those sites indicative of single-use resource exploitation or as a resting place while in transit. These may have been used by a single individual or one or two small families, and were probably not reused. These sites are by far the most commonly found type of site in Owens Valley. Cultural evidence at such sites typically consists of remnants of flaked stone from tool manufacture, although burned or fire-cracked rocks (from campfires) and food-grinding implements may also be in evidence. Many of the village sites known today were observed in use during the 1800s.

HISTORICAL

Although trappers and explorers in the region may have passed through the Owens Valley at some point in the early 19th Century, the earliest recorded passage into the area occurred in 1833, when Joseph Walker led the first group of Anglo explorers into the Valley from a Sierran crossing near Mono Lake.[15] Other expeditions occurred in the 1840s, but it was Anglo-European interest in the economic opportunities in the area in the 1850s that drew public and government attention to the Valley. Paiute Indian groups were becoming distressed at encroachment into their territory, and the U.S. Government sent troops into the area to determine the feasibility of establishing an Indian reservation.

The Valley, prior to 1861, was populated by Paiute Indians and the occasional prospector and mountain man. The Valley was mainly used as a shortcut to California or to the gold fields in order to avoid going over the Sierra Nevada. In 1861, the first white men built permanent dwellings in the Valley, near the present City of Bishop and on the current site of the Town of Independence. In 1862, Lieutenant Colonel George S. Evans established a military post, named Camp Independence, to protect the few white people in Owens Valley. Troops were maintained at Camp Independence until 1877.

The Town of Independence was established in 1861 with the opening of the first trading post. The Town was the center of a rich mining area for some years, after gold was discovered in 1862. The plotting of the town site was completed in 1866, and when the County of Inyo was organized that same year, Independence became the county seat and remains so today.

The City of Bishop was named for Samuel A. Bishop, who settled about three miles west of the present town of Bishop in 1861. The City of Bishop is now the largest community in the County, developed to take advantage of the rich agricultural land surrounding it and the early mining in the area. It now occupies a strategic place at the intersection of U.S. Highways 395 and 6, and it has become a commercial hub for all of northern Inyo County.

The Paiute's widespread use of irrigation to support agriculture in the Valley was evident to government representatives. Both the agricultural potential of the valley and the mining opportunities in the region soon began to draw large numbers of people to the area. By 1861, groups of homesteaders began to settle in the Valley from Bishop south to Independence, pursuing mining, cattle ranching and agriculture.

Increased grazing led to decreases in seeds and plant resources, and pinenuts began to diminish as trees were cut to supply lumber for the mines. Within a very few years of Anglo and Mexican settlement of the Valley, the Paiute subsistence strategy and lifestyle began to break down. Local Indian groups began to raid cattle herds and were subsequently shot. Agitation between whites and Indians ultimately led to the establishment of Fort Independence in 1862 and the forced removal of Owens Valley Paiute groups to Fort Tejon, southeast of Bakersfield, by the mid 1860s.[16] As a result, the traditional Paiute lifestyle ceased to exist by 1870, although some aspects of their cultural heritage are practiced today by the Owens Valley Paiute-Shoshone Band of Indians.[17] Clashes between white settlers and the Indians continued until 1866.

The narrow-gauge Carson and Colorado Railroad was completed into Owens Valley in the early 1880s as an aid to the mining boom in the Inyo Mountains. As the short-lived mining boom began to wane, the railroad shifted to carrying local agricultural products and livestock to markets as far away as Reno and San Francisco.[18] The town of Laws was the rail depot for the Bishop area and is listed as a Historic District on the National Register of Historic Places.

By the turn of the century, mining activity had dwindled further and agriculture and ranching had become the dominant economic focus of the valley. By 1905, Los Angeles had begun to purchase water rights and large plots of land as a means of providing water to the growing metropolis to the south. The Los Angeles Aqueduct resulted in the eventual shift to ranching as the basis of the regional economy.

Part of the stage route through the Owens Valley was the settlement of Manzanar, which developed until it was abandoned when Los Angeles bought the land. In 1942, the same area became the site of a Japanese War Relocation Center, housing 10,000 people.

RESULTS OF THE RECORD SEARCH

As a part of this EIR, a record search of the entire proposed project area was undertaken at the Archaeological Information Center, U.C. Riverside, on January 19, 1990. To determine whether the proposed project could threaten any areas of cultural value, all known cultural resource sites and previous surveys within one mile of the proposed 15 new well locations and two spreading basins were identified and plotted on USGS 7.5' topographic maps of the area.

A total of 42 historic and/or prehistoric cultural resource sites are known to exist within the area covered by the record search. Of these, five sites are located within the vicinity of a proposed spreading basin area, the remainder are located within one mile of a proposed well or spreading basin boundary. In addition, 13 previous cultural resource surveys have been conducted in the area covered by the record search. The majority of these were conducted outside proposed project areas; the Hall (1982) and Jenkins (1986) surveys included portions of proposed project areas. The exact locations of existing historic or prehistoric cultural resources are not reported to avoid any potential disturbance of these sites.

Three National Register of Historic Places properties are also known to exist in the project vicinity. The Paiute precontact agriculture and village site of Pawona Witu is located immediately south of the Bishop airport. It is listed as a historic district covering nearly three square miles. The Laws Railroad Depot and surrounding structures are also listed on the National Register of Historic Places as a District of about 300 acres in size.[19]

The Manzanar War Relocation Center, located along U.S. Highway 395 between Independence and Lone Pine, is also on the National Register. This site covers an area of approximately 400 acres, although some structures and facilities associated with the property (e.g., the airfield) are located over a much larger area.

15.2 IMPACTS OF THE PROJECT

Between 1970 and 1990, no impacts to cultural or historical resources occurred as a result of water management practices by LADWP. Impacts and mitigation measures associated with proposed actions contained in the Agreement are referenced below and described in Chapter 16, Ancillary Facilities.

The project area was examined from February 5-8, 1990. Each of the proposed well locations were surveyed for cultural resources. In addition, all of the proposed spreading ground locations were visited and examined. Chapter 16, Ancillary Facilities, contains a detailed description of the field evaluations.

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16. ANCILLARY FACILITIES

16.1 INTRODUCTION

The proposed project analyzed in this EIR consists of all water management practices and facilities that were implemented or constructed in Owens Valley to supply water to the Second Los Angeles Aqueduct which was completed in 1970, together with the projects and water management practices contained in the Agreement on a long-term groundwater management plan for Owens Valley and Inyo County.

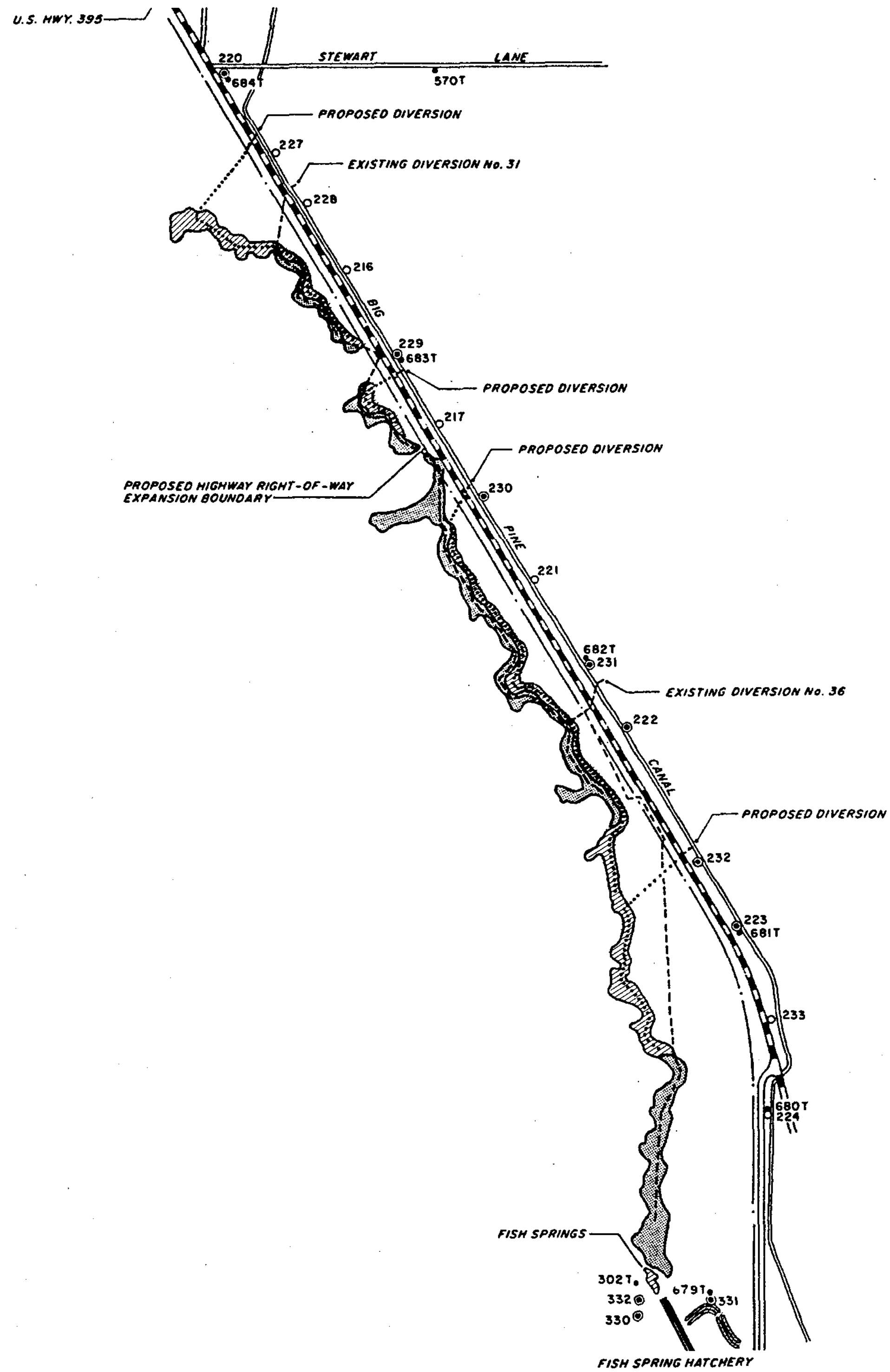
This chapter provides a description of the new facilities that will be constructed by LADWP if the proposed project is approved and describes the potential impacts associated with these facilities. The facilities described are: (1) the construction of expanded recharge facilities, including additional supply ditches in Big Pine and new infiltration trenches in the Laws area; and (2) construction of 15 new wells in five well field areas from Bishop to Lone Pine. This section also describes the impacts associated with increased groundwater pumping on the Bishop Cone.

16.2 GROUNDWATER RECHARGE FACILITIES

Groundwater recharge facilities in the Owens Valley are used to capture and store excess runoff and/or intentional releases from the aqueduct system so that it will recharge the groundwater basin.

PRE-PROJECT AND 1970-90 PERIOD

Historically, LADWP has spread water from the Big Pine Canal to the volcanic formation south of Big Pine and west of Highway 395. LADWP has also spread water from the McNally Canals in the Laws area (see Figures 16-1 and 16-2, which show the existing recharge areas in Big Pine and in Laws).



O W E N S V A L L E Y

- - - - Existing Ditch
······· Propsed New Ditch
Existing Spreading Area
Proposed Additional Spreading Area
Pump Equipped Well
Observation Well
Monitor Well

FIGURE 16-1

EXISTING AND PROPOSED SPREADING AREAS, BIG PINE

SOURCE: LADWP, AQUEDUCT DIVISION

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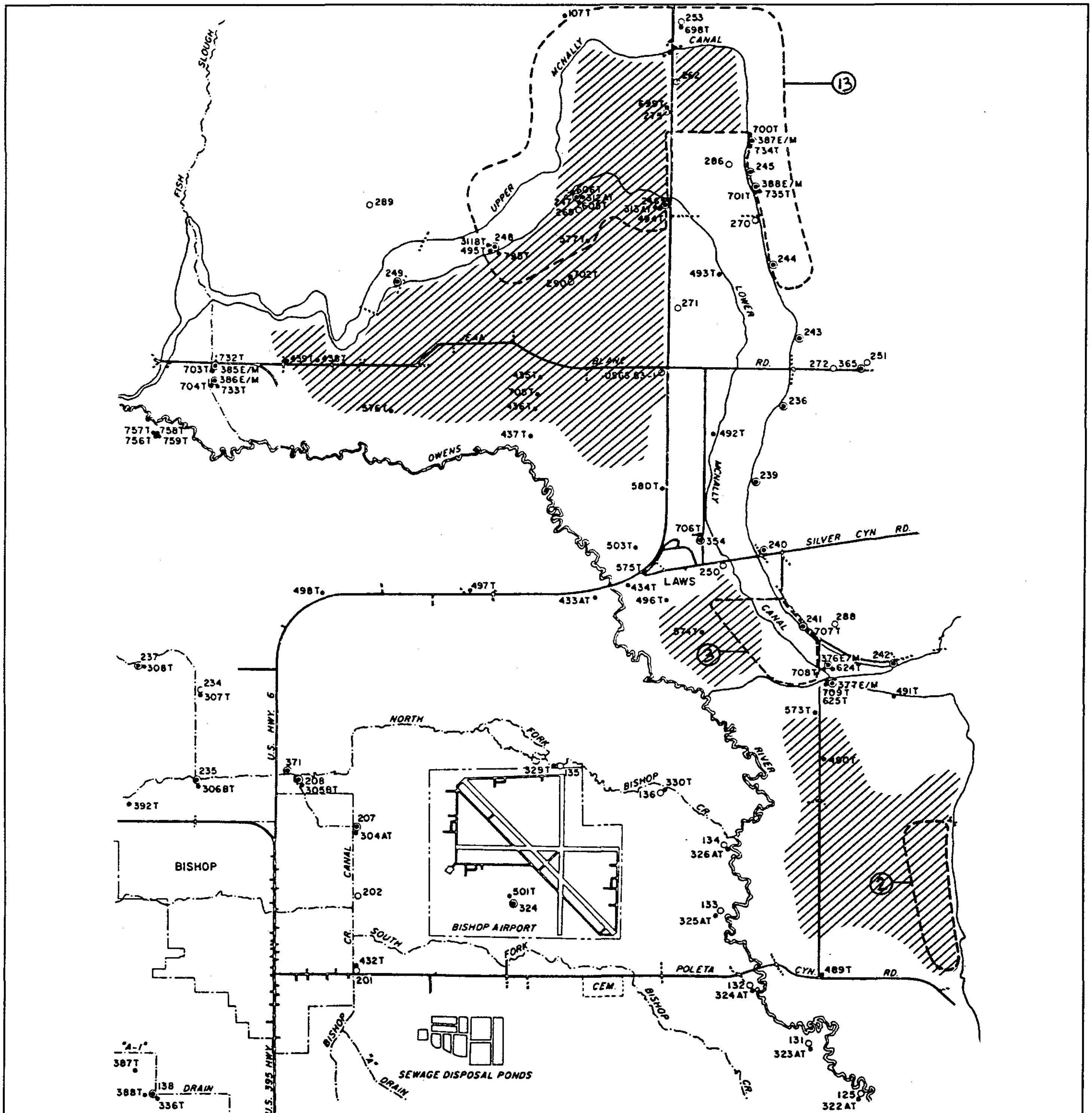

O W E N S V A L L E Y

Existing Spreading Areas
Pump Equipped Well
Observation Well
Monitor Well
Boundary of Proposed Area
Number of Proposed Trench within Boundary

FIGURE 16-2
EXISTING AND PROPOSED SPREADING AREAS, LAWS

SOURCE: LADWP, AQUEDUCT DIVISION

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Facilities required for recharge operations already exist at the proposed sites, including the major conveyance systems (Upper and Lower McNally and Big Pine Canals) for transporting water to and from the spreading areas, and the recovery system (pump-equipped wells).

POST-1990 PROJECT

Under the proposed project existing recharge facilities would continue to be used for recharging during above-normal precipitation years. Improvements are planned in the Laws and Big Pine areas to enhance the recharge capabilities. Existing and new facilities would typically be operated during the period from approximately February or March to September. This period is the same as when spreading has occurred in the past.

Groundwater pumping would occur during normal and below-normal runoff years to recover the stored water. Recovered water from the Big Pine spreading area would be pumped from existing wells directly into Big Pine Canal. Groundwater pumped from the Laws Area would be pumped from existing wells into either Upper or Lower McNally Canal and used for irrigation or returned to the Owens River via the Laws Return Ditch. Water recovered from the proposed Laws recharge area south of Laws Ditch would be pumped from proposed new wells (see below) and returned to the Owens River via pipeline. All groundwater pumping will be managed in accordance with the provisions of the Agreement.

BIG PINE

Improvements at the Big Pine spreading area will consist of constructing four additional diversion structures along the existing Big Pine canal, four culverts under Highway 395, conveyance ditches within the spreading area, and an increase in the area of ponding within the existing spreading area. Figure 16-1 (shown previously) shows the proposed addition to the Big Pine Spreading area and the location of the proposed four culverts. The anticipated area of the Big Pine spreading area is approximately 60 acres. The current spreading area is approximately 45 acres in size. Construction of the four new ditches will result in some minor vegetation removal and disturbance. It is not planned to construct berms or dikes that might cause large-scale clearing of the area. Intermittent flooding and drying of the ponded area can create stresses on existing vegetation and encourage the infestation of salt-cedar.

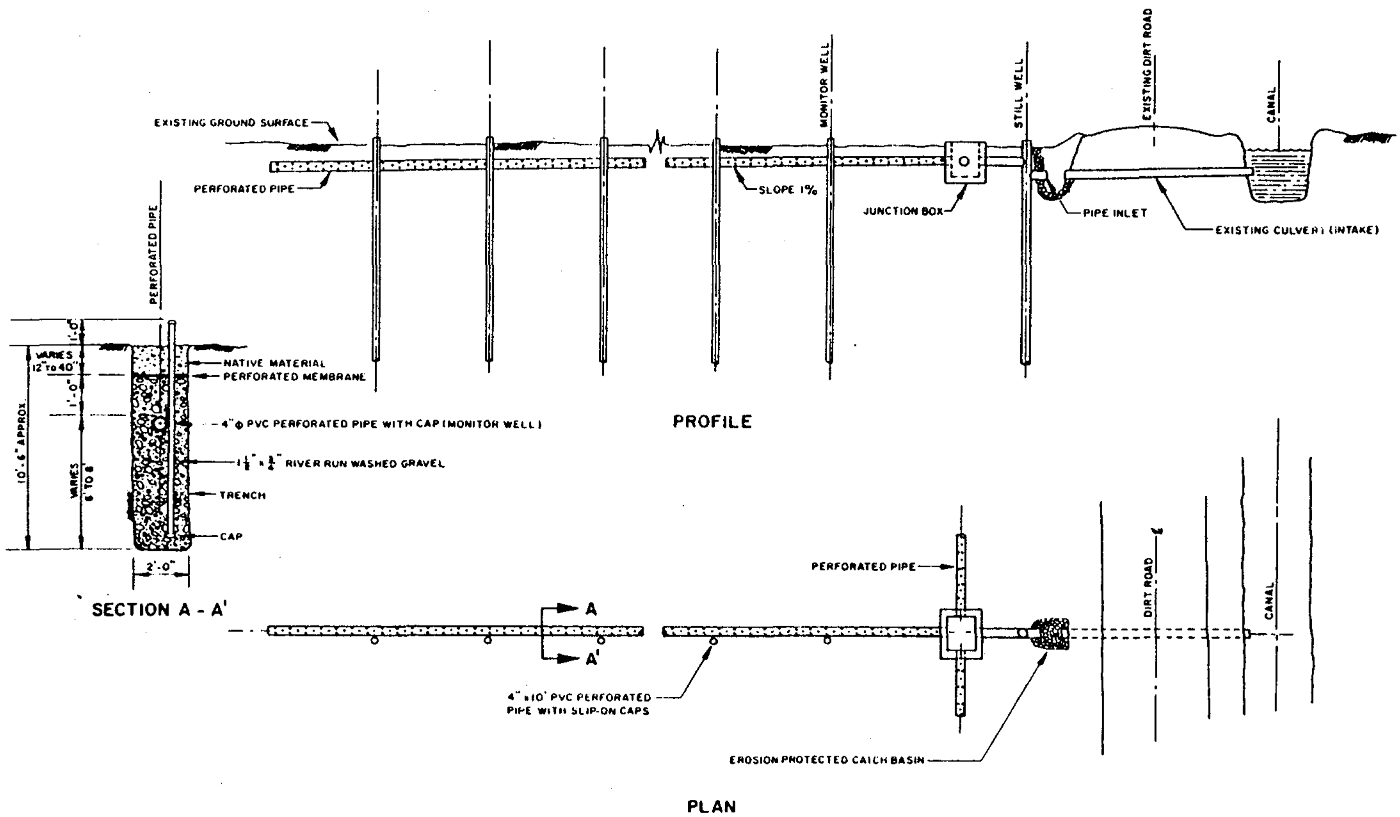
The construction of new culverts and the extension of existing culverts and channel diversions in the Big Pine area will be coordinated with the California Department of Transportation, which has proposed the widening of the existing Highway 395 in the Big Pine area.

Based on an estimated long-duration spreading rate of 45 cfs in Big Pine, and the assumption that maximum recharge operations will occur two out of every ten years, an increase in recharge of approximately 3,000 AF above pre-project practices would occur during a given ten-year period. The actual amount diverted into the spreading area will depend on the capacities of the canals, available groundwater storage space, and hydrogeologic characteristics (infiltration rates, plugging rates, and permeability) of the existing basin materials.

LAWS

In the Laws area, infiltration trenches would be constructed. Infiltration trenches were selected instead of expanding LADWP's existing spreading basins, because they cause less ground and vegetation disturbance during construction, and will have a higher infiltration rate to the deeper aquifer in the area. New spreading basins would have required substantial surface alteration and would have increased the size of the existing area where water is spread. It is anticipated that 18 trenches (see Figure 16-3), 2-feet wide, up to 1,000-feet long will be constructed. They would be approximately ten-feet deep, or as deep as required to penetrate the shallow, low-permeability formations, so that the deeper aquifer can be more efficiently recharged. The trenches will contain a perforated pipe and will be backfilled with gravel to within one to three feet of the surface. The remainder of the trench will be filled with native soil to permit revegetation. New diversion structures along the McNally Canals will be similar to existing diversion gates/culverts. The general location of the 18 trenches and the diversion structures is shown previously on Figure 16-2. The actual locations will be dependent upon the location of gravel deposits.

It is estimated that an additional 30,000 AF can be stored using the proposed Laws facility above the amount stored under current conditions. This estimate is based on a long-duration recharge rate of 100 cfs and the assumption that maximum recharge operations will occur two out of every ten years.



O W E N S V A L L E Y

FIGURE 16-3

SCHEMATIC OF PROPOSED INFILTRATION TRENCHES, LAWS AREA

SOURCE: LADWP, AQUEDUCT DIVISION

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HYDROGEOLOGY

Percolation tests were recently performed at the two proposed sites to gain a better understanding of the characteristics of these sites. These tests included standard infiltration tests as well as tests to approximate trench recharge rates. Test results are summarized on Table 16-1. Although the infiltration rates at Big Pine were on the order of tens of feet per day, two feet of infiltration per day were assumed for long-term spreading. The tests at Laws provided infiltration information on the upper clayey silt layer (designated "(s)" on Table 16-1) as well as the underlying sand and gravel layers. The recharge rate of the underlying sands and gravels in the Laws area was generally ten times greater than the surface soils. This information indicates that the use of trenches is much more efficient than surface spreading for recharging the deep groundwater basin in the Laws area. Additional tests will be conducted to verify the rates and to select specific depths for recharge trenches in the Laws area. Based on the preliminary data, it is estimated that as many as 18 trenches, each 1,000 feet long, will be constructed.

The construction of new spreading basins was considered as an alternative; however, trenches were selected because they will result in less ground and vegetation disturbance. The proposed trenches will also eliminate the potential for adverse vegetation changes due to the alternating flooding and drying cycles that occur within surface spreading areas.

VEGETATION

Within surface spreading areas the alternating cycles of flooding and drying create an environment that is unfavorable to certain species of native vegetation and favorable to the establishment of salt cedar. Salt cedar infestations in the Owens Valley have been and will be the subject of eradication and control studies and efforts.

The proposed new facilities in Laws will facilitate recharge efficiency but will not result in a significant salt cedar related impact compared to current operations. In the Big Pine area, the spreading of an additional 3,000-acre-feet over a given ten-year period within spreading basins that have been enlarged by 15 acres will not cause a significant increase in salt cedar. Any salt cedar growth that results from the project will be controlled.

TABLE 16-1

PERCOLATION TEST RESULTS[1]

	Date of Test	Depth to Bottom of Hole (inches)	Percolation Rate: Minutes per Inch	Percolation Rate: Feet per Day
BIG PINE	3/28/90	16	1.6	72.7
	3/29/90	16	3.3	36.4
	4/19/90	15	1.3	92.3
	4/20/90	16	5.2	23.1
	4/20/90	14	10.7	11.2
	4/20/90	16	5.6	21.4
	4/20/90	16	10.0	12.0
	4/20/90	16	3.0	40.0
LAWS	3/22/90(s)	22	25.3	4.7
	3/22/90(s)	19	13.3	9.0
	3/22/90(s)	22	4.1	29.3
	3/22/90(s)	17	14.6	8.2
	3/22/90(s)	24	3.6	33.3
	3/22/90	99	7.6	15.8
	3/22/90	48	1.3	92.3
	3/22/90	50	0.4	300.0
	3/22/90	146	0.2	600.0
	3/22/90	95	7.2	16.7

[1]Six-inch diameter test hole.

(s) = Surface (upper layer) test.

Source: LADWP, Aqueduct Division, August 1990

Surface spreading operations can also have an effect on the composition of some native vegetation communities. It has been shown that some native species, such as rubber rabbitbrush, and Nevada saltbush, are adaptable to alternate flooding and drying conditions. Other species, such as greasewood, are not as tolerant of flooding. The loss of greasewood could lead to an increase in rubber rabbitbrush and Nevada saltbush in both the desert sink and desert greasewood scrub communities.

These species are highly opportunistic and invasive, and are able to form monocultures under some conditions, leading to a decrease in plant and wildlife species diversity. However, since future water spreading practices are expected to be similar to pre-project practices, use of these new facilities will not result in a significant impact on vegetation.

IMPACTS AND MITIGATION MEASURES

Impact

16-1 **The construction phase of the addition of new recharge facilities could result in vegetation decrease or change.**

Construction of the proposed new culverts and ditches in the Big Pine area is not expected to significantly impact vegetation. The new ditches, that will convey the water form the culverts under Highway 395 to the spreading areas in the volcanics, will be located in order to avoid significant adverse impact on existing vegetation. The historic area of ponding in the Big Pine spreading area will increase by approximately 33 percent (from 45 acres to approximately 60 acres). Removal of approximately one acre of vegetation within the existing spreading area will occur during construction of the ditches.

The potential for vegetation impact was a consideration in developing the concept for infiltration trenches in the Laws area. Initially, large areas of new spreading basins were proposed for construction which could have removed large areas of vegetation. The infiltration trenches will allow increased capability to recharge the groundwater basin, but with less impacts than new spreading basins. The size and number of trenches proposed were reduced from earlier consideration to further reduce the potential for impacts. Assuming 18 trenches, each 1,000 feet in length are constructed, a maximum of ten acres would be disturbed. The trenches would be backfilled with native soils near the surface to allow natural revegetation to occur. The Technical Group will monitor natural revegetation and will determine the need for any specific revegetation activities. The locations of the new trenches will be selected to minimize impacts on existing vegetation.

Mitigation Measure

16-1 *Provisions of the Agreement will be met. No further mitigation measures are required.*

WILDLIFE

No significant impacts on wildlife habitat or populations would occur due to construction and operation of recharge facilities. The areas in which these facilities are proposed have been used historically for recharge.

LAND USE

Impact

16-2 **Operation of recharge basins and infiltration trenches during wet years would remove land from grazing or other economic use.**

It is not anticipated that this will have a significant impact on grazing patterns or uses, because the affected areas have been used for many years for groundwater recharge.

Mitigation Measure

16-2 *None required.*

AIR QUALITY

Impact

16-3 **Air quality could be adversely affected by the construction of recharge facilities.**

Ponding and drying associated with spreading activities after 1990 are expected to be substantially similar to pre-project practices; therefore, operations under the proposed project will cause no significant impact on air quality as compared to pre-project conditions.

Construction of the proposed ditches in the Big Pine area and the proposed infiltration trenches in the Laws area could temporarily increase PM_{10} concentrations and could lead to localized violations of federal and State 24-hour PM_{10} standards if the wind was blowing and on-site dust suppression measures were not implemented. The source of PM_{10} would include clearing, excavation and grading operations, and movement of construction vehicles on unpaved surfaces.

It is not possible to precisely estimate the PM_{10} concentrations that would occur at or adjacent to the construction sites, because such concentrations are very sensitive to local meteorology and topography. Soils with a high silt content have a great capacity to produce fugitive dust.

Mitigation Measure

16-3 *All disturbed areas would be wetted during construction to minimize generation of fugitive dust.*

ENERGY

Impact

16-4 **Equipment used to construct the new recharge facilities would consume energy in the form of fossil fuels.**

Graders and excavators would all be powered by internal combustion engines, as would the vehicles used by construction workers and material and equipment suppliers. The amounts of fuel consumed during construction would not be great in the overall context of fuel use in the Valley. No special provisions for construction fuel supply would be needed.

Mitigation Measure

16-4 *None required.*

CULTURAL RESOURCES

Impact

16-5 **Construction of proposed recharge projects could disturb subsurface archaeological resources, with possible significant impact.**

The record search of the Big Pine area indicated that one site, CA-INY-1716, is known to exist within the boundaries of the spreading ground. Two additional sites, CA-INY-124 and CA-INY-1719, are located immediately adjacent to the area.

The recharge area is presently covered in native shadscale vegetation with predominantly saline soils. Spreading of excess surface waters has occurred intermittently since the 1930s, and although the site was dry during the field survey, evidence of flooding is apparent.

While examining the area for site CA-INY-1716, it was noted that a very large part of the southern portion of the area contained dispersed, prehistoric lithic artifacts. The original site record for CA-INY-1716 indicates it is a sparse lithic scatter typical of a "temporary camp." It is possible that in the 16 years since the site was recorded, surface water spreading and natural erosion in the area have exposed additional artifacts.

Although no attempt was made to survey the entire preliminary recharge basin site, the southern portion contains prehistoric lithic materials spread over about 40 acres or more. Whether these materials have eroded from a more confined area is unknown. Although the northern portion of the proposed ground was not examined on foot, the potential for cultural resources should approximate the southern portion.

All of the dirt roads bordering and/or passing through the Laws recharge area were driven and random portions of the area examined for cultural resources as a basis upon which to make recommendations for project planning.

The record search indicated that four archaeological sites (CA-INY-2244, 2250, 2254 and 2271) were known to exist within Area No. 10, north of Five Bridges. All of the sites were characterized as sparse lithic scatters, small in size; one site was reported to have contained Owens Valley

Brownware pottery fragments. None of the sites could be relocated in the area, although a piece of reinforcing bar was observed at the location of one of the sites.

During the survey of the Laws recharge area, a large, previously unrecorded historic site was noted. It was recorded and given the temporary designation WS-3. The site appears to be the remains of a turn-of-the-century homestead/ranch that may have been vacated following purchase of the land by the City of Los Angeles about 1915. Embossed bottles on the site indicate dates of 1904 and 1915. The site does not appear to have suffered much vandalism, and overall site integrity is good.

The brief examination of the Laws recharge area indicates that there exists a potential for both historic and prehistoric cultural resources in the area. Use of this portion of the Owens Valley by local Paiutes at the time of Anglo-European contact has been well documented (Hall, 1982; Liljeblad and Fowler, 1986; Steward, 1933). Evidence of historic ranching or agricultural settlements could also exist throughout the area.

As noted previously, much of the town of Laws is included in the Historic District on the National Register of Historic Places. One proposed recharge area lies adjacent to Laws, but outside the boundaries of the National Register District. The "Pawona Witu" National Register property is located immediately west of the boundary of the northerly Laws spreading area.

Both the Laws and Big Pine recharge areas potentially contain historic or prehistoric cultural resources that could be adversely impacted by construction and use of the areas as proposed. As has been discussed, prehistoric and ethnographic land use in Owens Valley was intense and widespread. Archaeological list densities in the surveyed portions of Owens Valley are moderately high, and previously unrecorded sites could exist within the proposed project areas.

Widespread historic resources exist in the vicinity of Laws, a National Register District, and resources associated with early settlement of the northern Owens Valley similar to those already known (e.g., sites CA-INY-2519 and WS-3) could also exist within the project area.

Mitigation Measures

16-5(a) *The proposed recharge facility project locations would be surveyed for cultural resources prior to the initiation of any ground-disturbing project activities associated with the construction of any culverts, ditches or trenches, once the exact locations of these features are determined. The significance of any site recorded during the survey would be determined through the use of subsurface testing, as appropriate.*

16-5(b) *In accordance with the requirements of 36 CFR 800.11, should a previously unidentified National Register or eligible property be discovered during construction on any and all parts of the project, LADWP would comply with the provisions of the Archaeological and Historic Preservation Act of 1974 by evaluating the resources and implementing mitigation measures as warranted.*

16.3 NEW WELLS

INTRODUCTION

The Agreement provides for the construction and operation of 15 new wells to increase LADWP's operational flexibility and to facilitate rotational pumping. LADWP has selected sites in the Laws, Bishop, Big Pine, Independence-Symmes-Bairs, and Lone Pine well fields for these new wells. Construction and operation of these 15 new wells by LADWP will be in conformance with the provisions of the Agreement. The total expected capacity of the 15 new wells is estimated to be 65 cfs (47,000 AFY) which will increase the aqueduct supply pumping capacity from 269 cfs (195,000 AFY) to 334 cfs (242,000 AFY) and the total pumping capacity from 376 cfs (272,000 AFY) to 441 cfs (319,000 AFY).[1] Groundwater pumping from existing wells during the 1970-1990 period and in the future under the proposed Agreement is described in previous chapters along with a discussion of impacts and mitigations. The pre-project environmental setting is also discussed in the prior chapters.

This section will describe the location of the proposed 15 new wells along with the impacts associated with construction and operation of these wells. (The proposed new wells in the Bishop area are also discussed in the section of this chapter on Increased Pumping on the Bishop Cone.)

Table 16-2 provides a summary of the proposed new wells including location, proposed diameter, expected depth, screen interval and estimate production rate.

TABLE 16-2

PROPOSED NEW WELLS

Well Field	Well No.	Diameter (Inches)	Expected Depth (ft.)	Expected Screen Interval (ft.)	Production Rate (cfs)
Laws	L-1	18	560	200 - 550	4.5
	L-2	18	560	200 - 550	4.5
Bishop	B-1	18	600	200 - 590	3.5
	B-2	18	600	200 - 590	3.5
	B-3	18	650	300 - 640	3.5
	B-4	18	650	300 - 640	4.0
	B-5	18	650	300 - 640	4.0
Big Pine	BP-1	18	450	200 - 440	3.0
	BP-2	18	450	260 - 440	5.5
Independence-Symmes-Bairs	ISB-1	18	600	200 - 590	5.0
	ISB-2	18	600	200 - 590	5.0
	ISB-3	18	600	300 - 640	5.0
	ISB-4	18	600	200 - 590	5.0
	ISB-5	18	600	200 - 590	5.0
Lone Pine	LP-1	18	560	200 - 550	4.0

Source: Los Angeles Department of Water and Power, January, 1990.

LOCATION AND DESCRIPTION OF NEW WELLS

Laws Area

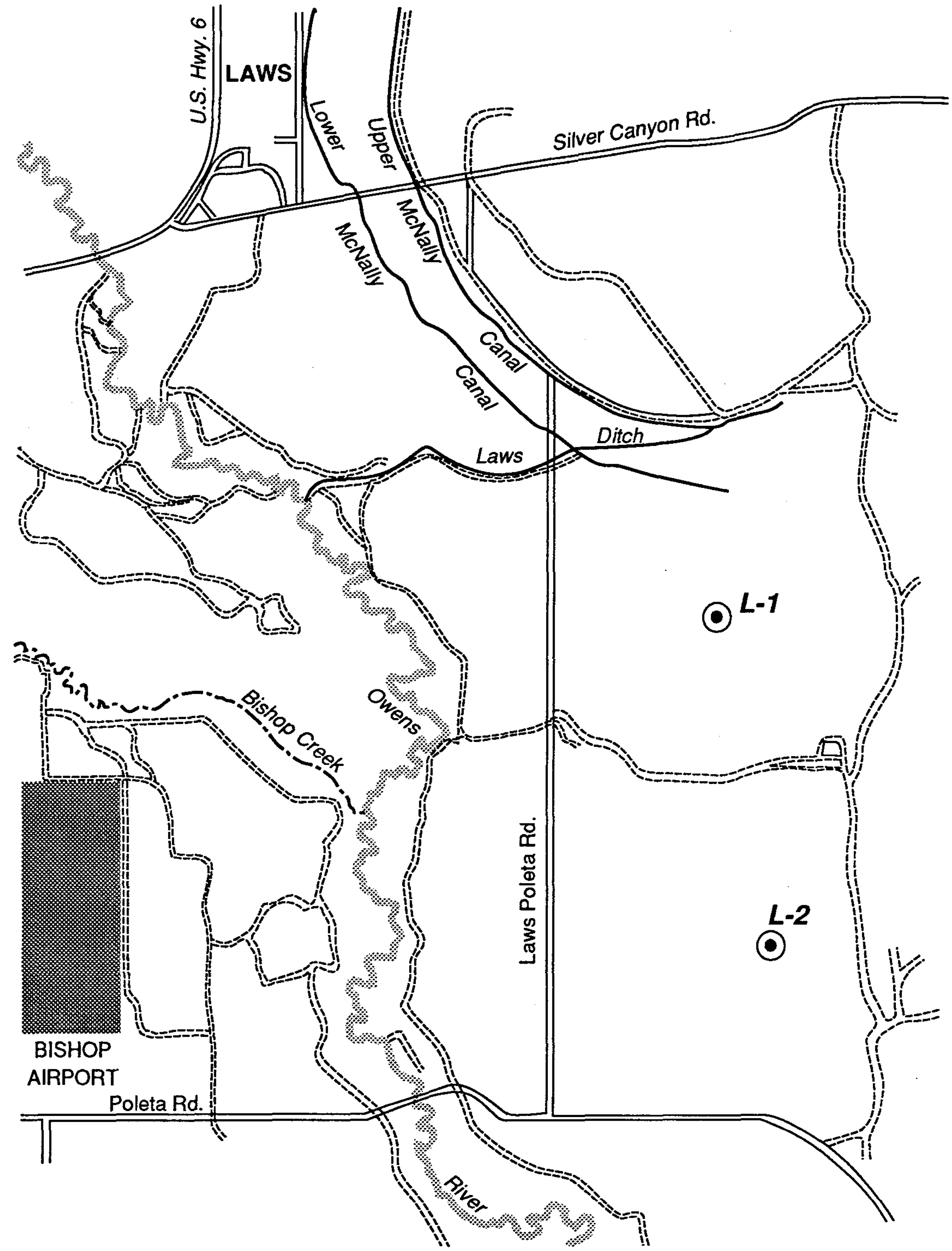
Two new wells are proposed for the Laws area and are shown in Figure 16-4. Location L-1 is approximately 3/4 of a mile south of the Laws Return Ditch and E/M Well 377, and approximately 1/2 mile east of the Owens River and Wells 134 and 136. Location L-2 is approximately 1-1/2 miles east of Wells 133 and 134. These locations were selected because construction of the proposed wells should have minimal effect on the surface vegetation and the environment. The locations are conducive to operating the proposed wells in conjunction with the proposed spreading facilities; the sites are near conveyance facilities (McNally Canals), and hydrological conditions are favorable.

Hydrogeologic conditions were based on an evaluation of well logs from nearby wells (Nos. 377, 134, and 136). The subsurface in the vicinity of L-1 and L-2 is generally alluvial fan deposits, composed of fine to very coarse alluvium. Other hydrogeologic data considered include deep observation wells and shallow test holes in close proximity to the site, historic water level responses to pumping of other wells in the area, and knowledge gained from the USGS Groundwater Investigation.

Since the L-2 site is approximately 1-1/2 miles from the nearest existing production well, sites L-1 and L-2 will be drilled one-at-a-time. The first well will be operated for a period of at least six months before drilling the second well, in order to gain any new information that might be useful in designing the second well and determining monitoring requirements in order to minimize the potential for impacts.

The Laws well field area currently has 13 existing aqueduct supply wells with a capacity of 36.4 cfs (26,300 AFY) and 6 E/M wells with a capacity of 32.1 cfs (23,200 AFY). The proposed new wells will increase the total pumping capacity within the Laws well field by 9 cfs (6,500 AFY) to 77.5 cfs (56,100 AFY), an increase of approximately 13 percent.

An inventory and classification of vegetation in the Laws area has been completed and is shown on the Laws and Poleta Canyon Vegetation and Well Field Management Area maps. These maps (attached to the Agreement) show management area boundaries that were generated by the Bishop



O W E N S V A L L E Y

FIGURE 16-4

PROPOSED NEW WELLS, LAWS AREA

SOURCE: LADWP, AQUEDUCT DIVISION

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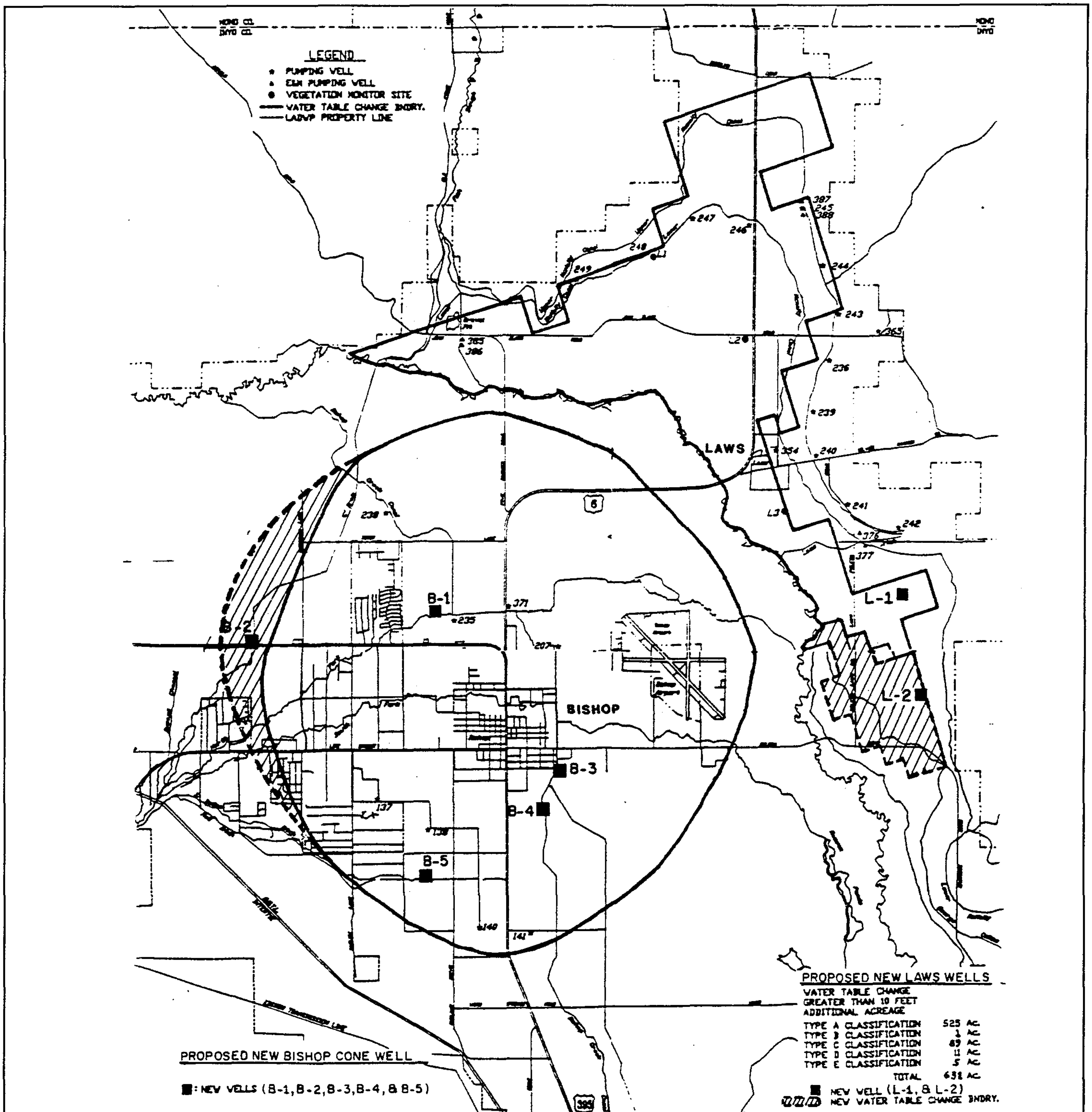
Basin mathematical groundwater flow model under a pumping scenario that involved pumping all existing wells during a worst-case three-year drought (hydrologic condition of 1978, which is the driest on record, repeated three times). The identified management area boundary is defined as containing the area within which drawdown of the water table is ten feet or greater during the worst-case, low runoff/maximum pumping scenario, i.e., the area of concern. The groundwater model has been re-run with the two proposed new wells included to identify changes in management area boundaries and the vegetation that has the greatest potential for being affected by the new wells. The original management area and the additional area of ten-foot or greater drawdown (designated by cross-hatching) are shown in Figure 16-5.

Bishop Area (See also discussion below on increased pumping on Bishop Cone.)

Five new wells are proposed for the Bishop area and are shown in Figure 16-6. Location B-1 is approximately 1/4 mile west of Well 235 and just north of North Bishop Creek. Site B-2 is approximately 1/2 mile east of Well 279 and adjacent to the "C" drain and U.S. Highway 395 (located east and south, respectively, of B-2). Location B-3 is approximately 1/4 and 3/4 of a mile south of Wells 201 and 202, respectively, and just east of the "A" Drain. Location B-4 is approximately one mile northeast of Well 139, 1-1/2 miles northwest of Well 292, and just west of Bishop Creek Canal. Location B-5 is approximately 1/2 mile south of Well 138, approximately 1/2 mile west of Well 139, and just north of Hall Ditch. These locations were selected so that construction of the proposed wells should have minimum effect on the surface vegetation and the environment. The sites are near creeks and ditches that provide conveyance to areas of water demand/use on the Bishop Cone; and hydrological characteristics are favorable.

Hydrogeologic conditions were based on an evaluation of well logs from nearby wells (Nos. 235, 279, 201, 202, 139, 292, and 138). The well field area lies on the broad alluvial fan of Bishop Creek. The subsurface in the vicinity of B-1 through B-5 consists of heterogeneous fluvial and lacustrine deposits of highly variable hydrologic character. Gravel beds principally fluvial in nature, with an interlaying of silt-clay and clay lenses, create a generally confined system throughout, with free water table conditions at the west and east edges of the area. Other hydrogeologic data considered include a number of deep observation wells and shallow test holes in close proximity to the proposed well sites, past pumping and water level records on the Bishop Cone, and findings of the USGS Groundwater Investigation.



O W E N S V A L L E Y

FIGURE 16-5

LAWS AND BISHOP
MANAGEMENT AREAS

SOURCE: LADWP, AQUEDUCT DIVISION

NO SCALE

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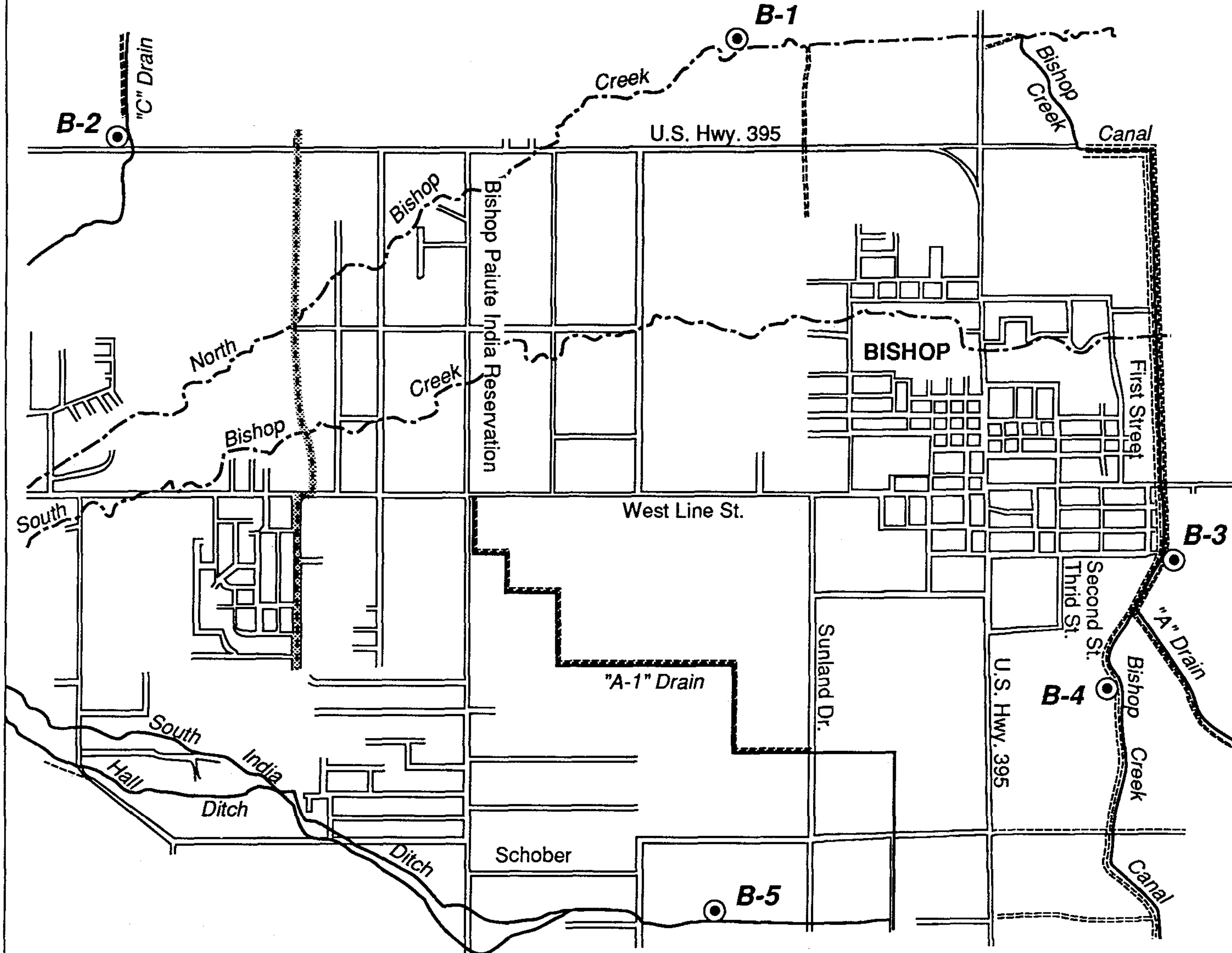

O W E N S V A L L E Y

FIGURE 16-6

PROPOSED NEW WELLS, BISHOP AREA

SOURCE: LADWP, AQUEDUCT DIVISION

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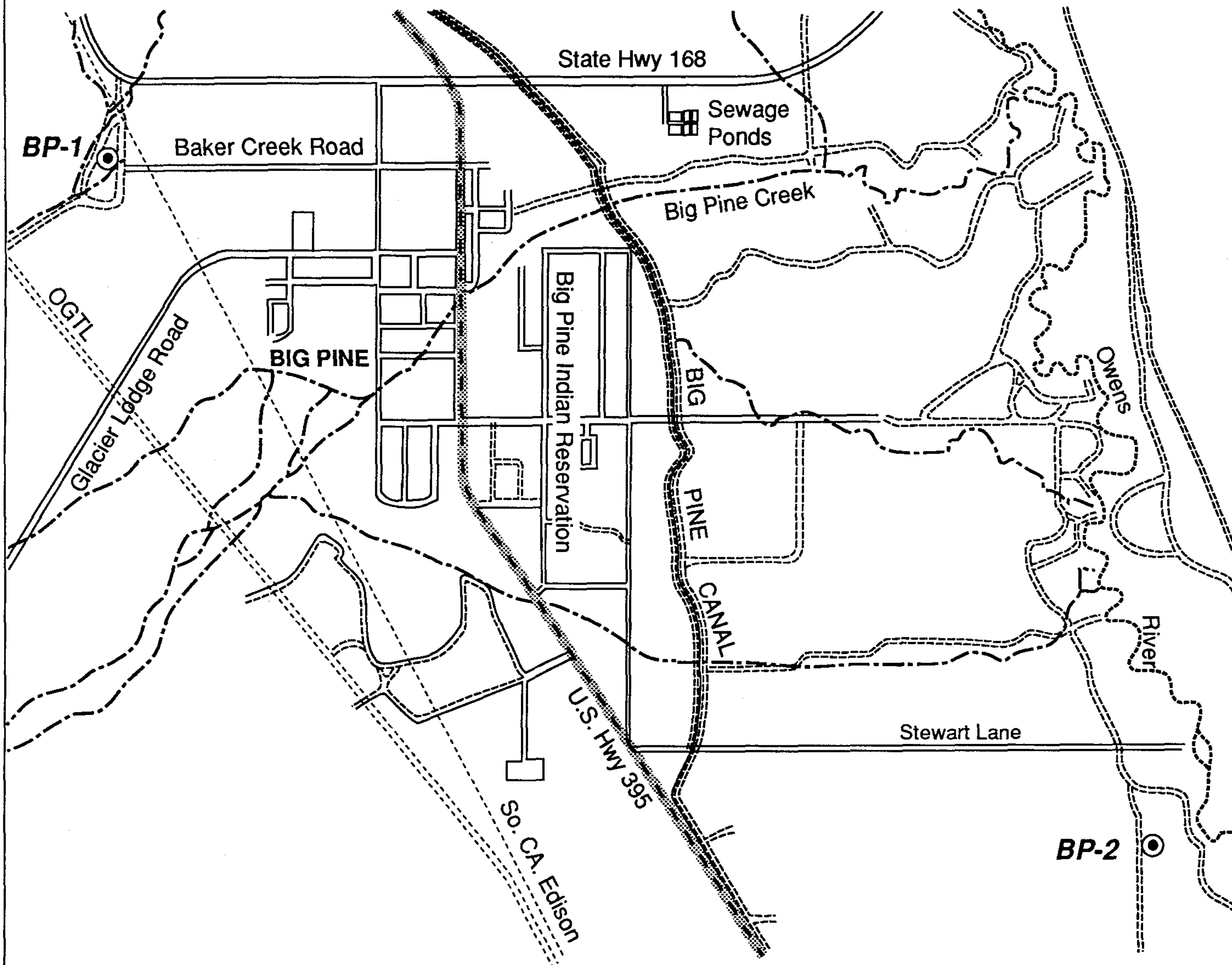
The Bishop Cone well field area currently has nine existing irrigation supply wells with a capacity of 25.7 cfs (18,600 AFY). The proposed new wells will increase the total pumping capacity within the Bishop Cone well field by 18.5 cfs (13,400 AFY) to 44.2 cfs (32,000 AFY), an increase of approximately 72 percent.

An inventory and classification of vegetation in the Bishop Cone area has been completed and is shown on the Fish Slough, Laws, Bishop, and Poleta Canyon Vegetation and Well Field Management Area maps. The existing vegetation management area boundary for Bishop was developed by the Technical Group and takes into consideration hydrology, modeling results, well locations, and land use (irrigation ditches). These same factors were again evaluated assuming the five new wells were in place. Because of restrictions on LADWP pumping on the cone, the management area was only slightly changed in the area of well B-2. The management area is shown previously in Figure 16-5.

Big Pine Area

Two new wells are proposed for the Big Pine area and are shown in Figure 16-7. BP-1 is located near Baker Creek approximately 1.1 miles north of Well 341. BP-2 is located west of the Owens River, approximately one quarter mile south of E/M Well 375. These locations were selected because construction of the proposed wells should have minimum effect on the surface vegetation and the environment; from these locations pumped water from BP-1 can be conveyed directly into Baker Creek for irrigation needs and/or export; and water from BP-2 can flow directly into the Owens River. Hydrological characteristics at both locations are favorable.

Hydrogeologic conditions were based on an evaluation of well logs from nearby wells (numbers 341, 375, USGS 83-14A, and USGS 83-14B, and the Inyo County Baker Creek Campground Well). The subsurface in the vicinity of BP-1 is alluvial fan deposits, composed of fine to very coarse colluvium mixed with cobbles and boulders transported by debris flow. North-south faults are located east of BP-1 and west of the town of Big Pine. The fault zone has disrupted the subsurface material, creating a barrier that retards the west-to-east flow of groundwater. These faults will also limit the spread of the pumping cone of depression to the east of BP-1. Since the aerial extent of the cone of depression is limited, groundwater pumping causes a greater drawdown of the aquifer than if the fault zone were absent.



O W E N S V A L L E Y

FIGURE 16-7

PROPOSED NEW WELLS,
BIG PINE AREA

SOURCE: LADWP, AQUEDUCT DIVISION

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The subsurface in the vicinity of BP-2 is generally comprised of heterogeneous fluvial and lacustrine deposits of highly variable hydrologic character including a massive clay layer (between approximately 150 and 250 feet below ground surface) that extends over most of the southern part of the Bishop Basin.

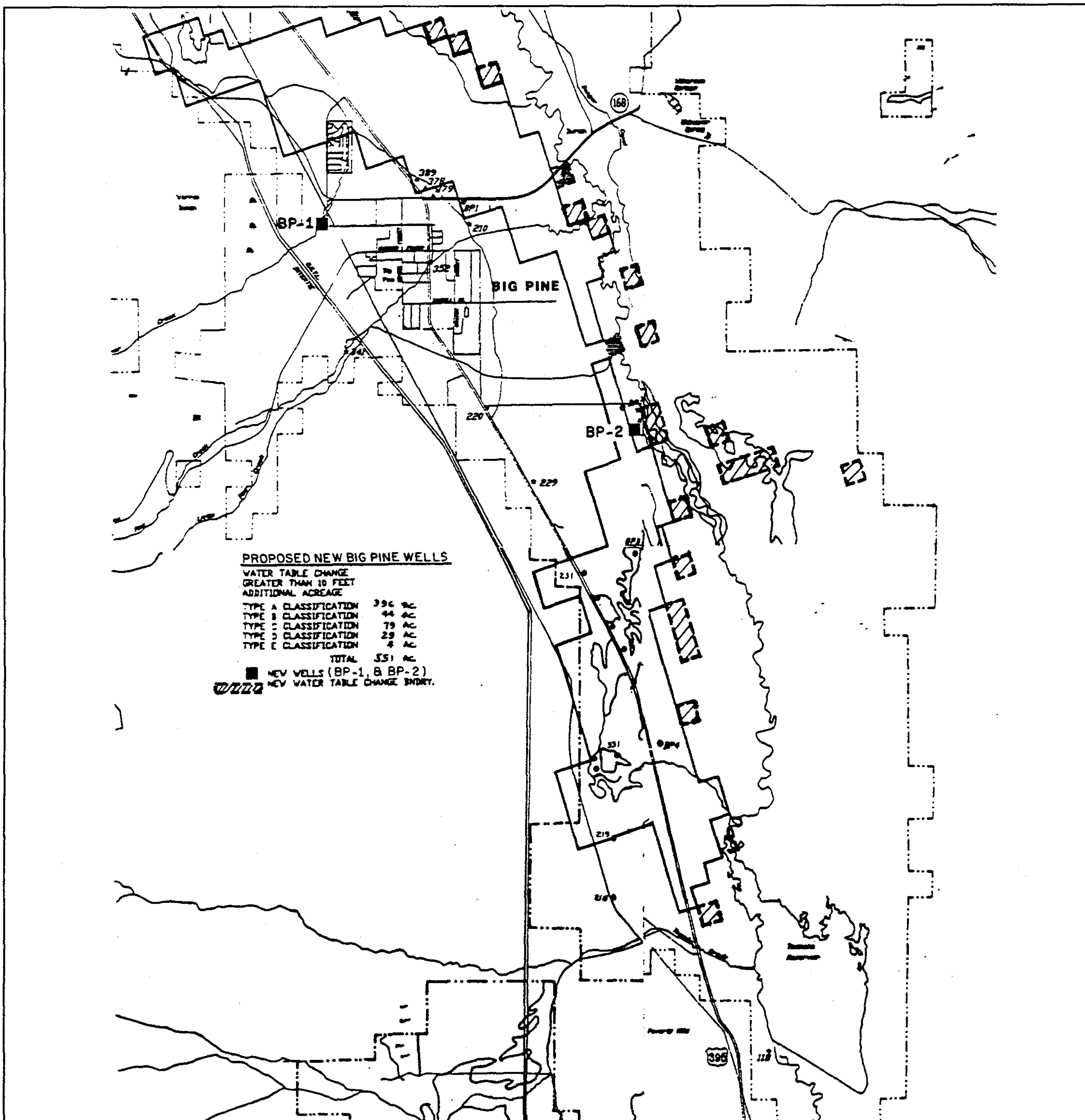
At the BP-1 site, hydrogeologic information is limited to a relatively shallow well and a well over one mile away. Therefore, a deep test hole (approximately 500 feet) will be drilled to develop more information on the hydrologic conditions at the site. Results from the test hole will be evaluated as provided in the Agreement and the Green Book before proceeding with construction of production well BP-1. Other hydrogeologic data considered for BP-2 include intermediate and deep observation wells in close proximity to the site, past pumping and water level response records, and knowledge gained from the USGS Groundwater Investigation.

The Big Pine well field area currently has 13 existing aqueduct supply wells with a capacity of 70.6 cfs (51,000 AFY) and 4 E/M wells with a capacity of 19.1 cfs (13,800 AFY). The proposed new wells will increase the total pumping capacity within the Big Pine well field by 8.5 cfs (6,100 AFY) to 98.2 cfs (71,000 AFY), an increase of approximately 12 percent.

An inventory and classification of vegetation in the Big Pine area have been completed and are shown on the Big Pine, Uhlemeyer Spring and Tinemaha Vegetation and Well Field Management Area maps. These maps were generated by the Bishop Basin mathematical groundwater flow model with all existing wells pumping during a worst-case, three-year drought. The groundwater model has been re-run with the two proposed new wells to identify modified management area boundaries. The original management area and the additional area of ten-foot or greater drawdown (designated by cross-hatching) are shown in Figure 16-8.

Independence-Symmes-Bairs Area

Five new wells are proposed for the Independence-Symmes-Bairs (ISB) area and are shown in Figure 16-9-A and 16-9-B. ISB-1 is located north of Shepherd Creek approximately one-quarter mile east of Well 784T and approximately 70 feet northeast of Well 70. ISB-2 is located east of Highway 395, approximately one-quarter mile southeast of Well 86 and one-quarter mile east of Well 97. ISB-3 is located just west of the Los Angeles Aqueduct approximately one-half mile



O W E N S V A L L E Y

FIGURE 16-8
BIG PINE MANAGEMENT AREA

SOURCE: LADWP, AQUEDUCT DIVISION

NO SCALE

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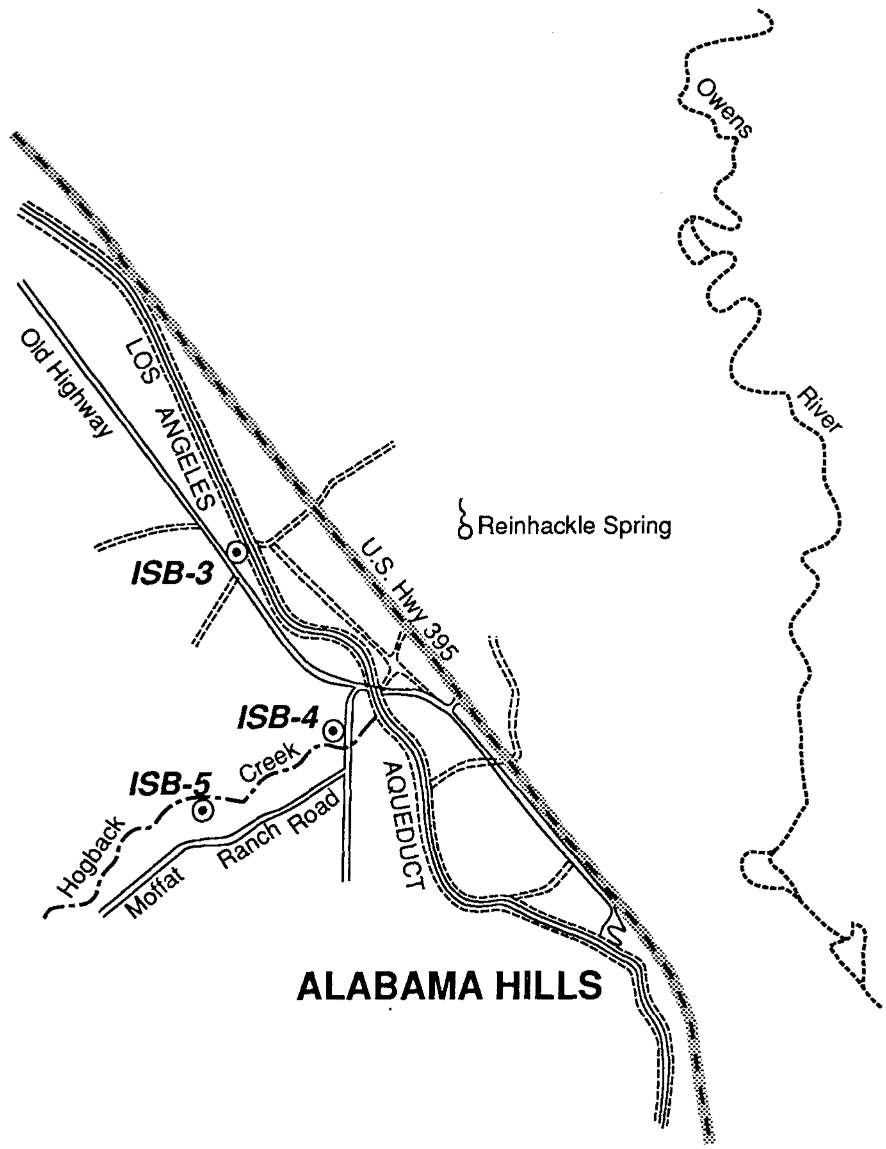

O W E N S V A L L E Y

FIGURE 16-9A

PROPOSED NEW WELLS, INDEPENDENCE SYMMES-BAIRS AREA

SOURCE: LADWP, AQUEDUCT DIVISION

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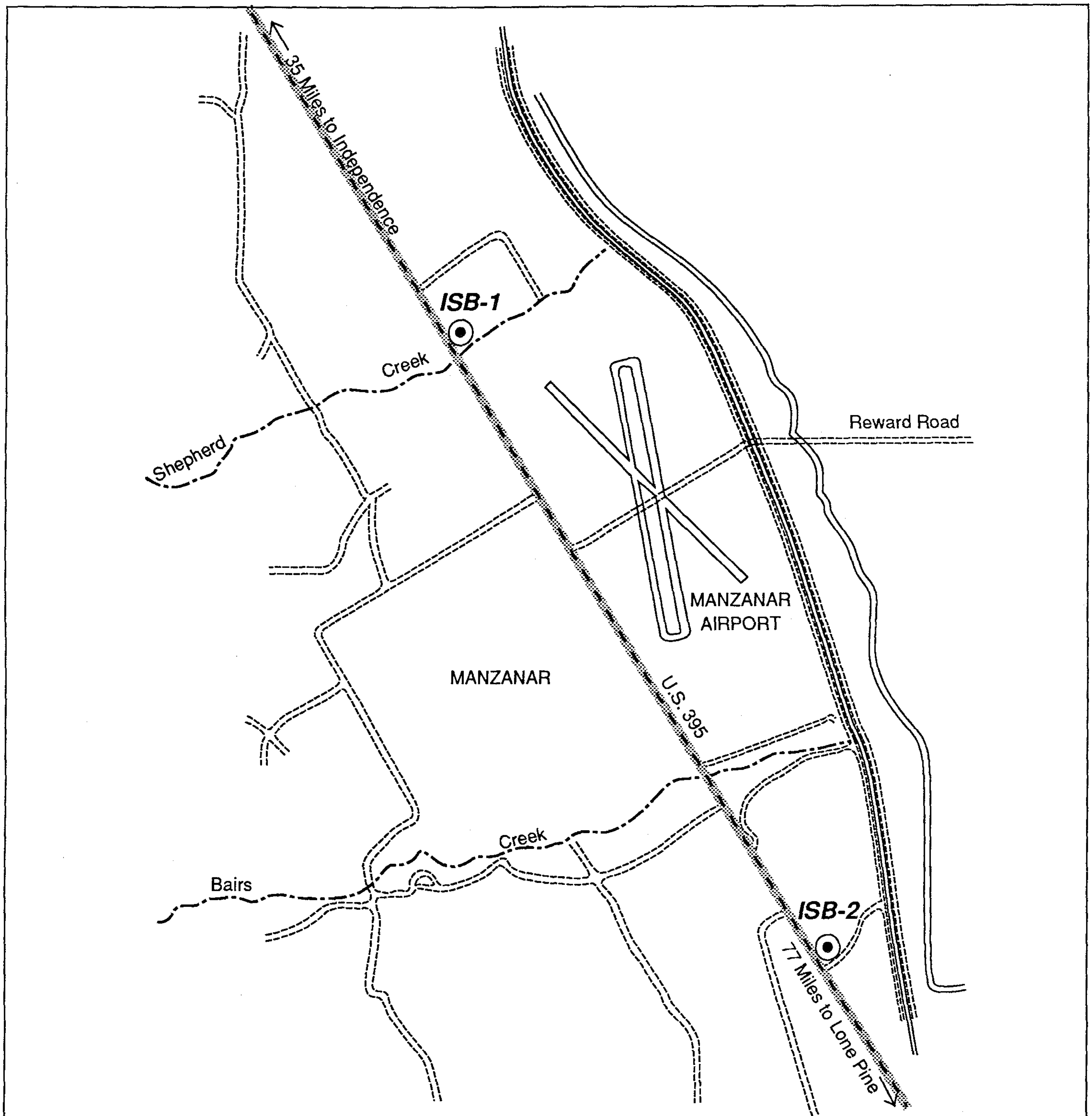

O W E N S V A L L E Y

FIGURE 16-9B

PROPOSED NEW WELLS, INDEPENDENCE SYMMES-BAIRS AREA

SOURCE: LADWP, AQUEDUCT DIVISION

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southeast of Wells 89 and 348. ISB-4 is located just north of Hogback Creek and approximately 800 feet north of Well DT-9. ISB-5 is located just south of Hogback Creek and over one-quarter mile west of Well DT-9. These locations were selected because construction of the proposed wells should have minimum effect on the surface vegetation and the environment; pumped water can be conveyed directly into the Los Angeles Aqueduct (ISB-1, 2, and 3) or to the Aqueduct via Hogback Creek (ISB-4 and 5) from these sites; and hydrological characteristics are favorable.

Hydrogeologic conditions were based on an evaluation of well logs from nearby wells (Nos. 70, 784T, 97, 86, 348, 89 and DT-9). The subsurface in the vicinity of the five wells is a layering of sediment that generally consists of alternating gravel, sand, silty-clay, and clay beds and lenses and is referred to as transition-zone deposits, a zone of north-south oriented lenses of coarse-grained sediment recognized by stringers of well-sorted sandy gravel and cobble layers. The layers are characterized by better sorting, fairly continuous north-to-south correlation, and greater hydraulic conductivity than the alluvial fan or valley floor deposit. Other hydrogeologic data considered included a number of shallow test holes and deep observation wells in close proximity to the well sites, past pumping and water level response records, and the knowledge gained from the USGS Groundwater Investigation.

Since the ISB-4 and ISB-5 locations are over one mile from the nearest existing production well, these well sites will be drilled one at a time. The first well will be operated at full capacity for six months prior to drilling of the second well, in order to gain any new information that might be useful in designing the second well and determining monitoring requirements in order to minimize the potential for impacts.

The ISB well field area currently has 23 existing aqueduct supply wells with a capacity of 70.9 cfs (51,300 AFY) and 6 E/M wells with a capacity of 15.8 cfs (11,400 AFY). The proposed new wells will increase the total pumping capacity within the ISB well field by 25 cfs (18,100 AFY) to 111.7 cfs (80,800 AFY), an increase of approximately 29 percent.

An inventory and classification of vegetation in the ISB area have been completed and are shown on the Independence, Manzanar, and Union Wash Vegetation and Well Field Management Area maps. These maps were generated by the Owens Lake Basin (OLB) mathematical groundwater flow model with all wells pumping during a worst-case three-year drought. The OLB model has been re-run with the addition of the five proposed new wells to identify modified management area boundaries. The original management area map and the additional area of ten feet or greater drawdown (designated by cross-hatching) are shown in Figure 16-10.

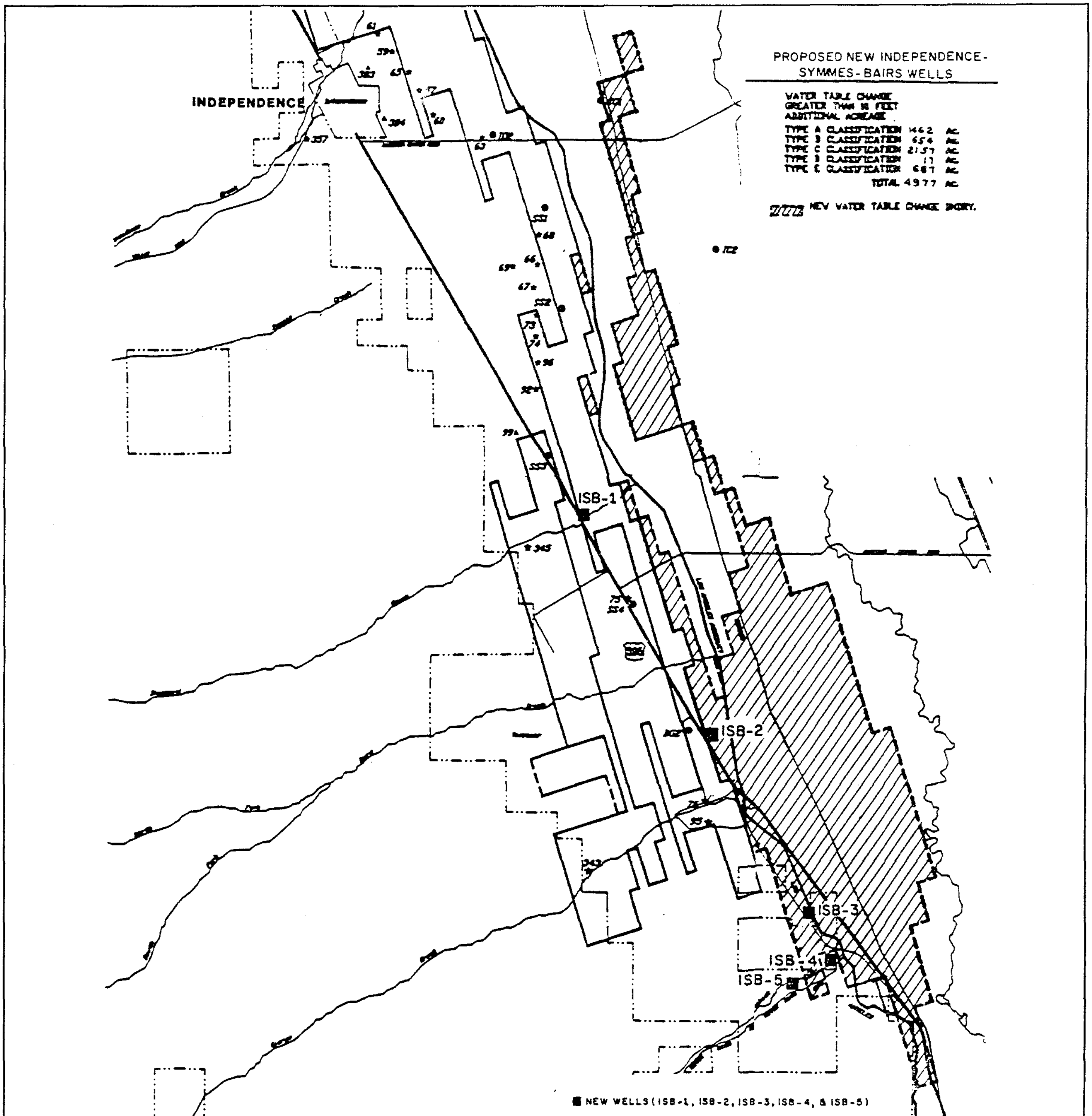
Lone Pine Area

One new well, LP-1, is proposed for the Lone Pine area and is shown in Figure 16-11. This well is located west of the Los Angeles Aqueduct over one-half mile southwest of Well 344 and approximately three-quarters mile southwest of Well 346. This well location was selected because construction of the proposed well will have minimum effect on the surface vegetation and the environment; pumped water from the site can be conveyed directly into the Los Angeles Aqueduct; the site is near a water demand; and hydrological characteristics are favorable.

Hydrogeologic conditions were based on an evaluation of well logs from nearby wells (Nos. 344 and 346). The subsurface in the vicinity of LP-1 is a layering of sediment that generally consists of alternating gravel, sand, silty-clay, and clay beds and lenses. Known north-south faults are located east of the new well site and have disrupted and offset the layered valley-fill sediments in the Lone Pine area, creating a barrier that retards groundwater flow from the west. These faults limit the spread of the pumping cone of depression to the east. Since the areal extent of the cone of depression is limited, groundwater pumping causes a greater drawdown of the aquifer than if the fault zone were absent. Other hydrogeologic data considered include deep observation wells and shallow test holes in close proximity to the site, historic water level responses to pumping of other wells in the area, and knowledge gained from the USGS Groundwater Investigation.

The Lone Pine well field area currently has two existing town supply wells with a capacity of 4.4 cfs (3,200 AFY) and one E/M well with a capacity of 4.1 cfs (3,000 AFY). The proposed new well will increase the total pumping capacity within the Lone Pine well field by 4.0 cfs (3,000 AFY) to 12.5 cfs (9,000 AFY), an increase of approximately 47 percent.

An inventory and classification of vegetation in the Lone Pine area have been completed and are shown on the Lone Pine Vegetation and Well Field Management Area map (see Appendix B).



O W E N S ● V A L L E Y

FIGURE 16-10
INDEPENDENCE-SYMMES-BAIRS MANAGEMENT AREA

SOURCE: LADWP, AQUEDUCT DIVISION

NO SCALE

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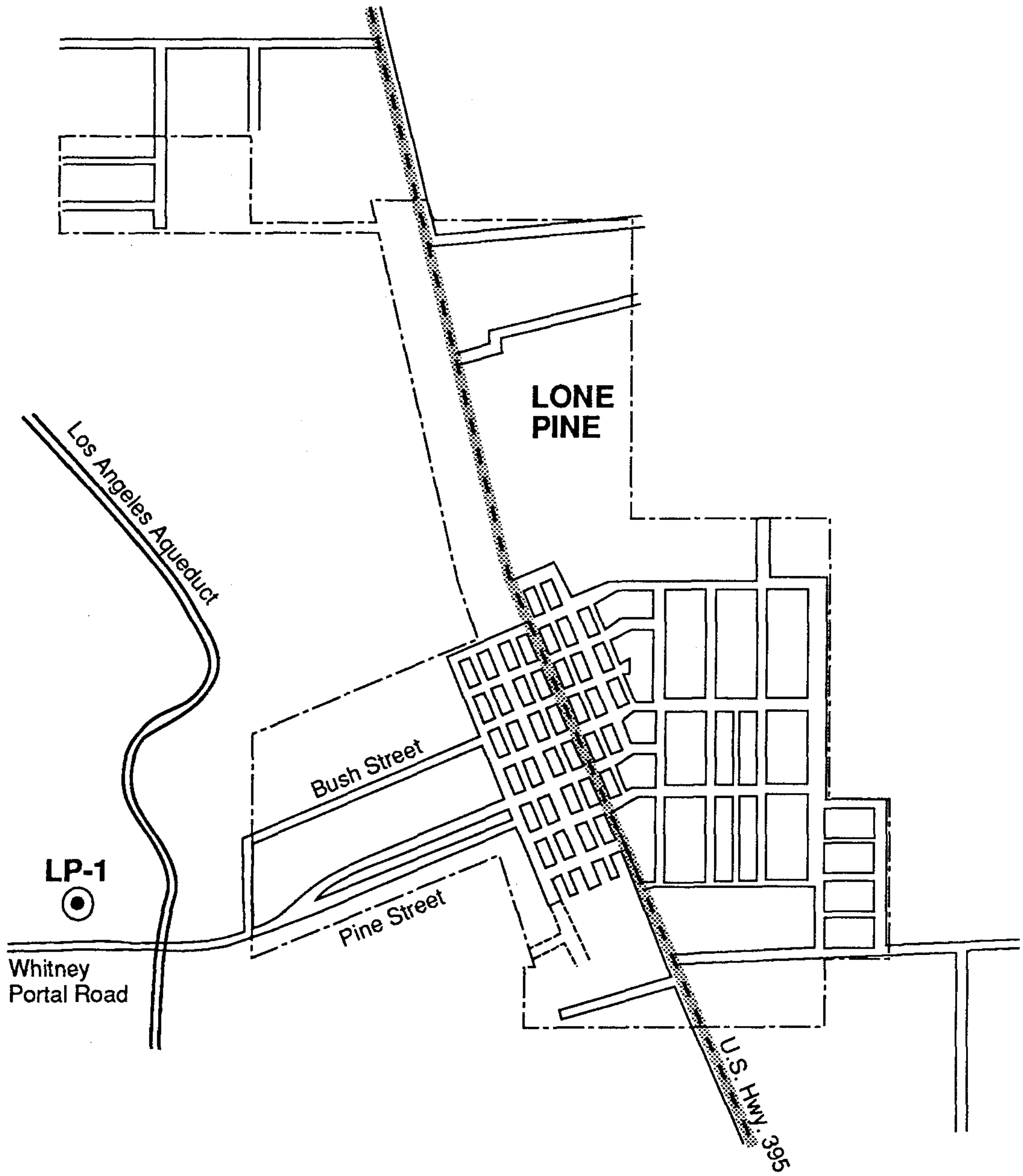

O W E N S V A L L E Y

FIGURE 16-11

PROPOSED NEW WELL, LONE PINE AREA

SOURCE: LADWP, AQUEDUCT DIVISION

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IMPACTS AND MITIGATION MEASURES

GEOLOGY, SOILS AND SEISMICITY

No significant impacts on soils, geology or seismicity would occur as a result of construction and operation of the new wells. As described in Chapter 9 - Water Resources, there is no evidence that the lowering of the groundwater table that occurred between 1970 and 1990 resulted in land subsidence in the Owens Valley. Pumping under the Agreement would be of a similar magnitude to pumping between 1970 and 1990.

Accordingly, no land subsidence is expected to occur as a result of water management under the Agreement.

Some limited soil erosion may occur during construction of the 15 wells. The subject of dust generation during construction is addressed later in this chapter under the section on air quality.

WATER RESOURCES

Under provisions of the Agreement, groundwater pumping will be managed so as to avoid significant decreases in the live cover of groundwater-dependent vegetation, to avoid a change in a significant amount of such vegetation from one management type to vegetation in another management type that precedes it alphabetically, and to avoid other significant effects on the environment.

In addition, the Agreement provides that long-term mining of groundwater will be avoided by managing groundwater pumping so that the total pumping from any well field over a 20-year period (the then current year plus the 19 previous years) does not exceed the total recharge to same well field area over the same 20-year period.

Another goal of the Agreement is to manage groundwater pumping to avoid causing significant adverse impacts to private (non-Los Angeles-owned) wells and to mitigate such impacts if any should occur.

All of these provisions of the Agreement apply equally to the 15 proposed new wells and to existing (pre-1970, and 1970 to 1990) wells in the Owens Valley.

It is expected that these provisions of the Agreement will result in little overall impact to the water resources of Owens Valley, and the groundwater flow directions will be similar to those observed in the 1970 to 1990 period. Some localized impacts are expected to occur as discussed below.

Impact

16-6 **It is not expected that water quality or quantity in private wells on the Bishop Cone would be adversely impacted due to a lowering of the water table associated with pumping the new wells on the Cone.**

The five new Bishop Cone wells are not expected to cause a significant adverse impact on private wells because the wells have been sited, operated, and monitored to avoid or minimize impacts on private wells.

Mitigation Measure

16-6 *Monitoring wells will be installed and monitored in accordance with the Agreement to monitor water levels near private wells (see Section 4 of the Green Book).*

Any significant adverse impacts on water quality or quantity in private wells will be promptly mitigated by LADWP, such that the impact will be reduced to a less-than-significant level (see Section 4 of the Green Book).

Impact

16-7 **New wells in the Big Pine area would lower groundwater levels, and could result in significant impacts to local private wells.**

Operation of the proposed new Big Pine wells in addition to operation of existing wells may affect water levels in Inyo County's Baker Creek Campground Well or the Steward Ranch Wells (east of Big Pine and the Owens River). Due to the design of the proposed new wells and due to local faulting, such drawdown impacts are expected to be minimal. The greatest potential drawdown is expected during dry years when recharge is low and pumping would likely be increased. The proposed well at the BP-1 site on Baker Creek will provide supplemental flow in the creek during dry years. Also, this well will provide a more reliable irrigation and enhancement/mitigation project water supply. Impacts and mitigation measures to the Steward Ranch wells are discussed in the Water Resources chapter of this EIR. The provisions for the location of monitoring wells and for the mitigation of impacts to private wells is discussed in Section 4 of the Green Book.

Mitigation Measure

16-7 *Monitoring will be conducted as provided in the Agreement and the Green Book. If pumping of the new production well is shown to cause a significant adverse impact to any private well, the impact will be mitigated as described in the Agreement and in Section 4 of the Green Book.*

VEGETATION

Following the construction of each new well, an aquifer test of up to 72 hours duration will be conducted in conjunction with monitoring of one or more existing or new monitoring wells as determined necessary by the Technical Group. Following testing, the Technical Group will establish monitoring sites that will be used to monitor vegetation, soil moisture, and groundwater levels when the well is operated. (See Section 3 of the Green Book.)

All wells in the Owens Valley, including the 15 new wells, will be operated in accordance with the provisions of the Agreement and the Green Book which provide for management of groundwater pumping to avoid significant decreases of changes to vegetation and other significant effects on the environment.

Impact

16-8 **New wells in the five areas described above would result in fluctuations in groundwater levels, but would not result in significant impacts.**

Mitigation Measure

16-8 *All new wells would be operated in accordance with provisions of the Agreement so as to avoid creating significant impacts to vegetation and to the environment (see above).*

Impact

16-9 **Operation of the two new wells in the Laws area could cause flow in artesian wells to stop or to diminish to a degree that impacts to the vegetation dependent on such flow would result.**

The potential impact of these two Laws wells on the artesian wells along the Owens River was investigated using the BB model. Running the BB model under the worst-case, three-year drought scenario indicated that the pumping of these two wells alone will cause a slight reduction in flow from these artesian wells.

Mitigation Measure

16-9 *Existing and new monitoring wells will be used to monitor water levels and vegetation as provided in the Agreement and the Green Book. Groundwater pumping will be managed to avoid causing reductions in the amount of water flowing from theses wells such that significant decreases and changes to vegetation would result. If it is projected that such decreases and changes could occur, water will be supplied to avoid such vegetation decreases or changes.*

Impact

16-10 **Pumping of the Big Pine well BP-1 may impact Type D vegetation along the fault zone west of Big Pine.**

Pumping of a new well at site BP-1 may lower the water table in the vicinity of the Type D vegetation which parallels the fault zone on the west edge of Big Pine which could cause impacts to the vegetation along this fault.

Mitigation Measure

16-10 *As provided in the Agreement and the Green Book, existing and new monitoring sites would be utilized to monitor vegetation, water levels, and soil water. Groundwater pumping would be managed to avoid significant decreases and changes in vegetation.*

Impact

16-11 **New wells in the Independence-Symmes-Bairs area may reduce or eliminate the flow from Reinhackle Spring and impact vegetation dependent upon flow from the spring.**

In addition to lowering of the water table, flow from Reinhackle Spring could be reduced because of groundwater production from the lower aquifer zone. Results of the OLB model and an independent hydrograph analysis by Hutchison (December 1, 1989, 89-1-093) indicate that flow from Reinhackle Spring may be reduced or may dry up during dry periods with low runoff and high pumping.

Mitigation Measure

16-11 *If it is projected that a decrease or change in vegetation dependent on flow from Reinhackle Spring will result if flow from the spring stops or is reduced, LADWP will reduce pumping to the degree necessary to restore the flow to avoid such decreases or changes or provide water to avoid such decreases or changes.*

Impact

16-12 **Operation of the proposed new well in the Lone Pine area would result in fluctuations in groundwater levels.**

It is expected that vegetation impacts from this well will be minimal, if any. The area in the vicinity of the proposed new well is either covered with non-groundwater-dependent vegetation (management type A) (depth to water in the area is normally greater than 20 feet), paved over, or irrigated. The nearest groundwater-dependent vegetation to this site is over one mile away.

Mitigation Measure

16-12 *See Chapter 10 - Vegetation, the Agreement and the Green Book for provisions concerning groundwater management, protection of vegetation, and avoidance of other significant effects on the environment.*

WILDLIFE

No significant impacts on wildlife habitat or populations would occur due to construction and operation of the new wells. The vegetation protection provisions of the Agreement will avoid significant changes in habitat or food supply.

AIR QUALITY

Impact

16-13 **Air quality could be adversely affected by the construction and maintenance of new wells.**

Between 1970 and 1990, 37 wells were drilled. A comparison of TSP and PM_{10} incidents with construction of wells indicates that construction and maintenance activities did not contribute significantly to dust episodes causing or contributing to exceedances of standards. Construction and maintenance of wells would in some part contribute to increased background levels of PM_{10}. Emission of fugitive dust generated by construction of wells may have exceeded standards on a local scale, but were not detected due to their localized effects (i.e., the source was not near an air quality monitoring site).

Construction of new wells in the Valley could temporarily increase PM_{10} concentrations and could lead to localized violations of the federal and State 24-hour PM_{10} standards if the wind was blowing and on-site dust suppression measures were not implemented. The source of PM_{10} would include clearing, excavation and grading operations, and movement of construction vehicles on unpaved surfaces.

Mitigation Measure

16-13 *All areas disturbed during construction of the new wells would be wetted during construction to minimize generation of fugitive dust.*

ENERGY

Impact

16-14 **The proposed project would increase localized demand for electricity due to the addition of 15 pumps in Owens Valley well fields; however, the water produced would generate an increase in electrical power as it moves through the Aqueduct system to Los Angeles.**

The energy demands resulting from the operation of the new pumps should be similar to the pumps operated to supply enhancement/mitigation projects over the last four years (1987 through 1990), which averaged about 230 kwh/AF in power consumption during this period, resulting in a loss in net energy production from the Owens Valley of only 10 kwh/AF (220 kwh/AF minus 230 kwh/AF = -10 kwh/AF). The estimated net energy produced by these wells would decline slightly to approximately 870 kwh/AF (1,100 minus 230 = 870 kwh/AF), assuming overall system power generation remains at historical levels. This is not considered to be a significant impact.

Equipment used to construct the new wells and recharge facilities would consume energy in the form of fossil fuels. Operation of the wells would use electrical energy. Well drilling equipment, graders and dozers would all be powered by internal combustion engines, as would the vehicles used by construction workers and material and equipment suppliers. The amounts of fuel consumed during construction would not be great in the overall context of fuel use in the Valley. No special provisions for construction fuel supply would be needed.

Mitigation Measures

16-14 *None required.*

Land Use

Impact

16-15 **Drilling of 15 wells would remove less than a total of one acre of land from grazing.**

No significant adverse land use impacts are expected from using a small amount of land for wells.

Mitigation Measures

16-15 *None required.*

Cultural Resources

Impact

16-16 **Construction of 15 new wells could disturb subsurface archeological resources, with possible significant impact.**

Table 16-3 presents the results of a cultural resources survey of the proposed 15 new wells. Construction of two new wells in the Laws area would have no significant adverse impacts on subsurface archaeological resources. Surveys for cultural resources covering ten acres were performed at both Laws well sites and resulted in negative surveys (no cultural resources of any kind observed). The ten-acre areas surveyed are of sufficient size to construct the well and associated piping.

Construction of the five new wells in the Bishop area would have no significant adverse impacts on subsurface archeological resources. Surveys for cultural resources covering ten acres (sites B-1 and B-5) and four acres (sites B-2, B-3, and B-4) resulted in negative surveys (no cultural resources of any kind observed). The ten- and four-acre areas surveyed are of sufficient size to construct the wells and associated pining.

Big Pine wells BP-1 and BP-2 are located in cultural resources sites. A previously unknown cultural resources site (designated WS-2) was discovered during a four-acre survey for new well BP-1. WS-2 is located at the western end of Baker Creek Road and is surrounded by Baker Creek Campground. The site is located within a granite boulder field and appears to be the remains of a dumpsite. The integrity of the site has been greatly disturbed due to the proximity of the site to popular Baker Creek Campground and as a result of a recent fire over the entire site. Archeological site CA-INY-1698, originally recorded in 1974, was found within the four-acre survey area performed for BP-2. The site is situated about two miles southeast of Big Pine and was previously documented as a sparse lithic scatter and characterized as a "temporary camp". During the survey, only three small black obsidian waste flakes were evident at the site.

Neither site WS-2 nor CA-INY-1698 appear to contain information of significance to regional prehistory, nor do they appear to meet the criteria for eligibility to the National Register of Historic Places as defined in 36 CFR 60.4. There is no regulatory requirement to avoid or otherwise protect these sites since they appear not to be significant. However, if subsurface prehistoric archeological resource evidence is found during construction, excavation or other construction activity in the area would cease and an archeological consultant would be retained to evaluate findings in accordance with standard practice and applicable regulations. Data/artifact recovery, if deemed appropriate, would be conducted during the period when construction activities are on hold.

TABLE 16-3

RESULTS OF THE PROPOSED WELL SURVEYS

Well Designation	Survey Coverage	Cultural Resources Survey Results
B-1	10 acres	Negative.
B-2	4 acres	Negative.
B-3	4 acres	Negative.
B-4	4 acres	Negative.
B-5	10 acres	Negative.
L-1	10 acres	Negative.
L-2	10 acres	Negative (site WS-3 about 150m west).
BP-l	4 acres	Situated on historic site WS-2.
BP-2	4 acres	Situated on prehistoric site CA-INY-1698.
ISB-l	4 acres	Negative.
ISB-2	4 acres	Negative.
ISB-3	4 acres	Negative.
ISB-4	4 acres	Negative.
ISB-5	10 acres	Negative.
LP-1	4 acres	Situated on historic site WS-1.

Source: William Self Associates, February 1990.

Construction of the five new wells in the Independence-Symmes-Bairs area would have no significant adverse impacts on subsurface archeological resources. Surveys for cultural resources covering four acres (sites ISB-1 through ISB-5) and ten acres (site ISB-5) resulted in negative surveys (no cultural resources of any kind observed). The four- and ten-acre areas surveyed are of sufficient size to construct the well and associated piping.

A previously unknown cultural resource site (designated WS-1) was discovered during a four-acre survey for new Lone Pine well LP-1. Site WS-1 is located immediately adjacent to and north of Whitney Portal Road and is bisected by Lone Pine Creek. Much of the cultural debris is exuding from the road material that forms the base of Whitney Portal Road and it is not clear whether the cultural debris was transported into the area with the road fill or was exposed during road construction. Cultural materials are also visible in a large granite boulder field north of the creek. The integrity of the site has been greatly disturbed due to the recent operation of heavy earthmoving equipment in the area and past floodings. It is unlikely that information of significance to local or regional history is contained at the site and the site does not appear to meet the criteria for eligibility to the National Register of Historic Places as defined in 36 CFR 60.4. If subsurface prehistoric archeological resource evidence is found, excavation or other construction activity in the area would cease and an archeological consultant would be retained to evaluate findings in accordance with standard practice and applicable regulations. Data/artifact recovery, if deemed appropriate, would be conducted during the period when construction activities are on hold.

Mitigation Measures

16-16(a) *Construction activity at the LP-1, BP-1, and BP-2 sites will be monitored. If subsurface prehistoric archeological resource evidence is found, excavation or other construction activity in the area will cease and an archeological consultant would be retained to evaluate findings in accordance with standard practice and applicable regulations. Data/artifact recover, if deemed appropriate, would be conducted during the period when construction activities are on hold.*

16-16(b) *An appropriate representative of Native American Indian groups and the County Coroner would be informed and consulted if remains are discovered, as required by State law.*

Other Impacts

Other potential impacts that could occur due to construction of new wells include vehicle traffic and noise from new wells. These impacts would occur in isolated locations in the Valley, at considerable distances from sensitive receptors. Any traffic or noise impacts would be short-term in nature and confined to the construction period. No significant impacts would be expected to occur to ambient noise levels or traffic on local roadways.

16.4 GROUNDWATER PUMPING ON THE BISHOP CONE

Introduction

Under a stipulation and order filed in Inyo County Superior Court in 1940 (commonly called the "Hillside Decree"), Los Angeles is precluded from exporting groundwater from an area surrounding Bishop that is commonly referred to as the "Bishop Cone." Under this decree, Los Angeles is permitted to pump and use groundwater on its lands on the Bishop cone.

The Agreement provides that Los Angeles will continue to irrigate its lands on the Cone that were irrigated in 1981-1982, and any other of its lands on the Cone that have been irrigated since 1981-1982. It is estimated that Los Angles has annually supplied approximately 27,000 acre-feet of water (excluding conveyance losses) on its lands on the Cone since 1981-1982, while Los Angeles has utilized an annual average of 11,532 acre-feet of groundwater from the Cone since 1981-1982. This includes average pumping of about 7,045 AFY and an average from flowing wells of about 4,487 AFY. As allowed by the decree, Los Angeles may increase ground water pumping from the Cone. The exact amount of the allowable increase is uncertain, but will be established as set forth below. Any increase in groundwater pumping on the Bishop Cone is governed by the Agreement and the Hillside Decree. The Agreement provides:

> Any groundwater pumping by the Department on the "Bishop Cone" (Cone) will be in strict adherence to the provisions of the Stipulation and Order filed on the 26th day of August, 1940, in Inyo County Superior Court in the case of Hillside Water Company, a corporation, et al. vs. The City of Los Angeles, a Municipal Corporation, et al. ("Hillside Decree").
>
> The Department's annual groundwater extractions from the Cone shall be limited to an amount not greater than the total amount of water used on Los Angeles-owned lands on the Cone during that year. Annual groundwater extractions by the Department shall be the total of all groundwater pumped by the Department on the Cone, plus the amount of artesian water that flowed out of the casing of uncapped

wells on the Cone during the year. Water used on Los Angeles-owned lands on the Cone shall be the quantity of water supplied to such lands, including conveyance losses, less any return flow to the Aqueduct System.

Before the Department may increase groundwater pumping above present levels, or construct any new wells on the Cone, the Technical Group must agree on a method for determining the exact amount of water annually used on Los Angeles-owned lands on the Cone. The agreed-upon method shall be based on a jointly conducted audit of such water uses.

Figure 16-5 (shown previously) shows the boundaries of the Bishop Cone.

Pre-Project Pumping and Water Use on the Bishop Cone

Prior to 1970, up to 3,900 acres of Los Angeles-owned lands on the Bishop Cone were irrigated with annual water use averaging 19,500 AFY (excluding conveyance losses). The amount of acreage irrigated prior to 1970 varied from as much as 3,900 acres to as little as 400 acres depending on runoff conditions and the need for water by Los Angeles.

Prior to 1940, Los Angeles had approximately 31 production wells on the Bishop Cone which had been pump-equipped. By 1970, only five of these wells were pump-equipped. These five wells had a capacity of about nine cfs (6,800 AFY). Prior to 1970, pumping on the Bishop Cone averaged approximately 19 AFY. Maximum pumping, which occurred in 1930-31 (Water Year) was 44,430 acre-feet. Flowing groundwater averaged about 3,760 AFY during the pre-project period.

Pumping and Water Use on the Bishop Cone From 1970-1990

By 1990, nine wells on the Bishop Cone were pump-equipped with a capacity of 26 cfs (18,800 AFY). From 1970 to 1990, pumping on the Bishop Cone varied from 0 AFY to 13,000 AFY with average pumping of about 5,200 AFY. During this period, flowing groundwater averaged 4,570 AFY.

From 1970 to 1990, approximately 3,730 acres on the Bishop Cone were irrigated with a firm water supply except for a reduction of irrigation during the 1976-77 drought. Irrigation use on Los Angeles-owned lands on the Cone ranged from 2,985 AFY (1977 drought) to 20,690 AFY, and the average water use from 1970 to 1990 was about 18,000 AFY (excluding conveyance losses). In addition, an average of 9,000 AFY was supplied on the Bishop Cone for livestock watering and wildlife and recreational purposes at the Bishop Saddle Club, the Farmers Ponds and the Buckley Ponds.

Construction of the five new wells on the Bishop Cone with a total capacity of 18.5 cfs (13,400 AFY) (described above) will increase the total pumping capacity on the Cone to 44.2 cfs (32,000 AFY).

Pumping and Water Use on the Bishop Cone After 1990

After 1990, in accordance with the provisions of the Agreement, irrigation on the Cone will be the same as existed during the 1981-1982 runoff year. LADWP plans to increase groundwater pumping from current levels on the Bishop Cone using existing wells and new wells that are part of the proposed project. The amount of increased pumping will be in accordance with the Hillside Decree and the provisions of the long-term Agreement, including those providing for environmental protection.

IMPACTS AND MITIGATION MEASURES

GEOLOGY, SOILS AND SEISMICITY

No significant impacts on soils, geology or seismicity are expected to occur as a result of increased pumping on the Cone.

WATER RESOURCES

Impact

16-17 **Increased pumping on the Bishop Cone could cause increased fluctuation in groundwater levels but would not result in significant impacts to water resources or to the quality or quantity of water in private wells in the Bishop area.**

Any increase in pumping on the Cone must be in accordance with provisions of the Agreement and the Hillside Decree. Prior to any increase in pumping, new monitoring sites will be established to monitor vegetation, water levels, and soil moisture. Annual groundwater pumping together with water from flowing wells will not exceed actual annual water use on Los Angeles-owned lands on the Cone as determined by the annual audit of such use.

As provided in the Green Book, water level changes will be monitored to assess impacts on private wells, and any significant impacts on water quality or quantity in private wells will be promptly mitigated by LADWP.

Increased levels of groundwater pumping in dry years would increase flows in certain canals and ditches, and would allow more creek flow to remain in Bishop Creek rather than being diverted for use on Los Angeles-owned lands on the Bishop Cone.

Mitigation Measure

16-17 *Existing and new monitoring wells installed in accordance with the Agreement would be used to monitor changes in water levels and to avoid impacts on private wells. Any significant impacts due to pumping would be promptly mitigated as required by the Agreement (see Section 4 of the Green Book).*

Impact

16-18 **Increased pumping on the Bishop Cone could affect the rate of discharge from flowing wells.**

Mitigation Measure

16-18 *Changes in flow rates from flowing wells will be monitored along with vegetation dependent upon flows from such wells. Groundwater pumping will be managed to avoid significant decreases or changes in vegetation dependent upon water from flowing wells. Water will be provided if necessary to avoid such decreases and changes in vegetation if flows from such wells are diminished due to groundwater pumping.*

VEGETATION

Impact

16-19 **Increased pumping on the Bishop Cone could adversely affect vegetation due to lowered water levels or reduced flows from flowing wells.**

Mitigation Measure

16-19 *As provided in the Agreement, existing and new monitoring sites would be utilized to monitor vegetation, water levels, and soil water. Groundwater pumping would be* *managed to avoid significant decrease and change to vegetation and other significant effects on the environment.*

WILDLIFE

No significant impacts on wildlife habitat or populations are expected as a result of increased pumping on the Cone. As a result of pumping, less water would need to be diverted from Bishop Creek for purposes of irrigating City lands and this could be beneficial to trout populations during dry years when flows in the creek are low.

AIR QUALITY

No significant impacts on air quality are expected as a result of pumping on the Cone.

ENERGY

Impact

16-20 **Increased pumping on the Cone would result in increased power consumption for operation of the well pumps but would not cause a significant adverse impact on energy resources.**

Mitigation Measure

16-20 *None required.*

LAND USE

No significant impacts on land use are expected as a result of future pumping on the Bishop Cone.

CULTURAL RESOURCES

Increase pumping on the Cone would have no adverse impacts on cultural resources.

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1. Wherever pumping capacity is indicated in AFY, it is speculative because it assumes continuous pumping at the flow rate given in cubic feet per second (cfs) for an entire year.

2. State Implementation Plan and Negative Declaration/Initial Study for Owens Valley PM10 Planning Area, Section 1.4.2 PM10 Data, December 1988, p. 12.

3. National Register of Historic Places. 1979. Federal Register, (44:26; Department of Interior, National Park Service (February 1979; and March 1980, February 1981, February 1982, March 1983, February 1984, March 1985, and February 1986 Federal Register updates).

17. CEQA CONSIDERATIONS

17.1 INTRODUCTION

The purpose of this EIR is to describe the environmental effects of the proposed project in its entirety to the public and decision-makers. To present a balanced picture of the range of environmental effects, CEQA Guidelines (Section 15126) require discussion of the following subjects:

- o significant environmental effects of the proposed project;
- o unavoidable effects and mitigation measures;
- o alternatives;
- o relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity;
- o significant irreversible environmental changes of the proposed action;
- o growth-inducing impacts of the proposed action;
- o cumulative impacts;
- o areas of controversy known to the lead agency, including issues raised by agencies and the public.

Discussions of significant and unavoidable effects, and corresponding mitigation measures are found in Chapters 8 through 16; alternatives are discussed in Chapter 7. This chapter summarizes the effects of the proposed project on the relationship between short-term uses of Owens Valley resources and their long-term effects; on potentially irreversible effects of the proposed project; and on growth-inducing impacts of the proposed project on Owens Valley and Los Angeles. Finally, the cumulative impacts of the proposed project are summarized, and areas of controversy are outlined.

17.2 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE OF LONG-TERM PRODUCTIVITY

CEQA Section 21100 states that the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity is to be addressed. This discussion is to include the cumulative and long-term effects of the proposed project that adversely affect the environment. Special attention is to be given to impacts that narrow the range of beneficial uses of the environment. To some extent, the following may overlap or reinforce concepts already expressed in individual environmental issue sections, or in Chapter 6, Alternatives to the Proposed Project.

With the above in mind, the proposed project has numerous features that entail short-term uses of the environment with the goal and likely consequence of maintenance of long-term productivity. These include:

- Provisions for protection of vegetation as part of the goals and provisions of the Agreement will serve to maintain the ecological and aesthetic values of live vegetative cover, wildlife habitat, and forage, and would minimize potential for topsoil loss due to wind erosion.

- Jointly collected, interpreted, and managed data on the part of Inyo County and Los Angeles will provide a series of checks and balances, and verification to the actions proposed in the groundwater management plan and the procedures designed to manage those actions.

- Provisions for enhancing natural environmental systems such as lakes and the Owens River would serve to maintain the unique wildlife-to-plant-to-soil relationships that have evolved in the Owens Valley.

- Provision prohibiting long-term groundwater mining will prevent long-term depletion of groundwater from the Owens Valley groundwater basin. With this provision, the rate of pumping of the underground water supply would not exceed the long-term rate of recharge over any 20-year period.

17.3 SIGNIFICANT IRREVERSIBLE ENVIRONMENTAL EFFECTS

CEQA states that a number of types of impacts associated with a proposed project may be considered to be significant and irreversible for the following reasons:

- o Uses of nonrenewable resources (e.g., fossil fuels, minerals) during the initial and continued phases of a project may be irreversible since a large commitment of such resources would make removal or non-use thereafter unlikely.

- o Primary and secondary impacts (such as road or sewer improvements to a previously inaccessible area) generally commit future infrastructure systems to similar uses.

CEQA also states that irretrievable commitments of resources are to be evaluated to assure that such consumption is justified.

The proposed project would irretrievably commit building materials and energy resources in the construction, operation, and maintenance of new facilities, such as new wells, power lines, and spreading grounds. Development of some facilities would represent an irreversible conversion of open space to developed space with resulting visual impacts. It is unlikely that after conversion, these developed lands would revert to open space.

17.4 GROWTH INDUCEMENT

Operation of the second aqueduct from Owens Valley to Los Angeles, and other water-gathering practices by LADWP between 1970 and 1990 had little impact on economic or urban growth in the Owens Valley. LADWP's ownership and control of most Valley floor lands, combined with its mission to supply Los Angeles with high-quality water, have served as effective limits to residential and commercial growth in Owens Valley towns.

The proposed project provides for the LADWP's release of about 101 acres of land for public and private development. This release will induce some growth of the housing stock and the commercial real estate base in Owens Valley. The degree of growth inducement is not expected to generate significant adverse impacts. The releases and development of these lands will be subject to future CEQA review.

The proposed project would provide water which would sustain urban development in Los Angeles. The secondary environmental impacts of growth in Los Angeles include the conversion of undeveloped or agricultural land to urban uses and the associated generation of vehicular traffic movements and air and water pollutants.

If the proposed project was not implemented it is unlikely that the secondary impacts of growth would be avoided. The demographic and economic forces propelling growth in Southern California are powerful. In the absence of voter-approved growth control measures or an economic recession, urban development will continue. Water to support growth will be found somewhere: If the proposed project is not implemented, an alternative will be. Water will not likely limit urban growth in California while a substantial proportion of the State's water supply is used by irrigated agriculture. In California, free market competition for water between cities and farmers has always been resolved in favor of the cities. The cities can afford to pay a price for water that makes farming uneconomical.

17.5 CUMULATIVE IMPACTS

CEQA Guidelines (Section 15130) require that cumulative impacts of a proposed action "shall be discussed when they are significant." Cumulative impacts are defined by the Guidelines as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." Cumulative impact analysis seeks to evaluate the potential for cumulative effects becoming greater than the sum of various individual, isolated impacts. CEQA Guidelines call for evaluating the cumulative impacts of projects past, present, and anticipated, relevant to the proposed project.

The Owens Valley has been subject to the cumulative effects of Los Angeles' water-gathering activities since 1913. The proposed project is the most recent in a series of actions designed to increase export of water to Los Angeles. LADWP's past activities, when considered together with the proposed project, have had significant effects on the Owens Valley environment -- both adverse and beneficial. As more fully described in Chapters 8 through 16, since 1913, Los Angeles' water management practices have led to the drying-up of Owens Lake, adversely affected parts of the Owens River, its tributary streams and its associated vegetation and wildlife, adversely affected areas of groundwater-dependent vegetation, dried up springs, and caused limitations on and disruptions of population and economic opportunities. On the other hand, Los Angeles' land management policies have prevented uncontrolled urban development, and the pollution and destruction of natural habitats that inevitably accompany it.

The degree of significance of the cumulative impacts of Los Angeles' activities since the turn of the century varies depending on whether the impacts are compared to a pristine Owens Valley environment, an agricultural Owens Valley in the early 1900s, conditions in 1970, or to an Owens Valley as it might appear today, had Los Angeles never entered the Valley and had the land remained in private ownership. Under the last scenario, one can only speculate on the level of development and environmental change that would have occurred; without doubt, the Valley would likely be different than it is today.

As is the case with the determination of the significance of impacts, the determination of whether or not a mitigation measure or measures prescribed for an identified significant impact reduces the impact to less than significant also is somewhat subjective.

Cumulative impacts of LADWP's past water gathering activities, if applicable, are discussed in the pre project setting sections of Chapters 8 through 16. Although the mitigation measures prescribed for the significant impacts of the proposed project identified in each of these chapters are intended to reduce each impact to less than significant, some of the prescribed measures may also mitigate some of the overall impacts of Los Angeles' activities since 1913. An example of this second type of mitigation is the restoration of flow in approximately 50 miles of channel of the lower Owens River.

To prescribe mitigation to reduce all of the overall cumulative impacts of Los Angeles' activities in the Owens Valley is beyond the scope of this EIR, however, the following two mitigation measures will be implemented in addition to those described in the preceding chapters.

Land Management

The proposed project includes provisions that would protect vegetation in the Owens Valley from the effects of groundwater pumping, changes in surface water management practices and other water management activities. Grazing management is not a part of the proposed project. However, it is recognized that vegetation is affected not only by water management but also by land management activities, including livestock grazing. Vegetation is subject to the cumulative effects of water management and livestock grazing. Therefore, to avoid significant cumulative impacts, the following grazing management program will continue to be implemented by LADWP:

- o Mapping of all LADWP lands for documentation of the vegetation species present, percent cover, and percent composition.
- o Establishment of carrying capacity based on the above-noted vegetation documentation.
- o Documentation of livestock use on Los Angeles lands in terms of lessee range practices.
- o Identification of problem areas and imbalance in either over or under utilization.
- o Development, application and enforcement of appropriate range management practices.

Town Water Systems

Between 1934 and 1972, water systems supplying the towns of Lone Pine, Independence and Laws were purchased by Los Angeles. Prior to and after the purchases of these systems, the amount of water available in the soil to supply vegetation in and near these towns was reduced due to several factors. It should be noted that not all of these factors were under the control of LADWP.

The factors are: 1) a reduction by LADWP in the amount of irrigated lands in and around the towns -- this reduced groundwater recharge; 2) construction of sewer systems and the abandonment of septic systems -- this reduced a source of supply of soil water; 3) the conversion of the source of the town water supply from surface water to groundwater -- pumping from the town supply well has lowered the water table in the vicinity of the well; and 4) the installation of water meters by LADWP and the increase by LADWP of the water rates in the towns to rates equal to those charged in Los Angeles -- this reduced water use in the towns. In 1985, under the provisions of the interim agreement between Inyo County and Los Angeles, town water rates were reduced to 50 percent of the rates in existence in August, 1983. At present, the town water rates are approximately one third of the rates that would be in effect if the reduction had not been implemented. An additional factor in the town of Lone Pine was the diversion of Lone Pine Creek in 1913 into the aqueduct. This also reduced groundwater recharge.

In addition to the enhancement/mitigation projects described in Chapter 5 that have been or will be implemented in each of the Valley towns, Los Angeles will transfer the town water systems in Lone Pine, Independence, Big Pine and Laws to Inyo County or to another public entity. As part of this transfer, for the first five years following the approval of the Final EIR, Los Angeles will supply treated groundwater to each of the town water systems up to certain specified amounts at no cost. At the end of the fifth year, the systems will be transferred to Inyo County (or to another public entity), but LADWP will permanently supply untreated groundwater to each town system up to certain specified amounts at no cost. The transfer of the town water systems is more fully described in Chapter 5, Project Description.

The provision of groundwater at no cost to each of the town water systems will allow Inyo County (or another public entity) to have the option of maintaining water rates at a level substantially below the rates that would have to be charged if all of the costs of pumping groundwater and of maintaining the well equipment were to be passed along to the users. The rates could also be substantially less than the rates that would be charged by Los Angeles if the systems were to remain in the control of Los Angeles. The transfer of the town water systems thus will mitigate for the long-term reduction in water available in the soil in these towns since residents will have the option of supplying water to vegetation in the towns at a lower cost than if the systems remained under the ownership and operation of Los Angeles.

17.6 RELATIONSHIP TO OTHER WATER SUPPLY PLANS

Table 17-1 summarizes other water supply actions in California, the outcomes of which could affect and/or be affected by the increased groundwater pumping plan evaluated in this report. These actions include:

- San Francisco Bay-Sacramento Delta water quality control plan hearings currently being held by the State Water Resources Control Board (SWRCB) in Sacramento. The outcome of these hearings is to be a water quality control plan which promulgates Delta water quality standards intended to protect all beneficial uses of Delta water, including in-stream uses and water to Delta exporters.

- Proposed expansion of the State Water Project (SWP) in the form of cross-Delta channel enlargements and construction of Los Banos Grandes Reservoir by the California Department of Water Resources.

- Revision of LADWP's water rights licenses in Mono Basin by SWRCB. This revision involves the establishment and maintenance of instream flow standards in the Mono Lake tributaries from which LADWP diverts water, and the establishment and maintenance of water elevation standards and salinity standards in Mono Lake to provide appropriate protection for public trust resources and beneficial uses of Mono Lake.

- o Implementation of a 1989 water conservation agreement between Metropolitan Water District of Southern California and Imperial Irrigation District (IID). This action involves Metropolitan paying for concrete lining of earthen canals owned by IID, as well as new storage facilities for water that is conserved. In return, MWD will receive a minimum of 100,000 acre-feet of water from IID annually, and more in wetter years.

- o Proposed water storage and exchange agreement between MWD and Arvin-Edison Water Storage District (A-E) near Bakersfield. As with the IID "water trading" agreement, MWD will pay costs of improving spreading basins for Arvin-Edison (A-E) for storage of surplus wet year water exported through the Friant-Kern and Cross-Valley canals. A-E obtains stabilized groundwater supplies consistently and Metropolitan receives a minimum of 100,000 acre-feet of water during dry years stored in A-E's aquifers.

- o Central Arizona Project.

All of these actions affect future of water supply planning for Los Angeles. The Metropolitan Water District (MWD) is currently short of water supply, although MWD stands to have greater access to water supplies as a result of expansion of the cross-Delta channels and construction of the Los Banos Grandes Reservoir. Since LADWP is a member agency of the MWD, it will have access to significant amounts of the "new" water supplies created through the conservation-for-water-trade agreements MWD has undertaken with IID and Arvin-Edison, possibly as much as 80 percent of the increment conserved in the Imperial Irrigation District, or some 80,000 acre-feet.[1]

LADWP stands to lose water from the water rights decision in the Mono Basin. LADWP is the predominant diverter of water in the Mono Basin, and its rights will be limited to the point where they are consistent with public trust goals, instream uses (e.g., fish and other aquatic forms of life) and salinity standards in the Mono Basin. It is unknown at this time how much water LADWP will lose as a result of this decision.

The outcome of the Bay-Delta hearings before the SWRCB is unknown. The hearings were begun at the direction of the State Third District Court of Appeal in early 1987 in the wake of the "Racanelli Decision" which required the SWRCB to re-evaluate its 1978 Water Right Decision 1485 for the Delta and Suisun Marsh. The Court specifically required the SWRCB to review water quality standards and water rights licenses from a "global perspective" which incorporated the water needs of instream uses into its interpretation of beneficial uses. The degree to which water quality

Table 17-1
RELATIONSHIP OF OTHER WATER SUPPLY ACTIONS
TO INCREASED GROUNDWATER PUMPING PLAN IN OWENS VALLEY

Action	Status of Action	Direct Effect If Implemented	Potential Cumulative or Indirect Effects
San Francisco Bay-Delta hearings at State Water Resources Control Board (SWRCB).	In process; responses to Draft Water Quality Control Plan.	Would establish new levels of protection for all beneficial uses of Bay-Delta Estuary water, indirectly limiting exports.	Dry Years: Would probably decrease supply of water for export from Delta due to more restrictive water quality criteria.
Cross-Delta channel enlargement, and construction of Los Banos Grandes Reservoir, proposed by California Department of Water Resources (DWR).	Initial proposals to be released in mid-1990.	Would permit increased diversions of high quality Sacramento River water into State Water Project pumps.	Wet Years: Would permit greater diversions of surplus water beyond what is currently available in wet years. Dry Years: Would provide greater drought protection to Delta water exporters.
Revision of LADWP's water rights licenses in Mono Basin by SWRCB.	Notice of Preparation of an EIR sent out March 1990; plus temporary court orders pending.	Would limit LADWP's diversions from Mono Basin to levels which will protect fish populations in tributaries and stabilize lake elevation in Mono Lake.	Wet Years: Would allow LADWP to divert surplus water above that required to sustain fish populations and maintain lake elevations in Mono Lake. Dry Years: Would limit LADWP's diversions to whatever is available after in-stream uses were satisfied.

Table 17-1 (continued)

Action	Status of Action	Direct Effect If Implemented	Potential Cumulative or Indirect Effects
1989 Water conservation agreement between Metropolitan Water District (MWD) and Imperial Irrigation District. (110)	Construction to commence in 1991-1992. Completion due in 1994.	MWD would provide capital for lining of IID canals and new storage facilities while MWD will receive a minimum of 100,000 acre-feet of conserved water.	All Years: LADWP, as MWD member, gets share of conserved water.
Proposed water storage and exchange agreement between MWD and Arvin-Edison Water Storage District. (A-E)	Draft EIR/EIS released May 1990.	MWD would pay costs of improving spreading basins for Arvin-Edison. A-E obtains stabilized groundwater supplies; MWD obtains stabilized dry year supplies from A-E's storage.	All Years: LADWP, as a MWD member, would receive a share of the dry year supplies.
Central Arizona Project begins taking its full entitlement to Colorado River water in 1991.	As noted.	Would reduce MWD's entitlement from 1.3 million acre-feet in 1989 to 470,000 acre-feet after 1991.	All Years: Would reduce absolute amount of water available to Los Angeles beginning in 1991 from MWD through the Colorado River Aqueduct.

Source: EIP Associates, May 1990.

standards implemented by the new Bay-Delta water rights decision to be issued by the SWRCB protects instream uses will determine the loss of water available for other beneficial uses including export to the Central Valley and Southern California.

The Central Arizona Project is increasing its use of water from the Colorado River. When Arizona use reaches its full entitlement, MWD, which wholesales water from the Colorado River, will see its entitlement decline by about 60 percent, from 1.3 million acre-feet in 1989 to about 470,000. LADWP is entitled to about 26 percent of MWD's total supply, so the effect of the Central Arizona Project on Los Angeles' water supply outlook will be substantial.

LADWP will continue its water conservation programs outlined in Chapter 3, Water Supply for Los Angeles. LADWP believes that these programs will simply delay the arrival of increased demand associated with population growth. The population has been growing at a rate of 38,000 per year; therefore, a 10 percent reduction in use due to conservation would occur in 10 years. Since Los Angeles envisions implementing new conservation programs determined to be feasible, even if the proposed project is implemented, conservation is not viewed as a true alternative to replace water from Owens Valley. Efforts to replace potable water with reclaimed wastewater will continue but again are not expected to be sufficient to make up shortfalls in the next several decades. If the regulatory climate changes so that reclaimed wastewater can be injected into groundwater basins used for drinking water supplies, the potential for reclamation would be improved.

Evaluation of the cumulative impact of these actions in combination with the proposed project evaluated in this report is complicated and fraught with uncertainty. In instances such as the Bay-Delta hearings and the Mono Basin water rights case for LADWP, rights to water have yet to be defined, which makes quantification of cumulative impacts impossible. In a qualitative sense, however, both instances involve establishing or modifying water quality standards to provide increased protection for instream uses. This means that it is likely that less water will be available in the future for export to Los Angeles from the Delta and the Mono Basin.

On the other hand, agricultural water conservation and conjunctive use projects undertaken by MWD are projected by MWD to yield upwards of 200,000 acre-feet in a dry year to the MWD service area. With a preferential right to 26 percent of MWD supplies, LADWP could receive about 53,000 acre-feet of water from MWD from these projects.

To meet projected demand requirements of Los Angeles' growing population, LADWP looks to Owens Valley and MWD as the primary means for increasing water supply to Los Angeles, as compared to its pre-1970 water supply. LADWP's control of water rights in Owens Valley makes the Valley's water resources the most stable source of supply for the City outside the Los Angeles Basin. The quality of water from the Los Angeles Aqueduct is better than water from either the State Water Project or the Colorado River. It is also less expensive on a cost per unit of production basis and generates electricity for Los Angeles residents, whereas the other two projects consume more energy than they produce.

A qualitative balance of water supply gains and losses from the cumulative evaluation of water supply actions in the California water system suggests that cumulative changes will be neutral, that is that gains from conservation, reclamation and conjunctive use will be balanced by losses to instream uses or other beneficial uses in the Bay-Delta hearings. Water supply gains will likely be offset by losses resulting from more restrictive water quality standards for protection of instream uses in the Bay-Delta estuary and Mono Basin.

17.7 AREAS OF CONTROVERSY

The primary impact of the proposed project is on the vegetation of the Owens Valley. While there are many anecdotal accounts of how the vegetation has changed since 1970, there is little quantitative data. Between 1920 and 1970, changes in the Valley's vegetation were largely the result of surface water management practices and changes in agricultural land use. In 1970, when groundwater pumping was increased, a new factor entered the equation. Experts differ regarding the interpretation of existing data, including aerial photographs, to determine the cause and extent of some vegetation changes. However, all known areas of significant impact have been identified in this Draft EIR and will be mitigated through direct or compensatory mitigation.

Some Owens Valley residents believe that the Valley should be restored to conditions that existed prior to operation of the second aqueduct in 1970 or prior to the operation of the first aqueduct in 1913. Inyo County and LADWP have agreed that a final court judgement will be entered that will provide that groundwater and surface water will be managed so that the Valley's vegetation will not significantly decrease or change from the conditions that were documented during the 1984 to 1987 vegetation inventory. During this period the Valley experienced a series of wet years which resulted in the healthiest vegetal cover since 1970. While the Agreement does not return irrigated acreage to its pre-1970 levels, abandoned agricultural lands that have not sufficiently revegetated and the impacts to riparian and wetland areas will be mitigated by direct or compensatory mitigation.

Some members of the public have questioned whether the soil water balance methods of the Agreement are adequate to achieve the goal of vegetation protection. The monitoring and management techniques of the Agreement are the subject of the Green Book and of ongoing and planned studies outlined in the Green Book. In order to protect vegetation, the Agreement provides for "increasing, decreasing, or changing the management areas, the monitoring sites, the type of monitoring, the procedures for analyzing and interpreting monitoring results, and for modifying the provisions of the 'Green Book' as a result of information gained from ongoing research and cooperative studies, or for other reasons as may be necessary to improve the effectiveness of the monitoring and the evaluation activities." It should be emphasized that the soil water balance projection is only one of the tools that will be used to meet the goals of the Agreement and that the Technical Group and the Standing Committee have a significant role in determining the methods of achieving these goals.

Questions have also been raised as to the success of mitigation in the Owens Valley. Mitigation of riparian, or Type D vegetation has proven successful through application of surface water. Revegetation of shrub species has not been commonly practiced in the west and is, therefore, still largely experimental. LADWP and Inyo County will conduct studies in the near future to develop methods for revegetation. These methods will be used to mitigate formerly irrigated lands that have not successfully revegetated and other areas as described in this Draft EIR. Since the goal of the Agreement is to avoid significant decreases or changes in vegetation, in the future mitigation is viewed only as a secondary tool in the management of Owens Valley resources.

Air quality is an area of ongoing contention in the Valley. Owens Lake, which became dry in the 1920s, is the primary cause of air quality problems. Since the dust problem caused by the lake is attributable to pre-1970 water management practices, it is not dealt with in this Draft EIR. The Great Basin Air Pollution Control District is currently conducting field studies to determine the best way to control dust generation at the surface of the lake bed. Once a control program is selected, it will be the subject of separate environmental review pursuant to CEQA. This Draft EIR addresses the effects of post-1970 management practices on air quality.

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1. Reported in "Ten steps forward, eight back," Focus, published by the Metropolitan Water District of Southern California, Number 5, 1989, p. 1.

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20. GLOSSARY AND ABBREVIATIONS

Acre Foot
The volumetric equivalent of one acre covered to a depth of one foot or about 326,000 gallons. An acre-foot of water would meet the needs of a family of five living in Southern California for one year.

Alkali
Salts left behind on the soil surface as water evaporates.

Alluvial Fan
The large mound of eroded material deposited by a stream at the mouth of a canyon.

Alluvium
Clay, silt, sand, gravel or similar material eroded from the surrounding mountains and deposited by running water.

Amp (or Ampere)
A measure of electrical current, or the quantity of electrons flowing in a wire or a conductor.

Aquifer
Primarily sands, gravels or fractured lava porous enough for water to flow through in sufficient quantity to supply pumping wells or springs.

Basic Industries
Basic industries are economic sectors which produce goods and services for export from a region and bring income to a region. In Owens Valley, basic industries include tourism, retail trade, and agriculture/mining.

Consumptive Use
Generally, water is consumptively used when its use causes it to change from a liquid to a vapor. As examples, this occurs as it evaporates from a lake, as vegetation builds plant tissue water vapor is lost to the atmosphere (referred to as transpiration), and as water evaporates from soil. Water for household uses and watering of animals are minor categories of consumptive use in the Owens Valley.

Cubic Foot per Second (CFS)
A unit for measuring the flow of water, one cfs equals 448 gallons/minute. One cubic foot per second flowing continuously for a year would equal 724 acre-feet or nearly 240 million gallons.

Evapotranspiration (E.T.)
As generally used in this report, evapotranspiration includes all consumptive uses but consists primarily of water used by plants (transpiration) and water evaporated from the soil around the plant that has been stored in the soil zone from precipitation and irrigation or has been brought near the surface by capillary action.

Fault
A fracture or fracture zone within the earth's crust along which there has been movement of the two sides relative to each other.

Groundwater
Water below the ground surface that occupies the small spaces between the grains of gravel, sand or other geologic materials. Wells and springs are fed by this water as it flows through the pores. In a strict sense the term applies only to water below the water table.

1) Confined Groundwater
Water stored in an aquifer separated from other aquifers above or below it by dense layers such as clay. Depending on the denseness of the confining materials, the confined aquifer could be pumped with little or no change in the water table level near the surface. If there is such a change, there would be a significant time lag between the pumping in the confined zone and the effect on the free water above.

2) Free Groundwater
Free or unconfined groundwater is water stored in an aquifer that is not separated from the ground surface or by other aquifers above it.

Groundwater Basin
A pervious formation with sides and bottom of relatively impervious material in which groundwater is held stored or retained. Conceptually, it is like a bathtub full of very wet sand.

Inflation
An increase in available currency and credit beyond the proportion of goods, resulting in continuing price increases over time.

Non-basic Industries
Non-basic industries are economic sectors which serve the personal and business needs of local residents. Also called "local-serving" industries.

Kilowatt (Kw)
One thousand watts.

Kilowatthours (Kwh)
A measure of work performed. It is the equivalent of using 1,000 watts of electrical power over a one-hour period. Burning ten 100-watt light bulbs for one hour uses one kilowatt hour of electricity.

Megawatt (MW)
One million watts, or one thousand kilowatts.

Normal Year
A year during which the precipitation and streamflow (water supply to the area) approximates the annual amount that is representative of a long term average.

Phreatophyte
A plant which consumes relatively great amounts of water because its roots are in the ground water body or the moist (capillary) zone above the water table.

Plant Community
An assemblage of plants living together and interacting with each other in a common environment.

Plant Grouping
Usually refers to a plant community but may include several similar plant communities for the convenience of this report.

Plant Succession
The process of vegetational development whereby an area becomes successively occupied by different plant communities of higher ecological order.

Precipitation
The process by which atmospheric moisture is discharged (falls) onto a land or water surface. It includes snow, hail, and rain. Used interchangeably in this report with rainfall.

Recharge
In this report, the same as seepage or percolation. Recharge occurs from such things as direct precipitation, as water flows in streams and unlined canals, from the application of irrigation water or water released to recharge spreading basins.

Scrubland
Areas dominated by shrubby plants in contrast to grassland and forests.

Seepage (Percolation)
Seepage has normally been used in this report instead of percolation or deep percolation, which is the process of water moving downward from the ground surface through soil pores and into the ground-water reservoir.

Stress
Any condition imposed on a plant that impairs nutrient uptake, photosynthesis, growth, vigor, or reproduction, whether visually evident or not.

Taxable Retail Sales
Purchases of goods which are subject to the State and local tax rates. Most retail goods are taxable, except for periodicals and most food items.

Vacancy Rate
The ratio of unoccupied housing units to total housing units multiplied by 100.

Volts (Voltage)
An electrical force which produces electrons to flow in a wire or a conductor. It is very similar to water pressure which you might see in a pipe connected to the bottom of a water tank.

Water Table
The upper surface of the free groundwater reservoir below which spaces between the soil grains are completely filled with water.

Watt
A measure of electrical power which gives the rate at which work is done or energy is used. Watts are the products of volts multiplied by amps.

Zone of Pumping Influence (Cone of Depression)
The area within which the depth to groundwater has increased as a result of pumping from one or more wells. If the ground surface is level, as one moves toward the well from any direction the depth to groundwater progressively increases.