Arvin-Edison Water Storage District
Groundwater Management Plan

6/5/03

1801 21st Street, Suite 6
Bakersfield, CA 93301
Office Phone (661) 327-1985

Table of Contents

<u>Attachments</u>

A. List of Exhibits:

1. Tables
2. Figures
3. Appendices

B. References

I. Introduction

A. Background and History

The Arvin-Edison Water Storage District (District) was organized in 1942 under California Water Storage District law (Division 14 of the California Water Code) for the expressed purpose of, among other things, providing an agency to contract with the United States for water service from the Central Valley Project (CVP) as well as contracting for a Federal Power Contract and a Federal loan for construction of new facilities. The need for supplemental CVP supplies reflected the overdraft conditions occurring in the District at that time. The District is comprised of approximately 132,000 acres of land, 113,000 acres that are irrigated crops, located in the southeasterly portion of the San Joaquin Valley of California and lies entirely within Kern County. A Location Map and District Map are provided as Figures 1 and 2. Figure 1 shows the District's boundary as it relates to the boundary of the Kern groundwater basin as defined in the California Department of Water Resources (DWR) Bulletin 118.

In 1962, the District entered into a water supply contract with the United States Bureau of Reclamation (USBR) to supply water for the District's project from the Friant-Kern System of the Federal Central Valley Project (CVP). The water supply contract provides for the annual delivery of 40,000 acre-feet of Class 1 (firm) water and up to 311,675 acre-feet of Class 2 (non-firm) water. This contract was renewed in 2001 through 2026, with provisions for renewal after that.

Because the imported Friant Class II water is highly erratic, a key issue for the District has been to develop means to regulate this variable supply to a fairly constant irrigation demand. The original concept for the District program involved substantially greater recharge capacity within the District than has been constructed to date. However, the District has successfully regulated its imported water supplies historically through the use of groundwater banking facilities in combination with water management exchanges and transfers.

During the period 1964 through 1968, the District's water distribution facilities were constructed. Construction was financed with a $40 million loan by the USBR under Public Law 130.

Prior to the construction and operations of the District's water distribution facilities, groundwater overdraft was estimated at 126,000 acre-feet per year. See Appendix A-Attachment 2, Hydrologic Inventory for Arvin-Edison Water Storage District. This resulted in the continual lowering of groundwater levels, until pumping lifts exceeded 600 feet in many areas of the District.

Project operations commenced in July 1966, with the first diversions of water to the Sycamore Spreading Works. From 1966 to the present, the District has operated the project to provide reliable irrigation water supply to approximately 52,000 acres (approximately 40% of the District's area, and approximately 50% of all cropped acreage), and to stabilize groundwater levels in the remainder of the District, where, for the most part, growers rely solely on well water.

During 1974, the District entered into agreements for participation in the construction and operation of the Cross Valley Canal with the Kern County Water Agency and water exchange agreements with ten other public agencies (Exchangors) located on the east side of the San Joaquin Valley. This provided an exchange of a portion of the District's Federal water supply from the Friant-Kern System for Federal water supplies from the Shasta System of the CVP to be delivered into District facilities through the California Aqueduct and the Cross Valley Canal. Under the Exchange Program, the District received up to 128,000 acre-feet of a relatively firm water supply from the Exchangors delivered on an irrigation demand schedule, in return for delivery of a variable amount of Friant water to the Exchangors. The amount the Exchangors received varied up to 174,000 acre-feet in any given year. It was anticipated that the two hydrologically different supplies would generate roughly equivalent volumes of water over an extended period. The Lower Tule River and Pixley Irrigation Districts withdrew from the exchange agreement with the District in 1995. This reduced the amount of water available under the exchange program each year to 71,000 acre-feet of Friant-Kern CVP water and 66,000 acre-feet of Shasta CVP water.

To compensate, in part, for the loss of a portion of the CVP Exchange capacity, the District entered into a water banking agreement with Rosedale-Rio Bravo Water Storage District (RRBWSD) in 1995. Under this agreement, RRBWSD stores District water in RRBWSD groundwater storage facilities, and returns it later to the District. In addition, the District entered into a water management program with Metropolitan Water District of Southern California. As a result of this program the District was afforded the opportunity to expand its water banking facilities thus enhancing its ability to regulate erratic supplies and providing for a more reliable water supply.

The District expanded its spreading basins with the construction of the Tejon Spreading Basin in 1972, the North Canal Spreading Basin in 1999 and the construction of several new wells in the period of 1996-98. The construction of the North Canal Spreading Basin and associated wells was financed by a low interest loan from the State of California under Proposition 204, administered by DWR.

In December 1997, after over 10 years of planning and negotiations, the District entered into a 25-year water management program with Metropolitan Water District of Southern California (MWD). Under the agreement, the District agreed to bank a minimum of 250,000 acre-feet of MWD water in the aquifer below the District and return the water in certain drought years. Returned water is to be delivered during the District's off-peak periods so as not to interfere with normal, historic District operations. In order to accomplish these objectives, a program was structured to fund nearly $25 million in facility improvements within the District as well as reimbursing the District for all pass-through water banking costs.

The District's program with MWD was designed to enhance efficient use of available water supplies, and water bank facilities, for both parties. For MWD, the program allowed it to regulate 250,000 acre-feet to enhance dry year supplies. For the District, the program generated significant benefits in the form of reduced costs, improved water supply reliability and enhanced facilities. As part of the program, the District expanded its spreading works by 500 acres, added 17 new groundwater wells and constructed a 4.3-mile, bi-directional intertie pipeline and pump station connecting the terminus of the District's South Canal directly to the California Aqueduct. These facilities were constructed in the late 1990's, with substantial completion in 2000. The District has imported and stored approximately 250,000 acre-feet of MWD water in the District since December 1997, utilizing the Cross Valley Canal to transport the water to the District. Return of a portion of the water began in January 2003 (by exchange before then) through use of the Intertie Pipeline to deliver the return water to the California Aqueduct.

The District also constructed a new regulation/balancing reservoir near the beginning of the North Canal in 2000. The balancing reservoir provides canal regulation capabilities, access to stored water for power or load management and water recharge benefits as well. The property acquired for the Balancing Reservoir has room for future expansion of the reservoir.

Also, during the 1990's temporary interties between Kern Delta Water District's (KDWD) canals and Arvin-Edison's Intake Canal were constructed and utilized by both Districts to facilitate mutually beneficial exchanges of various water supplies. KDWD and Arvin-Edison are presently negotiating a Memorandum of Understanding with the goal of furthering the two District's coordinated use of the shared groundwater basin, joint regulation of surface water supplies, and joint use of facilities and interconnections. Appendix L contains a copy of Arvin-Edison Board Resolution Number 01-25 (dated October 9, 2001) directing Arvin-Edison staff and consultants to explore, investigate, and identify mutually beneficial activities that may be implemented with KDWD.

Currently, the District owns and operates a total of approximately 1,500 acres in spreading basins and 72 production wells. Landowners own and operate approximately 350 (active) additional wells within the District.

By the end of the 2002 Water Year, the District had imported a total of 5,714,000 acre-feet of water into the District. A total of 1,665,000 acre-feet had been delivered to spreading basins, with a net total (after evaporation losses) of 1,608,000 acre-feet of recharge. During the same period, the District extracted 901,000 acre-feet of water from its wells. A total of 4,649,000 acre-feet were delivered to customers, with 301,000 acre-feet of losses or metering inaccuracies. A summary of District water operations data from water years 1966-67 through 2002-2003 is included in Appendix B-Water Resources Management Program, April 2003.

As a result of project operations, groundwater levels in the District no longer have a downward trend, but have stabilized. The District has also experienced a substantial reduction in subsurface inflow from neighboring areas and a significant improvement in both groundwater depths and water quality for the irrigators in the District, who continue to rely on groundwater.

Changing conditions that could reduce or threaten the District's water supply are an on-going concern. Neighboring agencies and Exchangors that rely on Sacramento – San Joaquin River Delta imports have seen their water supplies cut dramatically since 1991 due to regulatory decisions arising from endangered species issues and water quality concerns. This has resulted in increased reliance on groundwater in neighboring areas and has reduced the volume and reliability of the District's exchange program. Urbanization in the greater Bakersfield area places additional demand on groundwater supplies. The District's own surface water supply is also facing a threat of reduction. The National Resources Defense Council (NRDC) and other environmental groups filed suit against USBR and various Friant districts over USBR contract renewal issues in 1988. The NRDC's goal is to re-establish regular flows in the San Joaquin River below Gravelly Ford. The Friant Water User's Joint Powers Authority, of which the District is a member, and the NRDC have been attempting to negotiate a settlement agreement that would allow river restoration without negative impacts to water supply reliability or costs for FWUA members. The District has been a key participant in negotiations and pilot projects. Studies and negotiations toward that goal were recently terminated by the NRDC.

B. Purpose and Goal

The purpose of this Groundwater Management Plan is to document and review the past 37 years of successful groundwater management in the District, and to develop a coordinated and comprehensive approach to the future evaluation and management of groundwater resources within the District specifically, and in concert with other groundwater management activities within the groundwater basin. The Plan will integrate past and present effective groundwater management activities with new proposed activities as part of a Management Program to meet specific Management Objectives.

The goal of this Plan is to implement effective groundwater management that works toward maintaining a high quality and dependable water resource for the District's water users and landowners while minimizing negative impacts to other affected parties. Specific Basin Management Objectives that reflect this goal are discussed in Section IV.

Upon adoption of this Plan, action on specific elements will be maintained and/ or initiated within the Management Program to achieve the stated Management Objectives. As specific elements take effect, and/ or other concerns arise; the Management Program will periodically be reviewed, and revised as needed to assure continued progress toward the Management Objectives.

C. Authority

The California legislature recognized that local groundwater management is preferable to State or Federal groundwater controls, and passed Assembly Bill 255 (AB 255) in 1989. AB 255 was the first statewide legislation allowing local water agencies to prepare and adopt groundwater management plans for their jurisdictions. California Assembly Bill No. 3030 (AB-3030), which became law on January 1, 1993, superceded AB 255, and authorized local agencies that are within groundwater basins, as defined in California Department of Water Resources (DWR) Bulletin 118, to prepare and adopt groundwater management plans. The District qualifies under this law. The District lies within the southeastern portion of the Kern County Groundwater Basin as defined in Bulletin 118 (Figure 1).

The District initiated the process of drafting a Groundwater Management Plan in 1996. But, that effort was not completed as other District activities, including long-term water contract renewal and the MWD Program were in the process of being finalized and those terms and conditions are an integral part of the District's groundwater management activities. California Senate Bill 1938, adopted in 2002, which added new requirements for Groundwater Management Plans, including requirement involving public funding, motivated the District to complete the process of drafting a Groundwater Management Plan.

Pursuant to AB-3030 provisions in the California Water Code, the powers of a Water Replenishment District will be added to the District if and when it adopts a Groundwater Management Plan. In general, the effect of adding these powers is relatively minor for Water Storage Districts.

D. Documentation of Public Participation

On December 24th and December 31st, 2002, the District published notice of a hearing on the Resolution of Intention to Draft a Groundwater Management Plan in the Bakersfield Californian and the Arvin Tiller respectively. As required by SB-1938, the notice included information on how members of the public may participate in the preparation of the Groundwater Management Plan. Copies of the hearing notice are included as Appendix C.

On January 14, 2003 a noticed public hearing was conducted at the District's office, and the District's Board of Directors adopted a resolution of intention to draft a Groundwater Management Plan, pursuant to California Assembly Bill No. 3030 (AB-3030). A copy of the District's Resolution No. 03-01 is included as Appendix D. Minutes of the Hearing and an attendance list are provided in Appendix E.

II. Description of District

A. Management Area

1. Location

The Arvin-Edison Water Storage District is situated at the extreme southern end of the San Joaquin Valley in California and approximately 14 miles southeast of the City of Bakersfield (Figure 2). The District lies mostly south of Highway 58 on the southern side of the Kern River.

2. Topography

The District lands overlie alluvial fans and cones (a piedmont alluvial plain) built up by the Kern River, the streams of the Caliente Creek group, and the southern stream group, that drain from the westerly slope of the Sierra Nevada and Tehachapi Mountains across the District's east and southern boundaries. Land elevations vary from below 400 feet at the west edge of the District to 1,000 feet at points along the east boundary. Prevailing land slopes are approximately 66 feet per mile southwesterly in the north end of the District, about 30 feet per mile westerly in the north central portion and approximately 44 feet per mile northwesterly in the south half of the District.

3. Climate

Hot, dry summers and mild winters characterize the climate of the District. The average frost-free period varies from 274 days at the west edge of the District to 320 days on the east edge. Average annual rainfall varies within the District, but averages approximately 8.2 inches per year. Annual evaporation in the District averages approximately 5 feet. The magnitude of annual rainfall is extremely erratic and during any given year, occurs largely during winter and spring months. Occasionally watershed areas tributary to the District experience summer or early fall “cloudburst” type storms and in the past, have wrought severe flood damage in portions of the District. Because of the magnitude and pattern of rainfall, agricultural enterprise is almost entirely dependant on irrigation.

B. Water Supplies

1. Surface Water

The District’s long-term contract for surface water is with the Friant-Kern portion of the CVP. Those supplies are utilized directly by the District, and have also been used to effect water transfers and exchanges for water management purposes. Subsequently, the imported supply consists mostly of Friant Class I, Class II, CVC exchange water, SWP water, and local Kern River supplies. Table 1 summarizes District surface water supplies imported since 1966.

In addition to Friant (CVP) contract supplies and CVC exchange supplies, the District has also historically purchased other supplies for spreading when available. These purchases have averaged approximately 13,000 acre-feet per year (ranging from zero purchases in some years to as much as 74,000 acre-feet in other years). Typically, such water is available in relatively “wet” years, in which Friant Class II water is also allocated to the District. These historical purchases have included: Friant Section 215 water (San Joaquin River Flood water) and Kern River Flood water.

The District participates in numerous water transfers and exchanges and, in a typical year, will participate in water transfers and exchanges with 15 to 20 other agencies in various locations throughout the State. The District’s strategic position, its interconnections to major Federal, State, and local water conveyance facilities, and its versatile facilities gives the District a unique ability to facilitate these transfers and exchanges. As a result, the District and its partners realize significant water management and cost-saving benefits.

2. Groundwater

Groundwater is found underlying essentially all parts of the District. Groundwater management within the District is rooted in the conjunctive use of surface water and groundwater resources, since water supplies from these two sources are integrated to accomplish optimum utilization of each supply. District landowners have conjunctively used imported surface water supplies with groundwater since the completion of the District's irrigation distribution system facilities. Since the availability of most of the imported water supply is extremely erratic, the District devised a plan of conjunctive use where the underlying groundwater reservoir is utilized directly for seasonal and long-term carry-over storage. Because of this, the District's distribution system, from the beginning, has incorporated recharge basins and District owned deep wells to capture, store, and recover wet period water for later use during dry periods.

C. Land Use

The District has approximately 113, 000 acres developed to irrigated crops with vineyards, truck crops, potatoes, cotton and citrus presently dominating. Table 2 summarizes District land use since 1993. Figures 3, 4 & 5 provide information regarding the Spring 2001 Land Use Survey for Agricultural Classes, Perennial Crops and Irrigation Methods respectively.

D. Distribution System

The District's backbone facility is a 45-mile canal system (Figure 2) that extends from the terminus of the Friant-Kern Canal, around the urbanized area of Bakersfield and through the District. This canal has a capacity, in its initial 30 miles, of 1,000 cubic feet per second; a rate of flow required to accommodate maximum water deliveries as provided in the District's original Federal water service contract.

A major feature of the project is the Forrest Frick Pumping Plant, located about three miles west of the District's westerly boundary and approximately 14 miles from the Friant-Kern Canal. This plant has a capacity of 27,500 horsepower, consisting of four pumping units rated at 5,500 horsepower each, two 2,000 horsepower units, and two smaller units rated at 1,000 and 500 horsepower. The pumps are the vertical turbine type designed to operate against a maximum total dynamic head of 190 feet and have a composite flow rate of 1,000 cubic feet per second.

This plant discharges water into a three-mile long pipeline, eleven feet in diameter and constructed of pre-stressed reinforced concrete.

Other facilities of the system include approximately 170 miles of pressure pipeline varying in diameter from 6 to 60 inches, 45 booster-pumping plants with a total of 25,000 horsepower and 462 farm turnouts.

From an operational standpoint, two key features of the water-related facilities are the spreading works and the associated well fields through which water is percolated to underground storage and later recovered when required through District owned wells.

The District's spreading basins consist of the Sycamore, Tejon and North Canal spreading works. The Sycamore Spreading Works comprise a total area of 569 acres and is located on the alluvial fan of Sycamore Creek near the middle of the District. The Tejon Spreading Works, which is located on the Tejon Creek alluvial fan, is approximately six miles south of the Sycamore Spreading Works and covers an area of 448 acres. The North Canal Spreading Basin consists of 300 acres and is 2 miles northwest of the Sycamore Spreading Works. The District also accomplishes groundwater recharge at its balancing reservoir near the beginning of the North Canal. These project facilities are shown on Figure 2.

The Sycamore well field is comprised of a total of 33 wells, 22 of which are located within the spreading works, and the remainder being located west of and adjacent to the Sycamore spreading works. The Tejon well field consists of 25 wells, 21 of which are located within the spreading works area, and 4 being located outside of the spreading works property. The North Canal well field consists of 14 wells in which 5 wells of similar design are located along the District Canal in the northern area of the District. The total number of wells in and adjacent to the District's spreading basins is 72.

E. Water Demand and Deliveries

1. Historic

Although the District's surface water supply varies widely from year to year, the District's conjunctive use facilities (spreading areas and wells) allow the District to provide a firm water supply for lands in the Surface Water Service Area within the District. Over a long-term period, the District's annual Friant-Kern Canal water entitlement has ranged from a minimum of approximately 10,000 acre-feet in a very dry year such as 1977, to a maximum of 352,000 acre-feet in very wet years such as 1978 and 1995.

In addition, by the end of the 2002-2003 water year, over 4.6 million acre-feet had been delivered directly to surface water users, 5.7 million acre-feet of water was imported to the District Basin and a total of 900,600 acre-feet of water extracted from underground storage. A history of Friant-Kern CVP entitlement is provided as Figure 6.

2. Projected Future

The future demand for water in the District cannot be predicted with certainty, as it will be highly dependent upon variations in planted acres, cropping patterns, and other factors. However, there is not presently any planned expansion of the acreage in the District's Surface Water Service Area and the most reasonable expectation is that future demands for water will likely be similar to demands experienced during the past 20 years.

F. Other Agencies and Programs related to Groundwater in AEWSD

A number of other Federal, State and local agencies have jurisdiction for regulatory activities and/or programs that may affect groundwater management in the District. A list of these agencies is provided in Table 3, along with a brief description of the agencies' jurisdictions, roles, activities, and programs that may pertain to groundwater management in the District. An understanding of the various agency roles in activities related to groundwater management is important to foster coordination and cooperation.

Arvin-Edison has a 37-year history of coordination and cooperation with the agencies listed in Table 3 and other agencies related to water management and groundwater management. The District participates in various meetings and cooperative programs with these agencies on an on-going basis.

The District's Water Conservation Plan is one example of a program involving a number of agencies. The Plan is required by the USBR as a condition of the Federal water supply contract. Arvin-Edison's Water Conservation Plan has been approved by the USBR, and has been implemented by the District. In addition, the District has joined the Agricultural Water Management Council, a group of agricultural water agencies that cooperatively develop water conservation best-management practices, and standardizes the preparation of water conservation plans.

Another example of Arvin-Edison's relationships with other agencies is evident in the numerous tours of the District and its facilities that are given to agencies and individuals from throughout California, the United States, and abroad. The primary purpose of these tours is to educate other agencies on the benefits associated with groundwater banking, conjunctive use, and the District's success in managing groundwater supplies. Appendix M lists tours the District conducted from January of 1999 through April of 2003.

III. Groundwater Conditions

A. Groundwater Basin Description

The District lies within the southeastern portion of the Kern County Subbasin of the San Joaquin Valley Basin (Basin 5-22.14). The Kern County Subbasin has been identified by the DWR as a basin with boundaries appropriate for groundwater management purposes, as defined in DWR Bulletin 118 "Ground Water Basins in California" (Figure 1). Bulletin 118 Basin boundaries are identified on the basis of geological and hydrological conditions as well as political boundary lines. A map of the California Basins and Subbasins is provided in Figure 7.

DWR Bulletin 118-80 "Ground Water Basins in California" identifies Kern County as Basin No. 11 and subject to a critical condition of overdraft based upon the following definition:

"A basin is subject to critical conditions of overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social or economic impacts".

According to Bulletin 118-80, this definition implies a more dire circumstance than "groundwater overdraft", which is often defined as that condition where extractions exceed groundwater replenishment over some specified period of time.

The Kern County Basin extends from the Sierra Nevada foothills on the east to the eastern boundary of the San Luis Obispo/ Santa Barbara County line on the west, and from the Southern boundary of Tulare/ Kings County line on the north to the northern boundary of the Santa Barbara/ Ventura/ Los Angeles County line on the south.

B. Physical Structure

The Kern County Basin is a large, deep asymmetric sedimentary basin consisting of deep depositional centers separated by a basement feature known as the Bakersfield Arch; located generally along the Kern River. The San Joaquin basin is bordered on the south and east by the crystalline igneous and metamorphic rocks exposed in the Sierra Nevada, Tehachapi, and San Emigdio Mountains. These rocks also underlie the basin at depth and are considered to be non-water bearing. Overlying these rocks is a thick sequence of consolidated marine sedimentary rocks exposed in the Coast Ranges to the west and the San Emigdio Mountains to the south and extending eastward to lap onto the crystalline rocks of the Sierra Nevada. The consolidated marine sedimentary deposits play no significant role in the developed part of the ground water basin.

Miocene to Pleistocene-aged continental sediments overlies the marine sedimentary rocks in the basin. These sediments are several thousand feet thick in the subsiding portions of the basin but considerably thinner where deposited on and draped over the Bakersfield Arch. In the west, these continental sediments form the Tulare Formation, a thick sequence of water-lain sands, silts, and clays exposed along the western side of the San Joaquin Valley and in the Elk Hills. In the east, continental sediments form the Kern River Formation; a westward thickening series of sands, conglomerates, and mudstones.

The geology and groundwater features of the District area were studied by the USGS and DWR in the late 1950's. Results were summarized in Geological Survey Water-Supply Paper 1656. Figure 8 (Map Insert) is a geologic map of the area, and Figure 9 is a geologic section taken from that Paper. While the field of geology has advanced tremendously since it was published, Water Supply Paper 1656 contains the last comprehensive mapping of the geology of the area. Also, USGS Water Supply Paper 1469, while covering a much larger area than the District, also provides significant comprehensive information on the geology and hydrology for that area.

There are also two faults (or fault zones) within the District. These faults, the White Wolf and the Edison, and their impact on groundwater conditions, are discussed in the following section.

C. District Aquifer Characteristics

The District's aquifer was essentially formed out of a series of coalescing alluvial fans that have been formed by streams channeling from the southernmost Sierra Nevada Mountains, Tehachapi Mountains and San Emigdio Mountains. The relatively coarse-grained alluvial deposits along the margins of the basin grade into more fine-grained deposits in the central portion of the basin. The aquifers include (from shallowest to deepest) recent alluvial deposits, older Pleistocene alluvium and the late-Tertiary Kern River and Chanac Formations. These deposits range from about 800 to 4,800 feet thick in the District. Within the District, the upper 260 to 580 feet is older and younger alluvium primarily consisting of discontinuous beds of sand, silt, clay and gravel deposited on alluvial fans. These deposits are generally coarser at the apices of the fans and become finer-grained toward the center of the valley. The Kern River

Formation consists of coarse to fine grained sand and sandy clay with lenses of gravels and cobbles. The Chanac Formation consists of continental conglomerate deposits with lenses of coarse sand and clays.

In addition, two faults, or "fault zones" that traverse the District are the White Wolf and Edison Faults. These faults are believed to impede groundwater flow and affect the movement from one side of the fault to the other. A small portion of the District lies north of the Edison Fault. Another relatively large area lies south of the White Wolf Fault. A major portion of the District lies between the two faults and comprises the majority of the District area.

While these faults do appear to provide some impediment to groundwater flow across these faults, this is a subject that may merit additional study in the future. In this regard, there has been some more recent work done in this area, such as a thesis prepared by Karin Hagan[1]. This thesis studied the White Wolf fault zone, and concluded that groundwater elevation data indicate that the fault is a "partial barrier" to groundwater flow. An analysis of groundwater quality data found little difference in water quality on either side of the fault.

In many portions of the San Joaquin Valley, the Corcoran Clay separates a generally unconfined aquifer system above and a confined aquifer system below. However, the District area and immediately neighboring areas are believed to be situated too far south for this regional confining layer to be present. However, there are other relatively fine-grained materials beneath the District that cause varying levels of confinement within different locations in the District. This confinement tends to be more pronounced towards the more central portions of the basin.

The aquifer underlying the District yields substantial amounts of water to wells. USGS Water Supply Paper 1618 tabulated average well yields by township. For the townships underlying the District, these yields range from approximately 622 gallons per minute (gpm) to1,786 gpm, and averaged 1,191 gpm.

Yields from District-owned wells vary with the depth to water. For example, early in the recent drought of the late 1980s and early 1990s, District wells produced an average of about 1,800 gpm per well. By the end of the drought, the wells yielded approximately 1,400 gpm per well. Higher well yields returned after the drought ended, with a series of wetter-than-average years and significant groundwater recharge through District recharge operations.

[1] "The Effects of the White Wolf Fault on Groundwater Hydrology in the Southern San Joaquin Valley, California" Thesis dated December 2001 for California State University Bakersfield - Masters of Science in Geology Degree

D. Groundwater Monitoring Activities

The District has an extensive groundwater monitoring program that began with District operations in the late 1960's and has evolved to its present state. Table 4 summarizes the District's present groundwater monitoring program.

The groundwater monitoring program consists of a number of different components including:

1. Well water-level[2] measurement

Selected District-owned and privately owned wells have been routinely measured since the commencement of District operations in the mid-1960s. The District staff measure water levels in selected Private and District wells on a bi-annual basis (Spring and Fall) using an electrical well sounder, an acoustic well sounder or by the use of airlines and compressed air. Water level readings are shared with the USBR, DWR, and KCWA staff as part of a multi-agency valley-wide monitoring program.

District staff also reads and records pumping or standing (static) water levels in all District production wells monthly (via airline pressure gauge reading) before, during, and after each pumping season.

2. Well water level mapping

Depth to water, change in depth-to-water and water level elevation maps are prepared annually (Spring) by an engineering consultant (Stanley Powell of SAIC) and are provided in Appendix F.

3. Well water level graphing (hydrographs)

Once a year, the engineering consultant also prepares a hydrograph showing average static depth to water in wells in the District since 1962. Hydrographs are also prepared for each of the three sub-areas of the District. These hydrographs are developed from the water level maps. In addition, every month, District staff update a hydrograph showing depth to water versus time in the District's monitoring well at the Sycamore Spreading Ponds. Hydrographs of other private and District monitoring wells have also

[2] The term "well water level" is used in this Plan, rather than the term "groundwater level", because it is a more accurate term for the measurements that are taken. The term "groundwater level" would be more appropriate for readings taken from piezometers that are screened over relatively small intervals. The term "well water level" is used for water level measurements taken in production wells that are typically screened over a relatively large interval, and therefore reflect a melded water level from a number of different layers of the aquifer adjacent to the perforations.

been prepared over time. Graphs are also prepared monthly and annually showing water levels in the District's production wells at the three spreading areas versus time. Figure 10 is an example, and shows pumping water levels for water years 2001, and 2002.

4. Recharge (spreading) water measurement

Flow measurement devices (propeller flowmeters with totalizers or overflow weirs with staff gauges) located on the turnouts to the spreading ponds, and water level gauges in the ponds are read and recorded daily during spreading operations. This information is summarized and tallied daily, monthly, and annually in Excel spreadsheets by District staff. The spreadsheets also estimate evaporation losses in the spreading ponds, and calculate net spreading amounts.

5. Recovery (extraction) water measurement

District staff also read and record well water flow measurements on all District production wells on a daily basis, when they are pumping. The readings are taken from totalizers on propeller flow meters located on the discharge of each well. This information is summarized and tallied daily, monthly, and annually in spreadsheets by District staff. A graph showing total annual spreading and extractions from District water bank facilities since 1966 is also included in Figure 11.

6. Well water quality analysis

District staff sample water withdrawn from the discharges of selected private and District wells once per year, and send the samples to a certified laboratory for irrigation water (agricultural suitability) analysis. In addition, District staff sample water from the discharge manifolds of all District wells, incoming surface water, and Intertie Pipeline flows to the Aqueduct weekly before and during recovery operations and delivery to the California Aqueduct. Samples are sent to a certified laboratory for testing of Constituents of Concern (COC) as identified by DWR. The District, MWD, and KCWA cooperatively developed and maintain a blending model spreadsheet to predict water quality going into the aqueduct under various operating scenarios in order to determine and optimize water quality.

7. Well water quality mapping and graphing

Bookman-Edmonston Engineering Company summarized well water quality data from a variety of sources on maps of the District in 1996, as part of a study to locate new water banking facilities and are provided as Figures 13 and 14. Kenneth D. Schmidt and Associates also summarized and graphed well water quality results from selected private irrigation wells and District wells in 2000 (Appendix G).

8. Well location surveys

About every 5 years, the District staff conducts a visual survey of the District and update a map showing the locations of all wells (active and inactive) in the District.

9. Hydrologic inventory

The District's groundwater consultant prepares a Hydrologic Inventory for the District annually. One use of this inventory includes water volume balance calculations to estimate with and without project average groundwater levels and pumping costs throughout the entire District, and separately, within the three sub-areas. The components of the inventory are estimated based on data collected and maintained by the District such as precipitation, water deliveries, crop surveys and recharge and recovery operations. A copy of the Hydrologic Inventory completed in 2003 is included in Appendix A, Attachment 2.

10. Groundwater modeling

Bookman-Edmonston Engineering Company (B-E) prepared a numerical groundwater model in the late 1980's to assist in the evaluation of the MWD program and to monitor the impacts of its implementation.

E. Historic and Current Conditions

1. Groundwater Levels

As seen in Figure 12, the effect of District operations, which were initiated on July 1966, is reflected by a general stabilization of groundwater levels by the late 1970's, and significant recovery since then. The water level decline shown to have occurred during the pre-project period represents a continuation of the average annual long-term decline in groundwater levels of 7 to 8.5 feet per year throughout most of the District. Under non-project conditions, it is estimated that by the end of the 2002, assuming the same amount of water that was imported was, instead, pumped from the aquifer, pumping season average static groundwater depths in the District area would have been approximately 595 feet depth to water, instead of the actual 330 feet. This represents a higher groundwater table of 265 feet. By the end of 2002, average static groundwater levels had recovered approximately 60 feet since the historic low of 390 feet reached in 1977.

Based on water level measurements in the District's wells collected in December 2002, average static water level depths below ground surface at the District's spreading grounds were as follows: 337 feet at the North Canal basins, 341 feet at the Sycamore Basins, and 414 feet at the Tejon Basins.

2. Water Quality

The District's primary surface water sources (Friant-Kern Canal, California Aqueduct, and the Kern River) have excellent water quality, and are suitable for irrigation of the crops grown in the District. California Aqueduct water typically has higher Total Dissolved Solids (TDS) than either Friant-Kern Canal or Kern River water. All three sources provide raw water suitable for drinking water supplies for other water agencies.

Groundwater quality in the District prior to the project was generally satisfactory for agricultural use in most areas. However, wells in portions of the District were affected by elevated levels of Boron, salt, and/or nitrates. Problem areas are shown in Figure 15, taken from USGS Water Supply Paper 1656.

A more current mapping of well water quality performed by B-E in 1996, is shown in Figures 13 and 14. This assessment relied on data from 1982 and older, and also shows areas with elevated levels of boron, nitrates, and salts. A small area at the north end of the District has Arsenic levels above the current MCL for drinking water. Arsenic is a naturally occurring element, commonly associated with sediments derived from the Sierra Nevada, Tehachapi, and San Emigdio Mountains.

A review of recent data from water samples taken from District well manifolds (Table 5) shows that only a few wells along the North canal have water quality concerns. Results of Constituents of Concern testing that exceed present drinking water or irrigation water standards are highlighted in yellow in Table 5. It is important to note that water from the North Canal wells blends with surface water and other well water before delivery to District customers or to the California Aqueduct.

Table 6 summarizes canal water quality from samples taken at various locations in the District canal, including incoming surface water supplies during the 2002 water year. The District has no difficulty delivering suitable water to customers throughout the District, and has been able to meet DWR requirements for the pump-in program to the Aqueduct. Users of the Aqueduct downstream of the Intertie see an overall improvement in water quality in the Aqueduct as a direct result of the District's pump-in program.

The District's conjunctive use project has improved the groundwater quality in the District, compared to what it would have been without the project. This was documented in a report by Kenneth D. Schmidt and Associates dated May 2000, which analyzed groundwater quality trends in the District (Appendix G).

F. Issues of Concern

1. Extraction and Perennial Yield

Groundwater is a key component of the District's water supplies, and the District was originally formed in part to implement a program to reduce and or mitigate overdraft conditions in the District. For the purpose of the groundwater management plan, "perennial yield" or "sustained yield" is defined as the average annual amount of groundwater pumping that can be supported over an average hydrologic base period that will not result in a long-term decline of water levels. The term "overdraft" refers to a condition where the long-term average groundwater production exceeds the perennial yield, so that there is a long-term decline in groundwater levels. Both the perennial yield and overdraft are defined on a long-term average basis, so that short-term declines in groundwater levels can occur (such as during drought years), and such short-term declines do not indicate overdraft.

Mitigation of overdraft continues to be a key issue of concern for the District because overdraft can lead to a variety of problems, such as increased pumping costs and reduced reliability of groundwater supply. Overdraft is also related to land subsidence and degradation of water quality, which are other issues of concern discussed in the sections that immediately follow.

A hydrologic inventory (mass balance) analysis has been used to estimate the perennial yield and overdraft in the District. The hydrologic inventory quantifies the various components of recharge and discharge from the aquifer underlying the District, including subsurface inflows/outflows from surrounding lands, and determines the change in storage. This analysis is presented in Appendix A-Evaluation of Perennial Yield for Arvin-Edison Water Storage District. In summary, the analysis indicates that the perennial yield for the District is about 228,000 acre-feet per year, and that there is a small estimated annual overdraft of about 4,000 – 5,000 acre-feet per year.

Avoidance of overdraft remains a key issue for the District, under both present and potential future conditions. This is based on several considerations, such as:

- **Current Overdraft Conditions within the District.** The hydrologic inventory analysis indicates that the District remains slightly in overdraft.

- **Current Overdraft Condition in the Region.** The hydrologic inventory analysis estimated the perennial yield for the District only, and depends on some assumptions about conditions in adjacent districts that can impact the perennial yield for the District through changes in subsurface inflow. On a more regional basis, it is noted that the DWR has identified the larger groundwater basin that includes the District as being subject to critical conditions of overdraft. According to DWR's California Water Plan, Bulletin 160-98, groundwater overdraft in the Kern-Tulare hydrologic region averages 745,000 acre-feet per year. A significant increase in overdraft has occurred since 1990 in the San Joaquin Valley due to Delta export conditions, CVPIA implementation and ESA requirements. Even if overdraft were eliminated within the District, the regional overdraft conditions would remain a concern.

- **Potential Changes in Imported Supply Available to the District.** The hydrologic inventory analysis relied on historical information, and therefore would not reflect future changes in the availability of imported water supplies available to the District. Changes in the availability of imported water might result from changes in the operation of the Friant Division, or changes in the operation of the District's exchange agreements.

- **Impact of Average Groundwater Levels on Perennial Yield.** The presently unfilled groundwater storage beneath the District may be used to develop water management / banking programs that could benefit the District, and at the same time help address statewide management issues. However, higher groundwater levels associated with such programs could result in reducing subsurface inflow to the District. Thus, if the program were to result in maintaining average groundwater levels higher than historical within the District, then the perennial yield available to the District could be reduced.

2. Groundwater Quality

As detailed in a prior section, the District's groundwater supply has generally proven to be suitable for agricultural use and for delivery into the California Aqueduct. Localized areas where wells have water with elevated levels of various constituents including Arsenic, Boron, salts (TDS), and/or nitrates are presently manageable by blending with surface water and other groundwater of higher quality. Arsenic may be more of a concern for the Aqueduct pump-in program in the future, if the MCL is lowered further (which is anticipated).

The District's conjunctive use project has improved groundwater quality relative to conditions that would have occurred absent the District's project. But, existing water quality monitoring and management programs will continue to be needed to track changes, assess potential threats, and assist in groundwater management.

As part of the on-going groundwater quality monitoring program, it is recommended that a hydro-geologist update District water quality maps and graphs of water quality trends every 5 years.

3. Inelastic Land Surface Subsidence

Half of the entire San Joaquin Valley has been affected by land subsidence caused by development of land and water supplies, as well as petroleum production in the San Joaquin Valley. Approximately 4,300 square miles have subsided more than 1 foot and maximum subsidence exceeds 28 feet. This subsidence results from the following four activities (although each of these activities is a net lowering of land surface, they are different in their causes and effects): 1) intensive pumping of groundwater, 2) the collapse of moisture-deficient deposits when water is first applied (hydrocompaction), 3) oxidation of organic soils, principally in the areas of the Sacramento and San Joaquin Rivers and 4) extraction of fluids from producing zones in several oil fields.

The Arvin-Maricopa area, in which three of the above types of subsidence occur, is the southern of the three principal areas of widespread subsidence in the San Joaquin Valley. The subsidence problem in this area was well documented by the USGS in Geological Survey Professional Paper 437-D, published in 1975.

As of 1970, approximately 700 square miles of agricultural land south of Bakersfield had been affected by subsidence caused by the excessive pumping of groundwater. Subsidence of this land represents approximately 60% of the Arvin-Maricopa area, and the maximum subsidence rate exceeded 0.5 feet per year. Total maximum levels approached 9 feet and total volume of subsidence was more than 1,060,000 acre-feet. Most of this was due to overdraft of groundwater, representing a one-time “mining” of the groundwater resource and a permanent decrease in the storage capacity of the area. The areas with the highest subsidence rates attributed to overdraft were centered west of the District’s boundary, within the eastern portion of Kern-Delta Water District.

USGS Professional Paper 437-D also included the following statement: “It has been clearly demonstrated in the service area of the Friant-Kern Canal that raising groundwater levels sufficiently high to eliminate all excess pore pressures in the aquitards can effectively stop subsidence. Also, it is concluded that if water levels are held at a constant low level, subsidence will stop after all lag or residual compaction has been accomplished; however, this compaction might require several decades. In conclusion, no method is known for stopping subsidence other than that of raising the head in the aquifers sufficiently to eliminate the excess pore pressures in the aquitards”

Aside from DWR’s on-going monitoring of subsidence along the California Aqueduct, an evaluation of subsidence in the District has not been performed since 1975. Since that time, however, groundwater levels have stabilized (by 1978) and have even recovered significantly. Since 1980, District staff have not observed subsidence related problems occurring in the District. It is therefore believed that subsidence problems have largely been arrested in the District due to the improvement in the water balance and stabilization of groundwater levels resulting from the District’s program. DWR surveys along the California Aqueduct generally confirm this belief, and are provided in Table 7.

IV. Basin Management Objectives

A. Federal Goals and Policy

Although not governing the use of groundwater in the District, it is noted that the objective of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) is to restore and maintain the chemical, physical and biological integrity of the nation’s waters. In order to achieve this objective, it was declared that:

- It is the national goal that the discharge of pollutants into navigable waters be eliminated by 1985
- It is the national goal that, wherever attainable, an interim goal of water quality, which provides for the protection and propagation of fish, shellfish and wildlife

and provides for recreation in and on the water, be achieved by July 1, 1983.
- It is the national policy that the discharge of toxic pollutants, in toxic amounts, be prohibited.

Under this act, the Environmental Protection Agency directs States to establish and enforce water quality objectives for waters of the United States, and to regulate the discharge of pollutants to waters of the United States.

B. State Goals and Policy

Although not governing the use of groundwater in the District, the following state goals & policies are noted which help protect groundwater quality within the District:

1. Statewide Goals and Policy

In addition to Federal Goals, The State of California has set forth environmental goals and enacted progressive legislation to protect water quality. The Porter-Cologne Water Quality Control Act states as a policy: “The quality of all the waters of the State shall be protected for use and enjoyment by the people”. This law also establishes the goal of achieving the highest possible water quality consistent with all demands presently being made and to be made on those waters.

On October 28, 1968, the State Water Resources Control Board adopted Resolution No. 68-16: “Statement of Policy with Respect to Maintaining High Quality of Waters in California” (Nondegradation Policy). The policy requires the continued maintenance of existing high quality waters, but provides conditions under which a change in water quality is allowable. These changes must:

- Be consistent with maximum benefit to the people of the state.
- Not unreasonably affect present and anticipated beneficial uses of water.
- Not result in water quality less than that prescribed in water quality control plans or policies.

Regional Water Quality Control Boards (including the San Joaquin Valley Regional Water Quality Control Board) are charged with creating Basin Plans that identify beneficial uses to be protected, and water quality objectives for specific water bodies, including groundwater.

A water quality objective is a statement on the conditions to be maintained in waters of the State. The statement may be general or specific. The establishment of water quality objectives, as with other aspects of water quality control planning, has become more complex in recent years because of increasing levels of protection demanded. This is due largely to the result of public awareness of benefits associated with a clean and healthy environment.

The Regional Boards enforce water quality objectives by regulating waste discharges to waters of the State through the issuance of waste discharge permits.

The California State Water Plan (Bulletin 160) prepared by DWR and updated every 5 years establishes State direction for water resources planning in various areas of the State. Interestingly, the State Water Plan contains few, if any specific objectives that pertain to groundwater management in the State.

2. State Goals and Policy for the Tulare Lake Basin

The San Joaquin Valley Regional Water Quality Control Board has established and periodically updates the Tulare Lake Basin Water Quality Control Plan. The District lies within this area. The following objectives presently pertain to the Regional Board's jurisdiction concerning the protection of waters within the Tulare Lake Basin: General Objectives for All Waters

The following objectives shall apply to waters of the Basin:

- Waters of the Basin shall not be polluted.
- Nuisance conditions shall not be caused in any waters of the Basin.
- Wherever the existing water quality is better than the quality established herein, such existing quality shall be maintained unless otherwise provided for by sections of the State Water Resources Control Board "Statement of Policy with Respect to Maintaining High Quality of Waters in California", including any revisions thereto.
- Wherever uncontrollable factors degrade water quality below these water quality objectives, then controllable factors shall not cause any degradation of water quality.

3. Objectives for Groundwater

Water quality objectives for all groundwater in the Tulare Lake Region are provided in Appendix H. The Water Quality Objectives apply to all inland surface water and groundwater.

Table III-4 of, Appendix H, presents the maximum limits for an average annual increase of groundwater salinity, by area. These levels of increase are interim and represent the present average rate of increase for each hydrographic unit. The Tulare Lake Basin and Groundwater Hydrographic Units are provided in Figure III-1.

The most recent version of the California Water Plan (Bulletin 160-2000) contains no specific objectives for groundwater in the Tulare Lake Hydrologic Study Area (which includes the District). However, the Plan's discussion implies the following goals:

- Reducing or eliminating groundwater overdraft
- Controlling groundwater pollution and/or degradation
- Controlling land-surface subsidence

C. Kern County Water Agency Objectives

KCWA has not adopted basin management objectives that pertain to groundwater management within its boundaries (which includes the District). A review of the Act, which created the KCWA in 1961 (Water Act 99), finds no basin management objectives. However, because KCWA is an important institution for the management of water in Kern County, coordination with KCWA on projects can help in the management of water resources at a county-wide level.

The District has a 37-year history of cooperation and coordination with the KCWA. As evidence of this, the District has coordinated with KCWA and gained KCWA approval for numerous programs related to groundwater management including:

- cooperative groundwater monitoring and data sharing programs
- participation in the construction of the Cross Valley Canal
- participation in the CVC Exchange Agreements
- participation in RRBWSD Banking Exchange Program
- participation in the MWD Water Management Program
- sales of banked water to the Environmental Water Account
- water quality exchange program with MWD
- water management exchanges and transfer with a variety of Kern County Agencies and Districts
- Participation in joint applications for Prop 13 Groundwater Construction Grant funds
- participation in partnership activities between Kern County Water Agency and Friant Water User's Authority

D. District Management Objectives

Prior to the adoption of this Plan, the District has not adopted formal groundwater management objectives. However, direct and implied management objectives can be found that pertain to groundwater in the District in a number of documents. These include the following:

- Water Supply Contract with United States for Friant Water Supply
- Exchange Agreements with CVC Contractors
- District Water Conservation Plan and Updates
- Agreement with MWD for Water Management Program
- Water Service Contracts with Landowners
- District Rules and Regulations

In addition to these documents, unwritten objectives have guided groundwater management in the District through the years.

The following groundwater management objectives are proposed to be adopted by the District as part of this Groundwater Management Plan to guide future activities, programs, and projects. These objectives are intended to memorialize written and unwritten objectives that have guided the District in the past, and should serve well to guide the District in the future. As with all objectives, these should not be viewed as laws, promises, or warranties, but rather as guiding principles and targets for which to aim. Some of the objectives may not be attainable in some circumstances. In other circumstances, specific objectives may conflict with each other. In those cases, the Board of Directors and staff will determine which objectives are the most important and prioritize accordingly. Actions taken as a result of this Plan shall be conducted with the following objectives:

1) **Water Supply Reliability**

1.1 Protect the District's USBR Water Supply Contract from external threats

1.2 Maximize the use of Contract water supplies within the District

1.3 Firm up the water supplies available to District water users by utilizing groundwater in conjunction with surface water supplies via operation of water bank facilities.

1.4 Whenever economically feasible, recharge surplus water in excess of irrigation demands in years of adequate supply to be extracted and delivered to water users in years of deficient supplies.

1.5 Purchase and utilize or bank supplemental surface water supplies (Sec. 215 & Kern River or other surplus supplies) when available and when irrigation demands or recharge capacity exist within the District.

1.6 If economical, exchange or bank available water with other agencies when irrigation demands or recharge capacity in the District is insufficient.

2) **Water Supply Affordability**

2.1 Keep the cost of water supplied to District customers and water assessments to all landowners in the District affordable.

2.2 Keep the cost of water supplied to District customers available at a cost that is comparable to landowner's costs for pumping groundwater from privately owned wells, in order to offer a viable alternative to groundwater.

3) **Groundwater Overdraft**

3.1 Do not increase, and, where possible, reverse long-term groundwater overdraft within the District

3.2 Do not increase, and, where possible, reverse groundwater overdraft within any of the three groundwater zones (separated by faults) within the District

3.3 Do not increase, and where possible, reverse groundwater overdraft within the Kern Basin (as defined by DWR Bulletin 118) or neighboring basins

3.4 Do not increase the pumping costs of other well owners (by lowering well water levels) and where possible decrease them

3.5 Do not create shallow groundwater related problems to other landowners or to District facilities

4) **Groundwater Quality**

4.1 Water delivered to customers (including groundwater) shall be suitable for irrigation purposes

4.2 Water delivered to the Aqueduct shall meet applicable standards

4.3 Do not contaminate groundwater

4.4 Do not add to the degradation of groundwater quality, and where possible, improve groundwater quality

4.5 Chemicals used for weed control or other purposes in spreading basins shall be selected and applied in a manner that does not contaminate groundwater

5) **Compliance with Contracts, Agreements, Laws, and Cooperation with Other Agencies**

5.1 Comply with the provisions of contracts and agreements that the District has entered into, including, but not limited to: Water Supply Contract with USBR, CVC Participation and Exchange agreements, and AEWSD/MWD Water Management Program agreements.

5.2 Comply with applicable laws and regulations including NEPA and CEQA

5.3 Cooperate with other Federal, State, and local agencies that have jurisdiction in the District

6) **Inelastic Land Surface Subsidence**

6.1 do not cause inelastic land surface subsidence that will result in property damage

7) **Groundwater Monitoring**

7.1 conduct monitoring programs to provide the District management with sufficient information to make informed decisions on groundwater management

7.2 conduct monitoring programs to measure results of programs undertaken and the attainment of Basin Management Objectives.

A separate description of "how meeting each Management Objective will contribute to a more reliable supply for long-term beneficial uses of groundwater within the plan area" (a DWR recommended part of the Plan) is not deemed necessary, as these are self-evident.

V. Components of the Groundwater Management Plan

Management Plan Elements Allowed by AB-3030

AB-3030 allows local agencies to adopt Groundwater Management Plans to address 12 specific elements. These elements and their application in the District are discussed below. A general discussion of each AB-3030 element is given below, followed by proposed District actions related to that element (*italicized to set them apart*).

A. Control of Saline Water Intrusion

Saline water can degrade groundwater quality and ultimately render part of the groundwater unusable (without treatment). It is desirable, therefore, in some areas of California, and particularly those areas influenced by sea-water intrusion, to control the movement of saline water to preserve groundwater quality.

Saline water intrusion is not as much of a concern in the District as it is in other areas of California. However, a number of areas were identified by the USGS within and adjacent to the District with elevated levels of salt in the groundwater before the District initiated operations. See Figure 15 from USGS Water Supply Paper 1656. These areas are believed to have occurred due to operation of natural processes and oil production activities, and existed prior to the initiation of irrigation in the District. Furthermore, groundwater pumping and overdraft prior to the District's project operations caused groundwater gradients that moved saline water into other areas of the District. The District's project has had the effect of reducing/ reversing that trend.

A number of sources, both natural and man-made, can increase the salinity in groundwater. Salts can come from imported water, salts in the soil (leached by irrigation), animal wastes, fertilizer use, soil amendment use and municipal and industrial wastewaters. Increases in groundwater salinity have always been a natural phenomenon in closed basin areas, like the Kern County Basin. The Tulare Lake Water Quality Control Plan recognizes that there are no proven means available at present to maintain groundwater salinity at current levels throughout the Basin, and recognizes that a certain amount of degradation is likely to occur due to man's activities. Kenneth D. Schmidt and Associates analysis of groundwater quality trends in the District (Appendix G) identifies gradual increases in groundwater salinity as an on-going concern.

In spite of the inherent difficulties of controlling groundwater salinity, the District is determined to minimize salinity degradation and migration related problems in its groundwater. The District's existing groundwater monitoring program will be continued, with improvements noted, in a manner that provides management information about salinity in the groundwater. Furthermore on-going efforts to control groundwater overdraft through the importation of high quality surface water for direct and in-lieu recharge, plus District management of extractions as provided in Section V.H. of this Plan will continue to limit saline water degradation and migration, and in some areas improve salinity of the groundwater. In addition, when alternative surface water supplies are available for importation into Arvin-Edison, the District considers not only the cost but the water quality of the alternatives. Water quality of surface supplies can also change with time and those changes are monitored by the District and scheduled, when possible, to achieve the maximum water quality benefit.

B. Identification and Management of Wellhead Protection Areas and Recharge Areas

The Federal Wellhead Protection Program was established by Section 1428 of the Safe Drinking Water Act Amendments of 1986. The purpose of the program is to protect groundwater sources of public drinking water supplies from contamination, thereby eliminating the need for costly treatment to meet drinking water standards. The program is based on the concept that the development and application of land-use controls, usually applied at the local level in California, and other preventative measures can protect groundwater. A Wellhead Protection Area (WHPA), as defined by the 1986 Amendments, is "the surface and subsurface area surrounding a water well or wellfield supplying a water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield". The WHPA may also be the recharge area that provides the water to a well or wellfield. Unlike surface watersheds that can be easily determined from topography, WHPA's can vary in size and shape depending on subsurface geologic conditions, the direction of groundwater flow, pumping rates and aquifer characteristics. There are several different methods typically used to delineate the lateral boundaries of a WHPA. Under the Act, states are required to develop an EPA-approved Wellhead Protection Program. To date, California has no state-mandated program, but instead relies on local agencies to plan and implement programs. This is one of the factors that prompted the State Legislature to enact AB-3030. Wellhead Protection Programs are not regulatory in nature, nor do they address specific sources. They are designed to focus on the management of the resource rather than control a limited set of activities or contaminant sources.

As the District does not provide public drinking water to its customers, Wellhead Protection Areas are generally not applicable to District and landowner irrigation wells. The District will, however cooperate with the Wellhead Protection programs of other overlapping or neighboring agencies with public water supply wells, to the extent that it can.

C. Regulation of the Migration of Contaminated Groundwater

Groundwater contamination can originate from many sources or activities. Clean-up of contaminated groundwater is a complex and expensive task, generally involving a number of organizations. Agencies with roles to play in mitigating groundwater contamination include the United States Environmental Protection Agency (EPA), California Regional Water Quality Control Board (RWQCB) and the California Department of Toxic Substances Control (DTSC). Each agency has its own set of regulatory authorities and expertise to contribute. The degree to which they participate depends upon the nature and magnitude of the problem.

The District cooperates with various other agencies to help insure that groundwater quality is not degraded. As an example, over the last two years, the District has intervened in and participated with the County of Kern in various lawsuits to assist the County in its efforts to insure that only the highest quality of sludge is utilized on lands overlying the groundwater basin.

The role of the District with respect to the regulation of the migration of contaminated groundwater will be to report any contamination that it discovers to the appropriate agency. Further cooperation and assistance with the responsible agencies will be given, if requested and as appropriate, according to the District's jurisdiction and authority.

D. Administration of Well Abandonment and Destruction Program

Existing State and Kern County law requires that owners or lessees properly destroy their abandoned wells. Proper destruction of abandoned wells is necessary to protect groundwater resources and public safety. Abandoned or improperly destroyed wells can result in contamination from surface sources, or water of different chemical qualities from different strata mixing in an undesired way. Either way, useable groundwater can become degraded and/ or contaminated.

This Plan recognizes that the responsibility for administration and enforcement of the County well ordinance will remain with the Kern

County Department of Health Services. The District will properly abandon its own wells when they are no longer useful. In addition, the District encourages landowners to convert useable wells to monitoring wells to become a part of the District's groundwater monitoring program. The District will continue to maintain copies of all Well Completion Reports that are filed with DWR for wells drilled in the District to facilitate evaluation of groundwater monitoring data.

E. Mitigation of Conditions of Overdraft

As mentioned in Section III. F1, overdraft of the groundwater supply can lead to a variety of problems. Groundwater overdraft is due to an imbalance in the rates of extractions and replenishment. There are several methods to correct this imbalance. The first is to decrease the extraction to match the rate of replenishment. The second is to increase groundwater replenishment to match the extraction rate and the third is a combination of the first two, to balance replenishment and extraction. Each of the methods must be applied over an extended period, making use of the storage capacity of the aquifer. Extractions can exceed replenishment in drought periods as long as replenishment equally exceeds extractions in wetter periods.

Overdraft is a significant concern in the District, and the desire to eliminate overdraft has driven many of the District's decisions and activities throughout its existence. While groundwater levels no longer have a downward trend, the District's most recent evaluation of overdraft (Appendix A, Attachment 3) shows a small amount of overdraft remaining in the District for the hydrologic period studied. In addition to this the DWR estimates the overdraft within the larger Kern-Tulare hydrologic area, which includes the District, to be approximately 745,000 acre-feet per year. Also, groundwater levels remain relatively deep in most of the District reflecting overdraft conditions present before operation of the District's project.

The District will continue to monitor, map, graph, and analyze groundwater levels and groundwater balance in the District, and its three sub-areas.

The District recognizes that any reduction in its surface water supplies, reduction of subsurface inflow, or increase in net groundwater pumping within or adjacent to the District could increase groundwater overdraft conditions in the District. The District will therefore continue to monitor these types of threats, and work toward reduction and elimination of overdraft conditions in the District and the Kern County Basin.

Furthermore, the District will continue to look for opportunities to further elevate groundwater levels within the District and reduce overdraft in the

Kern groundwater basin by participating in projects or activities that positively affect groundwater balance and are cost effective to implement.

F. Groundwater Replenishment

Replenishment of groundwater in the District occurs by both natural and artificial means and is an important technique in the management of water supplies, groundwater levels and groundwater quality, as well as for control of overdraft.

The District will continue to operate and manage existing groundwater replenishment facilities to meet the Objectives of this Plan. Furthermore, the District will continue to look for and evaluate opportunities to participate in projects or activities that further replenish groundwater. A list of potential projects and activities that would have groundwater replenishment benefits is given in Table 8.

G. Groundwater Monitoring

An effective groundwater level and storage monitoring program is a necessary part of a Groundwater Management Plan. The District's existing groundwater level and groundwater storage monitoring program has proven to be very effective. Therefore, it should be continued. A minor improvement would be to maintain more hydrographs of landowner wells in selected areas annually using water level data that is already collected. This will give a more complete picture of groundwater levels and storage in particular areas of the District.

The District will continue the current groundwater level and storage monitoring program previously described in Section III. D. In addition, hydrographs of selected landowner wells will be updated annually by District staff, and will be reported to the Board of Directors.

In addition, the District's existing groundwater quality monitoring program will be continued, with updated groundwater quality mapping by a hydro-geologist every 5 years.

H. Management of Groundwater Extractions

Management of groundwater extractions can help correct groundwater overdraft, and can also help control the migration of groundwater contaminants. The District presently manages groundwater extractions from its own wells near the District's canals, and indirectly manages extraction from some landowner wells by providing alternative supplies within the water service area. This program has proven to be effective in controlling district-wide overdraft (see Figure 12), negative localized groundwater level impacts, and contaminant migration. As can be seen, the District already practices extensive groundwater management.

The District will continue to manage extractions in its own wells through selective use of the pumps in a way that balances groundwater conditions district-wide and in the vicinity of each respective recharge area and well field.

The District will continue to indirectly manage extractions from landowner wells by providing alternative water supplies, where possible, to its surface water service area, and by continuing to manage its successful conjunctive use program. This will continue to include assessments to all District lands to generate funds for, among other things, purchasing water for spreading. Furthermore, the District will continue to evaluate opportunities to expand the surface water service area to reduce groundwater pumping particularly by providing temporary water service when available for deliveries.

I. Identification of Well Construction Policies

Improperly constructed wells may result in contaminated groundwater by establishing a pathway for pollutants entering a well through drainage from the surface, allowing mixing between aquifers of varying water quality, or the unauthorized disposal of waste into the well. The Kern County Department of Health Services has enacted and is responsible for enforcing a County Well Ordinance that regulates well construction. Owners must first obtain a well drilling permit from Kern County prior to drilling a well. The District has obtained permits for all of its wells, and will continue to do so.

This Plan recognizes that the responsibility for administration and enforcement of the County well ordinance will remain with the Kern County Department of Health Services. The District will apply for and obtain a well drilling permit for every well that it drills.

J. Construction and Operation of Groundwater Management Facilities

The successful construction and operation of the District's Project has proven to be effective toward solving groundwater related problems in the District. The District has a number of opportunities to further improve and enhance the water and groundwater supplies of its landowners and neighbors, as well as existing and potential water transfer and water banking partners. These opportunities involve a number of potential projects or activities (Table 8).

The District will continue to operate its existing groundwater management facilities for the primary benefit of its customers and landowners. Furthermore, the District will continue to participate in water transfers, water exchanges, water banking, and other water management arrangements that are mutually beneficial to the parties involved and are consistent with the Management Objectives of this Plan.

The District will continue to evaluate potential projects that would involve the construction and operation of additional groundwater management facilities. Additional groundwater management facilities can provide additional flexibility to the District to more optimally manage the groundwater

K. Development of Relationships with Federal, State and Local Regulatory Agencies

As detailed in Section II. F and Table 3, various Federal, State, and other local agencies have an involvement in groundwater management in Arvin-Edison. The District has been cooperative with these other agencies in the past, and plans to continue cooperation on a level appropriate to their various jurisdictions. The new requirements of SB-1938 concerning cooperative groundwater management within a given groundwater basin are discussed in Appendix I.

The District will continue to cooperate with, and operate under the requirements of the various Federal, State, and local agencies that have jurisdiction over various aspects of surface water and groundwater in the District. Furthermore, the District will participate in cooperative management of the Kern groundwater basin with other agencies that have jurisdiction there.

It should be stressed, however, that this Plan was formulated to ensure local control of groundwater management within the District. And, it is the intent of this Plan to foster this local control in as many aspects of groundwater management within the District as possible. This emphasis on local management is consistent with legislation authorizing development of groundwater management plans, as discussed previously in Section I.C.

L. Review of Land Use Plans and Coordination with Land Use Planning Agencies

One potential component of developing a groundwater management plan is the review of land use plans for the plan area and its surroundings and coordinating efforts with regional and local land use planning agencies. Land use planning activities in unincorporated areas of Kern County are performed by the Kern County's Planning Department and overseen by the Kern County Planning Commission. The District does not have direct land use planning authority. However, the District does have the opportunity to comment on the environmental documents for land use related activities, and comment or protest when appropriate.

Authority for land use plans will remain with the Kern County Planning Department and the Kern County Planning Commission. The District will, however, review environmental documents related to land use plans that will affect the District. Comments on the plans and/or protests will be made when land use plans conflict with Management Objectives contained in this Plan.

Program Components Required by SB-1938

Recent amendments to Water Code § 10750 resulting from the passage of SB-1938 require groundwater management plans prepared under that authority (i.e. AB-3030 Plans) to have components that address a number of issues. The SB-1938 requirements are summarized in Appendix I. A number of these components have already been addressed in the Plan above, including:

- Documentation that a written statement was provided to the public "describing the manner in which interested parties may participate in developing the groundwater management plan (Water Code § 10753.4) (See Section I. D of this Plan and Appendices C, D, and E.)
- Basin management objectives for the groundwater basin that is subject to the plan (Water Code § 10753.7 (a)(1)) (See Section IV.D).
- Components relating to the monitoring and management of groundwater levels and groundwater quality (Water Code § 10753.7 (a)(1) (See Section III.D).

In addition, the following components required by SB-1938 are included below.

M. Monitoring and Management of Inelastic Land Surface Subsidence

Water Code §10753.7 (a)(1) also requires groundwater management plans to address monitoring and management of inelastic land surface subsidence.

As discussed in Section III. F3, land surface subsidence was documented in the vicinity of the District in the 1975 USGS Professional Paper 437-D. At that time, some subsidence was observed along the western portion of the District that was attributed to overdraft. In addition, some subsidence in the vicinity of oil fields was also observed. Since that time, downward groundwater level trends have been arrested, eliminating one of the major causes of subsidence.

In recent years the District has seen no evidence of subsidence related problems in the District. This is significant because the District owns, operates, and maintains over 45 miles of concrete lined canals, 170 miles of pipelines, 72 production wells, and numerous booster pump stations. Evidence of subsidence problems would likely have been observed at District facilities, were they occurring.

While it would be an interesting exercise to document land surface elevation changes that have taken place in the District since the last USGS studies of subsidence, this is not a high priority for the District for the reasons mentioned above. Efforts to cooperate with other agencies studying land surface subsidence issues, like DWR and the USGS would be worthwhile.

Surveys by professional Land Surveyors utilizing Global Positioning Systems (GPS) could determine elevations of critical benchmarks and structures within the District with sufficient accuracy to identify significant elevation changes at relatively low cost (compared to conventional leveling techniques). Still, a separate effort to survey for subsidence related issues alone would not be worth the cost. It would be more cost-effective to have Professional Land Surveyors survey critical benchmarks and structures in Arvin-Edison as part of other land surveying efforts in the District.

The District has apparently effectively mitigated subsidence through the improvement of the water balance achieved from the District program. Maintenance and enhancement of the District management program is therefore important to continue to manage potential subsidence. Monitoring of subsidence is considered a low priority so long as the District program continues to result in relatively stable groundwater levels.

The District will cooperate with studies by other agencies (DWR and USGS in particular) of land subsidence. In addition, updated elevations of critical benchmarks and structures within the District may be conducted as part of other projects that require land surveying.

N. Changes in Surface Flow and Surface Water Quality that Directly affect Groundwater Levels or Quality or are caused by Groundwater Pumping

Water Code § 10753.7 (a)(1) also requires a groundwater management plan to address the topics given in the header above.

In some areas of the State, changes made to flows in surface streams can affect groundwater levels by changing recharge amounts from stream channels. Within the District, this is not the case, as flows in surface streams exist for extremely short durations, and diversions are generally not made from them. The District participates in the Kern County Coordinated Resource Management Program (CRMP), a program to develop funding and planning for projects that would reduce flooding problems from the streams that flow into the District from the east and south.

The District does obtain water from stream systems in other parts of the State where changes in surface flow and surface water quality could affect groundwater levels or groundwater quality in areas adjacent to the streams. Diversions made from these streams are generally made by other agencies, and management of those streams is outside of the District's jurisdiction. However, effects of changes in surface flows on these streams should be and normally are considered by these agencies during decision-making and environmental reviews.

Changes to surface water quality can also affect groundwater quality by changing the quality of water that seeps into the groundwater from the stream. The potential for groundwater contamination or degradation from eastside ephemeral streams in the District does exist. Upstream activities and/or waste discharges to these streams are a potential threat. The Regional Water Quality Control Board regulates several discharges to these streams. The District should monitor and report illegal waste discharges to these streams to the Regional Water Quality Control Board. Likewise, land use activities tributary to these streams that could impair their quality should likewise be monitored and controlled through available legal, regulatory, and planning means.

Groundwater pumping can increase seepage from surface streams in some areas. In the District, this is generally not a problem, as streamflow within the District occurs for short durations, and most of the water ends up seeping into the groundwater anyway.

The District is aware of the potential impacts that changes in surface flows may have on groundwater levels under streams that supply water to the District. The District will continue to work with agencies that have jurisdiction and decision-making authority to consider and mitigate this issue as decisions are made and environmental documents are prepared.

The District will continue to monitor activities and land use in ephemeral streams upstream of the District. Illegal discharges will be reported to the Regional Water Quality Control Board. Land uses or activities with the potential to negatively impact groundwater quality will be identified and opposed through legal, regulatory, and land use planning means available to the District.

O. Plan to Involve Other Agencies

Water Code § 10753.7 (a)(2) requires that a plan be developed by the managing entity (the District in this case) to "involve other agencies that enables the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin." A local agency includes "any local public agency that provides water service to all or a portion of its service area" (Water Code § 10752 (g)).

The development of relationships (and maintenance of existing relationships) between the District and the various agencies involved in managing groundwater in the Kern basin is an important part of an effective groundwater management plan. As documented in prior sections, the District has a 37-year history of effective groundwater management that has involved cooperation with, and the involvement of, other Federal, State, and local agencies.

It is important to note that "the plan to involve other agencies" in the Kern County groundwater basin will not, however, be entirely up to the District to develop. The development of the plan will require input from other affected agencies within the basin. And, there are a large number of agencies involved (at least 30).

An important step toward the development of a coordinated plan for the Kern groundwater basin is being undertaken now as part of KCWA's "Mediated Process". This process is still being conducted, and will continue for an undetermined duration. Critical issues related to groundwater management, some of which may be controversial, are being discussed and negotiated by the various parties. The result of these discussions and negotiations will no doubt affect the plan.

The District has already established effective relationships and on-going coordination with a number of agencies involved in groundwater management in the Kern basin, including the USBR, DWR, KCWA, overlapping, and adjacent local agencies. These relationships will continue.

Furthermore, preparation and adoption of this Plan will raise other agencies' awareness of the District's groundwater management activities, and will raise the level of cooperation with other agencies that have jurisdiction, overlap, or are adjacent to the District.

The District will propose periodic meetings with overlapping and adjacent agencies for the purpose of coordinating groundwater management activities and other water management related activities that the agencies have in common.

The District will also participate in the development and implementation of Kern groundwater basin coordination plans through the KCWA Mediated Process and/or other basin-wide planning efforts.

P. Adoption of Monitoring Protocols

Water Code § 10753.7 (a)(4) requires the "adoption of Monitoring Protocols for the components in Water Code § 10753.7 (a)(1).

The District staff has already adopted and implemented monitoring protocols for the monitoring of groundwater levels and groundwater quality. These protocols are included in Appendices J and K.

Protocols for the monitoring of inelastic land surface subsidence will be developed by various government agencies that study subsidence issues in the District, like DWR and the USGS. In addition protocols for determining elevations of critical benchmarks and structures in Arvin-Edison will be developed and implemented by a Licensed Land Surveyor when and if surveys are made for that purpose in the District.

Components Recommended by DWR

In addition to the requirements of AB-3030 and SB-1938, DWR, in coordination with the Association of California Water Agencies (ACWA), has developed recommended components that a managing entity (the District) should incorporate into a groundwater management plan and is provided in Appendix I. At the time this Plan was prepared, these recommended components were in draft form (draft dated 12/23/02 was used).

The District has voluntarily incorporated DWR's recommendations into its Plan. A number of these components have been addressed in prior sections including:

- Description of the physical structure and characteristics of the aquifer system underlying the plan area in the context of the overall basin (Section III. C)
- A summary of the availability of historical data including, but not limited to, the components in Water Code § 10753.7 (a)(1) (Sections I.A, II.E1, II.E1&2)
- Issues of concern including, but not limited to, the components in Water Code § 10753.7 (a)(1) (Section F)
- A general discussion of historical and projected water demands and supplies (Section II.E)
- A description of how meeting each Management Objective (MO) will contribute to a more reliable supply for long-term beneficial uses of groundwater within the plan area (Section IV.D)
- Existing or planned management actions to achieve the MO's (note, these are included in italics in this section of the Plan)
- A map indicating the general locations of any applicable monitoring sites for groundwater levels, groundwater quality, subsidence station, or stream gauges is provided in Appendices J & K.
- A summary of monitoring sites indicating type and frequency of monitoring. For groundwater level and groundwater quality wells, indicate the depth interval(s) or aquifer zone monitored and the type of well is provided in Appendix J
- Describe any current or planned actions by the local managing entity to coordinate with other land use, zoning, or water management planning (Section V.K & L).

In addition to these, the following components are a part of this Groundwater Management Plan:

Q. Advisory Committee of Stakeholders

DWR recommends that an advisory committee of stakeholders (interested parties) within the plan area be established that will help guide the development and implementation of the plan.

Unless other appointments are made by the Board of Directors of the District, the advisory committee of stakeholders will consist of the Board of Directors of Arvin-Edison. This is appropriate, as members of the Board of Directors are elected to represent landowners in the District, the primary stakeholders in the District. Other potential stakeholders may nominate *themselves, subject to the Board's approval to serve on the Advisory Committee.*

While the Advisory Committee's input will be sought, the ultimate authority for the implementation and periodic updating of this Plan will remain with the Board of Directors.

R. Periodic Reports Summarizing Groundwater Basin Conditions and Groundwater Management Activities

DWR recommends that groundwater management plans provide for periodic reports summarizing groundwater basin conditions and groundwater management activities.

The District staff presently prepares a summary of water management program activities annually that typically includes much of the information that DWR recommends. Pursuant to this Plan, the District will incorporate the following information into annual water management reports to the Board of Directors:

- *Summary of monitoring results, including a discussion of historical trends.*
- *Summary of management actions during the year covered by the report.*
- *A discussion, supported by monitoring results, of whether management actions are achieving progress in meeting Management Objectives.*
- *Summary of proposed management actions*
- *Summary of any plan component changes, including addition or modification of Management Objectives during the year*

Each Annual Report will be prepared following the end of the Water Year (February 28 or 29) for which the Annual Report applies to. The annual report shall be completed and presented to the Advisory committee by May 31st of each year.

S. Periodic Re-Evaluation of Entire Plan

The District Board already meets monthly (at regularly scheduled and special Board meetings) to review issues of importance and make decisions with respect to the management of the District, including groundwater management issues. And, this will continue. The Board of Directors reserves the right to continue to make decisions with respect to groundwater management issues at its Board meetings in accordance with the Plan and its Management Objectives.

The Advisory Committee will meet annually (prior to July 1st of each year) to review annual reports prepared pursuant to this Plan. These meetings may (or may not) coincide with regular or special Board meetings. The Committee may recommend changes to the Plan at the annual meetings.

The entire Plan may be re-evaluated and amended at any time. Scheduled re-evaluations will be conducted every 5 years, unless the Advisory Committee elects to forgo a re-evaluation.

Significant changes to the Plan will require appropriate public notice, and the same process that was originally done for adopting the Plan.

VI. Program Costs, Funding, and Potential Fees

Initial costs to implement the program will be borne by the District. These costs are anticipated to be within existing budgets established for the District's management activities.

Other sources of funds for projects or management activities pursuant to this Plan may be sought including:

- AB-303 funding for Groundwater Management Plan Implementation
- Proposition 82 Groundwater Recharge Feasibility Study and/or Construction Loans
- Proposition 13 Groundwater Storage Feasibility Study and/or Construction Grants
- Proposition 50 Funds
- Private or Public Financing through a bank or other lending institution, Certificates of Participation, or Bonds
- The levee of benefit assessments, water toll charges, or other mechanisms consistent with the Water Code and Proposition 218 requirements

If additional funds are necessary to implement the Program and are outside the current authority of the District to raise, but within the powers granted by AB-3030, a public vote will be required. A simple majority (weighted by assessed valuation) is necessary to approve a measure to levee a fee for groundwater management.

ATTACHMENTS

ATTACHMENT A

LIST OF EXHIBITS

ATTACHMENT A (continued)

C	Notice of Proposed Resolution of Intention to Draft a Groundwater Management Plan (posted in the Bakersfield Californian and Arvin Tiller)
D	Resolution No. 03-01of Intention of the Arvin-Edison Water Storage District to Draft a Groundwater Management Plan
E	Minutes of the Meeting of the Board of Directors, January 14, 2003 and Attendance Sheet
F	Contours of Equal Groundwater Elevation, Spring 2002 & Contours of Equal Groundwater Depth, Spring 2002
G	Draft Report of the Long-Term Monitoring of Well Water Quality in the Arvin-Edison Water Storage District by Ken Schmidt, May 8, 2000
H	Water Quality Objectives for the Tulare Lake Basin
I	Required and Recommended Components of Local Groundwater Management Plans
J	Groundwater Level Monitoring Program
K	Annual Water Quality Survey
L	Resolution No.01-25, Authorizing the Investigation of Water Management Opportunities with Kern Delta Water District
M	Summary of District Tours-January 1999 to Present

ATTACHMENT B

REFERENCES

1. United States Geological Survey, “Land Subsidence Due to Groundwater Withdrawal, Arvin-Maricopa Area, California”, Professional Paper 437-D (1975).

2. United States Department of the Interior, “Geology and Groundwater Features of the Edison-Maricopa Area, Kern County, California”, by P.R. Wood and R.H. Dale (1964).

3. “The California Water Plan Update”, Bulletin 160-98 (1998).

4. Arvin-Water Storage District, “Water Conservation Plan”, Kern County, California (1995).

5. Arvin-Edison Water Storage District, “Organization of Existing Groundwater Management Activities Under California Water Code Sections 10750 Et. Seq. (AB 3030)”, Bookman Edmonston Engineering, Inc., (1996).

6. Arvin-Edison Water Storage District, Kern County, California, “Report of District Operations for December 2002”.

7. “Use of Groundwater Reservoirs for Storage of Surface Water in the San Joaquin Valley, California”, by G.H Davis, B.E. Lofgren and Seymour Mack (1964).

8. State Water Resources Control Board, “Water Quality Control Plan, Tulare Lake Basin (5D)”, California, (1975).

Tables

TABLE 1

ARVIN-EDISON WATER STORAGE DISTRICT

IMPORTED SURFACE WATER BY SOURCE

(VALUES IN ACRE-FEET)

WATER YEAR	FRIANT-KERN CANAL CLASS I (1)	CLASS II (2)	OTHER (3)	TOTAL	KERN RIVER (4)	CALIF. AQUEDUCT	FARM WELLS (5)	TOTAL RECEIVED
1966	39,008	0	0	39,008	0	0	0	39,008
1967	26,884	56,967	0	83,851	0	0	0	83,851
1968	37,720	5,417	0	43,137	17,878	0	0	61,015
1969	17,884	181,055	0	198,939	1,057	0	0	199,996
1970	43,000	86,796	0	129,796	1,968	0	0	131,764
1971	43,933	102,820	0	146,753	0	0	0	146,753
1972	40,067	12,053	0	52,120	1,300	0	0	53,420
1973	46,996	130,609	0	177,605	3,985	0	0	181,590
1974	32,732	148,490	0	181,222	18,623	0	0	199,845
1975	35,666	146,076	0	181,742	17,325	3,597	0	202,664
1976	10,501	1,688	0	12,189	0	96,588	0	108,777
1977	2,351	0	0	2,351	400	28,812	0	31,563
1978	51,834	109,469	0	161,303	7,688	13,925	0	182,916
1979	19,268	82,701	0	101,969	0	123,973	0	225,942
1980	61,676	153,088	0	214,764	9,329	0	0	224,093
1981	21,607	8,246	0	29,853	696	141,590	0	172,139
1982	26,930	207,074	0	234,004	0	0	0	234,004
1983	45,818	120,398	0	166,216	16,109	0	0	182,325
1984	20,191	20,779	0	40,970	17,621	108,041	0	166,632
1985	22,449	0	0	22,449	5,645	130,117	0	158,211
1986	13,695	180,968	0	194,663	15,513	3,948	0	214,124
1987	11,742	0	0	11,742	0	114,222	0	125,964
1988	3,575	0	0	3,575	2,495	108,087	0	114,157
1989	920	81	0	1,001	0	118,679	0	119,680
1990	4,864	0	0	4,864	0	55,378	0	60,242
1991	17,510	0	0	17,510	0	19,285	0	36,795
1992	17,106	6,181	0	23,287	2,035	39,436	1,284	66,042
1993	40,000	150,734	0	190,734	8,821	61,292	0	260,847
1994	18,364	19,275	0	37,639	1,200	50,963	0	89,802
1995	1,213	215,171	32,685	249,069	9,802	23,696	0	282,567
1996	18,865	103,193	49,969	172,027	47,323	12,481	0	231,831
1997	33,265	117,410	25,990	176,665	68,772	12,795	0	258,232
1998	22,746	401	96,859	120,006	81,548	11,643	0	213,197
1999	9,960	37,473	22,078	69,511	37,588	144,243	0	251,342
2000	15,741	77,126	13,978	106,845	1,973	148,389	0	257,207
2001	24,028	6,038	2,720	32,786	662	13,602	156	47,206
2002	29,335	12,370	856	42,561	2,847	53,593	0	99,001
TOTAL	929,444	2,500,147	245,135	3,674,726	400,203	1,638,375	1,440	5,714,744
AVG	25,120	67,572	6,625	99,317	10,816	58,513	39	168,686

5/5/03

SUMMARIES/impsource.xls

NOTES: THE WATER YEAR IS MARCH THROUGH FEBRUARY OF THE FOLLOWING YEAR

(1) DISTRICT'S FRIANT-KERN CLASS 1 SUPPLY TAKEN IN-DISTRICT

(2) FRIANT-KERN CLASS 2 SUPPLY TAKEN IN-DISTRICT

(3) OTHER FRIANT-KERN SUPPLIES SUCH AS SECTION 215 AND FLOOD RELEASE PLUS PURCHASES AND EXCHANGES.

(4) CONSISTS PRIMARILY OF REREGULATED F-K SUPPLIES DELIVERED BY EXCHANGE PLUS MINOR QUANTITIES OF PURCHASES OF KERN RIVER SUPPLY (<3,000 AF/YR AVERAGE)

TABLE 2

ARVIN-EDISON WATER STORAGE DISTRICT

A 10 YEAR SUMMARY OF LAND USE (1993 - 2002)

LAND USE *(1) *(2)	1993	1994	1995*(3)	1996	1997	1998	1999	2000	2001	2002
Field Crops										
Cotton	12,619	12,171	14,176	15,535	12,974	7,764	6,660	7,132	8,661	5,771
Milo & Field Corn	96	0	103	354	410	709	371	97	373	578
Other Field Crops	673	449	0	0	130	217	842	1,264	1,981	60
Truck Crops										
Potatoes	16,383	16,379	15,302	19,224	15,728	19,808	13,356	16,111	16,423	19,788
Other Truck Crops	14,497	14,036	15,673	16,701	12,660	13,692	15,521	14,504	14,624	15,580
Grain & Hay Crops	4,556	4,568	6,100	6,551	6,015	6,791	11,060	10,096	8,992	7,228
Pasture	1,276	1,759	1,987	2,010	2,252	2,142	2,552	2,394	1,825	1,484
Vineyards	22,835	23,157	25,251	26,913	27,928	28,447	29,784	29,783	29,886	30,081
Deciduous Orchard	10,959	11,106	11,678	11,515	11,786	11,799	11,799	10,339	10,812	10,705
Citrus	11,657	11,805	12,430	12,504	13,223	13,477	14,416	14,186	14,274	14,172
Subtotal	95,551	95,430	102,700	111,307	103,106	104,846	106,361	105,906	107,851	105,447
Fallow *(4)	7,236	7,290	7,544	5,062	11,151	4,384	7,226	7,622	5,496	7,764
Total Irrigated Acres	102,787	102,720	110,244	116,369	114,257	109,230	113,587	113,528	113,347	113,211
Semi-Incidental To Agricultural	1,813	1,722	2,003	1,697	1,955	1,791	1,126	1,326	1,474	1,474
Urban	12,343	12,418	7,050	6,626	7,745	9,503	7,260	7,119	7,153	7,153
Non-Irrigated Crops	4,606	3,951	3,668	2,972	586	4,738	1,172	652	507	671
Abandoned Orchards/Vineyards	0	0	0	0	77	26	26	26	26	27
Idle Land *(5)	2,431	3,459	1,732	66	284	256	316	226	319	333
Native Classes	7,680	7,390	6,963	3,930	6,756	6,116	8,173	8,783	8,834	8,791
Total Non-Irrigated Acres	28,873	28,940	21,416	15,291	17,403	22,430	18,073	18,132	18,313	18,449
Total District Acreage	131,660	131,660	131,660	131,660	131,660	131,660	131,660	131,660	131,660	131,660

*(1) Standard Land Use Legend as prepared by DWR, July 1993
*(2) Land Use is surveyed during the Spring of each year
*(3) Land Use survey completed in July
*(4) Land is tilled at time of survey but current crop not identified
*(5) Land cropped within the past three years but not tilled at time of survey

10yrcrop 5/5/03

TABLE 3
OTHER AGENCIES AND PROGRAMS
RELATED TO GROUNDWATER MANAGEMENT IN
ARVIN-EDISON WATER STORAGE DISTRICT

Agency Name	ADDRESS	ROLES RELATED TO GROUNDWATER MANAGEMENT
United States Geological Survey	Placer Hall, 6000 J Street Sacramento, CA. 95819-6129	Made and periodically updates ground surface topographic maps Have done selected geologic and hydrogeologic investigations in the past Maintains cooperative programs to monitor land surface subsidence
United States Bureau of Reclamation	1243 N Street, Fresno, CA. 93721	Built and operates Central Valley Project (source of AEWSD water) Maps groundwater levels in CVP service area (shares data with AEWSD) Adminstered AEWSD's original PL 204 loan / partnership Prepared annual water supply reports for the Friant unit until 1991
Environmental Protection Agency	P.O. Box 2815, 1001 I Street, Sacramento, CA. 95814	Establishes national drinking water standards & water quality objectives Administers grant and loan programs for water and wastewater treatment Administers superfund program for hazardous waste cleanup
Department of Water Resources	901 "P" Street, Sacramento, CA. 94236	Built and operates State Water Project (includes California Aqueduct) Prepared and updates State Water Plan (Bulletin 160) every 5 years Prepares bi-annual groundwater level maps of San Joaquin Valley (SJV) Oversees coordinated groundwater level monitoring programs Has done selected groundwater quality testing and mapping in SJV Promulgate State Well Drilling standards Reviewed AB-3030 plans prepared by various agencies and reported to Legislature Prepared recommendations for AB-3030 plans subject to SB-1938 Administers Grant and Loan programs for groundwater recharge and storage projects Have participated in special studies of groundwater and subsidence in the SJV
San Joaquin Valley Regional Water Quality Control Board	1685 "E" Street, Fresno, CA. 93706-2020	Regulate the discharge of waste to streams and land Administers inland surface waters plan
State Water Resources Control Board	P.O.Box 100, Sacramento, CA. 95812	Oversees Regional Water Quality Control Boards Administers grant and loan programs for pollution control
California Department of Health Services	P.O.Box 942732, Fresno, CA. 94234-7320	Promulgates State drinking water standards Regulates drinking water supplies for larger communities and cities
Kern County Water Agency	3200 Rio Mirada Dr., Bakersfield, CA. 93302	Obtains water supplies for member units (AEWSD is not a member unit) Operates Cross Valley Canal Operates Improvement District No. 4 Prepares Annual Water Supply Report for Kern County area Shares groundwater level and quality data with AEWSD Conducts special studies related to water supply and groundwater in Kern County Administers Aqueduct pump-in programs in Kern County
Improvement District No. 4	3200 Rio Mirada Dr., Bakersfield, CA. 93302	Provides treated water supply to the greater Bakersfield area Prepares annual report: "Report on Water Conditions"
Cross Valley Canal Advisory Committee	3200 Rio Mirada Dr., Bakersfield, CA. 93302	Represents Cross Valley Canal contractors
Friant Water Users Authority	854 Harvard Ave., Lindsey, CA. 93247	Operates and maintains Friant unit of Central Valley Project (primary supply for AEWSD)
Metropolitan Water District	P.O Box 54153, Los Angeles, CA 90054	MWDSC stores SWP waters in the AEWSD banking facilities for later return
Kern County Department of Environmental Health	2700 "M" Street, Bakersfield, CA. 93301	Administers well drilling and well destruction permits program for all wells Regulates drinking water for small communities, individual dwellings, and businesses
Wheeler Ridge-Maricopa Water Storage District	P.O. Box 9429 Bakersfield, CA. 93389	Overlaps south, southwest and southeast of the southern most areas of AEWSD Provides water supplies to agricultural customers Cooperative groundwater level monitoring between Districts. Extraction of groundwater from the White Wolf basin and is therefore a party impacted by AEWSD's water management activities
Mettler County Water District	1822 Stevens Drive, Mettler, CA. 93313	Overlaps the southwestern portion of AEWSD Provides water to the community of Mettler Provides wastewater collection & treatment
Arvin Community Services District	141 Plumtree Drive, Arvin, CA. 93203	Borders and overlaps the central west boundary of AEWSD Provides water to the community of Arvin Provides wastewater collection & treatment
East Niles Community Services District	1417 Vale Street, Bakersfield, CA. 93306	Borders and overlaps the northwest boundary of AEWSD Relies on groundwater in order to supply its 4,600 acres Provides water to the community of East Niles
City of Bakersfield	1000 Buena Vista Road, Bakersfield, CA. 93311	Borders northeast boundary of AEWSD Supplies water to Cal Water Service who supples to the Bakersfield area Provides wastewater collection & treatment
Kern Delta Water District	501 Taft Highway, Bakersfield, CA. 93307	Borders the eastern boundary of AEWSD Provides water supplies to agricultural customers KDWD canals are intertied with the AEWSD intake canal to facilitate water exchanges
Lamont Public Utility District	8624 Segrue Road, Lamont CA. 93241	Overlaps and borders the east central area of AEWSD Provides water to community of Lamont Provides wastewater collection & treatment

TABLE 4
ARVIN-EDISON WATER STORAGE DISTRICT
GROUNDWATER MANAGEMENT PLAN
SUMMARY OF CURRENT GROUNDWATER MONITORING ACTIVITIES

Water-Level Monitoring	Wells or Area Tested/ Studied/ Used	Methods/ Procedures Used	Recipient of Data	Recipient of Finished Data	Frequency
Select Private and some District Wells	USBR determines 183 select wells to be read bi-annually	Powers well sounder or Acoustic well sounder; USBR provides schedule, reference points and elevations	DWR, USBR, KCWA & SAIC	SAIC prepares groundwater level maps for Staff and Board review	Bi-annually; in the Spring and Fall (Jan-Feb & Oct-Nov)
District Production Wells	All District wells are read monthly before, during and after pumping	Readings made via meter on Airline; record time and date for every well. Utilize sounding tube on concrete slab at ground level for reference point	District Staff only	District Staff tabulates and reports to Board monthly	Monthly
District Monitoring Wells	1 well at Sycamore & 1 well at North Canal are read monthly	Powers well sounder or Acoustic well sounder	District Staff only	District Staff tabulates and reports to Board monthly	Monthly
Water-Level Data Management					
Elevations Map of water in wells	Selected Private and some District	SAIC prepares	District Staff only	District Staff reports to Board monthly	Annually
Map of depth to water in wells	Selected Private and some District	SAIC prepares	District Staff only	District Staff reports to Board monthly	Annually
Map change in water level in wells	Selected Private and some District	SAIC prepares	District Staff only	District Staff reports to Board monthly	Annually
Hydrographs					
	Sycamore monitoring well	District Staff prepares	District Staff only	District Staff reports to Board monthly	Monthly
	Groundwater Cost Study	SAIC prepares	District Staff only	District Staff reports to Board annually	Annually
	District Average Standing Water Level	SAIC prepares	District Staff only	District Staff reports to Board annually	Annually
	Average Standing Water Level for 3 Subareas	SAIC prepares	District Staff only	District Staff reports to Board annually	Annually
Well Water Flow Measurements					
District Production Wells	All District Production wells	District Staff reads totalizer on propeller flow meters	District Staff only	District Staff reports to Board monthly & annually	Daily
Private Wells	None measured	SAIC estimates pumpage through hydrologic inventory	District Staff only	District Staff reports to Board annually	Annually
Recharge Water Measurements					
Gross deliveries to spreading basins	All turnouts to Spreading Basins	Staff reads totalizers on propeller flow meters or staff averages weir level measurements	District Staff only	District Staff reports to Board monthly & annually	Daily
Evaporation Loss	All Spreading Basins	District Staff estimates using CIMIS ETO	District Staff only	District Staff reports to Board monthly & annually	Daily
Hydrologic Inventory	District wide and 3 areas of District separated by Faults	Volume balance calculations to estimate pre and post-project average groundwater levels	SAIC (Stan Powell)	Staff reports to Board annually	Annually
Evaluation of Groundwater Conditions and Determination of Groundwater Production Costs	Surface water service area and non-service area	SAIC estimates groundwater pumping costs based upon average groundwater levels and typical capital, O&M, electricity, natural gas and diesel costs	District Staff only	District Staff reports to Board annually	Annually
Groundwater Modeling	District wide and 3 areas of District separated by Faults	B-E prepared Modflow groundwater model	District Staff	Staff reported to Board and MWD	One time program in late 1980's

Water Quality		Environmental Sampling Procedures Used	Constituents	Standards	Data Formulated	Laboratories Used	
District Production wells and select private wells	25 representative wells sampled, 31 target wells & 23 alternative wells sampled at the North Canal and the Sycamore, Tejon and North Canal Spreading Basins (a comprehensive survey is conducted every 5 years)	Samples obtained in plastic bottles and placed in cooler with ice; Samples obtained upstream from point source and 10 minutes after initial pumping; Samples refrigerated and returned to lab within 48 hours	Ca, B, Mg, Na, HCO_3^-, Cl, TDS, pH, EC, Hardness, SAR, Gypsum	Irrigation Water Analysis	Graphs & Charts (water quality trends)	B.C. Laboratories, Zalco Laboratories and Oilwell Research, Inc	Annually (every Summer)
Canal Water Quality	North Canal, Intake Canal and South Canal		Ca, B, Mg, Na, HCO_3^-, Cl, TDS, pH, EC, Hardness, SAR, Gypsum	Irrigation Water Analysis	Water Quality Summary	B.C. Laboratories and Zalco Laboratories	Monthly
Aqueduct Pump-in Wells	All well manifold and Intertie Pipeline		As, Br, Cr, Cr^{+}_{6}, NO_3, TDS, DOC, TOC, SO_4, U	Title 22, COC	Blending Model (graphs provided upon request). COCs on CD	B.C. Laboratories and Zalco Laboratories	COC performed annually; Title 22 performed every three years

Note:
1). Every 5 to 10 years the District attempts to document and inventory all wells
2). Record keeping of driller's logs since 1960s

TABLE 5

ARVIN-EDISON WATER STORAGE DISTRICT

Recent Water Analysis Data

Well Field	Sources	Date of Analysis	As (µg/L)	Br (mg/L)	Cr (µg/L)	Cr^{+6} (µg/L)	NO_3 (mg/L)	TDS (mg/L)	DOC (mg/L)	TOC (mg/L)	SO_4 (mg/L)	U (pCi/L)
			Constituents of Concern									
SOURCES	Initial (background)		4	0.067	5.8		3.2	186.2	*1.0*	1.0	15.7	1.2
	F-K		**2**	0.071	**1**	**0.1**	1.8	40	*2.2*	2.2	1	0.6
	CVC	12/25/02	2	0.290	1	0.1	2.9	349	6	*6*	43	0.8
	KR	1/7/03	7	0.064	1	0.1	1	120	*2.4*	2.4	21.8	1.4
	N1 Balancing Ponds	3/17/10	2	0.071	1	0.1	1.8	40	2.2	2.2	1	2
North Canal	AEN-1	6/26/01	9	0.200	**10**		21.7	447	*1*	**1**	83	3.6
	AEN-2	6/26/01	11	0.300	**10**		89.4	783	*1*	**1**	242	6.8
	AEN-3	6/26/01	5	0.300	**10**		58	560	*1*	**1**	80	4.3
	AEN-4	6/26/01	8	0.300	**10**		47.8	603	*1*	**1**	163	3.9
	AEN-5	6/26/01	4	0.200	**10**		52.7	533	*1*	**1**	99	6.6
	AEN-6,7,14	6/26/01	30	0.100	**10**		11.5	300	*1*	**1**	43	2.1
	AEN-8,9,10,11,12	6/26/01	48	**0.100**	**10**		1.6	210	*1*	**1**	27	0.0
	AEN-13	6/26/01	2	**0.100**	**10**		0.4	246	*1*	**1**	7.4	0.0
Sycamore	AE-35,36,37	6/28/01	9	**0.100**	**10**		0.71	190	*1*	**1**	22	2.0
	AE-31,32,33,34	2/3/03	4	0.110	4	3	3.3	230	**1**	**1**	28	*1.4*
	AE-16	1/21/03	4	0.095	11	10.8	6.5	260	**1**	**1**	21	*2.7*
	AE-17,18,28,29	2/3/03	**2**	0.016	1	0.7	1.3	230	1.9	1.8	7	*2.3*
	AE-15	1/21/03	5	0.053	6	5.1	2.9	220	**1**	**1**	19	*2.2*
	AE-13,14,25,26	6/28/01	8	**0.100**	**10**		2.3	145	*1*	**1**	13	0.7
	AE-12	2/3/03	17	0.047	9	9.7	1.1	200	**1**	**1**	23	*1.9*
	AE-10,11,23,24		*6*	*0.100*	*10*		*12.0*	*202*	*1*	*1*	*19.0*	*2.7*
	AE-9	2/3/03	3	0.054	8	7.8	3	200	**1**	**1**	20	*2.7*
	AE-8	2/3/03	2	0.046	6	4.8	2.5	200	**1**	**1**	17	*1.8*
	AE-6,7,22	2/3/03	3	0.043	5	4.8	1.1	169	**1**	**1**	11.0	*2.0*
	AE-4	2/3/03	**2**	0.061	4	3	2.2	180	**1**	**1**	14	*0.7*
	AE-1,2,5,20,21	2/3/03	3	0.036	2	2.3	1.3	140	**1**	**1**	10	*1.1*
Tejon	AE-78,79,84	2/4/03	**2**	0.065	5	3.5	1.1	180	0.5	0.5	15	*0.6*
	AE-73	2/4/03	**2**	0.100	4	2.8	1.5	260	**1**	0.5	24	*0.8*
	AE-77,81,82,83	2/4/03	3	0.046	3	3	1	160	0.9	1	12	*0.8*
	AE-92,93,94,95,96	6/25/01	3	**0.100**	**10**		5.9	165	***1***	**1**	15	0.5
	AE-72	2/4/03	**2**	0.078	5	3.6	2.4	240	**1**	**1**	26	*1.1*
	AE-76	2/4/03	**2**	0.050	4	3.1	0.7	200	**1**	**1**	13	*0.9*
	AE-71	2/4/03	**2**	0.057	4	3.1	2.2	250	**1**	**1**	21	*1.2*
	AE-74,75,80	2/4/03	3	0.047	3	2.7	1	160	**1**	**1**	12	*1.2*
	AE-90,91	2/4/03	*3*	*0.047*	*3*	*2.7*	*1*	*160*	***1***	***1***	*12*	*1.2*
	AE-86	2/4/03	**2**	0.035	3	1.4	3.6	200	**1**	**1**	12	*0.4*
	AE-87	2/4/03	**2**	0.068	6	4.9	3.1	280	**1**	**1**	26	*0.9*
	AE-89	2/4/03	**2**	0.091	9	8.3	3.4	320	**1**	**1**	35	*0.6*
	AE-88	2/4/03	**2**	0.140	9	7.6	7.3	360	**1**	**1**	41	*0.8*

ITALICIZED NUMBERS INDICATE ESTIMATED FROM CLOSEST AVAILABLE ANALYSES.

BOLDED NUMBERS INDICATE "NONE-DETECTED" LAB RESULTS.

YELLOW CELL HIGHLIGHTING INDICATES RESULTS GREATER THAN THE CDHS MCL.

T/ E 6

ARVIN-EDISON WA STORAGE DISTRICT

CANAL WATER QUALITY SUMMARY

Canal	Date	Flow	Source	Calcium		Magnesium		Sodium		Bicarbonate		Chloride		TDS	pH	EC	Hardness	SAR	Gypsum	Boron
		cfs		mg/l	me/l	mg/l	me/l	mg/l	me/l	mg/l	me/l	mg/l	me/l	mg/l		umhos/cm	mg/l		lbs/AF	mg/l
Intake Canal	12/16/02	45	CVC	31.0	1.55	2.8	0.23	23.0	0.99	110	1.79	15.0	0.42	143	8.0	259	88	1.1	0	0.14
	11/05/02	110	F-K	3.4	0.17	0.6	0.05	3.8	0.16	20	0.33	2.0	0.06	21	8.0	50	11	0.5	22	< 0.10
	10/01/02	211	F-K/CVC	13.0	0.65	9.1	0.74	43.0	1.85	54	0.88	55.0	1.54	174	9.0	330	70	2.2	0	< 0.10
	09/10/02	265	F-K/CVC	16.0	0.80	12.0	0.98	63.0	2.71	39	0.63	92.0	2.58	247	9.0	472	92	2.8	0	0.11
	08/02/02	135	CVC	17.0	0.85	12.0	0.98	49.0	2.11	87	1.42	64.0	1.79	209	8.3	397	94	2.2	0	0.12
	07/10/02	350	CVC	19.0	0.95	12.0	0.98	40.0	1.72	97	1.58	49.0	1.37	202	7.4	390	95	2.5	0	0.16
	06/18/02	230	CVC	24.0	1.20	15.0	1.23	59.0	2.54	75	1.22	72.0	2.02	272	8.7	513	123	2.3	0	0.19
	05/13/02	150	F-K	10.0	0.50	1.1	0.09	14.0	0.60	26	0.42	9.8	0.28	68	8.9	125	29	1.2	49	< 0.10
	04/10/02	400	CVC	21.0	1.05	11.0	0.90	49.0	2.11	97	1.58	52.0	1.46	230	7.9	420	98	2.1	126	0.28
	03/19/02	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	02/15/02	50	F-K	5.2	0.26	0.7	0.05	3.0	0.13	21	0.10	3.4	0.10	20	6.2	50	16	0.3	83.0	< 0.10
	01/10/02	35	F-K	8.2	0.41	0.6	0.05	<7.0	0.00	24	0.40	2.1	0.06	30	5.8	50	23	0.0	0.0	< 0.10
	Average			**15.3**	**0.76**	**7.0**	**0.57**	**34.7**	**1.36**	**59**	**0.94**	**37.8**	**1.06**	**147**	**7.9**	**278**	**67**	**1.6**	**25**	**0.11**
North Canal	12/16/02	30	CVC	14.0	0.70	1.8	0.15	9.7	0.42	56	0.91	6.0	0.17	69	7.5	128	43	0.6	11	< 0.10
	11/05/02	47	F-K	3.5	0.18	0.7	0.06	3.5	0.15	20	0.33	1.8	0.05	21	7.7	45	12	0.5	22	< 0.10
	10/01/02	51	F-K/CVC	11.0	0.55	7.7	0.63	37.0	1.59	53	0.86	46.0	1.29	147	8.8	290	59	2.1	0	< 0.10
	09/10/02	180	F-K/CVC	17.0	0.85	14.0	1.15	71.0	3.06	71	1.16	113.0	3.17	287	8.7	563	99	3.1	0	0.11
	08/02/02	36	Wells/CVC	21.0	1.05	5.0	0.41	34.0	1.47	97	1.58	13.0	0.37	156	8.3	276	74	1.7	125	0.12
	07/10/02	215	Wells/CVC	17.0	0.85	9.3	0.77	34.0	1.47	93	1.51	36.0	1.01	172	7.9	340	82	2.1	0	0.15
	06/18/02	85	Wells/CVC	24.0	1.20	9.6	0.79	48.0	2.07	97	1.58	37.0	1.04	242	8.6	367	99	2.1	22	0.23
	05/13/02	60	Wells/F-K	17.0	0.85	4.2	0.34	40.0	1.72	110	1.79	15.0	0.42	162	8.5	295	60	2.3	196	0.28
	04/10/02	180	CVC	20.0	1.00	10.0	0.82	60.0	2.63	120	1.99	51.0	1.45	250	7.8	420	91	2.8	480	0.45
	03/19/02	101	Wells	21.0	1.05	4.8	0.39	22.0	0.95	110	1.73	14.0	0.40	180	7.6*	250	72	1.1	0	< 0.10
	02/15/02	96	Wells/F-K	19.0	0.95	3.4	0.28	28.0	1.22	100	1.67	15.0	0.43	150	7.2	250	61	1.6	263	< 0.10
	01/10/02	17	F-K	13.0	0.63	0.8	0.06	<7.0	0.00	37	0.61	3.6	0.10	20	6.1	70	35	0.0	0	< 0.10
	Average			**16.5**	**0.82**	**5.9**	**0.49**	**35.2**	**1.40**	**80**	**1.31**	**29.3**	**0.83**	**155**	**7.9**	**275**	**66**	**1.7**	**93**	**0.13**
South Canal	12/16/02	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	11/05/02	25	F-K	3.9	0.20	0.7	0.06	3.7	0.16	21	0.34	2.0	0.06	22	8.0	46	13	0.5	22	< 0.10
	10/01/02	35	F-K/CVC	14.0	0.70	9.9	0.81	48.0	2.07	50	0.81	67.0	1.88	194	9.2	361	75	2.4	0	< 0.10
	09/10/02	60	F-K/CVC	20.0	1.00	13.0	1.06	72.0	3.10	42	0.68	111.0	3.12	287	9.0	560	104	3.1	0	0.12
	08/02/02	106	Wells/CVC	28.0	1.40	9.5	0.78	36.0	1.59	140	2.22	16.0	0.46	195	8.2	349	109	1.5	93	0.14
	07/10/02	115	Wells/CVC	22.0	1.10	9.6	0.79	34.0	1.46	130	2.12	27.0	0.76	187	8.1	350	93	1.5	1	0.14
	06/18/02	104	Wells/CVC	25.0	1.25	9.0	0.74	39.0	1.68	110	1.79	22.0	0.62	201	8.5	414	99	1.7	60	0.18
	05/13/02	70	Wells/F-K	23.0	1.15	6.7	0.55	35.0	1.51	110	1.79	14.0	0.39	168	8.4	309	84	1.7	103	0.15
	04/10/02	90	CVC	23.0	1.15	12.0	0.99	51.0	2.23	63	1.03	56.0	1.59	270	8.4	440	110	2.2	94	0.34
	03/19/02	87	Wells	23.0	1.10	7.8	0.64	34.0	1.47	140	2.33	16.0	0.45	220	8.0*	330	90	1.6	40	< 0.10
	02/15/02	114	Wells/F-K	22.0	1.10	6.3	0.52	26.0	1.15	120	2.00	14.0	0.40	180	6.9	280	81	1.3	12	< 0.10
	01/10/02	5	F-K	14.0	0.69	0.9	0.08	<7.0	0.00	43	0.70	3.1	0.09	40	6.0	80	38	0.0	0	< 0.10
	Average			**19.8**	**0.99**	**7.8**	**0.64**	**37.9**	**1.49**	**88**	**1.44**	**31.6**	**0.89**	**179**	**8.1**	**320**	**81**	**1.6**	**39**	**0.12**

pH* field results

Table 7
Land Surface Elevation Measurements
Along the California Aqueduct in Southern Kern County

From DWR survey of California Aqueduct from Kettleman City to Edmonston Pumping Plant
DWR uses a National Geodetic Vertical Datum of 1929 (NGVD 1929). The is the datum at which the California Aqueduct was built.

Elevation A is the structure
Elevation B is the top of the canal lining
Elevation C is the fence right of way

Elevations are in feet

Structure	Mile Post	1967 and 1969 Survey			1993 Survey			2000 Survey			Difference from 1967 to 2000		
		Elevation A	Elevation B	Elevation C	Elevation A	Elevation B	Elevation C	Elevation A	Elevation B	Elevation C	Elevation A	Elevation B	Elevation C
Check 25	217.79	311.07	308.35	298.54	310.53	307.85	n/a	310.38	307.69	n/a	-0.70	-0.65	n/a
Check 26	224.92	309.01	306.24	300.92	308.70	305.62	n/a	308.54	305.32	n/a	-0.48	-0.91	n/a
Check 27	231.73	307.38	304.68	300.24	307.40	304.69	300.28	307.29	304.58	300.17	-0.09	-0.10	-0.07
Check 28	238.11	303.58	300.64	299.63	303.70	300.68	299.72	303.54	300.51	n/a	-0.05	-0.12	0.09 **
Check 29	244.54	303.29	300.29	n/a	303.48	300.60	n/a	303.48	300.60	n/a	0.19	0.31	n/a
Buena Vista PP - 30	250.99	n/a	303.27	n/a	n/a	303.53	n/a	n/a	303.55	n/a	n/a	0.29	n/a
Check 31	256.14	506.62	503.96	n/a	n/a	504.14	n/a	n/a	504.07	n/a	n/a	0.10	n/a
Check 32	261.72	506.57	502.86	499.61	506.49	502.76	n/a	506.42	502.66	n/a	-0.15	-0.19	n/a
Check 33	267.39	504.82	n/a	498.36	505.15	n/a	498.92	505.14	n/a	n/a	0.31	n/a	0.56 **
Check 34	271.27	503.65	n/a	493.87	502.84	n/a	n/a	502.80	n/a	n/a	-0.85	n/a	n/a
	275.56	511.79	500.41	487.18	509.84	498.68	n/a	509.51	498.37	n/a	-2.28	-2.04	n/a
	276.71	501.21	500.18	485.92	500.88	499.89	486.20	500.76	499.77	n/a	-0.45	-0.42	n/a
Teerink PP - 35	278.13	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	278.40	n/a	731.06	n/a	n/a	731.32	n/a	n/a	731.19	n/a	n/a	0.13	n/a
Chrisman PP - 36	280.36	n/a	731.92	n/a	n/a	732.34	n/a	n/a	732.22	n/a	n/a	0.31	n/a
	280.74	1251.65	n/a	1251.10	1252.10	n/a	1251.56	1252.00	n/a	n/a	0.36	n/a	0.46
	281.16	1254.35	1246.88	n/a	1254.71	1247.31	n/a	1254.61	1247.22	n/a	0.26	0.34	n/a
	281.78	1255.47	1246.74	1235.35	1255.72	1247.00	n/a	1255.60	1246.89	n/a	0.12	0.15	n/a
	282.44	1255.50	1246.54	1251.04	1255.55	1246.96	1251.47	1255.45	1246.88	n/a	-0.05	0.33	0.43
Check 37	283.95	1248.89	1246.36	1232.43	1249.20	1246.86	n/a	1249.13	1246.79	n/a	0.24	0.43	n/a
	285.99	1244.28	1243.75	1233.31	1244.80	1244.27	n/a	1244.73	1244.20	n/a	0.45	0.45	n/a
Check 38	287.09	1245.94	1243.48	n/a	1246.43	1244.05	n/a	1246.36	1243.98	n/a	0.42	0.50	n/a
	288.27	n/a	1243.16	1238.62	n/a	1243.75	1239.21	n/a	1243.70	1239.15	n/a	0.54	0.59
	289.94	1251.89	1242.69	1238.58	1252.49	1243.31	n/a	1252.45	1243.27	n/a	0.56	0.59	n/a
Check 39	290.21	1245.03	1242.59	1231.82	1245.65	1243.22	1232.50	1245.63	1243.19	n/a	0.59	0.60	0.69
	290.34	1251.06	1242.59	1229.75	1251.63	1243.10	n/a	1251.59	1243.06	n/a	0.52	0.47	n/a
	291.19	1251.08	1242.30	1238.83	1251.72	1242.95	n/a	1251.69	1242.92	n/a	0.61	0.63	n/a
	292.11	1247.90	1242.17	1225.14	1248.54	1242.82	n/a	1248.53	1242.81	n/a	0.63	0.64	n/a
	293.07	n/a	1241.63	1243.39	n/a	1242.36	1244.08	n/a	1242.37	1244.07	n/a	0.74	0.68
Edmonston PP - 40	293.45	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Area Closest to AEWSD

Area Closest to AEWSD

**data compared from 1993 to 1969

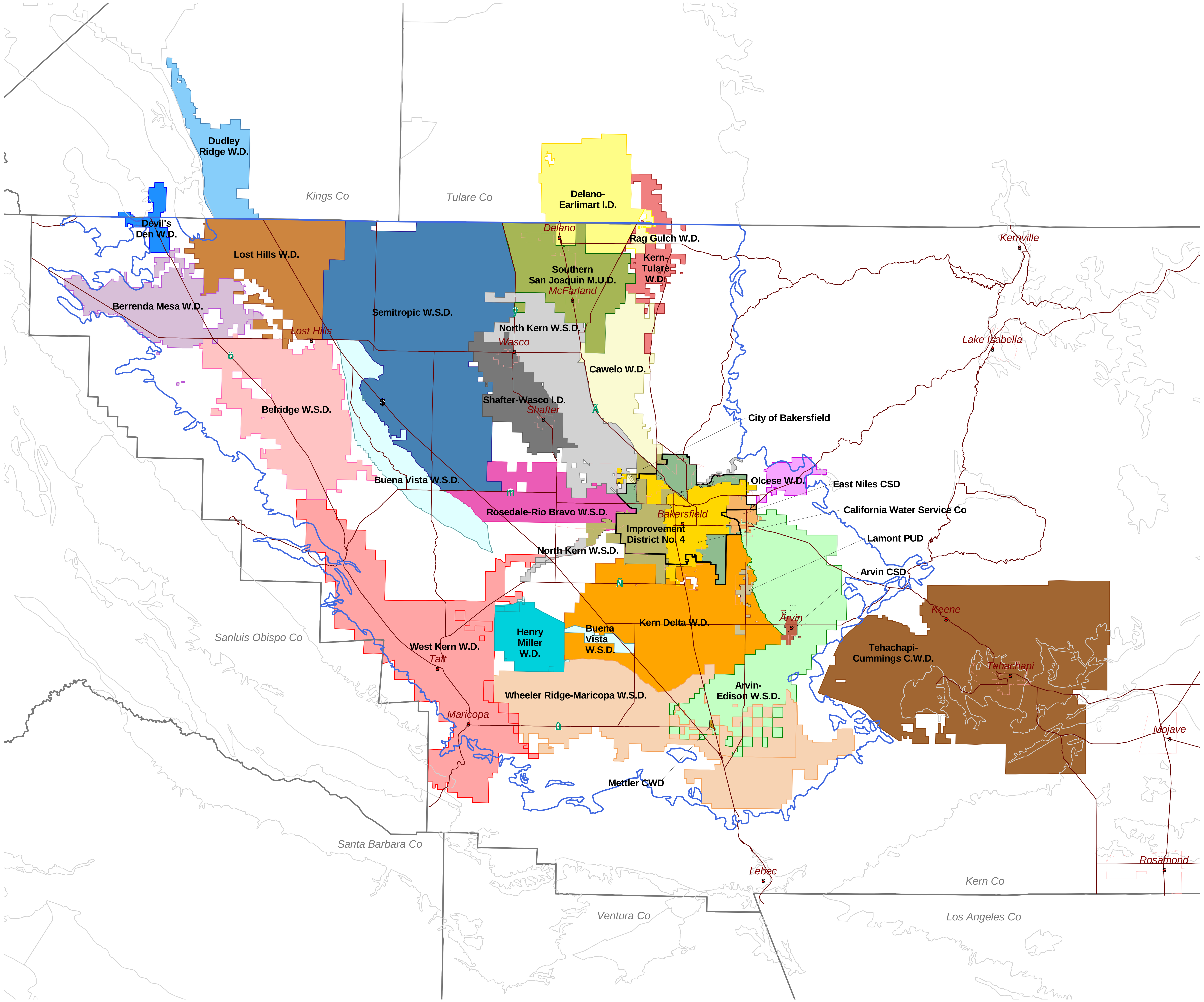
5/5/2003

Table 8
Arvin-Edison Water Storage District
Master Projects List (20 year horizon potential projects)

Project / Activity	Goal / Purpose	Notes	Funding Opportunities
Intake Canal			
Install More Radial Gates on Intake Canal	Improved flow regulation and delivery flexibility		
Construct Permanent Interties with KDWD Canals	Facilitate KDWD/MWD Program & exchanges with KDWD		
Construct Wells Along Intake Canal	Increase delivery capacity / facilitate exchanges with KDWD		
Reverse-flow Intake Canal	Facilitate exchanges		
Replace Faber Dam	Replace worn-out facility / conserve water		
Wasteway Water Recovery Project	Recover water lost to District		
Reverse-flow Forrest Frick Pumping Plant	Facilitate exchanges / power generation		
North Canal			
Expand Balancing Reservoir	Increase recharge capacity / improved flow regulation and delivery flexibility	High b/c ratio High yield	Prop. 13 GW Storage Construction Grant
Add Wells at Balancing Reservoir	Increase recovery capacity		Prop. 13 GW Storage Construction Grant
Add More Radial Gates to North Canal	Improved flow regulation and delivery flexibility	Gate at N. Canal Spreading Grounds is highest priority	
In-lieu Program (distribution to non-service area)	Groundwater storage program / revenue generation		Prop. 50 ?
Expand N. Canal Spreading Grounds	Increase recharge capacity	SW1/4 of Sec. 11?	
Expand Sycamore Spreading Grounds	Increase recharge capacity	Moderately High b/c ratio Moderately High yield	Prop. 13 GW Storage Construction Grant
South Canal			
Reverse-flow S. Canal (Tejon to Sycamore)	Increase recovery capacity / balance recharge & recovery		
In-lieu Program (distribution to non-service area)	Groundwater storage program / revenue generation	Deeper groundwater levels make this lower priority than in North	
Reverse-flow S. Canal (I-5 to Tejon S.A.) & Raise Liner	Reduce banking program costs from Aqueduct Increase recharge and recovery capacity		
Increase Spillway Basin Capacity	Improved flow regulation and delivery flexibility		
Interties with WRMWSD Facilities	Facilitate exchanges with WRMWSD	High cost for benefits	
Increase Capacity of Intertie to Aqueduct	Increase recharge / recovery / exchange capacity		
Global			
Complete and Adopt AB-3030 Plan	Secure position as groundwater management agency	Needed for State grants	
Market Water Management Services	Increase revenues / re-regulate supplies		
Flood Control Projects	Reduce flood damages to system and farms		
Power Supply Projects	Keep power costs down		

Figures

KERN GROUNDWATER BASIN and DISTRICT BOUNDARIES MAP for Arvin Edison Water Storage District Groundwater Management Plan



- Kern Groundwater Basin
- Bulletin 118 Groundwater Basins
- County Line

Water Purveyors
- Arvin CSD
- California Water Service Co
- City of Bakersfield
- East Niles CSD
- Lamont PUD
- Mettler CWD

Water Districts
- Arvin-Edison W.S.D.
- Belridge W.S.D.
- Berrenda Mesa W.D.
- Buena Vista W.S.D.
- Cawelo W.D.
- Delano-Earlimart I.D.
- Devil's Den W.D.
- Dudley Ridge W.D.
- Henry Miller W.D.
- Improvement District No. 4
- Kern Delta W.D.
- Kern-Tulare W.D.
- Lost Hills W.D.
- North Kern W.S.D.
- Olcese W.D.
- Rag Gulch W.D.
- Rosedale-Rio Bravo W.S.D.
- Semitropic W.S.D.
- Shafter-Wasco I.D.
- Southern San Joaquin M.U.D.
- Tehachapi-Cummings C.W.D.
- West Kern W.D.
- Wheeler Ridge-Maricopa W.S.D.

Note:
District boundaries are taken from a variety of public sources, and complete accuracy cannot be guaranteed

0 5 10 Miles

N

EST. 1968 PROVOST & PRITCHARD ENGINEERING GROUP

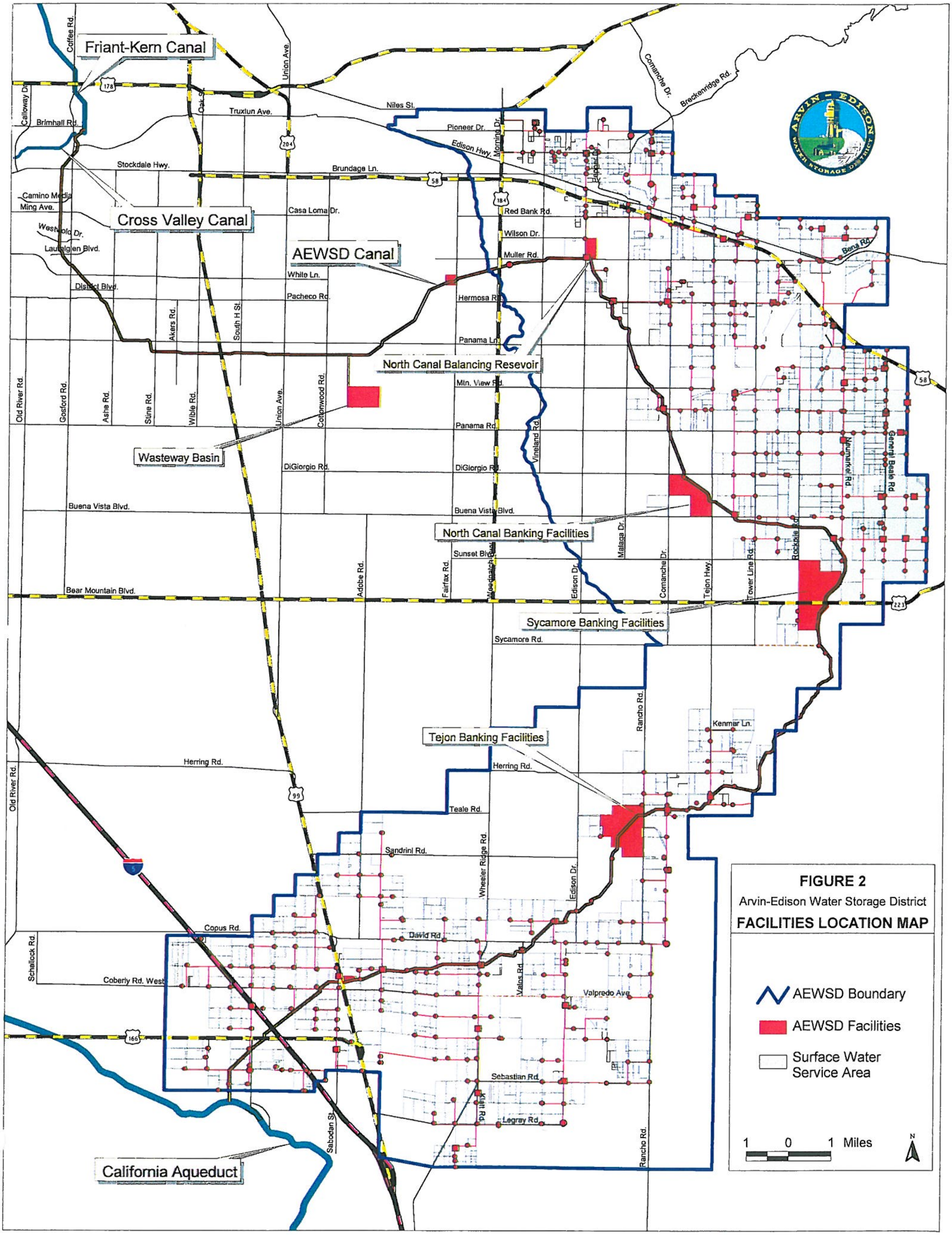


FIGURE 2

Arvin-Edison Water Storage District

FACILITIES LOCATION MAP

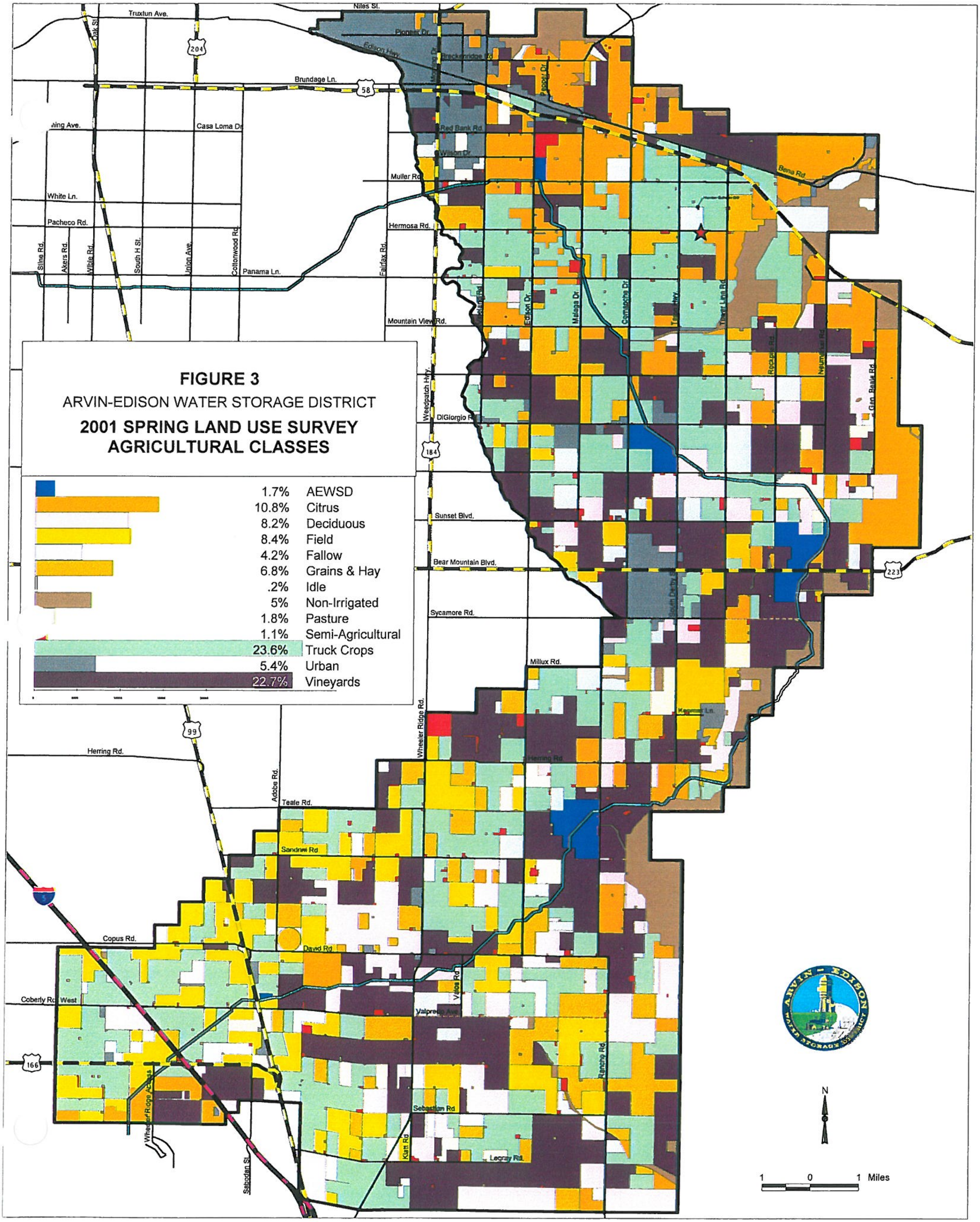


FIGURE 3
ARVIN-EDISON WATER STORAGE DISTRICT
2001 SPRING LAND USE SURVEY AGRICULTURAL CLASSES

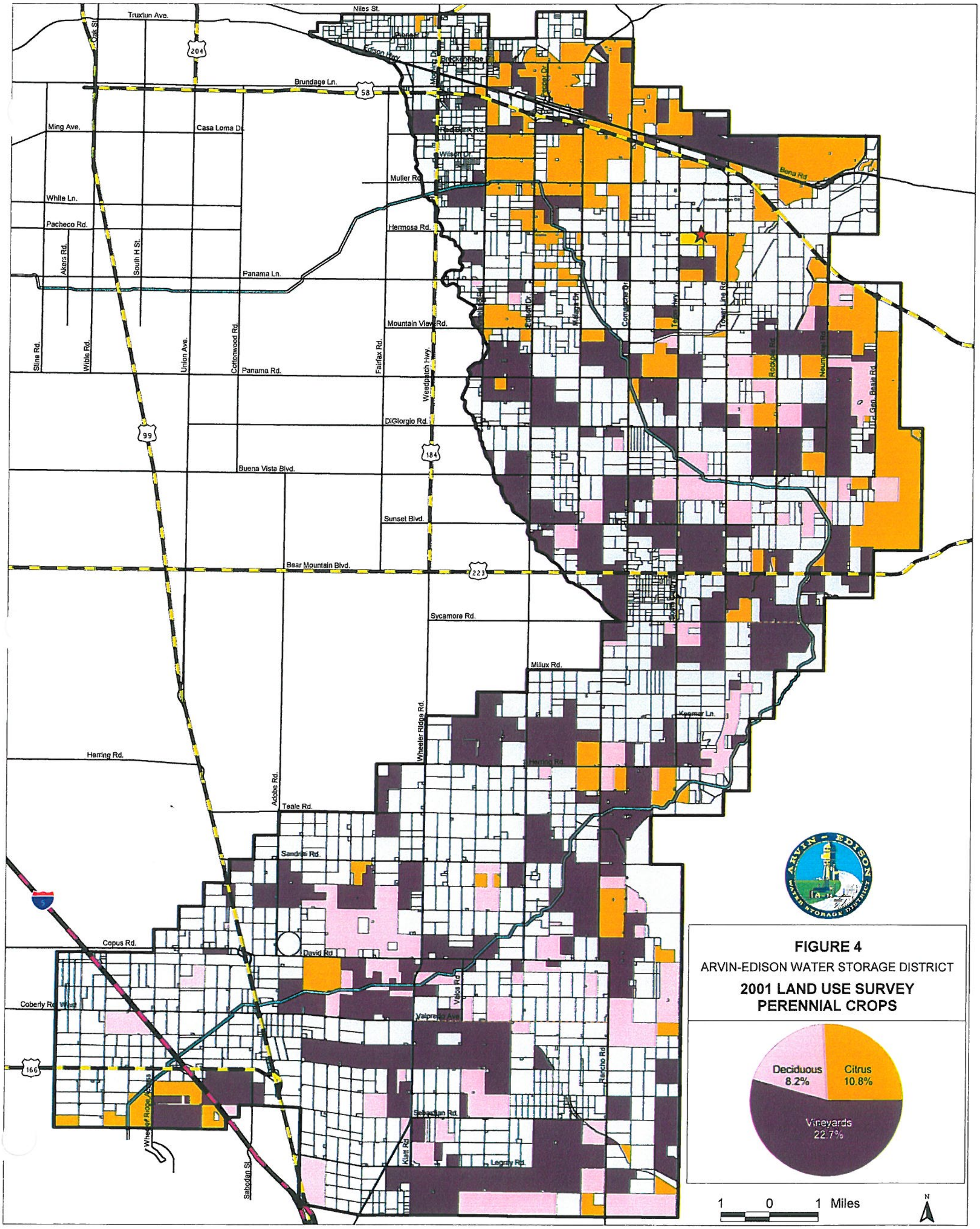


FIGURE 4

ARVIN-EDISON WATER STORAGE DISTRICT

2001 LAND USE SURVEY PERENNIAL CROPS

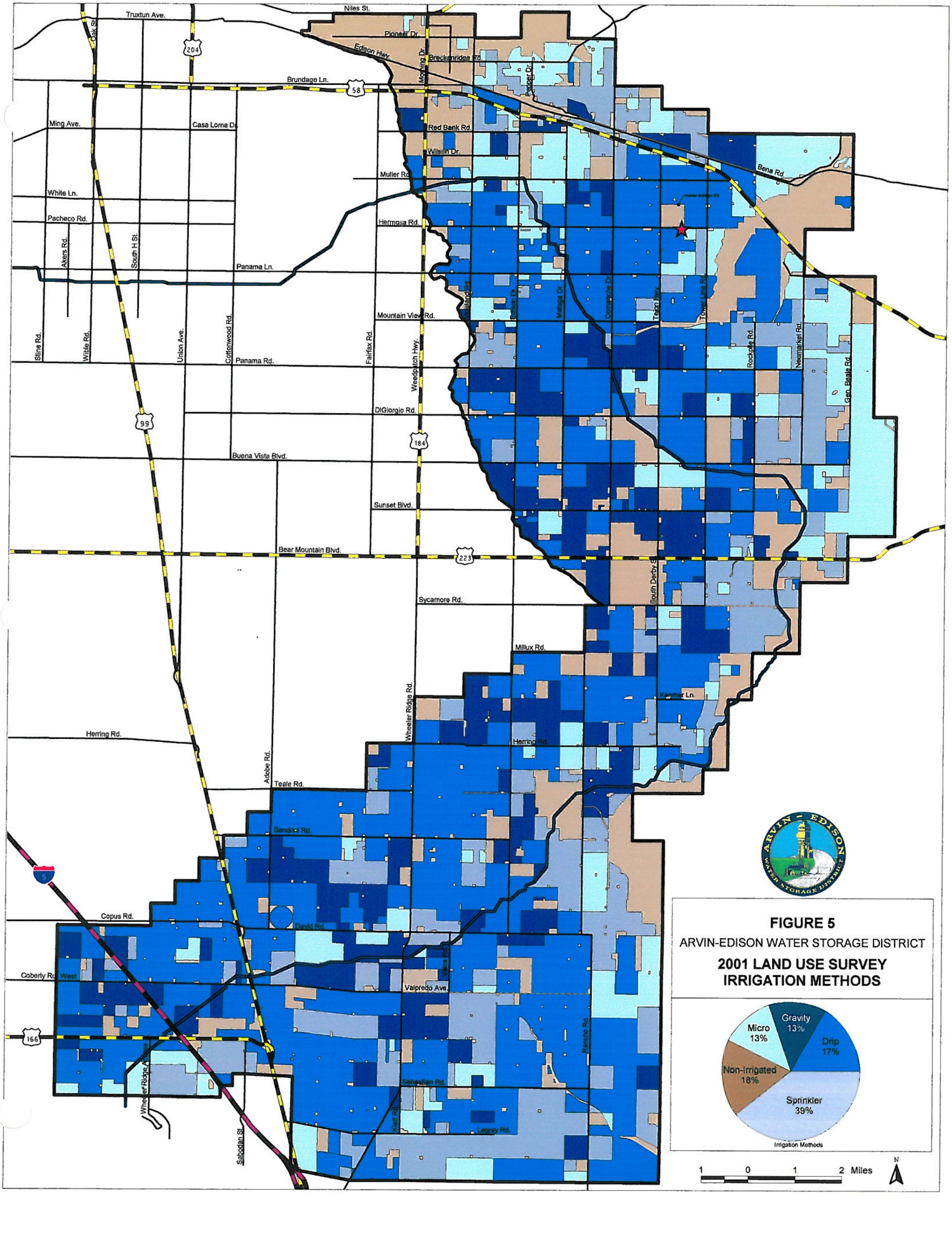


FIGURE 5
ARVIN-EDISON WATER STORAGE DISTRICT
2001 LAND USE SURVEY
IRRIGATION METHODS
Gravity 13%
Drip 17%
Sprinkler 39%
Non-Irrigated 18%
Micro 13%
Irrigation Methods
1 0 1 2 Miles
N
ARVIN - EDISON WATER STORAGE DISTRICT
Truxtun Ave.
Niles St.
Oak St.
Pioneer Dr.
Edison Hwy.
Breckenridge Rd.
Brundage Ln.
Ming Ave.
Casa Loma Dr.
Red Bank Rd.
Wilson Dr.
Muller Rd.
Bena Rd.
White Ln.
Pacheco Rd.
Hermosa Rd.
Akers Rd.
South H St.
Panama Ln.
Mountain View Rd.
Stine Rd.
Wible Rd.
Union Ave.
Cottonwood Rd.
Panama Rd.
Fairfax Rd.
Weedpatch Hwy.
Malaga Dr.
Comanche Dr.
Tejon Hwy.
Tower Line Rd.
Rockpile Rd.
Newmarket Rd.
Gen. Beale Rd.
DiGiorgio Rd.
Buena Vista Blvd.
Sunset Blvd.
Bear Mountain Blvd.
Sycamore Rd.
South Derby St.
Millux Rd.
Kenmar Ln.
Herring Rd.
Wheeler Ridge Rd.
Adobe Rd.
Teale Rd.
Sandrini Rd.
Copus Rd.
David Rd.
Coberly Rd. West
Valpredo Ave.
Vallos Rd.
Rancho Rd.
Sebastian Rd.
Klatt Rd.
Laguna Rd.
Wheeler Ridge Access
Sabodan St.
204
58
99
184
223
5
166

FIGURE 6

ARVIN-EDISON WATER STORAGE DISTRICT

HISTORY OF FRIANT - KERN ALLOCATION

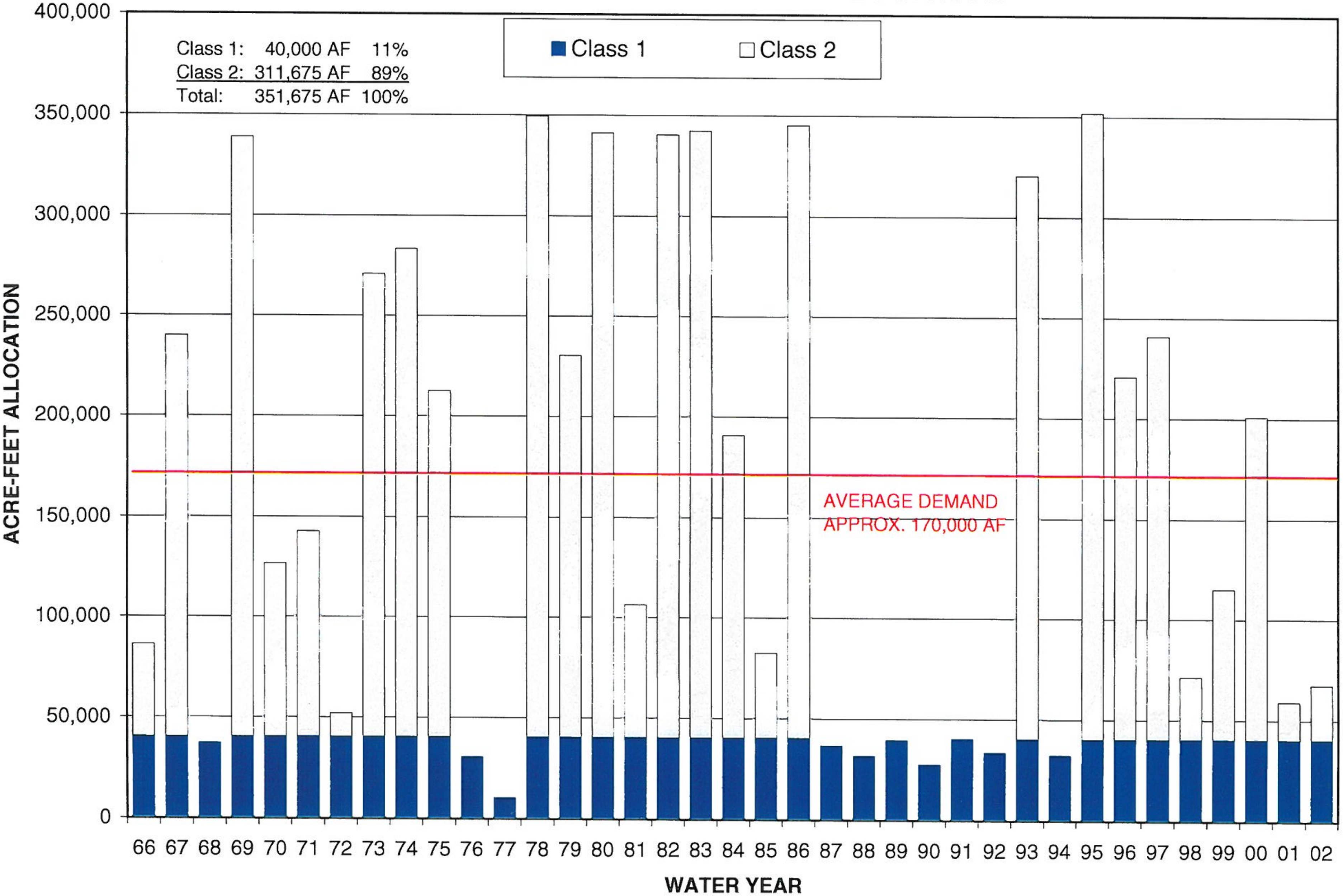
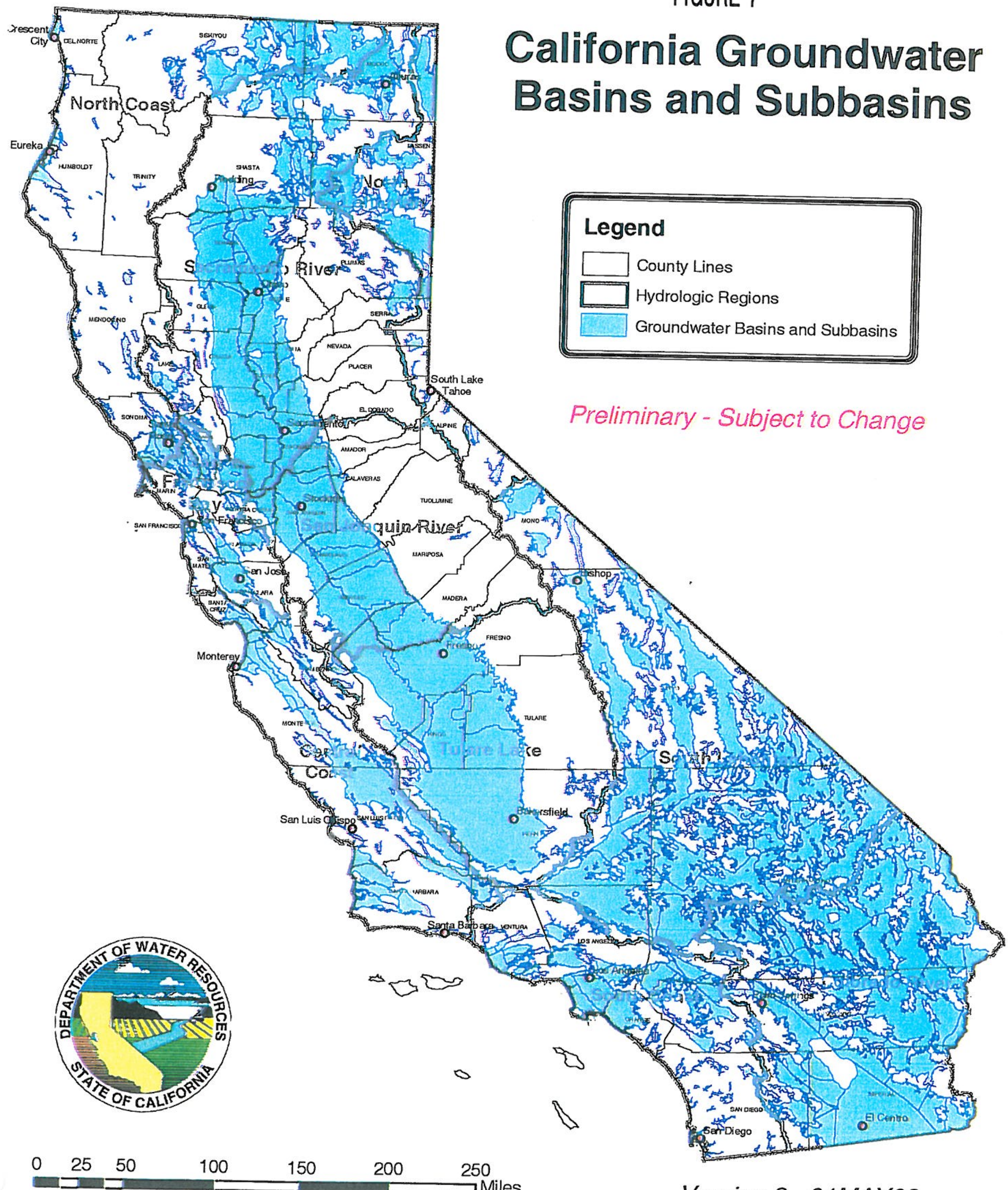


FIGURE 7

California Groundwater Basins and Subbasins



Version 2 - 01MAY02

Insert Figure 8

Geologic Map of the Edison-Maricopa Area - California

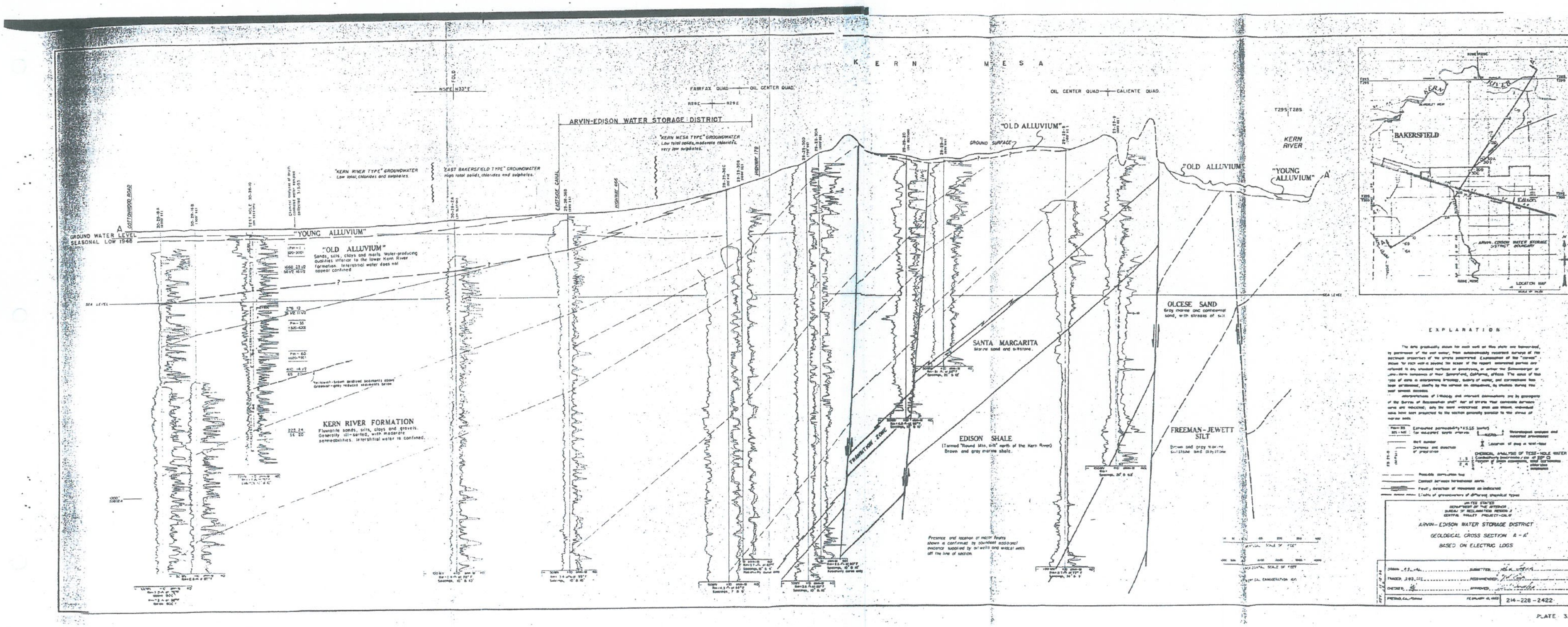


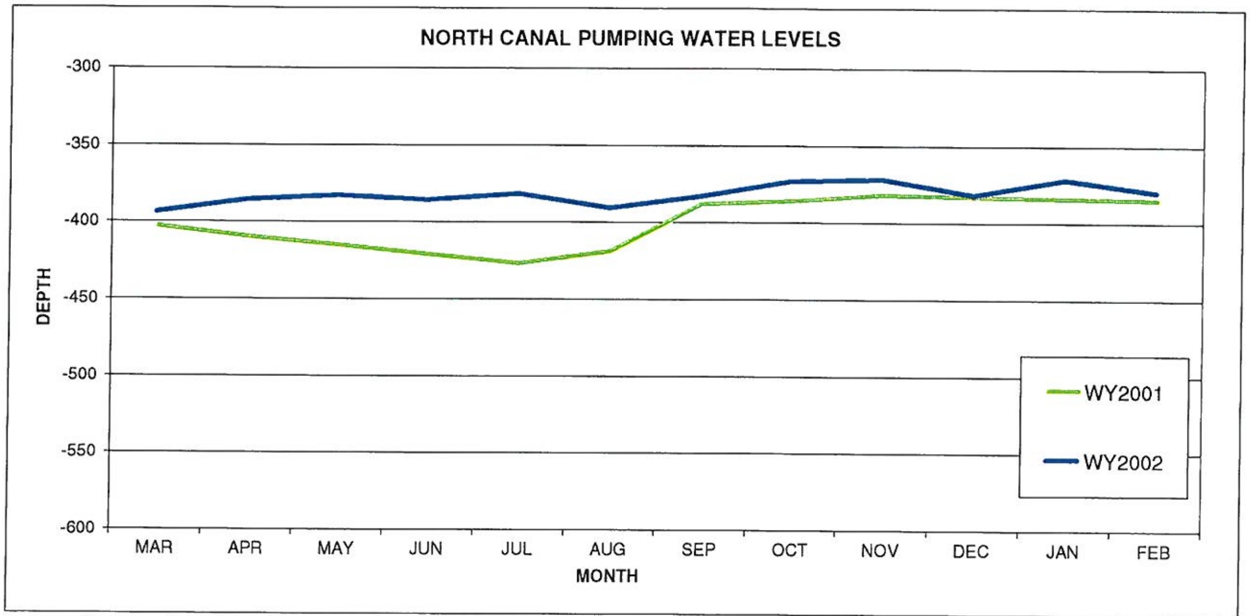
FIGURE 9

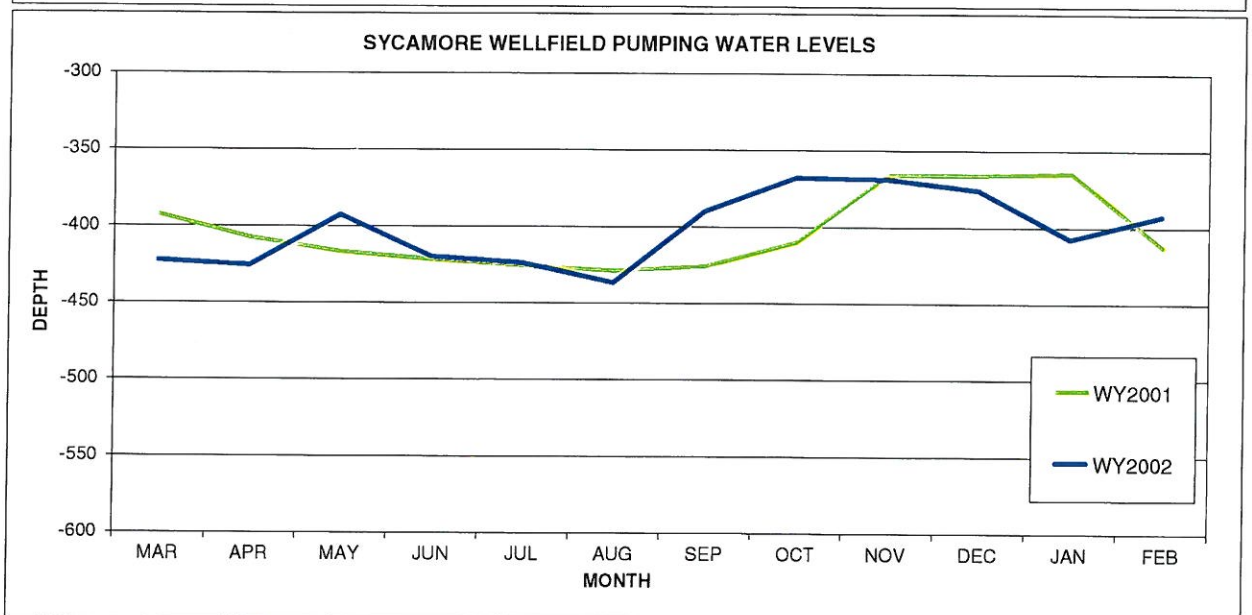
Geologic Cross Section

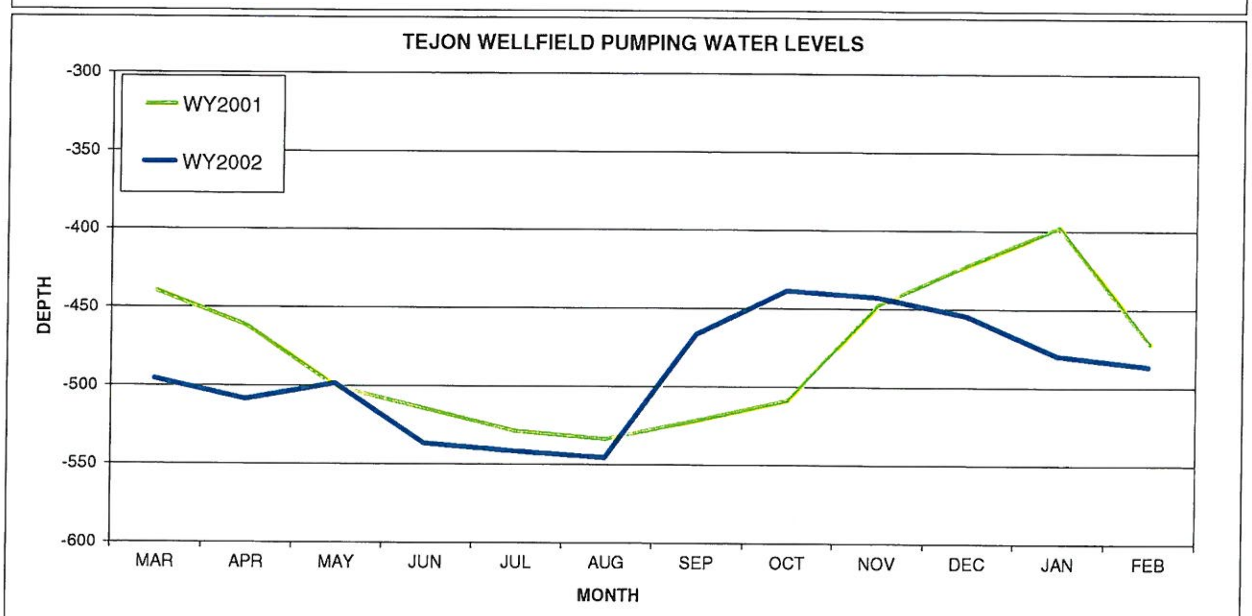
FIGURE 10

ARVIN-EDISON WATER STORAGE DISTRICT

DISTRICT PUMPING LEVELS FOR WATER YEARS 2001 AND 2002







5/5/03

FIGURE 11

ARVIN-EDISON WATER STORAGE DISTRICT

SUMMARY OF SPREADING AND EXTRACTION OPERATIONS

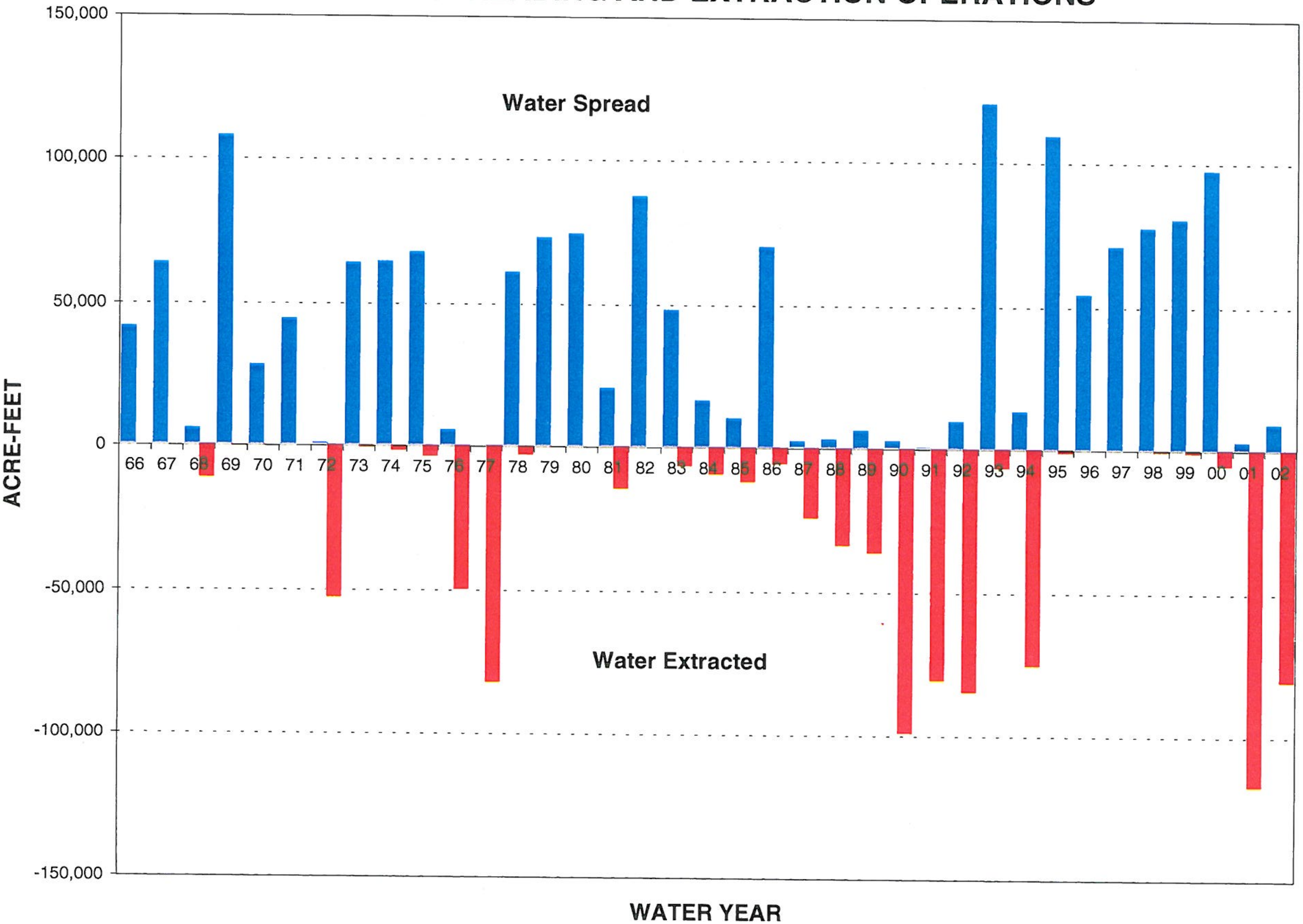
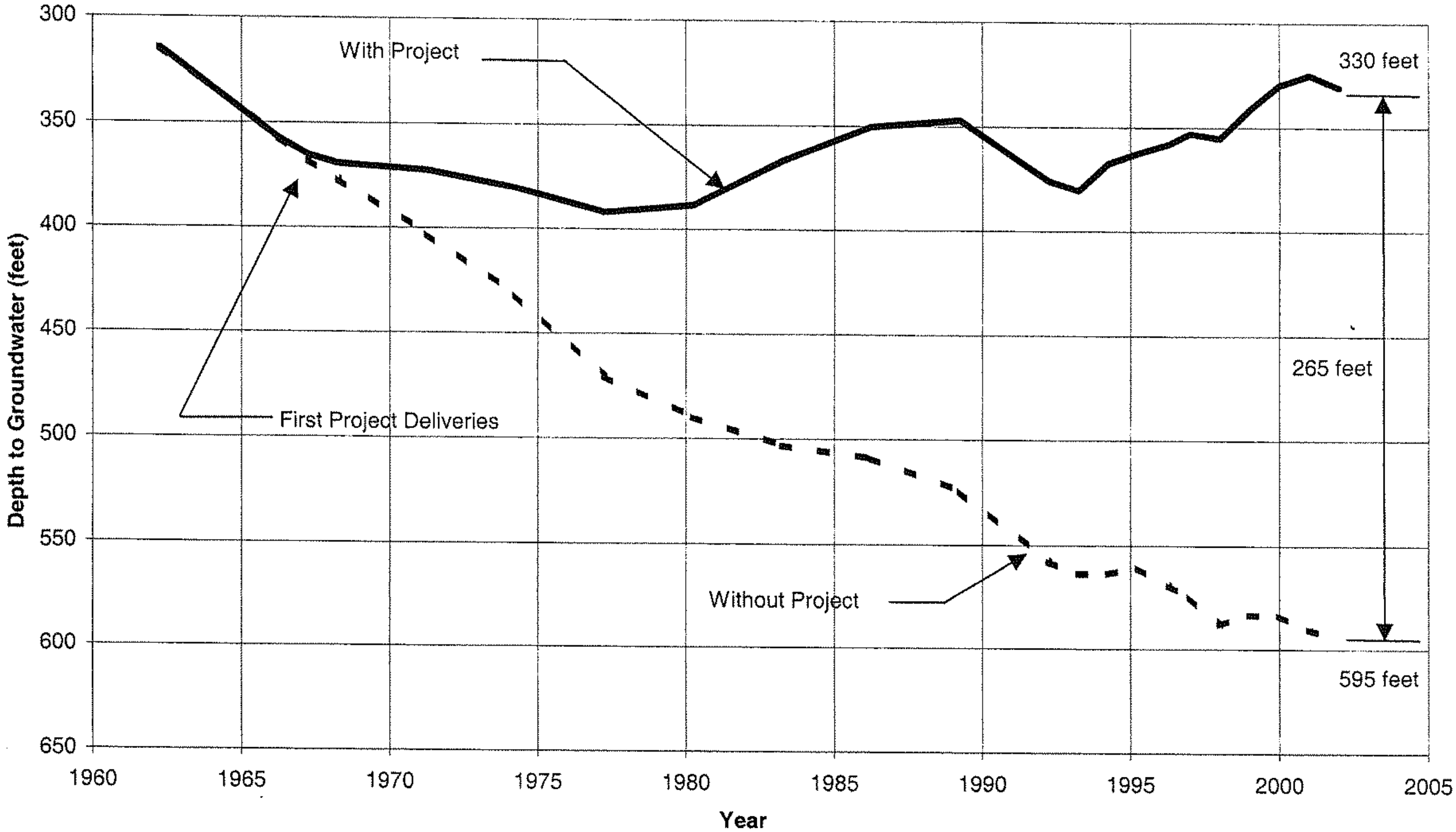
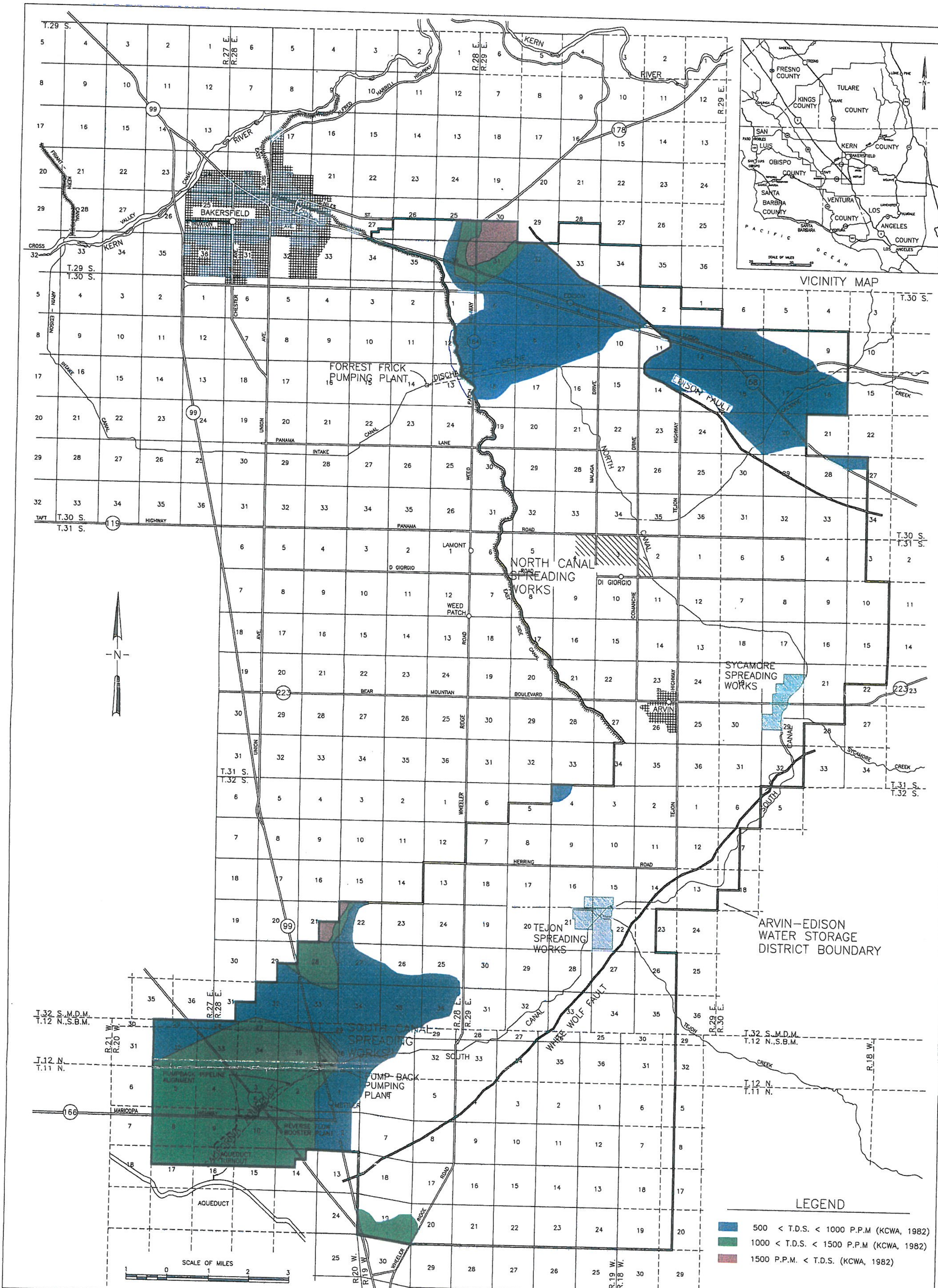


Figure 12

Arvin-Edison Water Storage District

AVERAGE STATIC GROUNDWATER DEPTH IN DISTRICT





ARVIN–EDISON/SPREADING GROUNDS EVALUATION

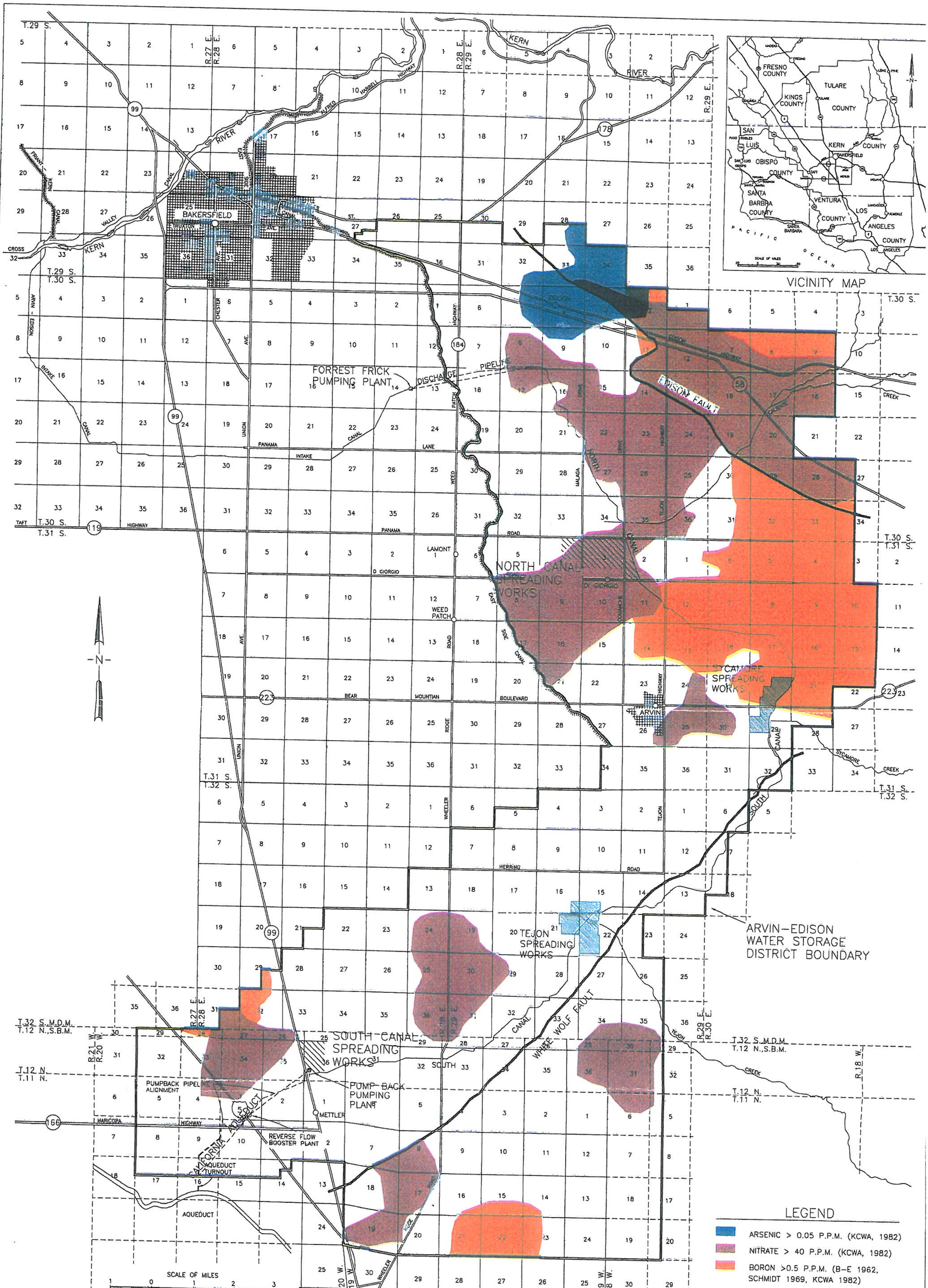
WATER QUALITY

TDS

FIGURE 13

BOOKMAN–EDMONSTON ENGINEERING, INC.

AUGUST 1996



ARVIN-EDISON/SPREADING GROUNDS EVALUATION

WATER QUALITY

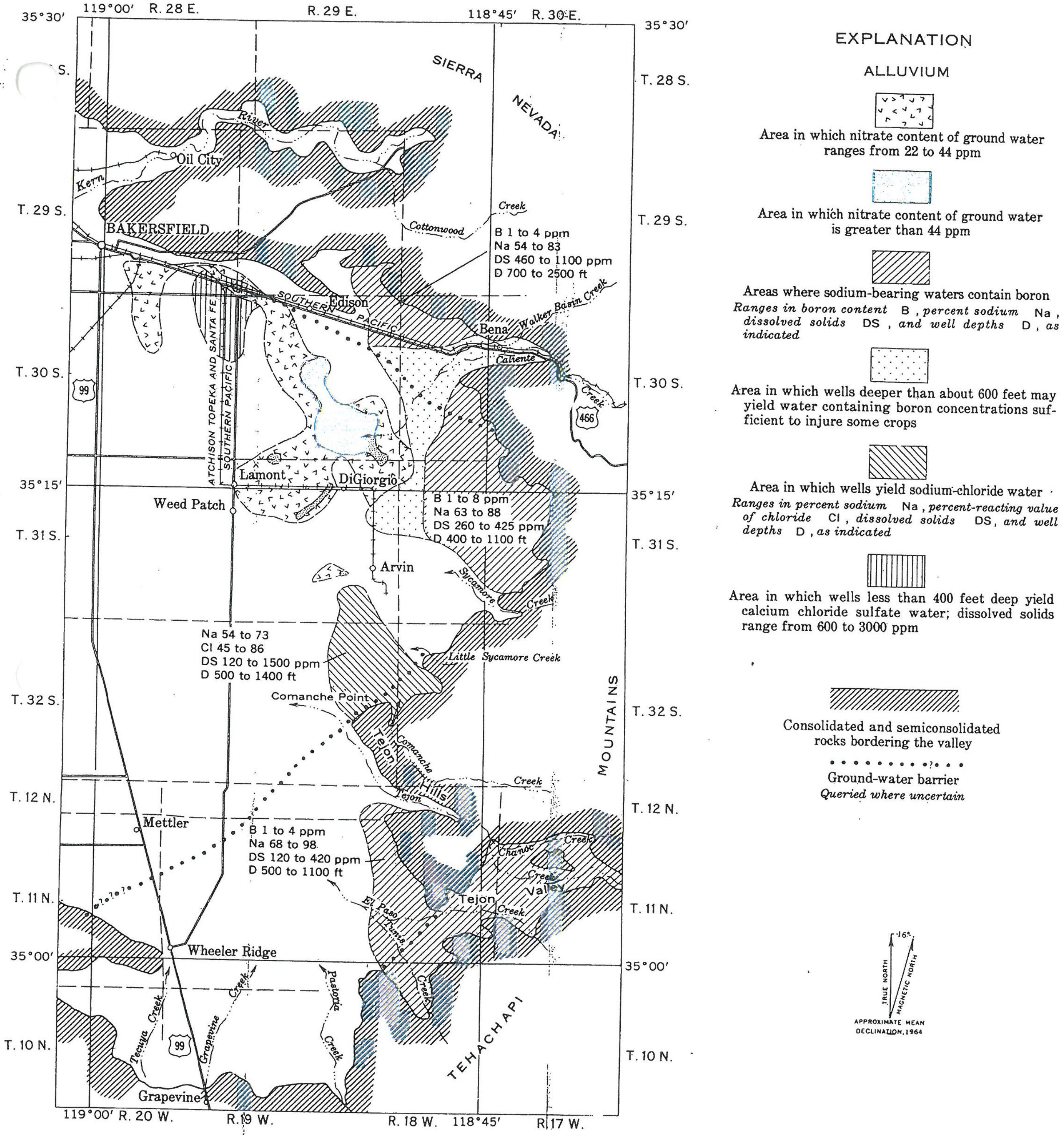
ARSENIC, BORON, NITRATE

FIGURE 14

E:\DWG\ARVIN\ARVIN.DWG

BOOKMAN-EDMONSTON ENGINEERING, INC.

AUGUST 1996



MAP OF THE EASTERN PART OF THE EDISON-MARICOPA AREA, CALIFORNIA, SHOWING AREAS OF GROUND WATER OF INFERIOR QUALITY

5 0 5 10 MILES

714-848 O - 64 (In pocket)

FIGURE 15

APPENDIX A

MEMORANDUM

TO: Mike Day, Provost & Pritchard

FROM: Stan Powell

RE: Evaluation of Perennial Yield for Arvin-Edison Water Storage District

DATE: March 27, 2003

This memorandum is intended to estimate the groundwater yield available for the Arvin-Edison Water Storage District (District). Among other things, it is intended to support your preparation of an AB-3030 Groundwater Management Plan on behalf of the District. It essentially updates a draft memorandum to Steve Collup dated October 31, 1994, prepared by Bookman-Edmonston Engineering.

DEFINITION OF TERMS

There are a number of definitions that can be used to estimate the groundwater yield. A useful definition of safe yield for the purposed identified above is presented in *Groundwater Hydrology* by Bouwer, which states:

> The safe yield of an aquifer is the rate at which groundwater can be withdrawn without causing a long-term decline of the water table or piezometric surface. Thus the safe yield is equal to the average replenishment rate of the aquifer.

This definition is generally consistent with the definition of "perennial yield" presented in the draft AB-3030 plan as follows:

> Perennial or sustained yield is defined here as the average annual amount of groundwater pumping that can be supported over an average hydrologic base that will not result in a long-term decline in water levels.

If the rate of groundwater withdrawal does cause a long-term decline in water levels, the groundwater aquifer is said to be in "overdraft". This is consistent with Provost & Pritchard's draft AB-3030 plan, which defines overdraft as "a long-term water level decline during an average hydrologic base period, and is not used to describe short-term water level declines during times of drought". In other words, overdraft occurs under operations that the groundwater production exceeds the perennial yield on a long-term average basis.

In using the above definition of safe yield, several factors should be recognized:

- Short-term variations in groundwater levels can be consistent with safe yield operation of the aquifer, and can occur when the replenishment of the aquifer on a short-term basis differs from the long-term average replenishment rate.

- Since a portion of the average replenishment to the aquifer is derived from irrigation return flows, the safe yield will vary depending on the total irrigation application and irrigation efficiency.

- The safe yield can be dependent on water levels, as deeper groundwater levels (if stable) can result in greater subsurface inflow that can increase the safe yield.

Other definitions of "safe yield" are available, and deserve some consideration in this analysis, particularly with respect to the dependence of the "safe yield" on groundwater levels as discussed in the last bullet above. For example, "safe yield" can be defined on an economic basis as the yield that does not cause groundwater production to be uneconomical, or on a water quality basis as the yield that does not result in water quality problems. While lowering of groundwater levels below the historical operating range could result in an increase in subsurface inflow (thus increasing the perennial yield), such levels might not be economically feasible and might cause movement of waters with high boron content. Therefore, the safe yield estimate presented herein is based on the historical operating range of water level elevations.

ESTIMATION OF PERENNIAL YIELD

The estimation of the perennial yield is presented below in subsections that consider the base period, use of the groundwater hydrologic inventory as an analysis tool, and perennial yield estimates.

Base Period

The perennial yield needs to be evaluated over a period with average hydrologic conditions. One method commonly used to identify such periods is to consider the cumulative departure of rainfall records. However, a limitation in using historical rainfall records is that the District's substantial supplies of imported water probably do not vary directly with local rainfall. For example, there are operational considerations (such as operation of the Friant Division, and operation of the District's exchange programs) that likely do not reflect local precipitation. For the purpose of this analysis, the base period was assumed to include all the years of operation of the District's project. This relatively long period (from the 1966-67 to the 2001-02 water year, a period of 36 years) would tend to reduce the impact of variances in the wetness or dryness of the period on an average annual basis, since as the period considered is extended it would tend to more closely approximate the long-term average.

Hydrologic Inventory as Groundwater Analysis Tool

A hydrologic inventory has been developed for the District, and is used to annual estimate groundwater levels in the District with and without the District's program of importation. The water balance involves quantifying the various components of recharge to and discharge from the aquifer underlying the District on an annual basis, and assessing the change in groundwater storage based on the differences between those components. This balance has been further described in a memorandum dated January 24, 2003 to Mr. Lloyd Fryer of the Kern County Water Agency, included as Attachment 1. That water balance covers the full period of District operations, and so can serve as the basis for estimation of the perennial yield.

Perennial Yield Estimates

The average annual components of the water balance are summarized in Attachment 2, both for with-project (historical) conditions and without-project conditions. Also, the average annual components of the hydrologic inventory are shown on Attachment 3, along with the estimation of the perennial yield and overdraft. It is noted that Attachment 3 includes some components of the inventory that are not directly computed in the inventory, but are helpful in understanding the perennial yield (such as the landowner pumping and the irrigation return flows). As shown on Attachment 3, there is a relatively small estimated overdraft of about 4,300 acre-feet.

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
WATER RESOURCES DIVISION – SACRAMENTO

TECHNICAL MEMORANDUM

TO: Lloyd Fryer, Kern County Water Agency-Attachment 1

FROM: Stan Powell

RE: Summary of Water Balance Assumptions and Methodology for Arvin-Edison Water Storage District

DATE: January 24, 2003

This memorandum discusses the methodology and assumptions used for a hydrologic inventory analysis of the Arvin-Edison Water Storage District (AEWSD). It is intended to provide you with sufficient detail to make a meaningful comparison of this analysis with that performed by other Districts, as it pertains to the groundwater mediation process.

This memorandum is generally organized to reflect the "Matrix of Water Balance Assumptions" dated November 6, 2002 developed by you for the mediation process. The first section presents a general discussion of the hydrologic inventory analysis (corresponding to the "Comments" section at the bottom of the Matrix), and is followed by sections on Inputs and Outputs.

Per our telephone conversation on January 6, 2003, we will be happy to provide additional information in those areas where this memorandum is not adequate for your purposes.

GENERAL DISCUSSION OF HYDROLOGIC INVENTORY ANALYSIS

AEWSD performs an annual evaluation of the water balance for the District. The balance includes water year 1962-63 to 2001-02, where the water year runs from March through February. Primary uses of the hydrologic inventory are to provide a check on groundwater contour maps, estimating impacts of AEWSD's program (improvement in groundwater levels with and without importation of water, assuming that historical demands would have occurred), and estimating impacts of alternative operations/programs by the District. This groundwater information and program accomplishments are also used in the District's annual rate-setting process. The components of the hydrologic inventory are illustrated in Attachment 3.

One element of the analysis for AEWSD that may differ from that of other Districts is that the hydrologic inventory considers four subareas, as shown on Figure 2. For the purpose of the analysis, it is assumed that there is no subsurface flow across the Edison and White Wolf faults, so the Edison and White Wolf subareas are treated as isolated basins in the analysis. In contrast,

3800 Watt Avenue, Suite 210 ◆ Sacramento, California 95821 ◆ 916/974-8800

the Upper East Side and Tejon Fan subareas consider underflow between each other and the Kern Delta Water District (KDWD).

In addition to tracking water volumes, resulting average groundwater levels in each subarea are also estimated based on an estimated specific yield value. It is noted that this essentially treats each subarea as an unconfined aquifer, although in fact there is confinement, particularly in the deeper zones, and with increased confinement towards the west.

INPUTS

The following sections discuss the inputs to the hydrologic inventory analysis.

Imported Water (SWP, CVP, Kern River, and Other)

The water balance aggregates imported water supplies, delivered via the Intake Canal (and future balances will incorporate deliveries through the intertie pipeline), into a single value for the inventory based on District records. While not broken out for the inventory, the various sources of the imported supply can be identified from District records if necessary.

The deliveries of imported water to the various subareas are estimated using the District's records of deliveries by "delivery unit". The proportion of land receiving surface water service in each delivery unit in each subarea is identified, and is used to distribute the imported water to the subareas.

Minor Streams

For Caliente Creek, a rough correlation was developed between rainfall at the Arvin Station and runoff based on stream gage records extrapolated to estimate Caliente Creek flows. For other streams, the average runoff is estimated on the basis of the drainage area and average unit runoff. The runoff from these other streams is varied for each year reflecting the variation in the flow for Caliente Creek (relative to the average flow) for that year.

Effective precipitation

Estimates of effective precipitation prepared by JM Lord for water years 1989-90 to 1993-94 were used directly. For prior and later years, effective precipitation is assumed to be 24 percent of precipitation. The 24 percent value was identified as it results in a similar estimate of the total effective precipitation for the 1989-90 to 1993-94 period estimated by JM Lord. The Arvin Station precipitation is used to estimate effective precipitation for the Edison and Upper East Side subareas, while that precipitation is increased by 15 percent for the Tejon Fan and White Wolf subareas to reflect variations in precipitation shown on isohyetal maps.

Subsurface flows

For purpose of balance, it is assumed that there are no subsurface flows across the Edison and White Wolf faults. Subsurface flows are considered between the Upper East Side subarea, the Tejon Fan subarea and the Kern Delta Water District (KDWD). Darcy's Law is used to compute the subsurface flows. Groundwater levels used to define the hydraulic gradient are based on the hydrologic inventory for the Upper East Side and Tejon Fan subareas, and are computed based on a very simple water balance for KDWD. Use of a water balance for KDWD levels rather than measurements has been used to provide flexibility to estimate conditions that may have occurred absent importation of water by AEWSD.

Safe Yield

Safe yield is not used as a component of the balance but is discussed further in the October 31, 1994 draft memo entitled "Safe Yield".

Other Input

Recharge from District spreading activities are input directly from District records. As illustrated on Figure 1, return flow is not directly estimated; rather it is considered by using net groundwater pumping rather than gross groundwater pumping. The implicit assumption is that all irrigation applications in excess of consumptive use percolate back into the groundwater aquifer.

OUTPUTS

The following sections discuss outputs from the hydrologic inventory analysis.

Crop Surveys

The hydrologic inventory uses cropping data from a biannual land use survey summarized by the District.

Crop ET

Unit crop evapotranspiration is taken from annual studies performed by JM Lord. The total crop evapotranspiration is estimated by multiplying the cropped acreage by the unit evapotranspiration rate. The evapotranspiration is distributed between the various subareas based on the distribution of the estimated irrigated acreage.

Surface Outflows

Gage data is not available to estimate outflow of surface water from AEWSD. The surface outflow is estimated to be one-half of the estimated surface inflow that is in excess of 25,000 acre-feet per year. Under this assumption, outflow occurs in water years 1968-69, 1969-70, 1977-78, 1978-79, 1982-83, 1994-95, 1995-96, and 1998-99. Amounts of estimated outflow for these years range from about 400 to 68,000 acre-feet.

As stated earlier, the analysis assumes that all water applications in excess of crop needs percolate and recharge groundwater in AEWSD. In other words, the evaluation does not include any tail water that may leave AEWSD.

Non-Recoverable Losses

Non-recoverable losses are not considered in the hydrologic inventory analysis.

Other Outputs

Groundwater pumping at District wells is explicitly considered in balance. As discussed earlier, other pumping reflects net pumping needed to supply water requirements in excess of effective precipitation and imported water supplies.

cc: Steve Collup, Engineer-Manager, Arvin-Edison Water Storage District

Attachment 2

Hydrologic Inventory for Arvin Edison Water Storage District

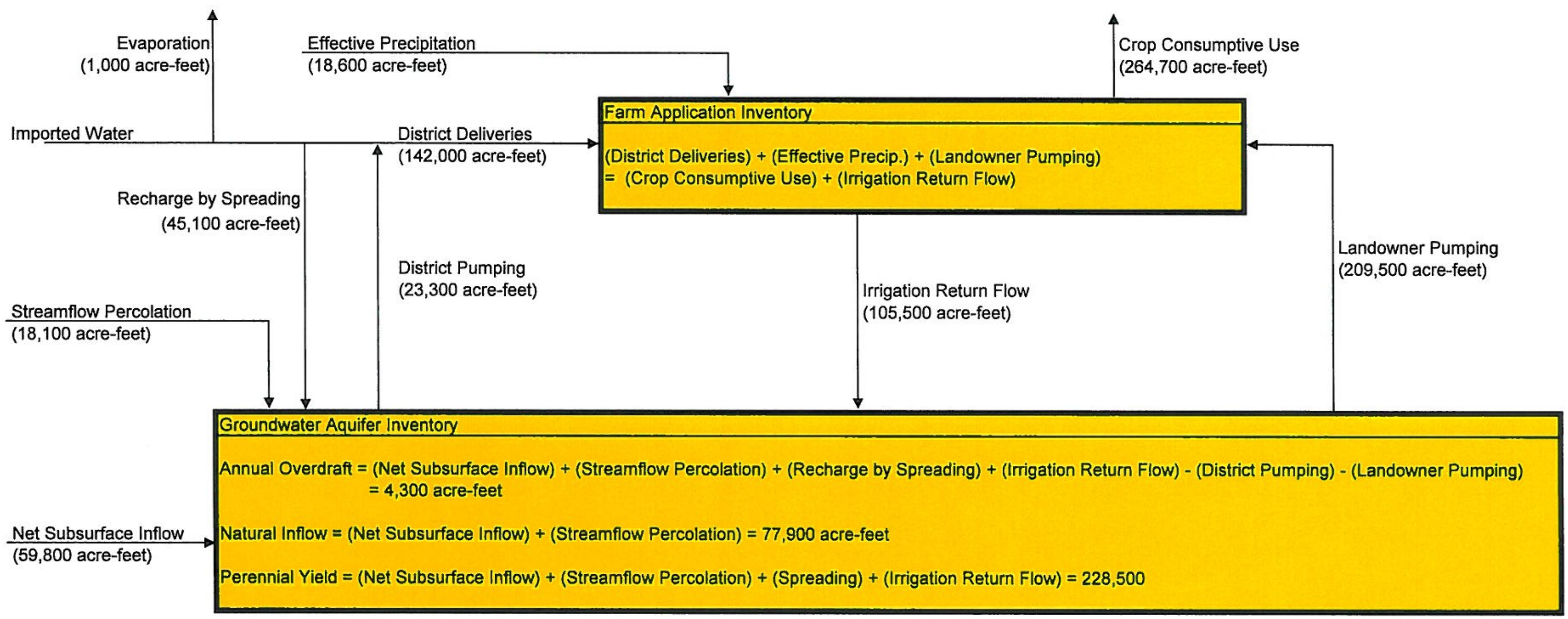
ITEMS OF SUPPLY	PROJECT (acre-feet per year)	NON-PROJECT (acre-feet per year)
Effective Precipitation	19,000	19,000
Surface Inflow	22,000	22,000
Subsurface Inflow	60,000	103,000
Import	164,000	0
Sub-total	265,000	144,000
ITEMS OF DISPOSAL		
Surface Outflow	4,000	4,000
Evaporation	1,000	1,000
Consumptive Use	265,000	265,000
Sub-total	270,000	270,000
SUPPLY MINUS DISPOSAL	-5,000	-126,000
AVERAGE ANNUAL CHANGE IN GROUNDWATER LEVEL	-0.1 feet	-7.4 feet

(1) From 1966-1967 water year to 2001-2002 water year

Attachment 3

Arvin-Edison Water Storage District

Average Annual Elements of Hydrologic Inventory under Project Conditions, 1966-2002



APPENDIX B

The Arvin-Edison Water Storage District Water Resources Management Program

Arvin-Edison Water Storage District

Arvin, California

THE ARVIN-EDISON WATER STORAGE DISTRICT

WATER RESOURCES MANAGEMENT PROGRAM

April 2003

TABLE OF CONTENTS

LIST OF FIGURES

THE ARVIN-EDISON WATER STORAGE DISTRICT WATER RESOURCES MANAGEMENT PROGRAM

INTRODUCTION

The Arvin-Edison Water Storage District of Kern County, California, through actions of its Board of Directors and Bookman-Edmonston Engineering, Inc., which was employed to design and supervise the construction of the District's water distribution facilities, has successfully completed a project to introduce supplemental water into an area of substantial groundwater overdraft. The District's project, construction of which was initiated in 1964 and completed in 1968, reflects the implementation of a plan for the integrated management of a supplemental imported surface water supply with existing groundwater reserves providing **a true conjunctive use program**.

THE DISTRICT

The Arvin-Edison Water Storage District was organized in 1942 under California Water Storage District law (Division 14 of the California Water Code) for the expressed purpose of providing an agency to contract with the United States for water and power service from the Central Valley Project. The District is comprised of approximately 132,000 acres of prime agricultural land located in the southeasterly portion of the San Joaquin Valley of California and lies entirely within Kern County. Approximately 100,000 acres are developed to irrigated crops, with vineyards, truck crops, potatoes, cotton, citrus, and orchard presently predominating. A summary of land use, surveyed each spring, is shown as Figure 1.

Long-term average rainfall in the District is about 8.2 inches per year and occurs largely during winter and spring months. Therefore, agriculture is almost entirely dependent upon irrigation. The absence of perennial surface streams in the District required that all irrigation water, prior to the District's first deliveries in 1966, be obtained from groundwater reserves.

Arvin-Edison Water Storage District

Figure 1: A 10 Year Summary Of Land Use (1992 - 2002)

LAND USE *(1) *(2)	1993	1994	1995*(3)	1996	1997	1998	1999	2000	2001	2002
Field Crops										
Cotton	12,619	12,171	14,176	15,535	12,974	7,764	6,660	7,132	8,661	5,771
Milo & Field Corn	96	0	103	354	410	709	371	97	373	578
Other Field Crops	673	449	0	0	130	217	842	1,264	1,981	60
Truck Crops										
Potatoes	16,383	16,379	15,302	19,224	15,728	19,808	13,356	16,111	16,423	19,788
Other Truck Crops	14,497	14,036	15,673	16,701	12,660	13,692	15,521	14,504	14,624	15,580
Grain & Hay Crops	4,556	4,568	6,100	6,551	6,015	6,791	11,060	10,096	8,992	7,228
Pasture	1,276	1,759	1,987	2,010	2,252	2,142	2,552	2,394	1,825	1,484
Vineyards	22,835	23,157	25,251	26,913	27,928	28,447	29,784	29,783	29,886	30,081
Deciduous Orchard	10,959	11,106	11,678	11,515	11,786	11,799	11,799	10,339	10,812	10,705
Citrus	11,657	11,805	12,430	12,504	13,223	13,477	14,416	14,186	14,274	14,172
Subtotal	95,551	95,430	102,700	111,307	103,106	104,846	106,361	105,906	107,851	105,447
Fallow *(4)	7,236	7,290	7,544	5,062	11,151	4,384	7,226	7,622	5,496	7,764
Total Irrigated Acres	102,787	102,720	110,244	116,369	114,257	109,230	113,587	113,528	113,347	113,211
Semi-Incidental To Agricultural	1,813	1,722	2,003	1,697	1,955	1,791	1,126	1,326	1,474	1,474
Urban	12,343	12,418	7,050	6,626	7,745	9,503	7,260	7,119	7,153	7,153
Non-Irrigated Crops	4,606	3,951	3,668	2,972	586	4,738	1,172	652	507	671
Abandoned Orchards/Vineyards	0	0	0	0	77	26	26	26	26	27
Idle Land *(5)	2,431	3,459	1,732	66	284	256	316	226	319	333
Native Classes	7,680	7,390	6,963	3,930	6,756	6,116	8,173	8,783	8,834	8,791
Total Non-Irrigated Acres	28,873	28,940	21,416	15,291	17,403	22,430	18,073	18,132	18,313	18,449
Total District Acreage	131,660	131,660	131,660	131,660	131,660	131,660	131,660	131,660	131,660	131,660

*(1) Standard Land Use Legend as prepared by DWR, July 1993
*(2) Land Use is surveyed during the Spring of each year
*(3) Land Use survey completed in July
*(4) Land is tilled at time of survey but current crop not identified
*(5) Land cropped within the past three years but not tilled at time of survey

10yrcrop 4/28/03

Groundwater overdraft prior to the introduction of Central Valley Project water was estimated to be 113,000 acre-feet per year, resulting in the continued lowering of groundwater levels until pumping lifts exceeded 600 feet in many areas of the District. Further, the receding water table in certain areas had induced the subsurface movement of water with high boron concentrations from the bedrock complex bordering the District to the east into the pumped aquifers underlying the area.

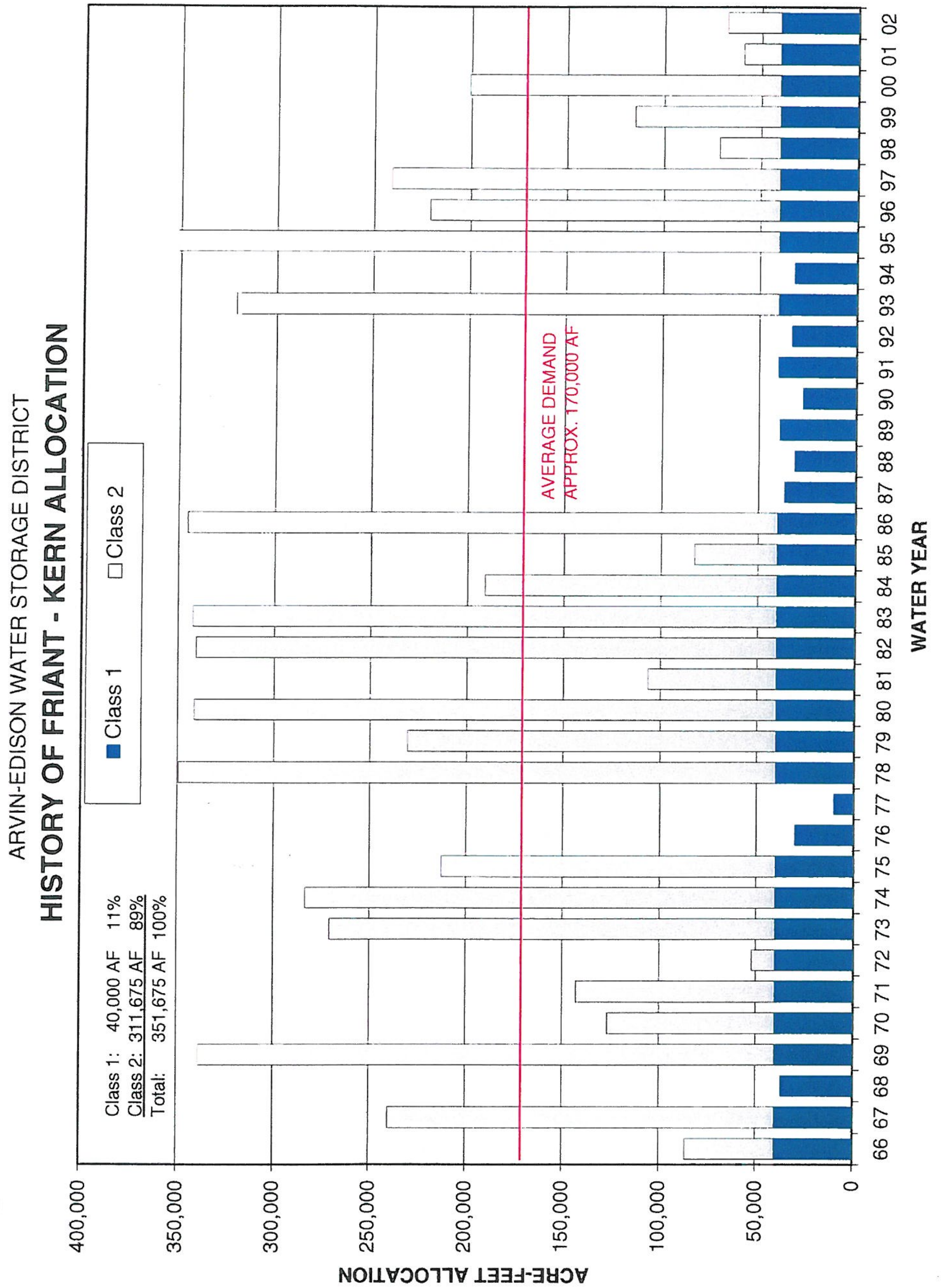
IMPORTED WATER SUPPLY

Water for the District's project is obtained primarily from the Friant-Kern Division of the Federal Central Valley Project. The District's water service contract with the United States provides for delivery of up to 40,000 acre-feet per year of Class 1, or firm water; and up to 311,675 acre-feet per year of Class 2, or nonfirm water. Over the long-term, the District's annual Friant-Kern Canal water entitlement has ranged from a minimum of about 10,000 acre-feet in a very dry year such as 1977, to a maximum of 351,675 in very wet years such as 1978 and 1995 (Figure 2).

Since the District's water supply varies widely from year to year, providing for a firm surface water supply for lands to be served within the District requires that both cyclic and seasonal regulation be provided within the District. This regulation is obtained, in part, by use of the groundwater reservoir underlying the District.

In an effort to further reduce the effects of the erratic nature of its water supply, Arvin-Edison entered into a Memorandum of Understanding, which provides for the exchange of a portion of its Friant-Kern Canal water supply for an alternate water supply to be delivered to Arvin-Edison through the California Aqueduct and the Cross Valley Canal. This exchange program, which is depicted schematically in Figure 3, is known as the Cross Valley Canal Exchange. Under terms of the original Exchange, Arvin-Edison annually would receive up to

FIGURE 2


ARVIN-EDISON WATER STORAGE DISTRICT
HISTORY OF FRIANT - KERN ALLOCATION
Class 1
Class 2
Class 1: 40,000 AF 11%
Class 2: 311,675 AF 89%
Total: 351,675 AF 100%
AVERAGE DEMAND
APPROX. 170,000 AF
ACRE-FEET ALLOCATION
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02
WATER YEAR

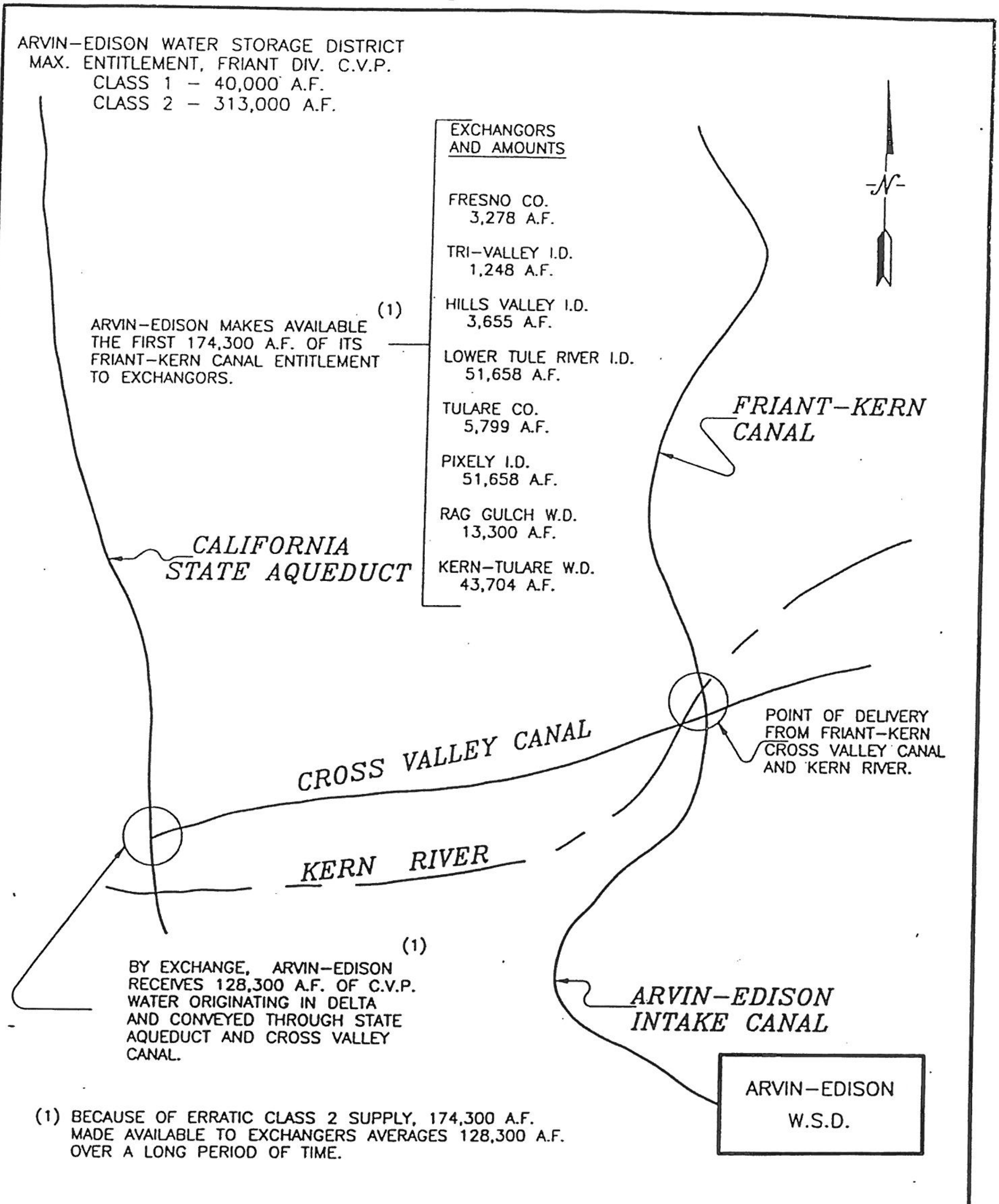
128,300 acre-feet of water from the Cross Valley Canal Exchangors delivered on an irrigation demand schedule in return for delivery of up to 174,300 acre-feet per year of its Class 1 and Class 2 Friant-Kern supply to eight Exchangor agencies located along the Friant-Kern Canal on the east side of the San Joaquin Valley. The District's Friant-Kern Canal supply to be delivered to the Exchangors would vary from year to year, but should average 128,300 acre-feet per year over the long term. Due to the termination of a portion of the exchange in 1995 by two districts, the size of the exchange has been reduced from its original size to its present size of a 66,096 AF maximum return and a 70,984 AF maximum delivery to six exchangors.

CONCEPT OF PROJECT OPERATIONS

The conceptual plan of the Arvin-Edison project includes the use of surface water and groundwater storage to regulate an erratic water supply to an irrigation demand schedule. Through service of this regulated water supply to about 40 percent of the land in the District formerly irrigated with groundwater, groundwater overdraft is being relieved and the remaining lands continue to be irrigated from a stabilized groundwater source. Several factors dictated that full water service be provided to a portion of the lands rather than partial service to all lands including economies of distribution system construction, the financial burden of operating a dual system to serve individual farms, and the desirability of introducing surface water to specified portions of the District with groundwater at greater depths and/or of poor quality.

To the extent there is a coincident demand, water conveyed to Arvin-Edison is delivered directly for irrigation through the District's distribution system. Water in excess of this coincident irrigation demand is banked in underground storage in District-operated spreading works. The spreading works are described in more detail later in this outline.

Figure 3



ARVIN-EDISON WATER STORAGE DISTRICT
CROSS VALLEY CANAL WATER EXCHANGE PROGRAM

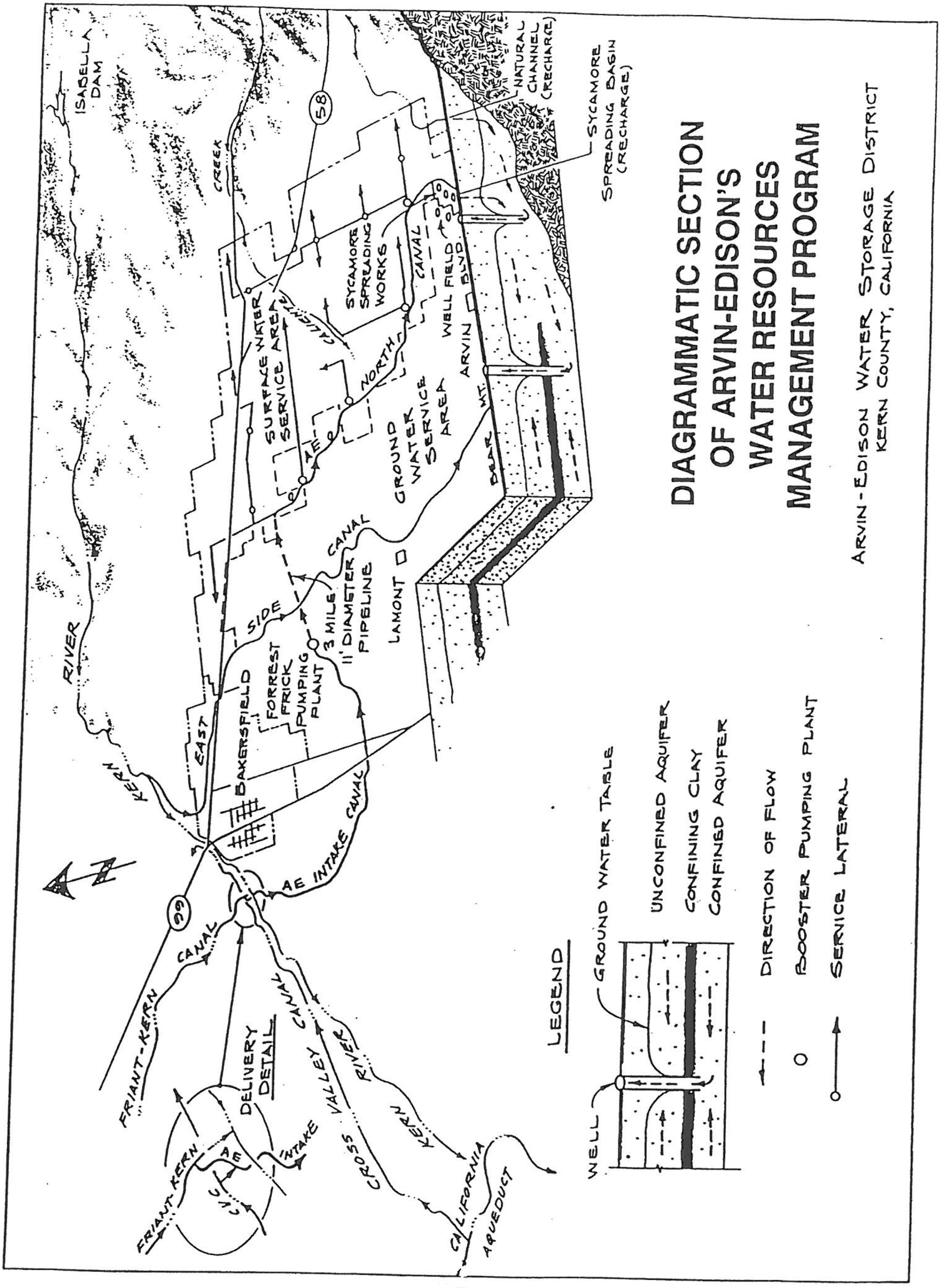
When water from the surface supplies are insufficient to meet demands of the District's Surface Water Service Area, water previously banked in underground storage by the District is recovered through District wells and delivered into the system to meet this deficiency. The program is diagrammed in Figure 4.

Over the long term, over 1,000,000 acre-feet of underground storage capacity will be utilized to regulate the District's water supply. Geologic studies show that there is in excess of this volume of de-watered storage capacity available for this purpose.

WATER SERVICE CHARGES

Surface water service is provided to water users under terms of individual water user contracts executed by the District and its water users. The charges for surface water service consists of two components: A Water Standby Charge and a Water Use Charge. The Water Standby Charge is a per acre charge and is due the District regardless of the quantity of water used. The Water Use Charge consists of a water component and an energy component. The energy component is a variable amount per acre-foot based upon the number of pumping lifts required to convey the water to the water user and is intended to recapture District power costs associated with the delivery of water. The water component of the Water Use Charge provides for a portion of the cost of the water. The total of the average water costs and the energy costs to surface water users approximates the average variable cost (PG&E energy cost) of pumping groundwater within the District. The Water Standby Charge for the 2003 Water Year is $49.00 per acre. The energy component of the Water Use Charge is $9.00 per lift per acre-foot and the water component is $37.00 per acre-foot. This results in an average composite Water Use Charge of approximately $60.00 per acre-foot. The water service charges are set annually by the District's Board of Directors and have been reduced in three of the last four years. A history of water charges is shown in Figures 5 and 6.

FIGURE 4


DIAGRAMMATIC SECTION
OF ARVIN-EDISON'S
WATER RESOURCES
MANAGEMENT PROGRAM
ARVIN-EDISON WATER STORAGE DISTRICT
KERN COUNTY, CALIFORNIA
ISABELLA DAM
KERN RIVER
CREEK
58
99
NATURAL CHANNEL (RECHARGE)
SYCAMORE SPREADING BASIN (RECHARGE)
SYCAMORE SPREADING WORKS
SURFACE WATER SERVICE AREA
GROUND WATER SERVICE AREA
WELL FIELD
ARVIN BLVD
AE NORTH CANAL
DEAR MT.
EAST SIDE CANAL
BAKERSFIELD
FORREST FRICK PUMPING PLANT
3 MILE 11' DIAMETER PIPELINE
LAMONT
AE INTAKE CANAL
FRIANT-KERN CANAL
CROSS VALLEY CANAL
KERN RIVER
CALIFORNIA AQUEDUCT
DELIVERY DETAIL
FRIANT-KERN
AE
CVC
INTAKE
LEGEND
WELL
GROUND WATER TABLE
UNCONFINED AQUIFER
CONFINING CLAY
CONFINED AQUIFER
DIRECTION OF FLOW
BOOSTER PUMPING PLANT
SERVICE LATERAL

In addition to long term water service, the Arvin-Edison Board of Directors has established a policy by which temporary water service is made available to lands outside the Service Area during those periods when the District is percolating water to underground storage.

Revenue to pay Project financial obligations is raised from water tolls as outlined above; and from General Administrative (GA) and General Project Service (GP) Charges levied on benefited lands within the District. The General Administrative and General Project Service Charges were initially levied by Board action for the 1973-74 Fiscal Year at the rate of $6.65 per acre and a flat charge of $3.00 per parcel for sub-acre parcels. By this means, all irrigated lands have contributed financially toward Project benefits. The same service charges for the 2003 Fiscal/Water Year are projected to be $23.00 per acre and a flat charge of $10.40 per parcel for sub-acre parcels. Collection of the charges was suspended in the 1982-83 and 1983-84 Fiscal Years, but reinstituted in the 1984-85 Fiscal Year, and collection remains in force at present.

PROJECT FACILITIES

The principal elements of the Arvin-Edison project were constructed during the period 1964 through 1968. The project, financed under Public Law 130, was administered by the Bureau of Reclamation and the United States Department of the Interior. The assistance and continued cooperation of the Bureau of Reclamation have contributed greatly in bringing this project to reality. The loan contract between the United States and the District provided for a 40-year repayment period following a maximum five-year development period which terminated as of January, 1972. Project facilities were completed for the Federal loan amount of $41 million, plus an additional contribution by the District landowners of $4.6 million used for the purpose of securing lands, easements, and rights-of-way.

FIGURE 5
HISTORY OF WATER COSTS AND ASSESSMENTS

Water Year	Water Service Charges - $/AF Power	Water	Total	Total $/AC	Standby $/AC	GA & GP ($/AC)	Total Costs ($/AC)	($/AF)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1966	2.70	0.00	2.70	7.43	33.00	0.00	40.43	14.70
1967	2.70	0.00	2.70	7.43	33.00	0.00	40.43	14.70
1968	2.70	0.00	2.70	7.43	33.00	0.00	40.43	14.70
1969	2.70	0.00	2.70	7.43	33.00	0.00	40.43	14.70
1970	2.70	0.00	2.70	7.43	33.00	0.00	40.43	14.70
1971	2.70	0.00	2.70	7.43	33.00	0.00	40.43	14.70
1972	2.70	0.00	2.70	7.43	33.00	0.00	40.43	14.70
1973	2.70	0.00	2.70	7.43	33.00	6.65	47.08	17.12
1974	2.70	0.00	2.70	7.43	33.00	6.65	47.08	17.12
1975	2.70	0.00	2.70	7.43	33.00	6.65	47.08	17.12
1976	2.70	0.00	2.70	7.43	33.00	6.65	47.08	17.12
1977	2.70	0.00	2.70	7.43	33.00	6.65	47.08	17.12
1978	7.20	0.00	7.20	19.80	44.00	6.65	70.45	25.62
1979	7.20	0.00	7.20	19.80	49.50	6.65	75.95	27.62
1980	7.20	0.00	7.20	19.80	49.50	6.65	75.95	27.62
1981	7.20	0.00	7.20	19.80	68.75	6.65	95.20	34.62
1982	7.20	0.00	7.20	19.80	68.75	0.00	88.55	32.20
1983	11.00	0.00	11.00	30.25	68.75	0.00	99.00	36.00
1984	13.50	0.00	13.50	37.13	74.25	6.65	118.03	42.92
1985	18.90	0.00	18.90	51.98	90.75	6.65	149.38	54.32
1986	24.30	0.00	24.30	66.83	74.25	6.65	147.73	53.72
1987	27.00	0.00	27.00	74.25	74.25	6.65	155.15	56.42
1988	27.00	0.00	27.00	74.25	74.25	6.65	155.15	56.42
1989	27.00	0.00	27.00	74.25	79.75	6.65	160.65	58.42
1990	27.00	5.00	32.00	88.00	79.75	6.65	174.40	63.42
1991	27.00	10.00	37.00	101.75	79.75	6.65	188.15	68.42
1992	27.00	6.00	33.00	90.75	101.75	6.65	199.15	72.42
1993	24.30	12.00	36.30	99.83	110.00	17.55	227.38	82.68
1994	24.30	21.00	45.30	124.58	118.25	18.00	260.83	94.85
1995	24.30	41.00	65.30	179.58	71.00	23.00	273.58	99.48
1996	24.30	41.00	65.30	179.58	71.00	23.00	273.58	99.48
1997	24.30	41.00	65.30	179.58	71.00	23.00	273.58	99.48
1998	20.80	44.00	64.80	178.20	57.00	23.00	258.20	93.89
1999	20.80	30.00	50.80	139.70	57.00	23.00	219.70	79.89
2000	20.80	30.00	50.80	139.70	57.00	23.00	219.70	79.89
2001	20.80	30.00	50.80	139.70	48.00	10.00	197.70	71.89
2002	20.80	30.00	50.80	139.70	48.00	10.00	197.70	71.89
2003	23.40	37.00	60.40	166.10	49.00	23.00	238.10	86.58

Shaded cells indicate estimated or proposed

04/28/03

WTR&PWR/charge2.xls

NOTES: (1) MARCH THROUGH FEBRUARY

(2) POWER CHARGE BASED ON AN AVERAGE OF 2.6 LIFTS

(3) REQUIRED PURSUANT TO RECLAMATION LAW

(4) SUM OF (2) AND (3)

(5) 2.75 X (4). ASSUMES A 2.75 AF/AC WATER APPLICATION RATE

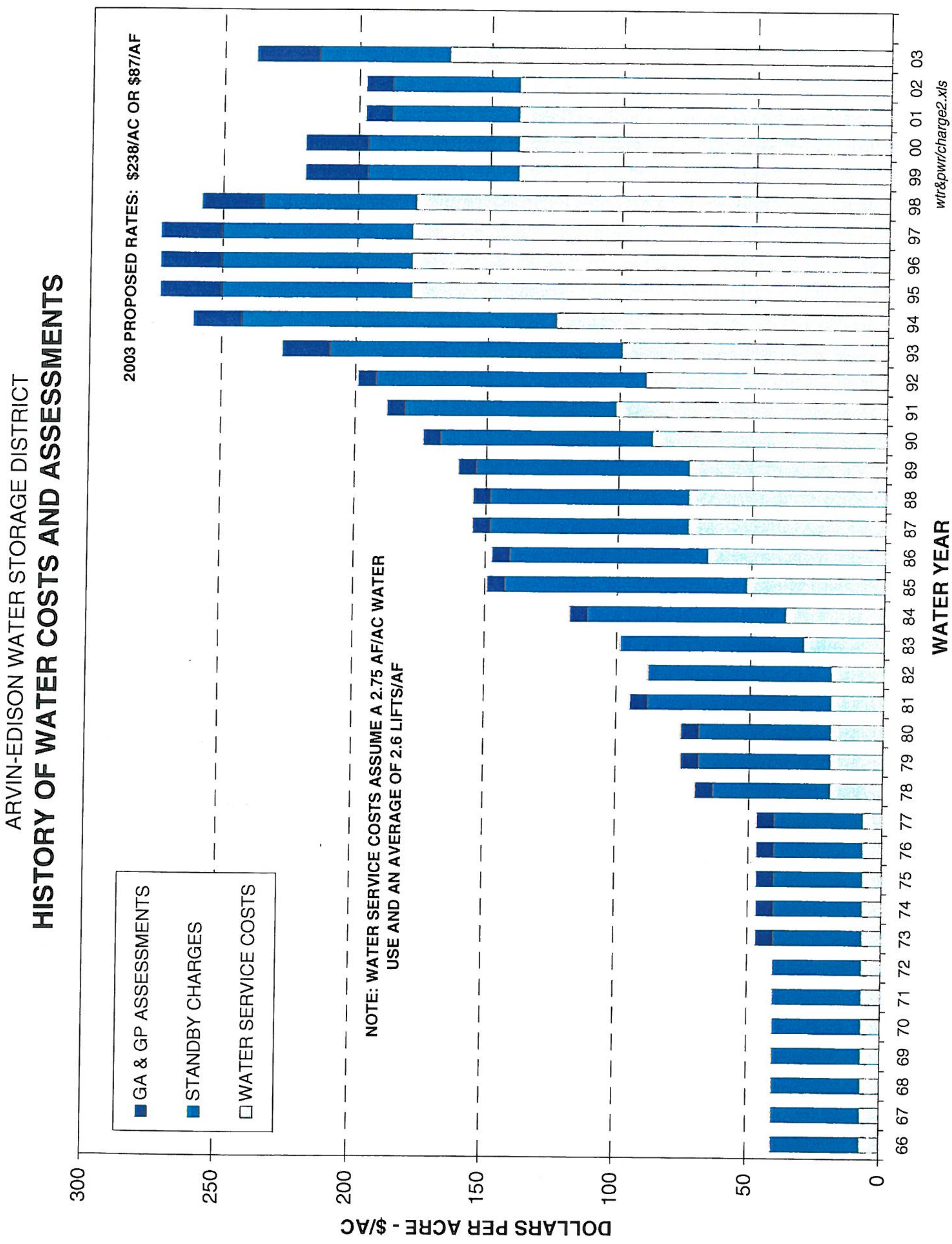
(6) FIXED CHARGE BASED ON CONTRACT ACRE-FT THROUGH 1994 (ASSUMES 2.75 AF/AC), THEN BASED ON CONTRACT $/AC RATES FROM 1995 ON.

(7) ESTABLISHED IN 1973, WAIVED FOR 1982 & 1983, CONSISTS OF GENERAL ADMINISTRATIVE AND GENERAL PROJECT SERVICE CHARGES

(8) (5) + (6) + (7). TOTAL PER ACRE COSTS FOR WATER SERVICE AND ASSESSMENTS

(9) (8) / 2.75 ASSUMES A 2.75 AF/AC WATER APPLICATION RATE

FIGURE 6



ARVIN-EDISON WATER STORAGE DISTRICT
HISTORY OF WATER COSTS AND ASSESSMENTS
GA & GP ASSESSMENTS
STANDBY CHARGES
WATER SERVICE COSTS
NOTE: WATER SERVICE COSTS ASSUME A 2.75 AF/AC WATER USE AND AN AVERAGE OF 2.6 LIFTS/AF
2003 PROPOSED RATES: $238/AC OR $87/AF
DOLLARS PER ACRE - $/AC
300
250
200
150
100
50
0
66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03
WATER YEAR
wtr&pwr/charge2.xls

In July of 1988, the District paid off the remaining $26 million principal balance of its PL-130 Loan, at a "discounted" payoff amount of $9 million. $3.4 million of the $9 million was paid out of AEWSD reserves; and the remaining $5.6 million was refinanced through the investment group of MNC Leasing Corp., to be repaid over a period of 7 years at a 7.5% annual rate. The refinanced annual loan payments were $952,000 per year, and the final payment date was July 1995.

The primary facility of the project is a 45-mile canal system which, as shown on the attached District map, extends from the terminus of the Friant-Kern Canal, through the increasingly urbanized area of Southwest Bakersfield and through the District. This canal has a capacity in its initial 30 miles of 1,000 cubic feet per second, which rate of flow is required to accommodate maximum water deliveries as provided in the District's Federal water service contract.

Another major feature of the project is the Forrest Frick Pumping Plant, located about three miles to the west of the District's westerly boundary and about 14 miles from the terminus of the Friant-Kern Canal. This plant has a capacity of 27,500 horsepower, consisting of four pumping units rated at 5,500 horsepower each, two 2,000 horsepower units, and two smaller units rated at 1,000 and 500 horsepower. The pumps are the vertical turbine type designed to operate against a maximum total dynamic head of 190 feet and have a composite flow rate of approximately 1,000 cubic feet per second. The plant discharges water into a three-mile long, eleven-foot diameter pipeline, which is constructed of pre-stressed reinforced concrete.

Other facilities in the system include about 170 miles of pressure pipeline varying in diameter from 6 to 60 inches, and 45 booster pumping plants having a total horsepower of 25,000, and 440 farm turnouts.

From an operational standpoint, three key facilities are the spreading works and the associated well fields through which water is stored in the underground and later recovered when required through District wells.

Spreading Works - A program of investigation and analysis was conducted by the District's engineering consultants prior to final design to determine the most favorable location and the area needed for the spreading basins. The Sycamore Spreading Works comprises a total area of 569 acres and is located on the alluvial fan of Sycamore Creek near the middle of the District. The Tejon Spreading Works is located on the Tejon Creek alluvial fan approximately six miles south of the Sycamore Spreading Works and covers an area of 516 acres. In Water Year 2000, the construction of the North Canal Spreading Works was completed. Located approximately 4 miles northwest of Sycamore, this new facility covers about 350 acres. All three facilities are shown on the attached map of the District.

Diversion of water into the spreading ponds is accomplished by gravity flow from the Arvin-Edison Canal through turnout structures equipped with manually operated slide gates. A portion of the Tejon Spreading Works comprising about 260 acres is located upslope from the Arvin-Edison Canal, requiring a 65-foot maximum pumping lift. Because electrical energy is required, the Tejon Pumping Plant is operated only when the availability of water exceeds the capacity of the Sycamore Spreading Works and the gravity portion of the Tejon Spreading Works. The Tejon Pumping Plant has fourteen 200 horsepower, electrically-driven pumps which have a capability of delivering a total of 280 cubic feet per second. The North Canal Spreading Works also consists of a pumped area and a gravity area. Two 100 hp electrically-driven pumps with a combined capacity of 40 cfs serve approximately 114 net acres, with the remaining 186 acres served by gravity through a 60" diameter reinforced concrete pipeline.

The principal operating difficulty experienced to date has been maintaining the spreading basin infiltration rates over prolonged periods of spreading. One factor, which contributes heavily to these difficulties, is that water delivered from the Cross Valley and

Friant-Kern Canals occasionally contains silt concentrations which exceed acceptable levels for spreading. Methods employed to maintain or restore infiltration rates include: (1) periodic drying of surface soils; (2) promotion of grass growth on pond surfaces; (3) termination of spreading operations when total suspended solids in the imported water exceeds 25 parts per million; (4) restriction of vehicular travel within basins; (5) scarification of surface soils by chiseling or discing; and (6) removal of silt accumulations by mechanical means.

Well Fields - The North Canal, Sycamore, and Tejon Well Fields are associated with the previously described spreading works and include 72 wells. Energy to operate the wells is supplied through District operated 12 kv power distribution facilities.

District wells are of the rotary, gravel envelope type of construction. Each well is equipped with 16-inch diameter casing, a 6 or 7-stage pump bowl assembly and a 300 to 400 hp electrically powered motor. The wells range in depth from 750 to 1,078 feet with pump bowl settings varying from 450 to 600 feet. The individual pumping units are designed to produce approximately 4 cfs at a total pumping head of approximately 450 feet.

The North Canal Spreading Works is comprised of 9 wells, all of which are located within the facility boundaries. The Sycamore Well Field is comprised of a total of 33 wells, 26 of which are located within the spreading works, and the remainder being located west of and adjacent to the Sycamore Spreading Works. The Tejon Well Field consists of 25 wells, 20 of which are located within the spreading works area, and 5 are located outside the peripheral dikes. In addition to the 67 wells included in the North Canal Spreading Works, Sycamore, and Tejon Fields, 5 wells of similar design are located along the Arvin-Edison Canal in the northern area of the District, bringing the total number of District wells to 72.

PROJECT ACCOMPLISHMENTS

Project operations commenced in July 1966, with the first diversions of water to the

Sycamore Spreading Works. Since that time, over 5.5 million acre-feet of water has been imported by the District. At the end of the 2000 Water Year, nearly 1.6 million acre-feet of water had been percolated to the underground and over 4.3 million acre-feet had been delivered directly to surface water users.

No significant groundwater extractions were made by the District prior to 1968. Beginning in March 1968, it became necessary to operate District wells for the first time to supplement the available surface water supply. Figures 7 and 8 reflect the history of percolation and extractions from the District's spreading and water recovery facilities.

Groundwater level fluctuations in an observation well located approximately one-quarter mile north of Sycamore Spreading Works are illustrated in Figure 9. Heavy extractions of groundwater were required to maintain firm water service during the 1972, 1976, 1977, 1987-92, and 1994 Water Years, during which the District's imported water supply was severely reduced. Such extractions were responsible for the sharp draw-down in water levels indicated to have occurred during those years.

As a result of the accumulation of nearly 500,000 acre-feet of water in groundwater storage achieved by the end of the 1980 Water Year, and the availability of additional quantities of firm water as a result of the Cross Valley Canal Exchange, the District increased its annual firm water service commitment to approximately 160,300 acre-feet.

The estimated net percolation (i.e., diversions to spreading less evaporation), ground water extraction, accumulation of groundwater storage and direct delivery of imported surface water which have occurred since 1966 are summarized by water year in Figure 7.

Stabilization of Groundwater Levels - The effect of District operations, which were initiated in July 1966, is reflected by a general stabilization of groundwater levels, as graphically illustrated in Figure 10. The water level decline shown to have occurred during the pre-project period represents a continuation of the average annual long-term decline in groundwater levels of 7 to 8.5 feet per year throughout most of the District. Under non-project conditions, it is estimated that by the end of the 2002 Pumping Season average groundwater levels in the Arvin-Edison area would have exceeded 590 feet. A review of project versus non-project conditions is presented in Figure 10 and a hydrologic inventory in Figure 11.

The effect of the project operations has been to provide a firm surface water supply to a large number of irrigators whose well supply was failing or who were pumping groundwater of unsatisfactory quality. In addition, the importation of a substantial quantity of surface water since the inception of District operations has resulted in a reduction in subsurface inflow from neighboring areas and a significant improvement in both groundwater depths and water quality for those irrigators in the District who continue to rely on groundwater.

ARVIN-EDISON/METROPOLITAN WATER MANAGEMENT PROGRAM

In December 1997, the District entered into a 25-year agreement with the Metropolitan Water District of Southern California (MWD), in which the District agreed to bank approximately 250,000 AF of MWD State Water Project Supply and return said water in certain drought years. Said water will be returned during off-peak times so as not to interfere with normal, historic District operations. In order to accomplish this program, nearly $25 million in new facilities are under construction, which includes 500 acres of new spreading, 15 new groundwater wells, and a 4½ mile, bi-directional intertie pipeline connecting the terminus of the District's south canal with the California Aqueduct, construction of which was completed in 2002. The District will utilize the new facilities to firm up its own water supplies as well as for effecting banking programs for others. Funding for the new construction is accomplished by the collection of water management fees as water is banked for and returned to MWD. With construction generally completed, the District now is able to utilize a total of 72 groundwater wells and close to 1,500 acres of spreading basins.

FIGURE 7

ARVIN-EDISON WATER STORAGE DISTRICT

PROJECT OPERATIONS SUMMARY - 1966 TO 2002

(Values in acre-feet)

Water Year	Imported Water Supply	Deliveries to Water Users	Underground Storage						Losses and Metering Inaccuracy
			Gross Spreading	Evapora-ration	Net Percolation	Extractions	Change	Cumulative	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1966	39,008	0	42,137	735	41,402	0	41,402	41,402	-3,129
1967	83,851	17,867	64,903	1,239	63,664	0	63,664	105,066	1,081
1968	61,015	63,940	5,550	93	5,457	11,374	-5,917	99,149	2,899
1969	199,996	95,251	110,844	3,016	107,828	447	107,381	206,530	-5,652
1970	131,764	104,210	28,565	572	27,993	85	27,908	234,438	-926
1971	146,753	100,625	45,425	1,208	44,217	32	44,185	278,623	735
1972	53,420	104,626	309	3	306	52,659	-52,353	226,270	1,144
1973	181,590	119,128	65,824	2,018	63,806	769	63,037	289,307	-2,593
1974	199,845	133,996	66,121	1,885	64,236	1,725	62,511	351,818	1,453
1975	202,664	138,599	69,557	1,928	67,629	3,642	63,987	415,805	-1,850
1976	108,777	148,374	5,290	45	5,245	49,875	-44,630	371,175	4,988
1977	31,563	107,067	0	0	0	81,979	-81,979	289,196	6,475
1978	182,916	123,040	62,603	1,959	60,644	2,922	57,722	346,918	195
1979	225,942	148,438	74,613	1,815	72,798	308	72,490	419,408	3,199
1980	224,093	154,104	76,532	2,219	74,313	27	74,286	493,694	-6,516
1981	172,139	152,673	20,649	432	20,217	14,599	5,618	499,312	13,416
1982	234,004	137,517	90,150	2,794	87,356	12	87,344	586,656	6,349
1983	182,325	135,762	50,038	2,154	47,884	6,560	41,324	627,980	3,085
1984	166,632	148,175	16,428	347	16,081	9,321	6,760	634,740	11,350
1985	158,211	141,865	10,156	263	9,893	11,892	-1,999	632,741	18,082
1986	214,124	139,176	73,268	3,174	70,094	5,660	64,434	697,175	7,340
1987	125,964	140,339	2,156	149	2,007	24,332	-22,325	674,850	7,801
1988	114,157	139,541	2,907	152	2,755	33,742	-30,987	643,863	5,451
1989	119,680	148,095	6,066	159	5,907	36,278	-30,371	613,492	1,797
1990	60,242	149,969	2,403	62	2,341	99,152	-96,811	516,681	7,022
1991	36,795	113,312	173	3	170	80,544	-80,374	436,307	3,854
1992	66,042	132,682	9,469	216	9,253	84,483	-75,230	361,077	8,374
1993	260,847	130,681	122,917	2,516	120,401	6,595	113,806	474,883	13,844
1994	89,802	137,277	13,031	192	12,839	75,279	-62,440	412,443	14,773
1995	282,567	135,481	112,971	3,745	109,226	1,095	108,131	520,574	35,210
1996	231,831	147,303	57,539	3,433	54,106	0	54,106	574,680	26,989
1997	258,232	149,338	73,403	2,409	70,994	0	70,994	645,674	35,491
1998	213,197	114,123	82,360	4,904	77,456	681	76,775	722,449	17,395
1999	251,342	151,376	87,179	6,639	80,540	1,049	79,491	801,940	13,836
2000	257,207	143,549	101,950	4,552	97,398	5,427	91,971	893,911	17,135
2001	47,206	153,343	2,737	180	2,557	117,608	-115,051	778,860	8,734
2002	99,001	148,054	9,090	326	8,764	80,519	-71,755	707,105	***22,376***
	5,714,744	4,648,896	1,665,313	57,536	1,607,777	900,672	707,105		301,207

NOTES:

4/28/03

(1) Water Year - March through February of the following year.

(2) Total imported supply - all sources

(3) Metered deliveries to turnouts

(4) Measured deliveries to spreading basins

(5) Calculated from wetted area and measured pan evaporation

(6) Col 4 - Col 5

(7) Metered wellfield production plus farm wells

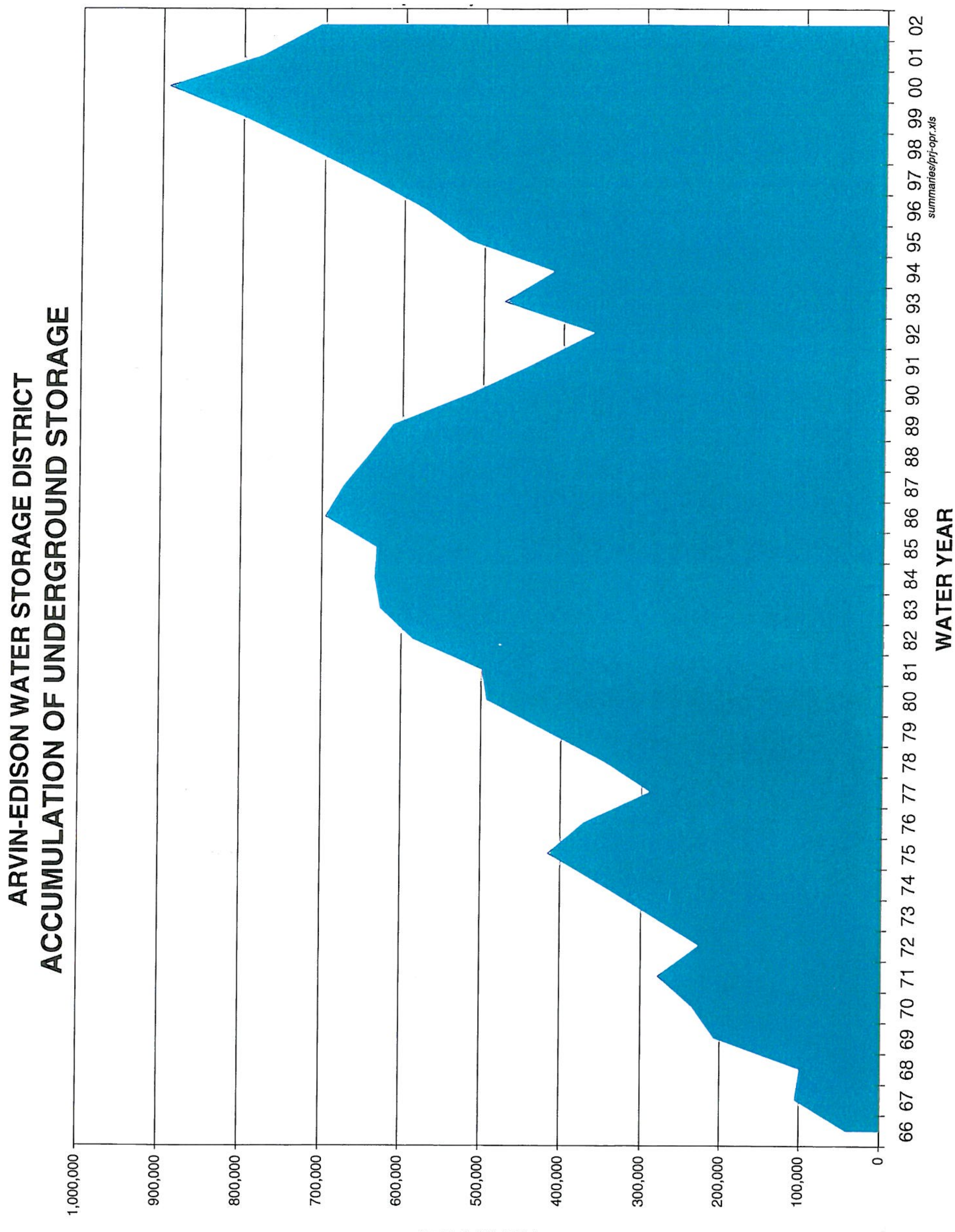
(8) Col 6 - Col 7

(9) Accumulated Col 7

(10) Col 2 + Col 7 - Col 3 - Col 4

22,376 INCLUDES DELIVERIES TO AQUEDUCT TURNOUT OF 11,483 AF

FIGURE 8


ARVIN-EDISON WATER STORAGE DISTRICT
ACCUMULATION OF UNDERGROUND STORAGE
ACRE-FEET
0
100,000
200,000
300,000
400,000
500,000
600,000
700,000
800,000
900,000
1,000,000
WATER YEAR
66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02
summaries/prj-opr.xls

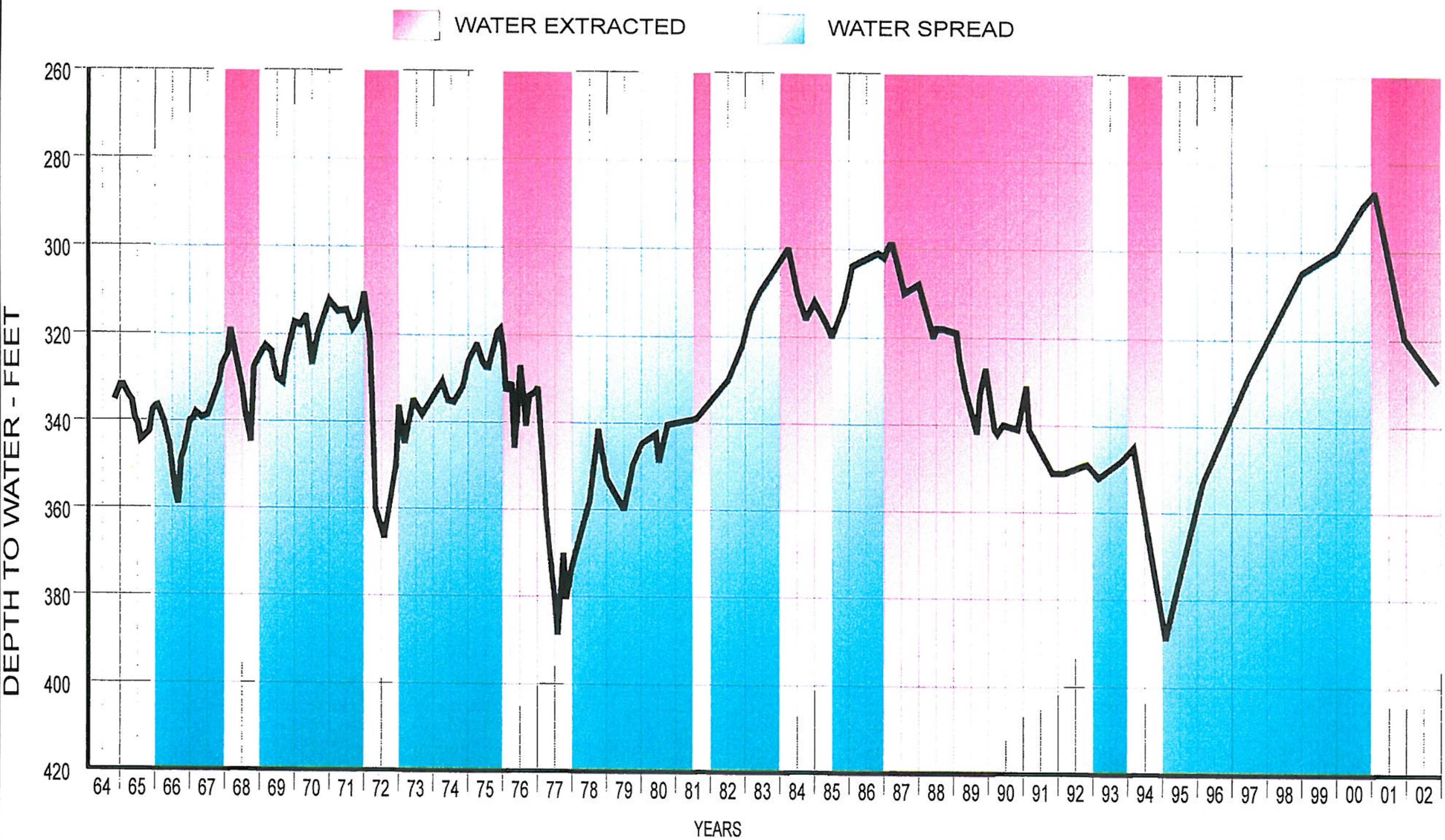


FIGURE 9: HYDROGRAPH OF WATER LEVEL FLUCTUATIONS
IN AN OBSERVATION WELL NEAR SYCAMORE SPREADING WORKS

SUMMARY

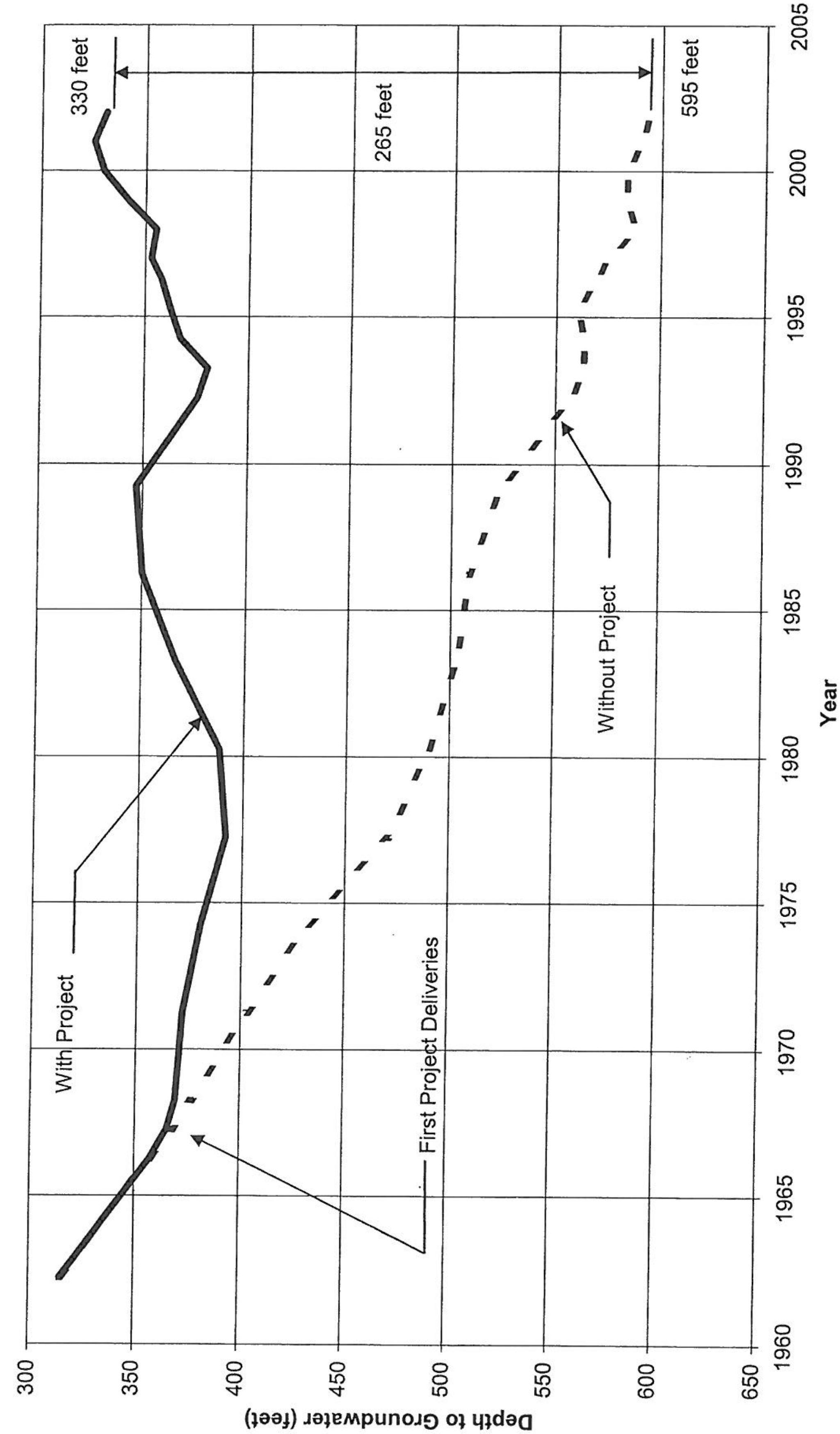
The Arvin-Edison Water Storage District is operating a project which embodies the somewhat unique concept of managing an erratic surface water supply in conjunction with existing groundwater reserves through the utilization of underground storage. Furthermore, the District continues to be actively engaged in securing new banking and exchange programs to better mitigate the effects of this variable water supply. In so doing the District has been able to provide firm water service to its surface water users while stabilizing groundwater supplies for those of its landowners who continue to depend upon that underground source. The project concept and facilities have now been successfully tested over a period of time, which has included years of both maximum and minimum imported water supplies. Achievement of full firm water service for the 52,000-acre Surface Water Service Area depends upon the year by year magnitude of imported water supplies under the District's Federal water service and exchange agreements as well as the acceptability of that water for spreading. Therefore, the occurrence of future wet years may enable additional increases in firm water service and will be another step forward in achieving the objectives of the project.

FIGURE 10

Arvin-Edison Water Storage District

Attachment 1

Average Static Groundwater Depth in District

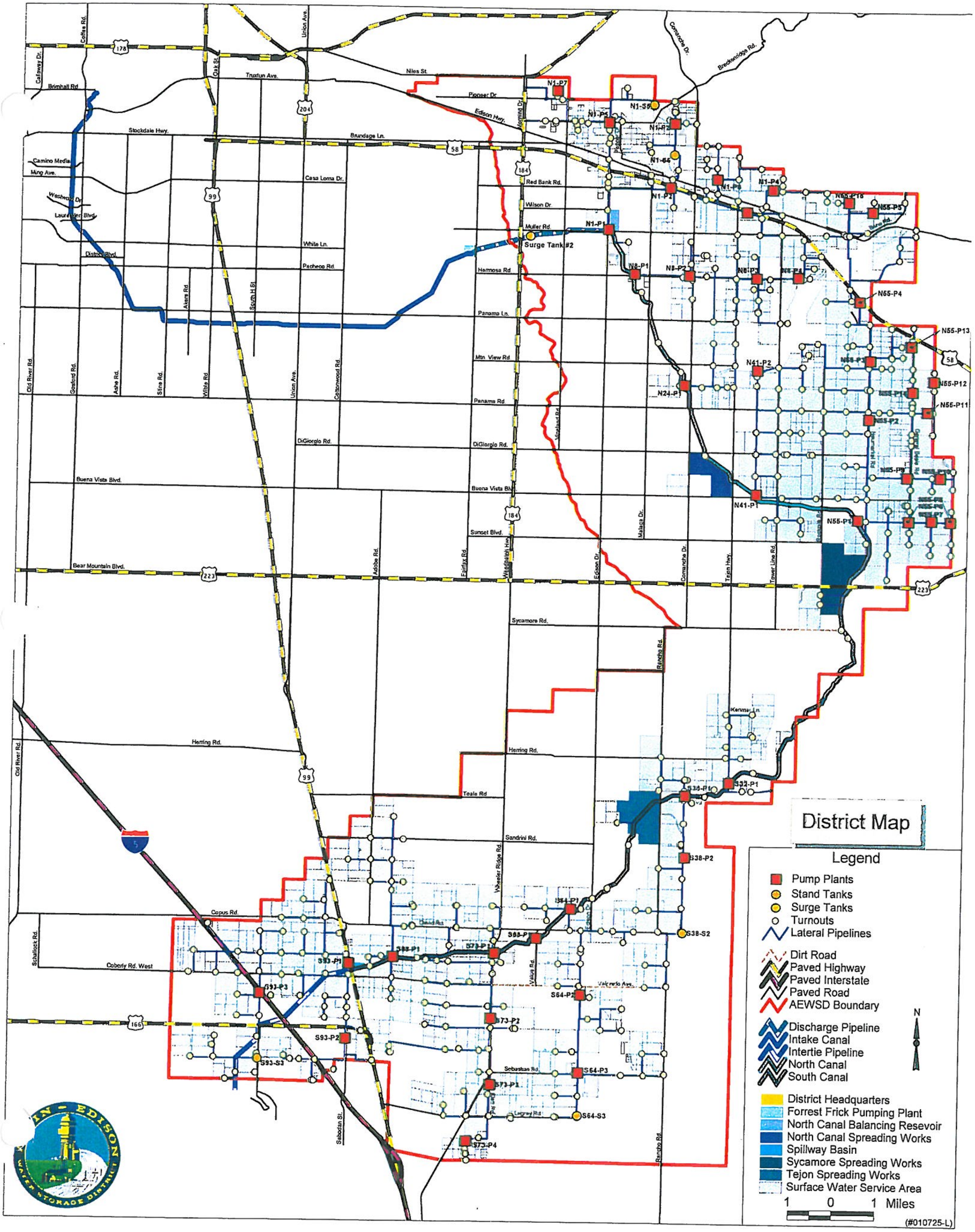


ARVIN-EDISON WATER STORAGE DISTRICT

FIGURE 11: HYDROLOGIC INVENTORY

ITEMS OF SUPPLY	PROJECT	NON-PROJECT
	(acre-feet per year)	
Effective Precipitation	19,000	19,000
Surface Inflow	22,000	22,000
Subsurface Inflow	60,000	103,000
Import	164,000	0
Subtotal	265,000	144,000
ITEMS OF DISPOSAL		
Surface Outflow	4,000	4,000
Evaporation	1,000	1,000
Consumptive Use	265,000	265,000
Subtotal	270,000	270,000
SUPPLY MINUS DISPOSAL	-5,000	-126,000
AVERAGE ANNUAL CHANGE IN GROUNDWATER LEVEL	-0.1 ft	-7.4 ft

SAIC 9/13/2002


District Map
Legend
Pump Plants
Stand Tanks
Surge Tanks
Turnouts
Lateral Pipelines
Dirt Road
Paved Highway
Paved Interstate
Paved Road
AEWSD Boundary
Discharge Pipeline
Intake Canal
Intertie Pipeline
North Canal
South Canal
District Headquarters
Forrest Frick Pumping Plant
North Canal Balancing Resevoir
North Canal Spreading Works
Spillway Basin
Sycamore Spreading Works
Tejon Spreading Works
Surface Water Service Area
1 0 1 Miles
N
(#010725-L)
Niles St.
Pioneer Dr.
Edison Hwy.
Brundage Ln.
Stockdale Hwy.
Truxtun Ave.
Brimhall Rd
Casa Loma Dr.
Red Bank Rd.
Wilson Dr.
Muller Rd.
White Ln.
Pacheco Rd.
Hermosa Rd.
Panama Ln.
Mtn View Rd.
Panama Rd.
DiGiorgio Rd.
Buena Vista Blvd.
Sunset Blvd.
Bear Mountain Blvd.
Sycamore Rd.
Herring Rd.
Teale Rd
Sandrini Rd.
Copus Rd.
Coberly Rd. West
Sebastian Rd.
Comanche Dr.
Breckenridge Rd.
Old River Rd.
Union Ave.
Cottonwood Rd.
Adobe Rd.
Wheeler Ridge Rd.
Edison Dr.
Malaga Dr.
Tejon Hwy.
Tower Line Rd.
Rancho Rd.
Sabodan St.
Schallock Rd.
Surge Tank #2
N1-P1
N1-P2
N1-P4
N1-P7
N8-P1
N8-P2
N24-P1
N41-P1
N41-P2
N55-P1
N55-P2
N55-P4
N55-P5
N55-P11
N55-P12
N55-P13
S32-P1
S38-P2
S38-S2
S64-P1
S64-P2
S64-P3
S64-S3
S73-P1
S73-P2
S73-P4
S93-P1
S93-P2
S93-P3
S93-S3
178
204
58
184
99
223
166
5

APPENDIX C

ARVIN TILLER

Published: Wednesday, December 25, 2002, and Wednesday, January 1, 2003

PUBLIC NOTICE

ARVIN-EDISON WATER STORAGE DISTRICT

NOTICE OF PROPOSED RESOLUTION OF INTENTION
TO DRAFT A GROUNDWATER MANAGEMENT PLAN

NOTICE IS HEREBY GIVEN that at 12:00 pm on January 14, 2003, at 20401 Bear Mountain Boulevard, Arvin, California, a public hearing will be held to discuss whether or not Arvin-Edison Water Storage District should adopt a resolution of intention to draft a groundwater management plan.

Part 2.75 of Division 6 of the California Water Code permits the adoption and implementation of groundwater management plans to encourage authorized local agencies to manage groundwater resources within their service areas. The Arvin-Edison Water Storage District is an authorized local agency covering all or portions of the following lands:

TOWNSHIP	RANGE	M.D.B.&M.	SECTIONS
T. 29 S.	R. 28 E.	"	25-27,34,35,36
T. 29 S.	R. 29 E.	"	28,30-34
T. 30 S.	R. 28 E.	"	1,12,13
T. 30 S.	R. 29 E.	"	1-36
T. 30 S.	R. 30 E.	"	7-9, 16-20,27-34
T. 31 S.	R. 29 E.	"	1-17, 20-28,34-36
T. 31 S.	R. 30 E.	"	3-10, 15-21, 22,28-32
T. 32 S.	R. 28 E.	"	13,21-29,31-36
T. 32 S.	R. 29 E.	"	1-5,7-23,26-35
T. 32 S.	R. 30 E.	"	6,7,18
T. 11 N.	R. 18 W.	**S.B.B&M.**	5-8,17-20
T. 11 N.	R. 19 W.	"	1-24
T. 11 N.	R. 20 W.	"	1-5, 8-12, 14-17
T. 12 N.	R. 18 W.	"	29-31,32
T.12 N.	R. 19 W.	"	25-36
T. 12 N.	R. 20 W.	"	25-29,32-36

Landowners within the Arvin-Edison Water Storage District and other interested parties are invited to attend the hearing. Copies of the proposed resolution and other relevant written materials will be available for review by the public at the hearing or may be obtained in advance at the District office, 20401 Bear Mountain Boulevard, Arvin, California. Opportunity for public questions/ input will be provided at the hearing.

In compliance with Water Code §10753.4 (b), landowners and other interested parties who wish to participate in developing the groundwater management plan may do so by attending the hearing, and indicating their interest, or by submitting a written letter to Engineer Manager Steven Collup, Arvin-Edison Water Storage District, P.O. Box 175, Arvin, California. 93203-0175.

Dated this 20th day of December 2002.

(District Seal)

Secretary of the Board of Directors

BAKERSFIELD CALIFORNIAN

Published: Tuesday, December 24, 2002, and Tuesday, December 31, 2002

ARVIN-EDISON WATER STORAGE DISTRICT

NOTICE OF PROPOSED RESOLUTION OF INTENTION TO DRAFT A GROUNDWATER MANAGEMENT PLAN

NOTICE IS HEREBY GIVEN that at 12:00 pm on January 14, 2003, at 20401 Bear Mountain Boulevard, Arvin, California, a public hearing will be held to discuss whether or not Arvin-Edison Water Storage District should adopt a resolution of intention to draft a groundwater management plan.

Part 2.75 of Division 6 of the California Water Code permits the adoption and implementation of groundwater management plans to encourage authorized local agencies to manage groundwater resources within their service areas. The Arvin-Edison Water Storage District is an authorized local agency covering all or portions of the following lands:

TOWNSHIP	RANGE	M.D.B.&M.	SECTIONS
T. 29 S.	R. 28 E.	"	25-27,34,35,36
T. 29 S.	R. 29 E.	"	28,30-34
T. 30 S.	R. 28 E.	"	1,12,13
T. 30 S.	R. 29 E.	"	1-36
T. 30 S.	R. 30 E.	"	7-9, 16-20,27-34
T. 31 S.	R. 29 E.	"	1-17, 20-28,34-36
T. 31 S.	R. 30 E.	"	3-10, 15-21, 22,28-32
T. 32 S.	R. 28 E.	"	13,21-29,31-36
T. 32 S.	R. 29 E.	"	1-5,7-23,26-35
T. 32 S.	R. 30 E.	"	6,7,18
T. 11 N.	R. 18 W.	S.B.B&M.	5-8,17-20
T. 11 N.	R. 19 W.	"	1-24
T. 11 N.	R. 20 W.	"	1-5, 8-12, 14-17
T. 12 N.	R. 18 W.	"	29-31,32
T.12 N.	R. 19 W.	"	25-36
T. 12 N.	R. 20 W.	"	25-29,32-36

Landowners within the Arvin-Edison Water Storage District and other interested parties are invited to attend the hearing. Copies of the proposed resolution and other relevant written materials will be available for review by the public at the hearing or may be obtained in advance at the District office, 20401 Bear Mountain Boulevard, Arvin, California. Opportunity for public questions/ input will be provided at the hearing.

In compliance with Water Code §10753.4 (b), landowners and other interested parties who wish to participate in developing the groundwater management plan may do so by attending the hearing, and indicating their interest, or by submitting a written letter to Engineer Manager Steven Collup, Arvin-Edison Water Storage District, P.O. Box 175, Arvin, California. 93203-0175.

Dated this 20th day of December, 2002.

(District Seal)

Secretary of the Board of Directors

The BAKERSFIELD CALIFORNIAN
P.O. BOX 440
BAKERSFIELD, CA 93302

PROOF OF PUBLICATION

RECEIVED
MAY 28 2003
A.E.W.S.D.

Ad Number	857305	**PO #**	PUBLIC HEAJ
Edition	TBC	**Run Times**	2
Class Code	2620	Legal Notices	
Start Date	5/18/03	**Stop Date**	5/25/03
Run Date(s)	05/18,25		
Billing Lines	100	**Inches**	8.33
Total Cost	330.00	**Account**	1AEW10
Billing Address	ARVIN EDISON WATER STORAGE DISTR PO BOX 175 ARVIN CA 93203		
Solicitor I.D.:	C010		

ARVIN EDISON WATER STORAGE DISTR
PO BOX 175

ARVIN CA 93203

--

STATE OF CALIFORNIA
COUNTY OF KERN

I AM A CITIZEN OF THE UNITED STATES AND A RESIDENT OF THE COUNTY AFORESAID: I AM OVER THE AGE OF EIGHTEEN YEARS, AND NOT A PARTY TO OR INTERESTED IN THE ABOVE ENTITLED MATTER. I AM THE ASSISTANT PRINCIPAL CLERK OF THE PRINTER OF THE BAKERSFIELD CALIFORNIAN, A NEWSPAPER OF GENERAL CIRCULATION, PRINTED AND PUBLISHED DAILY IN THE CITY OF BAKERSFIELD COUNTY OF KERN,

AND WHICH NEWSPAPER HAS BEEN ADJUDGED A NEWSPAPER OF GENERAL CIRCULATION BY THE SUPERIOR COURT OF THE COUNTY OF KERN, STATE OF CALIFORNIA, UNDER DATE OF FEBRUARY 5, 1952, CASE NUMBER 57610; THAT THE NOTICE, OF WHICH THE ANNEXED IS A PRINTED COPY, HAS BEEN PUBLISHED IN EACH REGULAR AND ENTIRE ISSUE OF SAID NEWSPAPER AND NOT IN ANY SUPPLEMENT THEREOF ON THE FOLLOWING DATES, TO WIT:

05/18,25

ALL IN THE YEAR 2003

I CERTIFY (OR DECLARE) UNDER PENALTY OF PERJURY THAT THE FOREGOING IS TRUE AND CORRECT.

DATED AT BAKERSFIELD CALIFORNIA
May 25, 2003

First Text
ArvinEdison Water Storage DistrictNOTICE

Ad Number 857305

Arvin-Edison Water Storage District

NOTICE OF PUBLIC HEARING

NOTICE IS HEREBY GIVEN that at 1:00 p.m. on June 5, 2003 at the Arvin-Edison Water Storage District Office at 20401 Bear Mountain Blvd., Arvin, California, the Board of Directors of the Arvin-Edison Water Storage District will hold a public hearing to receive comment concerning whether the District should adopt a groundwater management plan (Plan) pursuant to Division 6, Part 2.75 of the California Water Code.

The District covers approximately 132,000 acres wholly within Kern County and is situated at the extreme southern end of the San Joaquin Valley of California, approximately 14 miles southeast of the City of Bakersfield and lies just south of Highway 58 on the southern side of the Kern River. A description of the precise boundaries of the Arvin-Edison Water Storage District is available at the District office.

The goal of the Plan is to continue implementation of effective groundwater management that works towards maintaining a high quality and dependable water resource for the District's water users and landowners while minimizing negative impacts to other affected parties. Upon its adoption, this goal will be pursued through the implementation of specific programs listed within the Plan. The initial programs will include continuation of existing monitoring and reporting programs of groundwater levels and groundwater quality, as well as continued operation and maintenance of existing water management, conjunctive use, and groundwater storage facilities. The District will continue to cooperate with other regulatory agencies that have a responsibility and/or interest in groundwater matters within the District.

As the need arises, other components of the Plan that may be implemented include additional measures to mitigate conditions of overdraft and facilitate conjunctive use of groundwater and surface water supplies, including the construction of additional groundwater management facilities. Arvin-Edison Water Storage District will develop rules and regulations to implement the Plan if it is adopted, and will consider the potential impact of those rules and regulations on business activities, including agricultural operations, and to the extent practicable and consistent with the protection of the groundwater resources, minimize any adverse impacts on those business activities.

The preceding is a summary of the Plan only. Interested parties may obtain a copy of the Plan for the cost of reproduction at the District Office located at the above address.

In addition, on June 5, 2003, the District will also hold a separate discussion regarding a proposed 90 acre expansion of the Sycamore Spreading Works and a proposed 30 acre expansion of the N-1 Balancing Reservoir, two projects to be submitted for grant funding under Proposition 13.

/s/John C. Moore
John C. Moore,
Secretary/Treasurer
Of the Board of Directors
May 18, 25, 2003 (#857305)

PROOF OF PUBLICATION

(2015.5 C.C.P.)
(GENERAL FORM)

STATE OF CALIFORNIA }
County of Kern } ss.

I, the undersigned, am a citizen of the United States and a resident of the County aforesaid: I am over the age of eighteen years, and not a party to or interested in the above entitled matter. I am the chief clerk/publisher of *The Arvin Tiller*, a newspaper of general circulation, printed and published weekly, in the City of Arvin, County of Kern, and which newspaper has been adjudged a newspaper of general circulation by the Superior Court, order number 37403, of the County of Kern; that the notice, of which the annexed is a printed copy, has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to-wit:

May 21, 28, 2003

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

Diane Givens
(Signature)

Executed on May 28, 2003
at Arvin, California

The ARVIN TILLER
P.O. Box 548 Phone (661) 845-3704
LAMONT. CALIFORNIA 93241

PUBLIC NOTICE

ARVIN-EDISON WATER STORAGE DISTRICT
NOTICE OF PUBLIC HEARING

NOTICE IS HEREBY GIVEN that at 1:00 p.m. on June 5, 2003 at the Arvin-Edison Water Storage District Office at 20401 Bear Mountain Blvd., Arvin, California, the Board of Directors of the Arvin-Edison Water Storage District will hold a public hearing to receive comment concerning whether the District should adopt a groundwater management plan (Plan) pursuant to Division 6, Part 2.75 of the California Water Code.

The District covers approximately 132,000 acres wholly within Kern County and is situated at the extreme southern end of the San Joaquin Valley of California, approximately 14 miles southeast of the City of Bakersfield and lies just south of Highway 58 on the southern side of the Kern River. A description of the precise boundaries of the Arvin-Edison Water Storage District is available at the District office.

The goal of the Plan is to continue implementation of effective groundwater management that works towards maintaining a high quality and dependable water resource for the District's water users and landowners while minimizing negative impacts to other affected parties. Upon its adoption, this goal will be pursued through the implementation of specific programs listed within the Plan. The initial programs will include continuation of existing monitoring and reporting programs of groundwater levels and groundwater quality, as well as continued operation and maintenance of existing water management, conjunctive use, and groundwater storage facilities. The District will continue to cooperate with other regulatory agencies that have a responsibility and/or interest in groundwater matters within the District.

As the need arises, other components of the Plan that may be implemented include additional measures to mitigate conditions of overdraft and facilitate conjunctive use of groundwater and surface water supplies, including the construction of additional groundwater management facilities.

Arvin-Edison Water Storage District will develop rules and regulations to implement the Plan if it is adopted, and will consider the potential impact of those rules and regulations on business activities, including agricultural operations, and to the extent practicable and consistent with the protection of the groundwater resources, minimize any adverse impacts on those business activities.

The preceding is a summary of the Plan only. Interested parties may obtain a copy of the Plan for the cost of reproduction at the District Office located at the above address.

In addition, on June 5, 2003, the District will also hold a separate discussion regarding a proposed 90 acre expansion of the Sycamore Spreading Works and a proposed 30 acre expansion of the N-1 Balancing Reservoir; two projects to be submitted for grant funding under Proposition 13.

/s/ John C. Moore, Secretary/Treasurer
Of the Board of Directors
Publish *Arvin Tiller* May 21, 28, 2003

APPENDIX D

BEFORE THE BOARD OF DIRECTORS OF
ARVIN-EDISON WATER STORAGE DISTRICT

IN THE MATTER OF: RESOLUTION NO. 03-01

OF INTENTION OF THE ARVIN-EDISON WATER STORAGE DISTRICT
TO DRAFT A GROUNDWATER MANAGEMENT PLAN

WHEREAS, adoption of a Groundwater Management Plan is in furtherance of and consistent with the District's adopted project approved by the landowners and the historic operations of the District; and

WHEREAS, Part 2.75 of Division 6 of the California Water Code permits the adoption and implementation of groundwater management plans to encourage authorized local agencies to manage groundwater resources within their service areas; and

WHEREAS, the Arvin-Edison Water Storage District (the "District") is an authorized local agency and may therefore adopt and implement such a groundwater management plan; and

WHEREAS, a public hearing was held on January 14, 2003, to discuss the adoption and implementation of a groundwater management plan; and

WHEREAS, the Board believes the groundwater can best be managed, as in the past, by local agencies in coordination with owners of lands overlying the groundwater basin; and

WHEREAS, the Board believes the adoption of a groundwater management plan will be in the best interests of the District's landowners and water users and can help meet the projected long-term water needs of the District;

BE IT RESOLVED, by the Board of Directors as follows:

The foregoing findings are true and correct:

1. It is the intention of the District to draft a groundwater management plan in accordance with Part 2.75 of Division 6 of the California Water Code, and the District's consultant is hereby authorized and directed to draft such a plan;

2. That this resolution shall be deemed a resolution of intention in accordance with California Water Code Section 10753.2;

3. After such a plan has been prepared, the District will conduct a second public hearing in accordance with the California Water Code Section 10753.5, et seq. to determine whether to adopt the plan;

4. That the Engineer-Manager and the Assistant Manager are authorized and directed to publish this resolution of intention to draft a groundwater management plan in accordance with the provisions of California Water Code Section 10753.3 and to provide interested persons with a copy of this resolution upon written request;

5. That the Board hereby authorizes its Engineer-Manager and Assistant Manager to execute all documents and take any other action necessary or advisable to carry out the purposes of this resolution.

All the foregoing being on motion of Director, Valpredo seconded by Director, Giumarra and authorized by the following vote, to wit:

AYES: Directors' Frick, Giumarra, Moore, Fanucchi, Johnston, Fry, and Valpredo.

NOES: None

ABSTAIN: None

ABSENT: Directors' Camp and Lehr.

I HEREBY CERTIFY that the foregoing resolution is the resolution of said District as duly passed and adopted by said Board of Directors on the 14th day of January 2003.

WITNESS my hand and seal of said Board of Directors this 14th day of January 2003.

JOHN C. MOORE
Secretary-Treasurer
of the Board of Directors

ARVIN-EDISON WATER STORAGE DISTRICT

CERTIFICATE OF ASSISTANT SECRETARY-TREASURER

OF THE BOARD OF DIRECTORS

I, DAVID A. NIXON, Assistant Manager/Assistant Secretary-Treasurer of the Board of Directors of Arvin-Edison Water Storage District, hereby certify that the foregoing is a full, true, and correct copy of Resolution No. 03-01, OF INTENTION OF THE ARVIN-EDISON WATER STORAGE DISTRICT TO DRAFT A GROUNDWATER MANAGEMENT PLAN.

I further certify that the original resolution has not been amended, modified, or rescinded in any manner since the date of its adoption.

In Witness Whereof, I have executed this certificate and affixed the seal of Arvin-Edison Water Storage District hereto this 4th day of March, 2003.

David A. Nixon
Assistant Manager/Assistant Secretary-Treasurer

APPENDIX E

MINUTES OF THE MEETING

OF THE BOARD OF DIRECTORS OF

ARVIN-EDISON WATER STORAGE DISTRICT

JANUARY 14, 2003

President Howard Frick called to order the regular meeting of the Board of Directors of Arvin-Edison Water Storage District at the hour of 12:10 p.m., in the Board Room of District Headquarters, at 20401 Bear Mountain Boulevard, Arvin, California, with a quorum of the Board being then and there present, to wit:

Howard Frick, President
Salvador Giumarra, Vice President
John C. Moore, Secretary-Treasurer
Charles Fanucchi
Don Johnston
George Fry
Donald Valpredo

There were two absent Directors to wit:

Edwin Camp
Ronald Lehr

District staff present:

Steven C. Collup, Engineer-Manager
David A. Nixon, Assistant Manager/Assistant Secretary-Treasurer
Steve Lewis, Staff Engineer
Chris P. Krauter, General Superintendent

District consultants present:

Ernest Conant, District Legal Counsel
Scott Kuney, District Legal Counsel (departed @ 12:50 p.m.)
Norm Hile, District Legal Counsel (Via Conference Call @ 12:15 p.m. and ended @ 12:50 p.m.)
Michael J. Day, P.E., Provost & Pritchard Engineering Group, Inc.
Richard St.Claire, Provost & Pritchard Engineering Group, Inc.

Visitors and guests present:

Rick Iger, Kern County Water Agency (arrived @ 12:50 p.m. and departed @ 2:05 p.m.)

RECOGNITION OF VISITORS AND GUESTS

Mr. Frick requested that the order of the agenda be changed; if necessary, to facilitate the schedule and departure times of guests, consultants and board members. The Board unanimously agreed. Mr. Frick then stated that Rick Iger of the Kern County Water Agency is expected to be in attendance at today's scheduled public hearing on the District's Draft Groundwater Management Plan.

PUBLIC COMMENT

There was no public comment.

ACCEPTANCE OF THE MINUTES OF THE BOARD OF DIRECTORS' MEETING HELD ON DECEMBER 10, 2002

Mr. Collup stated that there is a change on Page 5 of the minutes on the second line from the bottom the word "tired" should be "tiered." The minutes of the Board of Directors' meeting were then approved on the motion of Director Valpredo, seconded by Director Johnston, and unanimously carried that the minutes from the December 10, 2002, Board of Directors' meeting be approved after the change is made to Page 5.

ACCEPTANCE OF THE DISTRICT TREASURER'S REPORT FOR DECEMBER 31, 2002, AND REVIEW OF DELINQUENCY LIST

Mr. Nixon briefly summarized the Treasurer's Report for December 31, 2002, stating that the District held cash and investments totaling $22,835,417 with a current average yield on invested funds of approximately 2.30%. Mr. Nixon then stated that as of January 8, 2003, the total delinquent amounts due the District were $117,737. Director Fanucchi motioned, seconded by Director Giumarra, and unanimously carried that the District Treasurer's Report for December 31, 2002, be approved, as mailed. Mr. Nixon then stated that the District is currently being audited for the approximately $2,000,000 in FEMA grants the District received for 1998 flood damage irrigation.

RESOLUTION NO. 03-02, ORDERING PAYMENT OF ACCOUNTS AND CLAIMS (December 2002, WARRANT NUMBERS 13859 THROUGH 14004)

Mr. Collup stated that included in this month's payments is $1,230,486.12 to W.M. Lyles Company for liner repair. Mr. Collup also stated that the total amount of the project is $1,417,206.80 with retention and remaining work still to be paid. Mr. Nixon then presented a form of resolution whereupon Director Fanucchi motioned, seconded by Director Giumarra, and unanimously carried that Resolution No. 03-02, ORDERING PAYMENT OF ACCOUNTS AND CLAIMS (December 2002, Warrant Numbers 13859 through 14004), be adopted. A copy of Resolution No. 03-02 is on file in the Resolution book and is hereby made apart of these minutes.

CLOSED SESSION (§54956.9 CONFERENCE WITH COUNSEL REGARDING PENDING LITIGATION) INTERTIE PIPELINE CSR HYDRO CONDUIT VS. ARVIN-EDISON WATER STORAGE DISTRICT

Based on advice from Legal Counsel that the matters involved litigation currently pending with Hydro Conduit Corporation vs. Arvin-Edison Water Storage District (CIV-F-01-0630-REC-SMS), and a related counter claim, which may result in other possible litigation; therefore, discussing this agenda item in open session could cause prejudice to the District, the Board adjourned into closed session in accordance with Government Code §54956.9 at 12:15 p.m. and reconvened into regular session at 12:50 p.m.

PUBLIC HEARING REGARDING THE RESOLUTION OF INTENTION TO DRAFT A GROUNDWATER MANAGEMENT PLAN FOR THE ARVIN-EDISON WATER STORAGE DISTRICT

Ernest Conant called the hearing to order at 12:50 p.m. and introduced Rick Iger, Engineering & Operations Manager of the Kern County Water Agency and acknowledged him as the only person from the public present at the hearing. Mr. Conant then explained that the Arvin-Edison Water Storage District is conducting this hearing in order to give the public a chance to participate and comment on the Resolution of Intention to Draft a Groundwater Management Plan. Mr. Conant continued by stating that a Groundwater Management Plan is a written plan documenting existing and proposed District activities, and to monitor and manage groundwater conditions within the District boundaries for the benefit of water users, landowners, and any other affected parties. Mr. Conant then stated that this Groundwater Management Plan is drafted in accordance with AB 3030 and SB 1938 and is required to have priority to receive State funding under Propositions 13 and 50.

Michael Day of Provost & Pritchard then presented a Power Point Presentation and reviewed the District's intention as well as the process to adopt a Groundwater Management Plan, and how the public may participate. Rick Iger of the Kern County Water Agency stated that a Groundwater Management Plan is very important if this District intends to apply for State Funding under Propositions 13 or 50. Mr. Collup then expressed his appreciation to Mr. Iger and the Kern County Water Agency for their help and support in this process and other actions. There was a long discussion, and then Mr. Conant asked if there were any other comments. There being none, he declared the public hearing adjourned at 1:20 p.m.

RESOLUTION NO.03-01, RESOLUTION OF INTENTION OF ARVIN-EDISON WATER STORAGE DISTRICT TO DRAFT A GROUNDWATER MANAGEMENT PLAN

Mr. Nixon presented a form of resolution whereupon Director Valpredo motioned, seconded by Director Giumarra and unanimously carried that Resolution 03-01, RESOLUTION OF INTENTION OF ARVIN-EDSION WATER STORAGE DISTRICT TO DRAFT A GROUNDWATER MANAGEMENT PLAN, be adopted. A copy of Resolution No. 03-01 is on file in the Resolution book and is hereby made apart of these minutes.

DISCUSSION REGARDING CHANGING THE REGULARLY SCHEDULED DATE OF THE FEBRUARY BOARD OF DIRECTORS' MEETING

After a brief discussion regarding the regularly scheduled date of February 11, 2003, Board of Directors' meeting, the Board unanimously agreed to tentatively reschedule the meeting for Thursday, February 20, 2003, at 12:00 noon.

REVIEW OF DISTRICT OPERATIONS AND RELATED MATTERS

Engineer-Manager Collup briefly reviewed the Report of District Operations for December 2002, highlighting pictures of winter maintenance activities, extensive concrete liner repair, and repairs to the S64-P3 Pumping Plant.

Mr. Lewis stated December deliveries of 937 acre-feet were 48% or 854 acre-feet below the 10-year historical average. Mr. Lewis then stated that year-to-date deliveries of 140,901 acre-feet are 6% or 7,599 acre-feet above the 10-year historical average. Mr. Lewis also stated that the Tejon Wellfield was utilized in December to meet irrigation demand at the south canal with 527 acre-feet pumped. Mr. Lewis then stated that 3,103 acre-feet was spread during the month consisting of 465 acre-feet, 236 acre-feet, 2,400 acre-feet, and 2 acre-feet at N1 Ponds, North Canal Spreading Works, Sycamore Spreading Works, and the Tejon Basin respectively. Mr. Lewis further stated that the District's total water supply for the 2002 Water Year is 178,022 acre-feet with an estimated cost of $5,151,086. There was a brief discussion. Mr. Lewis then stated that the 2003 Water Year is beginning to look dry, as the water content of the snow pack in the San Joaquin Basin has dropped below average for this time of year.

Mr. Collup briefly reviewed the status of various agreements still in progress for the AE/MWD Water Management Program as well as comprehensive water quality modeling/monitoring program the District is administering, and then stated that we are currently delivering to MWD a portion of their stored groundwater. Mr. Collup continued by stating that we anticipate being able to deliver approximately 6,000 acre-feet in both January and February 2003, depending on water users demand in the south canal. The costs associated with the program were also discussed.

Mr. Collup stated that as discussed at the December Board of Directors' meeting, the District has signed a one-year agreement with Improvement District #4, and Kern Tulare/Rag Gulch Water

District.

Mr. Collup then presented to the Board bids for repaving District facilities at headquarters and at the Forrest Frick Pumping Plant:

	Kern Asphalt	Granite Construction	Griffith
Headquarters	$45,849.00	$39,094.00	$72,111.00
FFPP	$61,505.00	$51,664.00	$79,793.00
Total	$107,354.00	$90,758.00	$151,904.00

After a long discussion, Director Valpredo motioned, seconded by Director Giumarra, and carried by a majority vote with Director Fry voting no, to accept the bid of $90,758.00 from Granite Construction, Inc. to repave headquarters and the Forrest Frick Pumping Plant.

Mr. Nixon then informed the Board that KV Farms is interested in selling their 91 acre grape vineyard adjacent to the District's Sycamore Spreading Works. Mr. Nixon stated that there is a current long-term water service contract on 19 acres of the property. After a long discussion, the Board authorized staff to make an offer, but not to exceed $2,000 per acre.

RESOLUTION NO.03-03, DETERMINATION THAT NO ELECTION BE HELD ON MARCH 4, 2003, FOR DIVISIONS 2,4,6,8, AND 9; AND REQUESTING APPOINTMENT OF DIRECTORS THEREFORE

Mr. Nixon presented a form of resolution whereupon Director Fanucchi motioned, seconded by Director Fry, and unanimously carried that Resolution 03-03, DETERMINATION THAT NO ELECTION BE HELD ON MARCH 4, 2003, FOR DIVISIONS 2, 4, 6, 8, AND 9; AND REQUESTING APPOINTMENT OF DIRECTORS THEREFORE, be adopted. A copy of Resolution No. 03-03 is on file in the Resolution book and is hereby made apart of these minutes.

DISCUSSION AND POSSIBLE APPROVAL OF FINAL 2003 WATER YEAR BUDGET

Mr. Collup reviewed with the Board the procedures for the preparation of the budget, and then reviewed the 2003 Budget and Water Charges, stating that projected total cash inflow is

$15,418,000, and total cash outflow is estimated at $17,555,000 with $2,137,000 of reserves being utilized. Mr. Collup further stated that the 2003 Water Year Budget reflects an increase in the District's average "Water Use" Charges of approximately 18%, and a 2% increase in "Standby" Charges. Mr. Collup then stated that the budget also includes increasing the General Administrative and General Service Charges from $10.00 per acre to $23.00 per acre. After a long discussion regarding the cost of groundwater pumping, tiered pricing, District banking programs, and District reserves, Director Moore motioned, seconded by Director Fry, and unanimously carried to approve the 2003 Water Year Budget.

RESOLUTION NO. 03-04, FIXING SURFACE WATER SERVICE AREA STANDBY AND WATER USE CHARGES FOR THE 2003 WATER YEAR; CONSISTING OF A "STANDBY CHARGE" AND A "WATER USE CHARGE"

Mr. Nixon presented a form of resolution whereupon Director Moore motioned, seconded by Director Fry, and unanimously carried that Resolution No. 03-04, FIXING SURFACE WATER SERVICE AREA STANDBY AND WATER USE CHARGE FOR THE 2003 WATER YEAR; AND ORDERING THAT SAID CHARGES BE COLLECTED UNDER THE TERMS AND CONDITIONS AS SET FORTH IN THE WATER USER CONTRACTS, WITH THE DISTRICT'S WATER USERS AND CONTRACTORS; AND THE DISTRICT'S RULES AND REGULATIONS FOR THE DISTRIBUTION OF WATER, AND THAT DELINQUENT CHARGES AND PENALTIES SHALL CONSTITUTE A LIEN UPON THE AFFECTED REAL PROPERTY AS SET FORTH IN THE SAME, be adopted. A copy of Resolution No. 03-04 is on file in the Resolution book and is hereby made apart of these minutes.

REVIEW AND POSSIBLE APPROVAL OF 2003 MEMBERSHIP DUES TO THE WATER EDUCATION FOUNDATION IN THE AMOUNT OF $338

Mr. Nixon presented the Water Education Foundation 2003 Memberships Dues in the amount of $338. After a brief discussion, Director Giumarra motioned, seconded by Director

Fanucchi, and unanimously carried to approve the Water Education Foundation 2003 Membership Dues in the amount $338.

REVIEW AND POSSIBLE APPROVAL OF 2003 MEMBERSHIP DUES FOR THE AGRICULTURAL ENERGY CONSUMERS ASSOCIATION IN THE AMOUNT OF $5,000

Mr. Nixon presented the Agricultural Energy Consumers Association 2003 Memberships Dues in the amount of $5,000. After a brief discussion, Director Giumarra motioned, seconded by Director Fanucchi, and unanimously carried to approve the Agricultural Energy Consumers Association 2003 Membership Dues in the amount $5,000.

REVIEW AND POSSIBLE APPROVAL OF 2003 MEMBERSHIP DUES FOR THE CENTRAL VALLEY PROJECT WATER ASSOCIATION IN THE AMOUNT OF $27,892

Mr. Nixon presented the Central Valley Project Water Association 2003 Memberships Dues in the amount of $27,892. After a brief discussion, Director Giumarra motioned, seconded by Director Fanucchi, and unanimously carried to approve the Central Valley Project Water Association 2003 Membership Dues in the amount of $27,892.

CORRESPONDENCE

There was no additional correspondence.

MATTERS OF DISTRICT COUNSEL

Legal Counsel Conant advised the Board that he would like to discuss existing litigation, anticipated litigation, and real property transaction, namely: Westlands vs. Patterson, NRDC vs. Rodgers, Delta Mendota Canal Authority vs. USBR, County Sanitation District #2 of L.A. County vs. County of Kern, Guzman & Calderon vs. Arvin-Edison Water Storage District, Tejon Creek Water Rights Filing, PG&E Bankruptcy/FERC Filing, Westlands Water District's August 3, 2000, application to the State Water Resources Control Board to appropriate San Joaquin River water, which anticipated litigation may arise and personnel issues. Based on advise from Legal Counsel, discussing such matters in open session would cause prejudice to the District; therefore, the Board adjourned into closed session in accordance with Government Code §54956.9, §54956.8 and §54957.6 at 2:40 p.m., and reconvened into regular session at 3:20 p.m.

OTHER ITEMS TO BE DISCUSSED PURSUANT TO GOVERNMENT CODE SECTION §54954.2 (RELATING TO ITEMS NOT APPEARING ON THE POSTED AGENDA); AND ADJOURNMENT

President Howard Frick then asked if there were any further matters that needed to be brought before the Board of Directors; and there being none, Director Moore motioned to adjourn the meeting, seconded by Director Fry, and by unanimous vote the meeting was declared adjourned at 3:25 p.m.

Respectfully submitted,

David A. Nixon,
Assistant Manager/Assistant Secretary-Treasurer

(District Seal)

ATTENDANCE SHEET

ARVIN-EDISON BOARD OF DIRECTORS' MEETING

DATE: January 14, 2003

12:00 P.M.			ARRIVED	DEPARTED
HOWARD FRICK	845-1112	(YES) NO MAYBE	✓	
msg SAL GIUMARRA	395-7031	YES NO MAYBE	✓	
JOHN MOORE	854-5588	(YES) NO MAYBE	✓	
ED CAMP	399-5511	YES (NO) MAYBE	O	
CHARLES FANUCCHI	858-2264	(YES) NO MAYBE	✓	
GEORGE FRY	858-2523	(YES) NO MAYBE	✓	
msg DON JOHNSTON	366-3201	(YES) NO MAYBE	✓	
RON LEHR	366-6936	(YES) NO MAYBE	O	
DON VALPREDO	858-2888	YES NO (MAYBE)	✓	must leave @ 3:30pm

OTHERS ATTENDING:

CONSULTANTS:

	ARRIVED	DEPARTED
EAC	✓	
SCOTT K	✓	12:50
MIKE DAY P&P	✓	
RICHARD ST. CLAIRE ✓	✓	
NORM HILE (TELEPHONE)	12:15	12:50

GUESTS:

	ARRIVED	DEPARTED
RICK IGER	12:50	2:05

STAFF:

	ARRIVED	DEPARTED
SCC	✓	
DAN	✓	
SL	✓	
CK	✓	

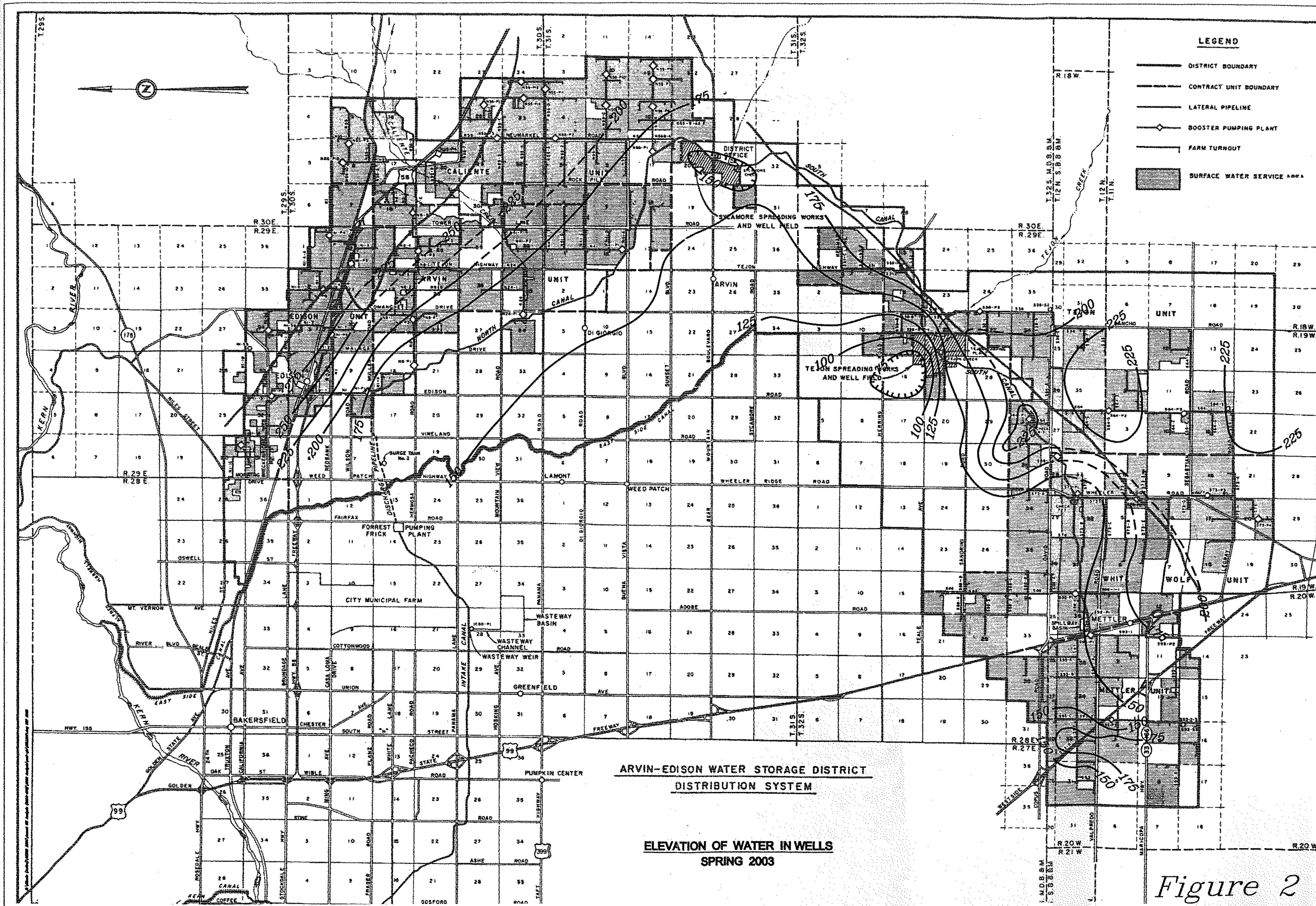
ARVIN-EDISON BOARD OF DIRECTORS

GUEST LIST

PRINT NAME	SIGNATURE	ADDRESS
Mike Day	Mike Day	1801 21st Street Suite 6 Bkfd
Richard St. Claire	[illegible]	1801 21st Street Suite 6 Bkfd 01
Rick Iger	Rick Iger	PO Box 58 Bakersfield, Ca 93302

APPENDIX F

Spring of 2002 Groundwater Maps to be included


LEGEND
DISTRICT BOUNDARY
CONTRACT UNIT BOUNDARY
LATERAL PIPELINE
BOOSTER PUMPING PLANT
FARM TURNOUT
SURFACE WATER SERVICE AREA
ARVIN-EDISON WATER STORAGE DISTRICT
DISTRIBUTION SYSTEM
ELEVATION OF WATER IN WELLS
SPRING 2003
CALIENTE
ARVIN
EDISON
UNIT
DISTRICT OFFICE
SYCAMORE SPREADING WORKS AND WELL FIELD
TEJON SPREADING WORKS AND WELL FIELD
SOUTH CANAL
NORTH CANAL
EAST SIDE CANAL
FORREST FRICK PUMPING PLANT
CITY MUNICIPAL FARM
WASTEWAY BASIN
WASTEWAY CHANNEL
WASTEWAY WEIR
BAKERSFIELD
LAMONT
WEED PATCH
DI GIORGIO
GREENFIELD
PUMPKIN CENTER
METTLER
WHEELER RIDGE
WOLF UNIT
METTLER UNIT
KERN RIVER
Figure 2

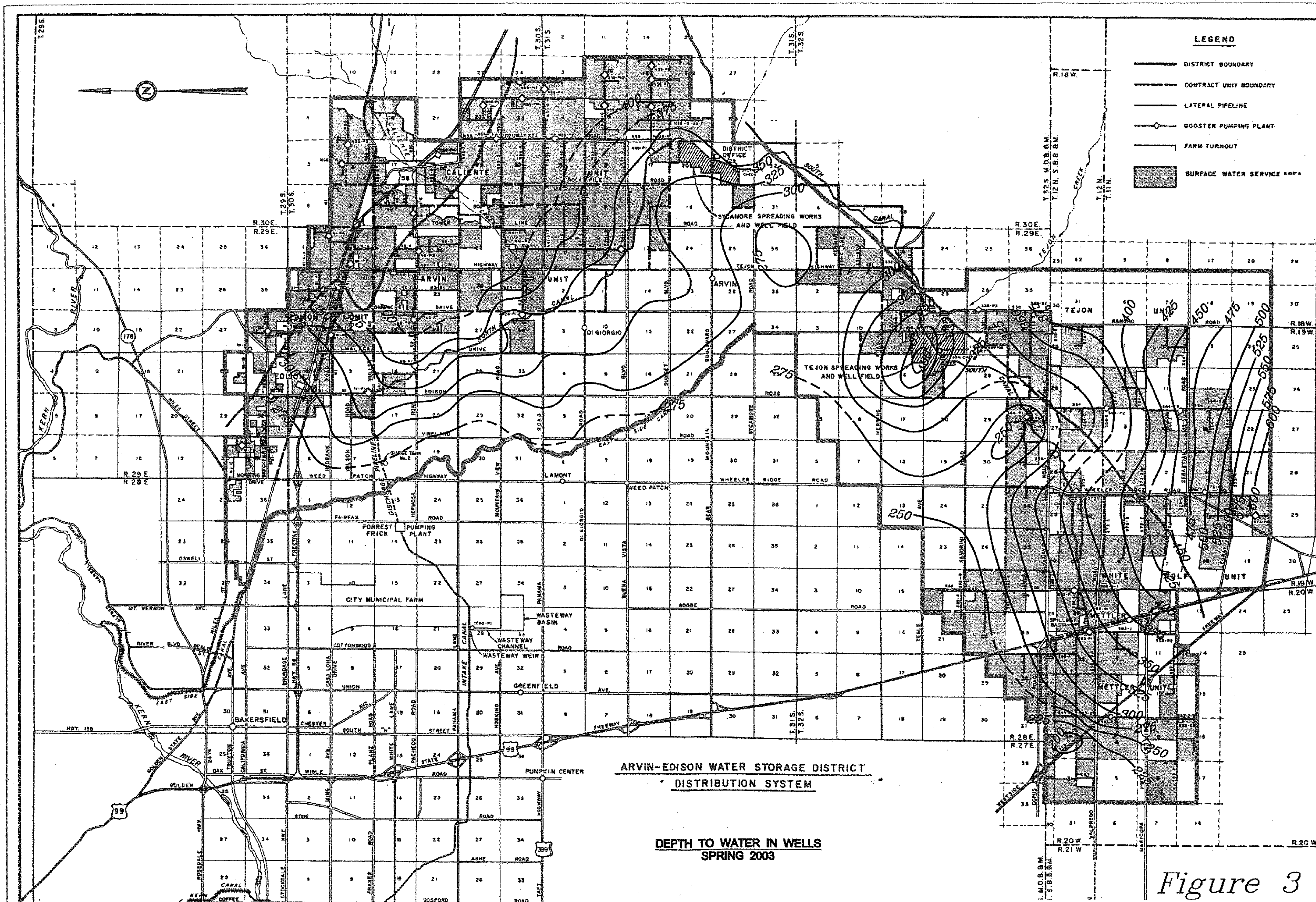

LEGEND
DISTRICT BOUNDARY
CONTRACT UNIT BOUNDARY
LATERAL PIPELINE
BOOSTER PUMPING PLANT
FARM TURNOUT
SURFACE WATER SERVICE AREA
ARVIN-EDISON WATER STORAGE DISTRICT
DISTRIBUTION SYSTEM
DEPTH TO WATER IN WELLS
SPRING 2003
CALIENTE UNIT
ARVIN UNIT
EDISON UNIT
TEJON UNIT
WHITE WOLF UNIT
METTLER UNIT
DISTRICT OFFICE
SYCAMORE SPREADING WORKS AND WELL FIELD
TEJON SPREADING WORKS AND WELL FIELD
FORREST FRICK PUMPING PLANT
CITY MUNICIPAL FARM
WASTEWAY BASIN
WASTEWAY CHANNEL
WASTEWAY WEIR
BAKERSFIELD
LAMONT
WEED PATCH
GREENFIELD
PUMPKIN CENTER
DI GIORGIO
METTLER
KERN RIVER
EAST SIDE CANAL
SOUTH CANAL
NORTH CANAL

Figure 3

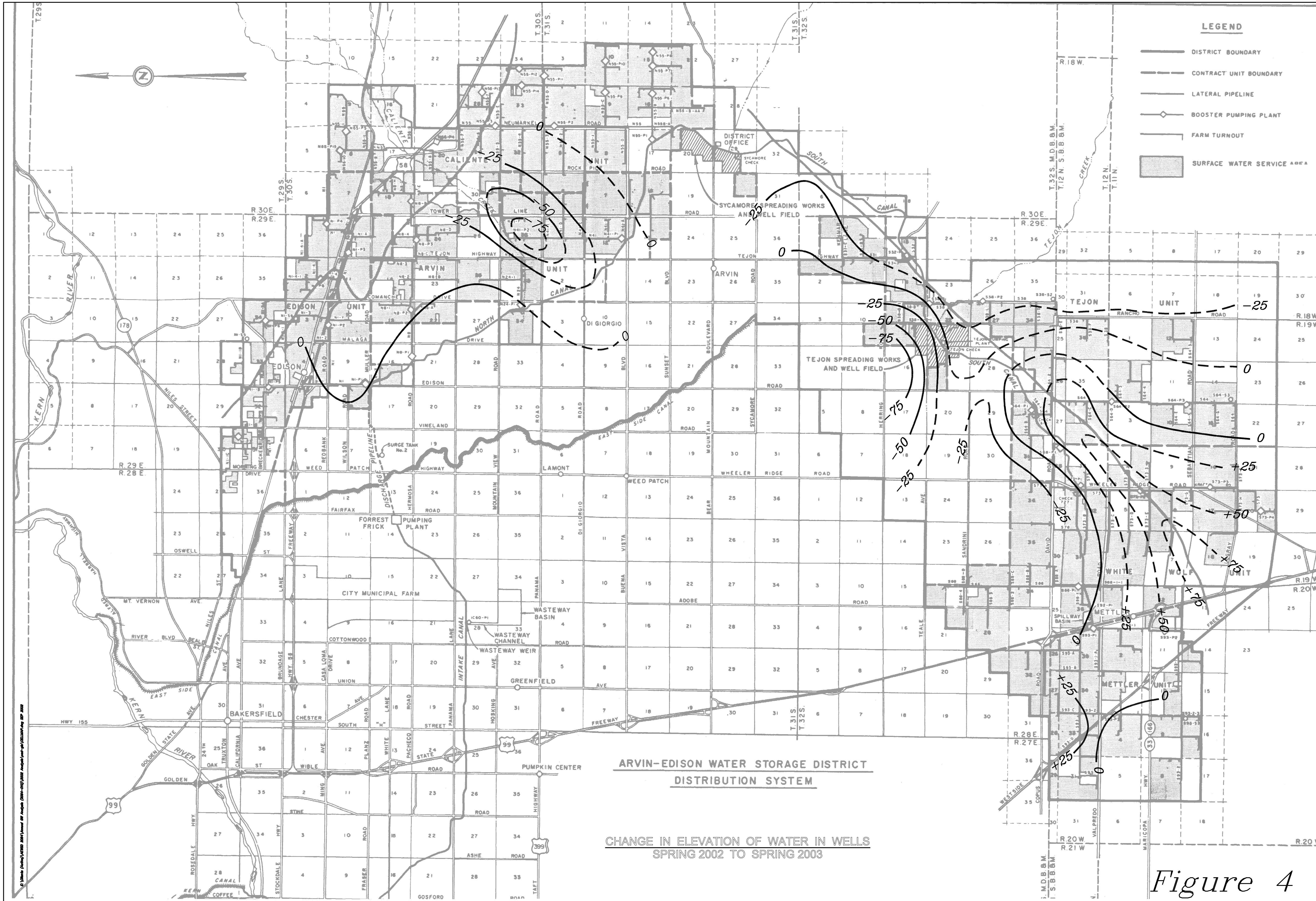

LEGEND
DISTRICT BOUNDARY
CONTRACT UNIT BOUNDARY
LATERAL PIPELINE
BOOSTER PUMPING PLANT
FARM TURNOUT
SURFACE WATER SERVICE AREA
ARVIN-EDISON WATER STORAGE DISTRICT
DISTRIBUTION SYSTEM
CHANGE IN ELEVATION OF WATER IN WELLS
SPRING 2002 TO SPRING 2003
DISTRICT OFFICE
SYCAMORE SPREADING WORKS AND WELL FIELD
TEJON SPREADING WORKS AND WELL FIELD
CALIENTE UNIT
ARVIN UNIT
EDISON UNIT
TEJON UNIT
WHITE WOLF UNIT
METTLER UNIT
ARVIN
EDISON
BAKERSFIELD
WEED PATCH
LAMONT
GREENFIELD
PUMPKIN CENTER
METTLER
CITY MUNICIPAL FARM
FORREST FRICK PUMPING PLANT
WASTEWAY BASIN
SPILLWAY BASIN
EAST SIDE CANAL
KERN RIVER
0
-25
-50
-75
+25
+50
+75

Figure 4

APPENDIX G

May 8, 2000

Mr. Steve Collup, Engineer-Manager
Arvin-Edison Water Storage District
20401 Bear Mountain Blvd.
Arvin, CA 93203

Re: Groundwater Quality Evaluation

Dear Steve:

Following is a draft report on my review and evaluation of the long-term monitoring of well water quality in the District. In reviewing the records, I decided that it was useful to combine the District North Canal wells with private irrigation wells for this evaluation. The parameters discussed are electrical conductivity, boron, and nitrate, in this order. Under each parameter the discussion is as follows:

1. Private irrigation and North Canal wells.
2. Sycamore Spreading Works wells.
3. Tejon Spreading Works wells.

We first made a tabulation of the dates of when samples were collected from each well. Because of the variability of the sampling results, wells with more sampling rounds were favored over wells with less rounds. I thus selected wells with the most sampling rounds for evaluation. Values for the three parameters were tabulated for each of the selected wells, and these are provided in Attachment A. Hydrographs were then prepared for these parameters for each of the selected wells. Hydrographs enable one to carefully examine changes in concentration over the period of record. One then attempts to relate the observed trends to the most likely causative factors.

Problems with some of the sampling results and data gaps are discussed in a subsequent section of this report. The relatively large variability in some of the sampling results makes determination of time trends difficult in some cases. Lastly, recommendations are provided for modifying the existing program, so that long term trends in well water quality can be more readily determined.

Background

In Summer 1966, prior to importation of canal water to the District, I sampled over 600 private irrigation wells in the District for irrigation suitability analyses. In addition, each District well was normally sampled near the end of the pump test following the initial development. Prior to importation of canal water to the District, water levels were declining an average of about seven feet per year. District records indicate that an average of 156,100 acre-feet per year of canal water have been imported since 1966. Of this, 114,300 acre-feet per year have been water of low salinity, primarily from the Friant-Kern Canal. The remainder of the imported water has been from the Cross Valley Canal (normally California Aqueduct water) of somewhat higher salinity. Water-level hydrographs indicate that importation of this water has nearly stabilized groundwater levels in the District. An average of 45,400 acre-feet per year of imported water has been recharged at the Sycamore and Tejon Spreading Works. An average of 22,500 acre-feet of water has been pumped from District wells. Years of heavy District well pumping were 1972, 1976-77, 1987-92, and 1994. A water-level hydrograph for Observation Well A, located just north of the Sycamore Spreading Works, shows at least four periods of overall water-level decline or rise. Significant water-level rises followed the cessation of heavy pumping during the last two major droughts.

Bookman-Edmonston Engineering, Inc. (1974) evaluated the chemical quality of existing and potential water supplies available to the District. As part of that evaluation, salt accumulation in the groundwater under pre-project conditions (prior to 1966) and as of 1974 were evaluated. First, a water budget was developed. The largest item of water input was groundwater inflow into the District. The sole item of water output was consumptive use (primarily evapotranspiration). A groundwater overdraft of about

183,000 acre-feet per year was indicated for the pre-project conditions. Salt input from the most important sources was estimated. The salt input under pre-project conditions from these sources was estimated to be about 85,000 tons per year. As of 1974, the annual salt input was estimated to be about 124,000 tons per year. Most of the increase was due to increased gypsum applications associated with use of Friant-Kern Canal water, and salt in this water. There was essentially no salt output, as the District is considered a closed hydrologic basin.

One ton of salt dissolved in an acre-feet of distilled water would result in a total dissolved solids (TDS) concentration of about 735 mg/l. Bookman-Edmonston Engineering, Inc. (1974) estimated the size of the mixing zone within the groundwater beneath the District to be about 20 million acre-feet as of 1974. This zone essentially comprises the depth interval tapped by irrigation wells. They projected that the continued use of Friant-Kern Canal water would result in an average increase in TDS concentration in the groundwater of about 4 mg/l per year.

Experience indicates that in groundwater basins that are solely dependent on groundwater for irrigation, the groundwater salinity eventually increases due to concentration of salts in the deep percolation by evapotranspiration. That is, while most of the applied water is consumed, most of the salt remains in the deep percolation. At an irrigation efficiency of two-thirds, for example, the salt concentration in the deep percolation would be increased three-fold compared to that in the applied water. However, when the depth to water is several hundred feet or more, it may take decades for this deep percolation to reach the water table. In basins that are not closed and where significant amounts of surface water are used for irrigation, much less increase in groundwater salinity is expected. An example would be for the Fresno Irrigation District. In this case, groundwater outflow removes large amounts of salt, and canal seepage contributes large amounts of recharge that is low in salinity (i.e. 30 to 50 mg/l TDS). Lastly, some of the major constituents in irrigation water, such as calcium and bicarbonate, can precipitate in the topsoil between irrigation events. Some of the precipitated salt may not be re-introduced into the deep percolation during subsequent irrigation events. Because of this, salt buildup in groundwater is more accelerated for certain water types, such as sodium chloride. This type of water is common in the Salt River Valley of Arizona, but is relatively unusual in the District. Groundwater in most of the District is of the bicarbonate type.

Electrical Conductivity

Private Irrigation Wells and North Canal Wells

The wells selected for evaluation are as follows:

AEN-1, 2 and 5.

T30S/R29E-3K1, 7L2, 15L3

T30S/R30E-6J1

T31S/R29E-16C1 & 36G1

T31S/R30E-17E1

T32S/R28E-33R1

T32S/R29E-4R1 & 28C2

T11N/R18W-18N1

T11N/R19W-7R1 & 22E1

T12N/R20W-33P2

Once the hydrographs were prepared, significant fluctuations in electrical conductivity became apparent in a number of cases. Thus boundary lines for both maximum and minimum values were added to help visualize long-term trends. Examples of the electrical conductivity hydrographs are shown in Figure 1. Ten of the selected wells showed increasing electrical conductivities for a significant part of the record. For most of these wells, long-term electrical conductivity increases ranged from 3 to 15 micromhos per centimeter at 25°C, and averaged 7 micromhos per year. The increase of 7 micromhos per year equals an average TDS increase of about 5 mg/l per year. This value is close to that projected by Bookman-Edmonston Engineering, Inc. in their 1974 report. Electrical conductivity increases for two wells (T32S/R28E-33R, and T11N/R19W-7R1) ranged from 34 to 53 micromhos per year. These are considered unusual cases, and probably are indicative of some type of localized groundwater contamination and/or a well conduit.

Three of the selected wells showed relative constant electrical conductivities for the period of record. Seven wells showed overall decreases in electrical conductivity for a considerable part of the record. These decreases ranged from 4 to 14 micromhos per year, and averaged 5 micromhos per year. These wells were generally located in one of the following areas.

1. Near the Spreading Works.
2. Near the Eastside canal, along the western edge of the District.
3. Near Caliente Creek.

In considering all of the private and North Canal wells that were evaluated, the overall trend is an average electrical conductivity increase of only about 2 micromhos per year, or slightly more than 1 mg/l of TDS per year. This lower than projected increase is due to the following:

1. Local recharge of low salinity water, both in the vicinity

of the spreading works and elsewhere.

2. Layering of the deposits and the large perforated intervals and relatively great depths of many of the sampled wells. This minimizes the apparent salt buildup, which is expected to be greater in the shallow groundwater (i.e. within several hundred feet of the water level).

3. Possible precipitation of some salt in the topsoil.

Sycamore Spreading Works Wells

The following wells were selected for evaluation:

AE-4, 5, 6, 10, 13, 16, 22, 31, and 34.

Figure 2 shows examples of electrical conductivity hydrographs for wells in the spreading works. Seven of the wells showed long-term electrical conductivity increases ranging from 3 to 12 micromhos per year, and averaging 6 micromhos per year. However, during drought periods and heavy pumping of District wells, electrical conductivity increases ranged from 10 to 23 micromhos per year. Five of the wells showed decreasing electrical conductivities for the periods of record, which generally ended prior to 1987. During periods of prolonged recharge, decreases in electrical conductivity ranged from 7 to 20 micromhos per year. This is attributed to the influence of recharge of the low salinity water. Six wells showed an overall constancy in electrical conductivity during at least eight years of record. In summary, electrical conductivities of water from these District wells decreased significantly during and following prolonged recharge cycles, and then increased at a similar rate during prolonged extraction cycles.

The extent of mixing of water recharged in the spreading works with native groundwater was evaluated. For the evaluated District wells, the lowest electrical conductivities (in the range of 140 to 200 micromhos) usually occurred in the mid-1970's, late 1970's, and early 1980's, associated with prolonged recharge cycles. Because the electrical conductivity of Friant-Kern water averages about 50 micromhos, and the average electrical conductivity of water from these wells was initially about 370 micromhos (prior to recharge), this indicates that about two-thirds of the water pumped from the Sycamore wells was recharged water and the remainder was native groundwater. The highest electrical conductivities were generally in 1992-94, at the end of the longest extraction cycle, and averaged about 320 micromhos. This indicates that at the end of the longest extraction cycle, about 15 percent of the water pumped from these wells was from water recharged in the spreading works. These results thus show the extent of mixing of the recharged water with native groundwater in the vicinity.

Tejon Spreading Works Wells

The following wells were selected for evaluation:

AE-72, 74, 75, 77, 79, 84, 89, and 91.

Electrical conductivities for almost all of these wells decreased due to recharge in the late 1960s and early 1970s. Thereafter, electrical conductivities remained relatively stable in water from five wells, and increased in water from three wells (examples shown in Figure 2). The increases ranged from 5 to 13 micromhos and averaged 8 micromhos per year. These increases are about the same as for many private wells in the District.

Summary of Electrical Conductivity Changes

In much of the District, electrical conductivity of water pumped from irrigation wells has increased an average of several micromhos per year. This is only about one-third the rate of what has been predicted on the basis of salt input and output. The most likely reasons are:

1. Recharge of low salinity water in the spreading works and elsewhere, such as Caliente Creek.
2. The relatively great depths and large perforated intervals of many irrigation wells, which dilute or mask the salt buildup that occurs in the shallow groundwater.

3. Precipitation of some salt in the topsoil and possibly vadose zone.

Recharge of low salinity water in the two spreading works and from other sources, such as Caliente Creek streamflow, has acted to stabilize or decrease electrical conductivities in well water in parts of the District.

Nitrate

Private and North Canal Wells

Figure 3 provides some examples of nitrate hydrographs. Nitrate hydrographs for the evaluated wells were almost evenly divided between ones showing increases, decreases, and a long-term constancy. Records for five wells showed increasing nitrate concentrations. Each of these wells had nitrate concentrations exceeding the maximum contaminant level (MCL) of 45 mg/l for at least part of the record. Two of these wells (T32S/R28E-33R1 and T11N/R19W-7R) had very high nitrate concentrations (exceeding 100 mg/l), and these wells also had large increases in electrical conductivity over the same time period. The nitrate increases in most of these wells had already occurred by about 1980.

Records for six wells, including AEN-1, showed decreases in nitrate concentrations. Records for six wells, including AEN-2, showed no long-term change in nitrate concentrations.

The overall trend in these wells was for relatively constant or decreasing nitrate concentrations. However, in several localized cases, there were significant increases in nitrate concentrations between the late 1960's and about 1980. These wells also generally had nitrate concentrations above the MCL.

Sycamore Wells

Records for five wells indicate long-term constant nitrate concentrations, and records for four wells show a long-term decrease in nitrate concentration. None of the selected wells had high nitrate concentrations, and most were less than 10 mg/l (compared to the MCL of 45 mg/l) in the 1990's. These trends are as expected, as the recharged water is very low in nitrate concentration. Also, nitrate concentrations in groundwater in this part of the District were relatively low prior to importation of canal water.

Tejon Wells

Most of the selected wells showed slight long-term decreases in nitrate concentrations, and the remaining showed long-term stable nitrate concentrations. As for the Sycamore wells, pre-project nitrate concentrations were relatively low, and recharge of low nitrate groundwater has resulted in even lower concentrations.

Boron

Private and North Canal Wells

Examples of boron hydrographs are shown in Figure 4. The overall trend is predominantly a constancy of boron concentrations. In a number of cases, the 1966 sampling results don't appear to be representative of later concentrations. Boron concentrations in water from some of these wells increased during drought periods, but then returned to pre-existing levels.

Sycamore Wells

Records indicate relatively constant boron concentrations for the period of record for the District wells. However, boron concentrations tended to increase during extraction cycles. This is particularly noticeable for the northernmost District wells. For AE-31, boron concentration normally ranged from about 0.1 to 0.4 mg/l, but during the recent drought increased to the range of 0.4 to 1.7 mg/l. The increases in boron concentrations in water from the northernmost wells are indicated to be from the southerly migration of the high boron groundwater present north of the Sycamore Spreading Works.

Tejon Wells

Records indicate relatively constant boron concentrations for the period of record for the selected wells. Boron concentrations are relatively low in groundwater in this area, normally about 0.1 to 0.2 mg/l or less. There has been a slight increase in boron concentrations during extraction cycles, but these are indicated to be minor.

Data Gaps and Problems

There are several primary problems with the sampling program. First, some of the sampled private wells have apparently been replaced by new deep wells, and careful records as to when this happened aren't available. The depth and perforated well interval normally have a major influence on the quality of water pumped from a well. Second, some of the water samples were collected from domestic storage tanks that are associated with some irrigation wells. In some cases these tanks were also connected to another water source, such as canal water. Third, the duration of pumping prior to water sample collection is very important in terms of the quality of water pumped from a well. For large capacity wells that have been idle, sampling results prior to at least several days of pumping are normally of limited value. It appears that pumping durations prior to sample collection were too short in some cases, and overall have not been documented. More consistent sampling results could be obtained by collecting water samples only after prolonged pumping.

Recommendations

Following are recommendations for modifications to the program, to provide results that would be more representative of long-term trends.

1. For District wells, sample only when in routine use. Collect a sample after about one week of pumping for determination of electrical conductivity. Collect a sample about one week before shutdown for determination of electrical conductivity. Boron would be determined on the second group of samples for Sycamore wells north of Bear Mountain Boulevard, North Canal wells, and DiGiorgio wells. An irrigation water suitability analysis would be obtained about every five years from selected District wells (about one-third).

2. For private wells, sample only when in use during heavy pumping. Before sampling, contact well owner to insure that well has been pumping at least several day prior to sampling. Concentrate on wells with long-term hydrographs. Sample only out of discharge line when pumping, as opposed to pressure tank or elsewhere. Select about 100 wells for electrical conductivity measurements to be made every five years. The District should purchase and maintain a suitable electrical conductivity meter.

3. Consider installation of some cluster monitor wells around the north part of Sycamore wells and near DiGiorgio wells for routine monitoring, as is done for the Kern Fan and Semitropic WSD water banking projects.

Please call me if you have any questions.

Sincerely yours,

Kenneth D. Schmidt

KDS/sll

ATTACHMENT A

TABULATIONS FOR RESULTS OF ANALYSES FOR SELECTED PARAMETERS

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR NORTH CANAL WELL AEN-1

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
08/11/72	930	391	0.10	33
08/14/73	410	256	0.12	1
07/04/75	490	283	0.15	2
08/31/76	500	298	0.15	15
07/27/77	600	377	0.14	39
08/15/78	440	275	0.22	<1
08/10/79	410	284	0.15	<0.5
08/14/81	500	437	0.12	5
09/20/82	500	405	0.10	<0.4
07/01/83	480	420	0.17	<0.4
08/04/92	810	480	0.17	32
07/15/93	560	456	0.17	5
08/08/94	790	473	0.30	18
08/22/95	-	330	0.15	2
08/05/96	-	320	0.16	3
08/20/97	-	350	0.15	1
07/22/99	-	350	<0.1	2

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR NORTH CANAL WELL AEN-2

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
08/04/72	970	434	0.21	56
08/15/73	400	223	0.31	2
08/08/74	370	206	0.35	2
09/16/75	400	219	0.27	1
08/31/76	480	264	0.17	<0.5
07/27/77	760	491	0.14	70
08/15/78	440	273	0.42	2
08/08/79	460	315	0.38	7
07/18/80	510	295	0.36	6
08/14/81	670	526	0.21	30
08/04/92	1,050	659	0.19	105
07/15/93	460	341	0.36	9
08/08/94	950	623	0.30	87
11/13/95	-	300	0.34	6
08/05/96	-	540	0.26	38
08/20/97	-	370	0.31	15
07/08/98	-	270	0.34	<1
07/22/99	-	320	<0.1	1.1

SELECTED INORGANIC CHEMICAL CONSTIUENTS
FOR NORTH CANAL WELL AEN-5

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
05/27/72	700	474	0.25	32
08/17/73	780	499	0.16	48
08/16/74	670	421	0.16	61
09/09/75	760	470	0.13	53
08/31/76	690	421	0.06	57
07/27/77	680	428	0.25	35
08/16/78	770	457	0.22	5
08/15/79	720	542	0.28	59
07/18/80	860	559	0.02	58
08/14/81	850	675	0.17	55
09/20/82	800	624	0.20	50
09/14/84	760	593	0.20	38
08/13/85	800	617	0.26	55
08/04/92	970	608	0.27	104
07/15/93	930	762	0.30	132
08/08/94	830	487	0.39	43
08/22/95	-	620	0.25	99
08/05/96	-	630	0.25	86
08/07/97	-	650	0.24	84
07/22/99	-	560	0.13	74

SELECTED INORGANIC CHEMICAL CONSTITUENTS FOR WELL T30S/R29E-3K1

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
0S/R04/66	628	572	0.20	6
07/12/71	1,050	584	0.17	68
05/17/72	1,090	671	0.15	108
06/28/73	1,040	644	0.19	109
06/17/74	990	615	0.13	114
07/03/75	1,030	632	0.15	126
06/11/76	800	514	<0.01	86
06/24/77	1,130	723	0.16	133
07/12/78	990	590	0.10	81
07/08/80	1,120	701	0.28	115
07/28/81	1,110	820	0.17	84
08/03/82	1,040	641	0.16	74
06/07/83	800	658	0.26	44
07/25/84	860	628	0.27	46
06/24/85	660	540	0.18	8
08/05/87	620	555	0.21	<1.0
06/13/88	610	550	0.21	<1.0
08/14/89	640	572	0.23	<1.0
08/09/94	610	335	0.3	

Most samples were taken from domestic tap. Samples after 1985 do not appear to be for same water as previously.

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR WELL T30S/R29E-7L2

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
05/05/66	1,388	1,015	<0.1	45
08/31/71	1,111	808	0.13	31
06/06/72	1,520	981	0.17	39
06/28/73	1,800	1,086	0.21	35
07/31/74	1,610	977	0.09	35
07/08/75	1,780	1,072	0.10	32
08/22/77	1,160	739	0.17	20
07/12/78	1,400	818	0.07	25
07/05/79	980	706	0.07	20
07/08/80	1,410	863	0.12	27
08/10/81	1,260	916	0.09	24
08/03/82	1,030	622	0.10	16
06/27/83	890	667	0.15	13
07/29/84	1,660	1,081	0.17	30
06/24/85	1,180	815	0.20	21
07/18/86	960	676	0.17	13
08/05/87	1,070	744	0.17	16
06/13/88	900	626	0.18	12
08/14/89	820	590	0.19	10
11/08/90	600	432	0.17	2
08/10/92	700	408	0.16	6

Most samples were taken from a domestic tap.

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR WELL T31S/R29E-36G1

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
07/17/66	445	246	<0.1	8
07/12/71	540	267	0.17	5
04/25/72	370	307	0.31	12
07/11/73	650	391	0.29	15
06/18/74	580	363	0.33	22
07/03/75	440	261	0.15	7
06/24/77	380	220	0.20	12
07/18/78	440	262	<0.01	41
06/28/79	390	247	0.13	11
07/17/80	450	266	0.14	9
08/03/81	480	285	0.12	11
08/12/85	450	301	0.15	11
07/21/93	500	354	0.21	18
08/21/97	400	260	0.16	12

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR WELL T30S/R30-6J1

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
06/23/66	1,225	852	0.80	18
09/08/71	1,000	836	1.8	13
04/26/72	1,120	1,025	0.66	18
07/12/73	1,210	822	0.62	15
06/17/74	1,180	793	0.49	20
07/08/75	1,140	768	0.63	15
08/19/76	1,200	870	0.43	11
06/24/77	1,110	767	0.48	15
07/19/78	1,530	759	0.18	14
06/27/79	1,730	764	0.59	23
07/09/80	1,110	752	0.40	15
07/28/81	1,130	847	0.61	14
08/04/82	1,560	872	0.52	12
06/27/83	1,060	760	0.90	15
08/01/84	1,180	817	0.92	30
06/25/85	1,150	820	0.87	13
07/22/86	1,110	819	0.88	12
08/10/87	1,180	896	0.80	12
07/25/88	1,110	811	0.79	12
08/14/89	1,120	835	0.38	12

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR WELL T31S/R30E-17E1

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
05/19/66	533	412	1.80	8
07/12/71	580	313	0.98	9
04/28/72	470	367	1.13	9
07/16/73	550	355	0.61	40
06/18/74	470	299	1.12	7
07/17/75	420	252	0.74	2
06/23/76	420	253	0.73	6
07/21/77	370	217	1.0	4
07/13/78	450	240	0.94	<1
06/28/79	410	252	1.1	1
07/09/80	470	253	0.88	2
07/29/81	480	326	1.1	3
08/03/82	470	322	0.86	3
08/08/94	550	339	2.99	<1
10/25/95	600	360	2.9	<1

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR WELL T32S/R28E-33R1

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
06/07/66	628	502	0.15	51
06/01/71	1,300	761	0.36	150
05/04/72	790	547	0.44	72
07/09/73	1,300	872	0.24	154
06/19/74	860	572	0.23	179
07/03/75	720	438	0.21	55
06/24/76	650	437	0.30	39
07/21/77	710	465	0.20	59
07/13/78	1,400	993	0.10	199
06/28/79	1,390	1,219	0.07	224
07/10/80	1,750	1,302	0.18	292
08/03/84	2,100	1,638	0.41	319
08/06/87	2,200	1,689	0.41	252
07/28/88	2,240	1,683	0.41	283
08/10/94	1,080	700	0.33	67

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR WELL T32S/R29E-4R1

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
05/23/66	681	456	0.25	6
07/12/71	580	291	0.17	1
04/25/72	640	483	0.33	5
06/28/73	750	473	0.33	6
06/24/74	630	375	0.33	4
07/03/75	800	465	0.23	6
07/21/77	610	349	0.17	4
07/13/78	590	338	0.10	5
06/28/79	500	324	0.17	4
07/09/80	630	345	0.17	4
07/29/81	700	472	0.17	4
08/31/82	560	400	0.18	6
06/29/83	650	469	0.25	5
07/30/84	550	372	0.22	14
08/14/85	540	383	0.26	5
07/24/86	510	369	0.19	4
08/06/87	510	374	0.18	5
08/29/88	500	366	0.19	4
08/25/89	600	432	0.22	6
08/14/92	600	322	0.23	4
08/09/94	540	361	0.28	2
08/01/96	470	310	0.18	4
07/14/98	640	370	0.21	7

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR WELL T32S/R29E-28C2

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
07/09/75	580	-	0.11	28
07/22/77	560	336	0.20	22
07/13/78	570	319	0.10	51
06/28/79	490	344	0.13	19
07/09/80	570	338	0.15	18
07/29/81	610	487	0.14	23
07/30/84	590	457	0.22	44
06/25/85	580	457	0.20	23
08/06/87	560	463	0.18	22
06/13/88	550	433	0.19	19
08/14/92	440	249	0.16	26
08/09/94	530	308	0.24	11
07/14/98	520	300	0.17	20

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR WELL T11N/R18W-18N1

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
06/16/66	570	442	0.70	8
07/01/71	660	331	0.08	27
05/05/72	540	374	0.34	23
07/11/73	620	367	0.24	22
06/19/74	580	348	0.29	34
07/07/75	570	343	0.17	43
07/22/77	570	347	0.15	31
07/13/78	560	349	0.12	34
07/31/78	490	315	0.20	36
07/05/79	510	355	0.17	22
07/10/80	620	364	0.17	36
07/29/81	630	514	0.17	39
08/05/82	640	488	0.16	45
08/03/83	560	466	0.23	42
07/23/86	590	458	0.23	25
08/24/87	580	463	0.22	22
06/29/88	610	445	0.20	22

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR WELL T11N/19W-7R1

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
06/15/66	463	382	0.75	8
07/02/71	550	417	0.29	23
05/10/72	560	369	0.23	32
07/09/73	840	547	0.22	91
06/24/74	800	512	0.25	85
07/03/75	600	367	0.23	39
07/21/77	640	423	0.22	51
07/27/78	1,070	778	0.18	160
07/02/79	1,010	807	<0.1	164
07/21/80	1,200	808	<0.1	166
08/27/81	1,200	915	0.22	172
08/04/82	1,170	883	0.18	168
07/12/83	1,130	840	0.26	159
08/08/84	1,270	884	0.27	177

Samples after July 1977 appear to be for different water than previously. Most samples after July 1997 are from a domestic tap.

SELECTED INORGANIC CHEMICAL CONSTITUENTS FOR WELL T11N/R19W-22E1

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
06/ /66	500	393	0.60	4
06/30/71	580	289	0.17	2
05/11/72	500	318	0.12	6
07/09/73	490	298	0.28	5
06/17/74	510	294	0.21	8
07/07/75	490	274	0.21	5
07/21/77	500	291	0.22	6
07/19/78	500	316	0.62	6
07/12/79	460	317	0.17	6
07/10/80	550	315	0.20	7
07/29/81	720	455	0.14	5
08/04/82	560	424	0.20	7
08/14/92	380	203	0.24	10
08/09/94	760	512	0.32	18
08/01/96	-	360	0.25	6

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR WELL T12N/20W-33P2

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
06/08/66	1,021	759	0.55	14
06/01/71	1,300	785	0.63	45
05/15/72	1,130	832	0.63	26
07/23/73	1,300	850	0.61	27
06/07/74	1,390	925	0.54	39
07/07/75	1,380	908	0.69	33
07/29/77	1,200	853	0.63	27
07/13/78	1,430	972	0.45	31
06/28/79	1,110	955	0.50	29
08/22/81	1,320	1,048	0.61	27
08/31/82	1,210	924	0.50	22
07/06/83	1,240	1,020	0.71	22
05/03/84	1,350	989	0.81	23

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR WELL T31S/R29E-16C1

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
05/16/66	817	562	<0.1	51
06/29/71	790	382	0.20	35
04/20/72	710	506	0.17	40
07/09/73	740	471	0.22	42
06/14/74	730	451	0.21	63
06/26/75	740	437	0.09	50
07/03/75	740	439	0.19	53
06/29/77	770	440	0.18	57
07/14/78	800	486	0.10	60
07/16/79	720	527	0.07	66
07/09/80	830	505	0.15	63
07/29/81	870	664	0.17	74
06/24/85	660	496	0.28	28
08/14/87	710	551	0.28	34
07/25/88	700	542	0.27	35
08/28/89	650	527	0.29	26
07/19/90	720	514	0.28	29
08/13/92	980	342	0.32	67

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR SYCAMORE SW WELL AE-4

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
06/25/67	333	191	0.04	3
09/09/71	180	95	0.02	5
06/14/72	270	133	0.06	6
08/16/73	140	83	0.04	3
08/21/74	120	69	0.03	3
09/10/75	140	67	0.06	1
08/27/76	130	68	<0.1	4
07/26/77	260	160	0.15	2
08/09/78	100	61	0.03	4
08/02/79	110	59	<0.1	1
10/30/80	130	73	0.04	3
08/14/81	180	119	0.04	5
09/15/82	210	145	0.04	3
07/06/83	210	138	0.06	1
09/12/84	210	153	0.02	1
08/27/85	200	148	<0.1	4
08/28/89	160	147	<0.1	3
08/04/92	360	200	<0.1	12
07/15/93	290	175	0.10	5
08/08/94	350	194	0.13	7
08/22/95	-	160	<0.1	6
08/05/96	-	140	<0.1	3

SELECTED INORGANIC CHEMICAL CONSTITUENTS FOR SYCAMORE SW WELL AE-5

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
06/02/67	377	257	0.10	2
04/29/68	442	208	0.06	20
09/21/71	190	115	0.05	6
07/05/72	250	145	0.06	8
08/21/74	160	97	0.07	5
11/25/75	150	78	<0.01	6
08/27/76	140	74	0.18	4
07/26/77	270	189	0.13	2
11/09/77	290	155	0.08	9
08/09/78	130	74	0.05	3
07/30/79	120	71	<0.01	2
07/17/80	150	84	0.12	2
08/14/81	210	134	0.01	3
09/12/84	210	148	0.06	3
08/26/85	210	135	<0.01	1
07/24/86	190	140	<0.01	2
08/03/88	180	149	<0.1	3
08/28/89	192	162	<0.1	3
08/04/92	310	166	<0.1	8
07/15/93	350	228	0.08	3
08/08/94	300	189	0.11	5

SELECTED INORGANIC CHEMICAL CONSTITUENTS FOR SYCAMORE SW WELL AE-6

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
05/22/67	316	167	0.10	4
12/23/70	360	200	0.03	20
07/11/72	300	191	0.10	9
08/20/74	250	140	0.04	8
11/25/75	200	108	<0.01	6
08/27/76	250	156	0.14	9
07/26/77	230	132	0.10	11
11/09/77	260	134	0.08	11
08/09/78	200	112	0.06	6
07/30/79	180	110	0.01	4
07/17/80	180	95	0.12	3
08/14/81	230	156	0.07	1
09/15/82	200	154	0.04	3
07/06/83	200	158	0.06	3
09/12/83	180	134	0.12	2
08/27/85	220	156	<0.1	1
07/24/86	210	160	<0.1	2
08/09/88	230	174	<0.1	4
08/28/89	250	183	<0.1	4
08/04/92	250	140	<0.1	5

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR SYCAMORE SW WELL AE-10

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
07/17/67	345	194	0.09	4
09/16/71	180	109	0.04	1
06/14/72	270	139	0.12	8
08/29/74	120	69	0.03	2
11/25/75	120	59	<0.01	1
08/27/76	130	62	0.01	1
07/26/77	260	150	0.20	6
11/09/77	280	140	0.14	6
08/09/78	130	74	0.10	2
08/02/79	130	77	0.03	2
07/17/80	160	86	0.14	2
08/14/81	200	126	0.04	4
09/15/82	170	125	0.06	2
09/12/84	180	129	0.08	1
08/27/85	150	112	0.13	1
07/24/86	140	116	<0.10	1
08/03/88	180	148	<0.10	2
08/28/89	240	180	0.10	3
08/04/92	280	152	0.10	4
07/15/93	200	145	0.33	2
08/08/94	300	157	0.17	3

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR SYCAMORE SW WELL AE-13

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
03/14/67	369	200	0.15	12
09/20/71	220	130	0.07	12
06/14/72	260	127	0.16	9
08/28/74	160	85	0.02	2
11/25/75	160	89	<0.01	3
08/27/76	150	76	0.14	<1
07/26/77	270	157	0.25	4
08/19/78	170	95	0.10	2
08/03/79	170	82	0.06	2
07/17/80	150	85	0.12	1
08/14/81	200	133	0.01	3
09/15/82	160	156	0.04	2
07/06/83	180	131	0.08	1
09/12/84	180	136	0.06	2
08/28/85	150	131	0.13	2
08/03/88	180	153	<0.10	2
08/29/89	184	165	0.10	2
08/04/92	350	186	0.24	6
07/15/93	220	155	0.12	2
08/06/94	350	181	0.36	3
08/19/97	-	120	<0.10	<1
07/07/98	-	120	<0.10	2
07/23/99	-	120	<0.10	1
07/27/99	-	120	<0.10	1

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR SYCAMORE SW WELL AE-16

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
02/23/67	421	268	0.72	29
06/27/68	608	294	0.62	47
09/13/71	400	220	0.25	21
07/05/72	370	223	0.80	27
08/16/73	250	171	0.20	8
08/28/74	280	167	0.19	10
09/09/75	260	162	0.21	25
08/27/76	250	137	0.20	2
07/27/77	370	227	0.71	23
11/09/77	390	223	0.87	25
08/10/78	330	207	0.69	10
08/08/79	200	125	0.17	3
07/17/80	250	140	0.28	4
08/14/81	300	240	0.31	9
09/15/82	240	194	0.10	4
07/06/83	290	231	0.41	11
09/17/84	240	185	0.17	3
08/28/85	320	229	0.50	7
07/28/86	260	195	0.14	4
08/03/88	360	260	0.78	9
08/29/89	350	274	0.68	16
08/04/92	430	244	0.90	26
07/15/93	400	316	0.92	17
08/08/94	350	225	0.59	6
08/22/95	-	180	0.11	6

SELECTED INORGANIC CHEMICAL CONSTITUENTS FOR SYCAMORE SW WELL AE-22

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
03/21/70	370	189	<0.01	14
06/14/72	300	167	0.04	12
08/17/73	240	151	0.06	11
08/31/74	240	144	0.07	9
09/16/75	190	104	<0.01	3
08/27/76	220	124	<0.01	5
07/27/77	280	160	0.18	11
11/09/77	310	168	0.12	11
08/19/78	200	117	0.10	5
08/08/79	170	104	0.09	4
07/18/80	180	101	0.08	4
09/17/82	200	153	0.10	3
09/12/84	220	164	0.06	3
08/29/85	230	163	<0.10	2
08/03/88	240	183	<0.10	4
08/24/89	250	200	<0.10	5
08/04/92	290	159	<0.10	8
07/16/93	250	206	0.17	9
08/08/94	290	169	0.13	5
08/22/95	-	160	<0.10	6
08/05/96	-	140	<0.10	3
07/23/99	-	130	<0.10	2

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR SYCAMORE SW WELL AE-31

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
03/08/70	423	269	0.41	12
06/14/72	340	196	0.34	<0.5
08/20/74	200	108	0.05	2
09/12/75	200	104	<0.01	2
08/27/76	200	106	0.22	1
07/27/77	320	176	0.26	2
11/09/77	340	198	0.38	10
08/09/78	280	161	0.22	6
08/08/79	180	113	0.17	4
07/18/80	180	105	0.12	3
08/14/81	230	156	0.07	2
09/17/82	310	239	0.10	4
09/24/84	210	150	0.12	2
08/29/85	240	162	0.11	2
08/10/88	240	187	0.24	2
08/04/92	480	260	1.2	0.4
07/15/93	340	243	0.46	3
08/08/94	510	302	1.86	<1.0

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR SYCAMORE SW WELL AE-34

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
05/08/70	520	257	0.36	38
06/14/72	300	159	0.38	16
08/16/73	200	129	0.12	6
08/22/74	260	146	0.28	13
09/16/75	270	174	0.29	19
08/27/76	210	125	0.16	5
07/27/77	340	205	0.36	23
08/10/78	330	200	0.38	7
08/08/79	200	124	0.17	3
07/17/80	280	170	0.28	15
08/14/81	260	230	0.24	8
09/17/82	250	179	0.10	3
09/12/84	250	191	0.18	4
08/29/85	250	213	0.20	5
07/28/86	270	208	0.16	4
09/03/88	300	227	0.24	5
08/29/89	360	265	0.38	14
08/04/92	410	228	0.67	14
07/15/93	380	292	0.46	13
08/18/94	360	208	0.33	9

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR SYCAMORE SW WELL AE-72

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
12/18/06	490	294	0.10	7
11/02/71	780	306	0.32	22
05/06/72	480	317	0.33	20
08/10/73	380	221	0.12	12
08/12/74	340	181	0.12	8
08/27/76	360	225	0.24	30
07/25/77	380	212	0.14	7
08/11/78	230	140	0.20	3
08/09/79	260	158	0.11	5
07/16/80	300	161	0.11	7
08/14/81	210	164	0.04	6
09/17/82	320	256	0.10	7
06/28/83	300	234	0.08	6
11/13/84	300	230	0.08	7
08/14/85	300	230	<0.10	7
07/29/86	290	223	0.10	7
08/03/88	310	240	0.10	9
08/28/89	340	268	0.12	9
08/05/92	380	206	0.12	13
07/21/93	260	181	0.09	6
08/08/94	260	136	0.13	3
08/23/95	-	220	<0.1	9

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR SYCAMORE SW WELL AE-74

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
12/06/66	505	304	0.22	5
09/22/71	480	324	0.05	12
05/08/72	540	382	0.33	10
08/09/74	430	236	0.14	10
11/25/75	480	273	0.10	10
08/31/76	460	253	0.06	11
07/25/77	480	284	0.17	10
08/14/78	390	243	0.22	10
08/08/79	400	255	0.11	7
07/16/80	450	241	0.11	9
08/28/81	440	344	0.13	6
09/17/82	430	345	0.10	7
07/16/83	410	340	0.14	6
09/18/84	400	304	0.22	5
08/04/85	400	316	0.15	5
07/29/86	390	309	0.13	5
08/09/88	400	322	0.14	5
08/28/89	440	350	0.14	8
08/05/92	450	252	0.14	9
07/16/93	380	281	0.19	5
08/08/94	420	284	0.26	6

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR SYCAMORE SW WELL AE-75

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
11/11/66	516	304	0.16	6
09/22/71	400	279	0.04	11
05/08/72	500	339	0.31	11
08/15/74	440	251	0.12	11
11/25/75	390	228	0.04	8
08/27/76	480	281	0.14	13
07/25/77	430	260	0.18	9
08/14/78	360	228	0.20	9
08/09/79	360	227	0.07	6
07/16/80	430	238	0.11	8
08/28/81	400	324	0.13	6
09/17/82	400	314	0.10	4
06/28/83	380	306	0.12	5
09/13/84	350	274	0.10	4
08/14/85	340	308	<0.10	4
07/29/86	360	283	0.12	4
08/03/88	350	285	0.13	4
08/20/89	360	296	0.13	5
08/5/92	400	219	0.13	5
07/16/93	230	169	0.12	3
08/08/94	390	235	0.20	4

SELECTED INORGANIC CHEMICAL CONSTITUENTS FOR SYCAMORE SW WELL AE-77

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
09/23/66	550	338	0.10	12
05/08/72	441	337	0.33	14
08/31/74	120	62	0.02	2
08/31/76	210	112	<0.01	2
07/25/77	310	188	0.18	7
08/11/78	220	126	0.12	3
08/09/79	230	127	0.18	2
07/16/80	260	139	0.05	0.5
08/28/81	350	244	0.04	4
09/17/82	250	196	0.10	2
08/14/85	210	174	<0.10	2
08/09/88	270	216	<0.10	4
08/28/89	270	220	<0.1	4
08/05/92	340	183	<0.10	6
07/16/93	420	313	0.21	9
08/08/94	280	161	0.14	3
07/07/98	-	100	<0.1	2
07/22/99	-	120	<0.1	1

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR SYCAMORE SW WELL AE-79

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
10/17/66	700	429	0	19
12/16/70	730	379	0.18	1
05/08/72	670	409	0.29	33
08/10/73	590	353	0.12	28
08/08/74	470	266	0.16	21
09/5/75	320	174	0.17	7
08/31/76	340	194	<0.01	10
07/21/77	340	238	0.18	11
08/10/78	400	248	0.17	11
08/09/79	310	202	0.15	7
07/16/80	290	160	0.09	4
08/28/81	370	274	0.13	6
09/17/82	320	242	0.10	4
06/29/83	280	219	0.14	2
09/13/84	280	210	0.12	3
08/14/85	260	207	0.10	3
08/28/89	300	236	0.10	6
07/16/93	450	237	0.13	10
07/16/93	410	279	0.18	13
08/08/94	470	300	0.20	8
07/07/98	-	130	<0.1	2
07/22/99	-	140	<0.1	2

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR SYCAMORE SW WELL AE-84

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
07/03/70	719	414	0.14	35
05/08/72	640	381	0.26	27
08/04/73	660	396	0.12	36
09/05/74	480	347	0.02	31
09/17/75	450	254	0.10	18
08/31/76	480	295	0.15	19
07/25/77	550	319	0.17	18
08/10/78	540	317	0.20	16
08/09/79	380	257	0.18	9
07/16/80	360	200	0.13	4
08/28/81	410	322	0.18	6
09/25/84	350	261	0.15	5
08/14/85	380	289	0.18	5
07/29/86	350	270	0.14	4
08/03/88	360	289	0.14	5
08/28/89	400	324	0.14	7
08/05/92	500	269	0.15	12
07/16/93	470	313	0.20	15
08/08/94	410	260	0.21	7
08/23/95	-	260	0.14	8

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR SYCAMORE SW WELL AE-89

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
04/28/70	650	313	0.15	32
03/14/72	620	408	0.18	18
05/08/72	580	356	0.33	23
08/15/73	580	360	0.18	21
09/6/74	560	322	0.18	20
09/08/75	550	320	0.17	11
08/31/76	560	322	0.09	20
07/25/77	530	320	0.17	21
08/14/78	470	306	0.27	17
08/29/79	450	309	0.16	20
07/18/80	530	318	0.24	15
08/28/81	510	427	0.18	16
09/20/82	500	400	0.10	12
08/14/85	450	366	0.12	9
07/29/86	490	398	0.18	13
08/03/88	440	377	0.17	12
08/28/89	470	388	0.15	17
08/05/92	540	301	0.16	23
07/16/93	370	259	0.25	3
08/08/94	400	235	0.23	4
08/23/95	-	320	0.16	8
08/05/96	-	320	0.17	14
07/08/98	-	330	0.17	15

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR SYCAMORE SW WELL AE-91

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
03/15/72	590	385	0.23	9
05/08/72	570	369	0.34	9
09/06/74	550	312	0.18	18
08/27/76	540	314	0.14	20
07/25/77	520	310	0.22	10
08/14/78	440	289	0.24	15
08/29/79	440	297	0.16	17
07/16/80	460	250	0.13	9
08/28/81	640	399	0.16	7
09/08/82	460	380	0.12	7
07/06/83	420	353	0.15	4
09/13/84	440	341	0.18	4
08/14/85	430	339	0.15	4
07/29/86	410	328	0.14	3
08/03/88	400	331	0.14	3
08/28/89	400	333	0.14	4
08/05/92	510	288	0.16	7
07/16/93	340	218	0.18	3
08/08/94	380	210	0.23	2

SELECTED INORGANIC CHEMICAL CONSTITUENTS
FOR WELL T30S/R29E-15L3

Date	Electrical Conductivity (micromhos/cm @ 25°C)	Total Dissolved Solids (mg/l)	Boron (mg/l)	Nitrate (mg/l)
08/05/75	470	-	0.11	<1
06/24/77	550	297	0.18	3
07/12/78	560	346	0.12	1
08/22/79	480	319	0.19	<1
07/08/80	620	345	0.11	<1
07/28/81	730	507	0.09	5
08/03/82	660	502	0.08	<1
06/17/83	620	503	0.16	<1
07/25/84	750	539	0.15	3
06/24/85	730	531	0.15	<1
07/18/86	770	609	0.14	<1
08/05/87	790	617	0.15	<1
06/13/88	640	501	0.13	<1
08/04/89	800	638	0.19	<1

Most samples were taken from a domestic tap.

APPENDIX H

California Regional Water Quality Control Board
Central Valley Region

Water Quality Control Plan for the Tulare Lake Basin
Second Edition - 1995

III. WATER QUALITY OBJECTIVES

The Porter-Cologne Water Quality Control Act defines water quality objectives as "...the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area" {Water Code Section 13050(h)}. It also requires the Regional Water Board to establish water quality objectives, while acknowledging that it is possible for water quality to be changed to some degree without unreasonably affecting beneficial uses. In establishing water quality objectives, the Regional Water Board must consider, among other things, the following factors:

- Past, present, and probable future beneficial uses;
- Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto;
- Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area;
- Economic considerations;
- The need for developing housing within the region;
- The need to develop and use recycled water. {Water Code Section 13241}

The federal Clean Water Act requires a state to submit for approval of the Administrator of the U. S. Environmental Protection Agency (USEPA) all new or revised water quality standards which are established for surface and ocean water. The ground water objectives contained in this plan are not required by the federal Clean Water Act. In California, water quality standards are either water body specific or are based on beneficial uses designated for a water body and the water quality objectives that protect those uses.

There are six important points about water quality objectives. The first point is that water quality objectives can be revised through the basin plan amendment process. Objectives may apply region-wide or specifically to individual water bodies or parts of water bodies. Site-specific objectives may be developed if the Regional Water Board believes they are appropriate. Federal regulations require the review of water quality standards at least every three years. These "Triennial Reviews" provide one opportunity to evaluate the effectiveness of existing water quality objectives because the reviews begin with an identification of potential and actual water quality problems. The results of the Triennial Review are used to identify and prioritize Regional Water Board actions to achieve objectives and protect beneficial uses. Actions include assessment, remediation, monitoring, or whatever else may be appropriate, to address water quality problems. For example, a beneficial use may be impacted because the existing water quality objective is inadequate. This water quality objective should be reevaluated and a proper objective should be amended into the Basin Plan, along with a plan and schedule for attainment. In other cases, the existing water quality objective may be adequate and it may be necessary to develop new implementation strategies to address the problem.

Changes to a water quality objective can also occur because of new scientific information on the effects of a pollutant on beneficial uses. A major source of information is USEPA data on the effects of chemical and other constituent concentrations on particular aquatic species and human health. Other common information sources for data on protection of beneficial uses include the National Academy of Science, which has published data on bioaccumulation, and the federal Food and Drug Administration, which has issued criteria for unacceptable levels of chemicals in fish and shellfish used for human consumption. The Regional Water Board may also make use of other state or federal agency information sources when assessing new or revised water quality objectives.

The second point is that achievement of water quality objectives depends on applying them to regulate controllable water quality factors, although regulating controllable water quality factors may not necessarily cause water quality objectives to be achieved. Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the waters of the State, that are subject to the authority of the State Water Board or the Regional Water Board, and that may be reasonably controlled. These factors are subject to the authority of the State Water Board or the Regional Water Board. Controllable factors are not allowed to degrade water quality unless it is demonstrated that degradation is consistent with maximum benefit to the people of the State. In no cases may controllable water quality factors unreasonably affect present and anticipated beneficial uses of water nor result in water quality less than that prescribed in water quality control plans and policies. In instances where uncontrollable factors have already resulted in water quality objectives being exceeded, controllable factors are not allowed to cause further degradation of water quality. The Regional Water Board recognizes that manmade changes that alter flow regimes can affect water quality and impact beneficial uses.

The third point is that water quality objectives are achieved primarily through the adoption of waste discharge requirements (including federal NPDES permits) and enforcement orders. When adopting requirements and ordering actions, the Regional Water Board considers the beneficial uses within the area of influence of the discharge, the existing quality of receiving waters, and water quality objectives that apply to the reach or uses of the receiving water. Effluent limits may be established to reflect what is necessary to achieve water quality objectives, or, if more stringent, will reflect the technology-based standard for the type of discharge being regulated. The objectives in this plan do not require improvement over naturally occurring background concentrations. Water quality objectives contained in this plan, and any State or Federally promulgated objectives applicable to the Tulare Lake Basin, apply to the main water mass. They may apply at or in the immediate vicinity of effluent discharges, or may apply at the edge of an approved mixing zone. A mixing zone is an area of dilution or criteria for diffusion or dispersion defined in the waste discharge requirements. The Regional Water Board recognizes that immediate compliance with water quality objectives adopted by the Regional Water Board or the State Water Board, or with water quality criteria adopted by the federal Environmental Protection Agency, may not be feasible in all circumstances. Where the Regional Water Board determines it is infeasible for a discharger to comply immediately with such objectives or criteria, compliance shall be achieved in the shortest practicable period of time, not to exceed ten years after the adoption of applicable objectives or criteria. This policy shall apply to water quality objectives and water quality criteria adopted after the effective date of this Basin Plan update.

The fourth point is that, in cases where water quality objectives are formulated to preserve historic conditions, there may be insufficient data to determine completely the temporal and hydrologic variability representative of historic water quality. When violations of such water quality objectives occur, the Regional Water Board evaluates the reasonableness of achieving those objectives through regulation of the controllable factors in the areas of concern.

The fifth point is that the State Water Board adopts policies and plans for water quality control that can specify water quality objectives or affect their implementation. Chief among the State Water Board's policies for water quality control is State Water Board Resolution No. 68-16, *Statement of Policy with Respect to Maintaining High Quality of Waters in California* (Antidegradation Policy). It requires that, wherever the existing quality of surface or ground waters is better than the objectives established for those waters, the existing quality will be maintained unless as otherwise provided by Resolution No. 68-16 or any revisions thereto. This policy and others establish general objectives.

The sixth point is that water quality objectives may be in numerical or narrative form. The enumerated milligram-per-liter (mg/l) limit for dissolved oxygen is an example of a numerical objective; the objective for color is an example of a narrative objective.

WATER QUALITY OBJECTIVES FOR INLAND SURFACE WATERS

Surface water quality in the Basin is generally good, with excellent quality exhibited by most eastside streams. The Regional Water Board intends to maintain this quality. The water quality objectives below are presented by categories which, like the beneficial uses of Chapter II, were standardized for uniformity among the regional water boards.□ Designated beneficial uses of the waters of the Tulare Lake Basin for which provisions should be made are identified in Chapter II; this chapter gives the water quality objectives to protect those beneficial uses. As new information becomes available, the Regional Water Board will review the appropriateness of these objectives, and may modify them accordingly.

Ammonia

Waters shall not contain un-ionized ammonia in amounts which adversely affect beneficial uses. In no case shall the discharge of wastes cause concentrations of un-ionized ammonia (NH_3) to exceed 0.025 mg/l (as N) in receiving waters.

Bacteria

In waters designated REC-1, the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed a geometric mean of 200/100 ml, nor shall more than ten percent of the total number of samples taken during any 30-day period exceed 400/100 ml.

Biostimulatory Substances

Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.

Chemical Constituents

Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. The Regional Water Board will consider all material and relevant information submitted by the discharger and other interested parties and numerical criteria and guidelines for detrimental levels of chemical constituents developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U. S. Food and Drug Administration, the National Academy of Sciences, the U. S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective.

At a minimum, water designated MUN shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in the following provisions of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, Table 64444-A (Organic Chemicals) of Section 64444, and Table 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) of Section 64449. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. At a minimum, water designated MUN shall not contain lead in excess of 0.015 mg/l. The Regional Water Board acknowledges that specific treatment requirements are imposed by state and federal drinking water regulations on the consumption of surface waters under specific circumstances. To ensure that waters do not contain chemical constituents in concentrations that adversely affect beneficial uses, the Regional Water Board may apply limits more stringent than MCLs

Color

Waters shall be free of discoloration that causes nuisance or adversely affects beneficial uses.

Dissolved Oxygen

Waste discharges shall not cause the monthly median dissolved oxygen concentrations (DO) in the main water mass (at centroid of flow) of streams and above the thermocline in lakes to fall below 85 percent of saturation concentration, and the 95 percentile concentration to fall below 75 percent of saturation concentration.

The DO in surface waters shall always meet or exceed the concentrations in Table III-1 for the listed specific water bodies and the following minimum levels for all aquatic life:

Waters designated WARM 5.0 mg/l
Waters designated COLD or SPWN 7.0 mg/l

Where ambient DO is less than these objectives, discharges shall not cause a further decrease in DO concentrations.

Floating Material

Waters shall not contain floating material, including but not limited to solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.

Oil and Grease

Waters shall not contain oils, greases, waxes, or other materials in concentrations that cause nuisance, result in a visible film or coating on the surface of the water or on objects in the water, or otherwise adversely affect beneficial uses.

pH

The pH of water shall not be depressed below 6.5, raised above 8.3, or changed at any time more than 0.3 units from normal ambient pH.

In determining compliance with the above limits, the Regional Water Board may prescribe appropriate averaging periods provided that beneficial uses will be fully protected.

Pesticides

Waters shall not contain pesticides in concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations in bottom sediments or aquatic life that adversely affect beneficial uses. (For the purposes of this objective, the term pesticide is defined as any substance or mixture of substances used to control objectionable insects, weeds, rodents, fungi, or other forms of plant or animal life.) The Regional Water Board will consider all material and relevant information submitted by the discharger and other interested parties and numerical criteria and guidelines for detrimental levels of chemical constituents developed by the State Water

TABLE III-1
TULARE LAKE BASIN
SPECIFIC DISSOLVED OXYGEN WATER QUALITY OBJECTIVES

Stream	Location	Min DO (mg/l)
Kings River		
Reach I	Above Kirch Flat	9
Reach II	Kirch Flat to Pine Flat Dam	9
Reach III	Pine Flat Dam to Friant-Kern	9
Reach IV	Friant-Kern to Peoples Weir	7
Reach V	Peoples Weir to Island Weir	7
Kaweah River	Lake Kaweah	7
Tule River	Lake Success	7
Kern River		
Reach I	Above Lake Isabella	8
Reach III	Lake Isabella to Southern California Edison Powerhouse (KR-1)	8

Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.□S. Food and Dmg Administration, the National Academy of Sciences, the U. S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective.

At a minimum, waters designated MUN shall not contain concentrations of pesticide constituents in excess of the maximum contaminant levels (MCLs) specified in Table 64444-A (Organic Chemicals) of Section 64444 of Title 22 of the California Code of Regulations, which is incorporated by reference into this plan. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. The Regional Water Board acknowledges that specific treatment requirements are imposed by state and federal drinking water regulations on the consumption of surface waters under specific circumstances. To ensure that waters do not contain chemical constituents in concentrations that adversely affect beneficial uses, the Regional Water Board may apply limits more stringent than MCLs.

In waters designated COLD, total identifiable chlorinated hydrocarbon pesticides shall not be present at concentrations detectable within the accuracy of analytical methods prescribed in *Standard Methods for the Examination of Water and Wastewater, 18th Edition*, or other equivalent methods approved by the Executive Officer.

Radioactivity

Radionuclides shall not be present in concentrations that are deleterious to human, plant, animal, or aquatic life nor which result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal, or aquatic life.

At a minimum, waters designated MUN shall not contain concentrations of radionuclides in excess of the maximum contaminant levels (MCLs) specified in Table 4 (MCL Radioactivity) of Section 64443 of Title 22, California Code of Regulations, which are incorporated by reference into this plan. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect.

Salinity

Waters shall be maintained as close to natural concentrations of dissolved matter as is reasonable considering careful use of the water resources.

"The only reliable way to determine the true or absolute salinity of a natural water is to make a complete chemical analysis. However, this method is time-consuming and cannot yield the precision necessary for accurate work" {*Standard Methods for the Examination of Water and Wastewater*, 18th Edition}. Conductivity is one of the recommended methods to determine salinity.

The objectives for electrical conductivity in Table III-2 apply to the water bodies specified. Table III-3 specifies objectives for electrical conductivity at selected streamflow stations.

Sediment

The suspended sediment load and suspended sediment discharge rate of waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.

Settleable Material

Waters shall not contain substances in concentrations that result in the deposition of material that causes nuisance or adversely affects beneficial uses.

TABLE III-2
TULARE LAKE BASIN
MAXIMUM ELECTRICAL CONDUCTIVITY LEVELS

Stream	Location	Max. Electrical Conductivity (µmho/cm)
Kings River		
Reach I	Above Kirch Flat	100
Reach II	Kirch Flat to Pine Flat Dam	100[a]
Reach III	Pine Flat Dam to Friant-Kern	100
Reach IV	Friant-Kern to Peoples Weir	200
Reach V	Peoples Weir to Island Weir	300[b]
Reach VI	Island Weir to Stinson Weir on North Fork and Empire Weir No. 2 on South Fork	300[b]
Kaweah River		
Reach I	Above Lake Kaweah	175
Reach II	Lake Kaweah	175[c]
Reach III	Below Lake Kaweah	[d]
Tule River		
Reach I	Above Lake Success	450
Reach II	Lake Success	450[e]
Reach III	Below Lake Success	[d]
Kern River		
Reach I	Above Lake Isabella	200
Reach II	Lake Isabella	300
Reach III	Lake Isabella to Southern California Edison Powerhouse (KR-1)	300
Reach IV	KR-1 to Bakersfield	300[f]
Reach V	Below Bakersfield	[d]

[a] Maximum 10-year average - 50 µmhos

[b] During the period of irrigation deliveries. Providing, further, that for 10 percent of the time (period of low flow) the following shall apply to the following reaches of the Kings River:

Reach V	400 µmhos
Reach VI	600 µmhos

[c] Maximum 10-year average - 100 µmhos

[d] During the irrigation season releases should meet the levels shown in the preceding reach. At other times the channel will be dry or controlled by storm flows.

[e] Maximum 10-year average - 250 µmhos

[f] Maximum 10-year average - 175 µmhos

TABLE III-3
TULARE LAKE BASIN
ELECTRICAL CONDUCTIVITY OBJECTIVES AT SELECTED STREAMFLOW STATIONS

Streamflow Station Number		Location	Electrical Conductivity (µmhos/cm)		
USGS	DWR		90-Percentile	Median	Mean
--	C01140.00	Kings River below Peoples Weir	198	81	102
11-2185	C11460.00	Kings River below North Fork	68	48	47
11-2215	C11140.00	Kings River below Pine Flat Dam	54	36	42
11-2105	C21250.00	Kaweah River near Three Rivers	154	95	94
11-2032	C31150.00	Tule River near Springville	429	278	367
11-2049	C03195.00	Tule River below Success Dam	368	244	235
11-1870	C51500.00	Kern River at Kernville	177	116	118
11-1910	C5135.00	Kern River below Isabella Dam	278	141	165
11-1940	C05150.00	Kern River near Bakersfield	233	158	167

Suspended Material

Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.

Tastes and Odors

Waters shall not contain taste- or odor-producing substances in concentrations that cause nuisance, adversely affect beneficial uses, or impart undesirable tastes or odors to fish flesh or other edible products of aquatic origin or to domestic or municipal water supplies.

Temperature

Natural temperatures of waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses.

Temperature objectives for COLD interstate waters, WARM interstate waters, and Enclosed Bays and Estuaries are as specified in the *Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays of California,* including any revisions. (See Appendix 10.)

Elevated temperature wastes shall not cause the temperature of waters designated COLD or WARM to increase by more than 5°F above natural receiving water temperature.

In determining compliance with the above limits, the Regional Water Board may prescribe appropriate averaging periods provided that beneficial uses will be fully protected.

Toxicity

All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances. Compliance with this objective will be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, biotoxicity tests of appropriate duration, or other methods as specified by the Regional Water Board. The Regional Water Board will also consider all material and relevant information submitted by the discharger and other interested parties and numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U. S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective.

The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors shall not be less than that for the same water body in areas unaffected by the waste discharge, or, when necessary, for other control water that is consistent with the requirements for "dilution water" as described in *Standard Methods for the Examination of Water and Wastewater, 18th Edition*. As a minimum, compliance shall be evaluated with a 96-hour bioassay.

In addition, effluent limits based upon acute biotoxicity tests of effluents will be prescribed where appropriate; additional numerical receiving water quality objectives for specific toxicants will be established as sufficient data become available; and source control of toxic substances will be encouraged.

Turbidity

Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:

- Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), increases shall not exceed 1 NTU.
- Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent.
- Where natural turbidity is equal to or between 50 and 100 NTUs, increases shall not exceed 10 NTUs.
- Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.

In determining compliance with the above limits, the Regional Water Board may prescribe appropriate averaging periods provided that beneficial uses will be fully protected.

WATER QUALITY OBJECTIVES FOR GROUND WATERS

The following objectives apply to all ground waters in the Tulare Lake Basin.

Bacteria

In ground waters designated MUN, the concentration of total coliform organisms over any 7-day period shall be less than 2.2/100 ml.

Chemical Constituents

Ground waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. The Regional Water Board will consider all material and relevant information submitted by the discharger and other interested parties and numerical criteria and guidelines for detrimental levels of chemical constituents developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.□S. Food and Dug Administration, the National Academy of Sciences, the U. S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective.

At a minimum, waters designated MUN shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in the following provisions of Title 22 of the California Code of Regulations, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, Table 64444-A (Organic Chemicals) of Section 64444, and Table 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) of Section 64449. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. At a minimum, water designated MUN shall not contain lead in excess of 0.015 mg/l. To ensure that waters do not contain chemical constituents in concentrations that adversely affect beneficial uses, the Regional Water Board may apply limits more stringent than MCLs.

Pesticides

No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses.

At a minimum, waters designated MUN shall not contain concentrations of pesticide constituents in excess of the maximum contaminant levels (MCLs) specified in Table 64444-A (Organic Chemicals) of Section 64444 of Title 22 of the California Code of Regulations, which is incorporated by reference into this plan. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. The Regional Water Board acknowledges that specific treatment requirements are imposed by state and federal drinking water regulations on the consumption of surface waters under specific circumstances. More stringent objectives may apply if necessary to protect other beneficial uses.

Radioactivity

Radionuclides shall not be present in ground waters in concentrations that are deleterious to human, plant, animal, or aquatic life, or that result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal or aquatic life.

At a minimum, ground waters designated MUN shall not contain concentrations of radionuclides in excess of the maximum contaminant levels (MCLs) specified in Table 4 (MCL Radioactivity) of Section 64443 of Title 22, California Code of Regulations, which are incorporated by reference into this plan. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect.

Salinity

All ground waters shall be maintained as close to natural concentrations of dissolved matter as is reasonable considering careful use and management of water resources.

No proven means exist at present that will allow ongoing human activity in the Basin and maintain ground water salinity at current levels throughout the Basin. Accordingly, the water quality objectives for ground water salinity control the rate of increase.

The maximum average annual increase in salinity measured as electrical conductivity shall not exceed the values specified in Table III-4 for each hydrographic unit shown on Figure III-1.

The average annual increase in electrical conductivity will be determined from monitoring data by calculation of a cumulative average annual increase over a 5-year period.

Tastes and Odors

Ground waters shall not contain taste- or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses.

Toxicity

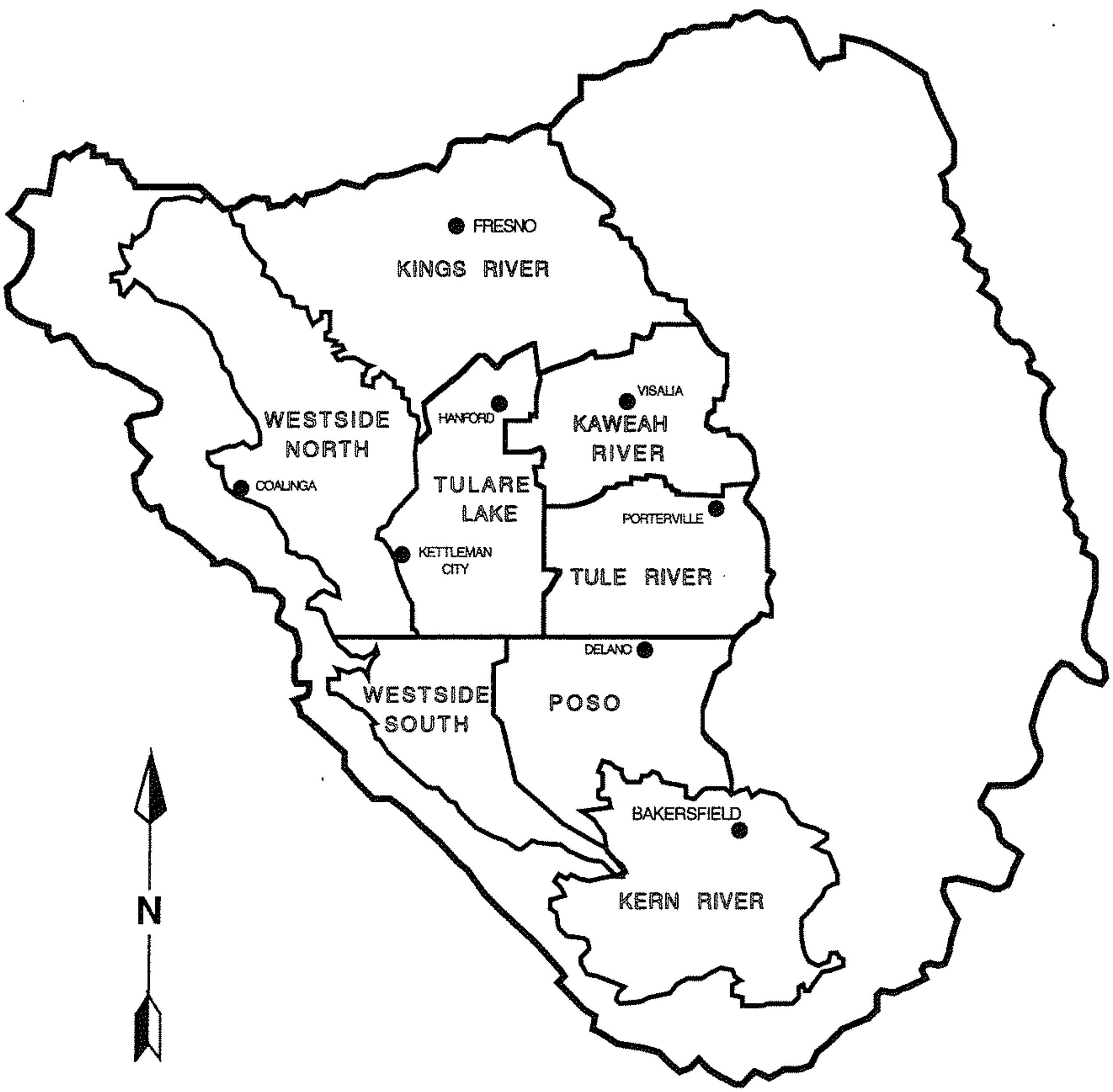
Ground waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life associated with designated beneficial use(s). The Regional Water Board will also consider all material and relevant information submitted by the discharger and other interested parties and numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.□S. Food and Drug Administration, the National Academy of Sciences, the U. S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances.

TABLE III-4
TULARE LAKE BASIN
GROUND WATER QUALITY OBJECTIVES FOR SALINITY

Hydrographic Unit	Maximum Average Annual Increase in Electrical Conductivity (µmhos/cm)
Westside (North and South)	1
Kings River	4
Tulare Lake and Kaweah River	3
Tule River and Poso	6
Kern River	5

FIGURE III-1

TULARE LAKE BASIN
GROUND WATER HYDROGRAPHIC UNITS



APPENDIX I

Required and Recommended Components of Local Groundwater Management Plans

A. REQUIRED COMPONENTS

Recent amendments to Water Code Section 10750 *et seq.* resulting from the passage of SB1938 (Stats 2002, Ch 603) require new groundwater management plans prepared under that authority (commonly referred to as AB3030 Plans) to include the seven components below. In addition, plans prepared under other authorities shall include components 2 through 7 to be eligible for the award of funds administered by DWR for the construction of groundwater projects or groundwater quality projects.

1. Documentation that a written statement was provided to the public "describing the manner in which interested parties may participate in developing the groundwater management plan," which may include appointing a technical advisory committee (Water Code § 10753.4 (b)).

2. Basin management objectives (MOs) for the groundwater basin that is subject to the plan. (Water Code § 10753.7 (a)(1)).

3. Components relating to the monitoring and management of groundwater levels, groundwater quality, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping. (Water Code § 10753.7 (a)(1)).

4. A plan by the managing entity to "involve other agencies that enables the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin." (Water Code § 10753.7 (a)(2)). A local agency includes "any local public agency that provides water service to all or a portion of its service area." (Water Code § 10752 (g)).

5. Adoption of monitoring protocols (Water Code § 10753.7 (a)(4)) for the components in Water Code § 10753.7 (a)(1). Monitoring protocols are not defined in the Water Code, but the section is interpreted to mean developing a monitoring program capable of tracking changes in conditions for the purpose of meeting MOs.

6. A map showing the area of the groundwater basin, as defined by DWR Bulletin 118, with the area of the local agency subject to the plan as well as the boundaries of other local agencies that overlie the basin in which the agency is developing a groundwater management plan (Water Code § 10753.7 (a)(3)).

7. For local agencies not overlying groundwater basins, plans shall be prepared including the above listed components and using geologic and hydrologic principles appropriate to those areas (Water Code § 10753.7 (a)(5)).

B. RECOMMENDED COMPONENTS

In addition to the requirements of SB 1938, included in A above, it is recommended that components 1 through 7 below be included in a groundwater management plan to be implemented by the managing entity. None of the suggested data reporting in the components below should be construed as recommending disclosure of information that is confidential under state law.

1. Establish an advisory committee of stakeholders (interested parties) within the plan area that will help guide the development and implementation of the plan.

2. Describe the area to be managed under the plan, including:

   a. The physical structure and characteristics of the aquifer system underlying the plan area in the context of the overall basin.
   b. A summary of the availability of historical data including, but not limited to, the components in Section A3 above.
   c. Issues of concern including, but not limited to, issues related to the components in Section A3 above.
   d. A general discussion of historical and projected water demands and supplies.

3. For each MO, describe:
   a. How meeting the MO will contribute to a more reliable supply for long-term beneficial uses of groundwater in the plan area.
   b. Existing or planned management actions to achieve MOs.

4. Describe the plan monitoring program adopted under Section A5 above, including:
   a. Map indicating the general locations of any applicable monitoring sites for groundwater levels, groundwater quality, subsidence stations, or stream gages.
   b. A summary of monitoring sites indicating the type (groundwater level, groundwater quality, subsidence, stream gage) and frequency of monitoring. For groundwater level and groundwater quality wells, indicate the depth interval(s) or aquifer zone monitored and the type of well (public, irrigation, domestic, industrial, monitoring).

5. Describe any current or planned actions by the local managing entity to coordinate with other land use, zoning, or water management planning.

6. Provide for periodic report(s) summarizing groundwater basin conditions and groundwater management activities. The report(s), prepared annually or at other frequencies as determined by the local management agency, should include:

a. Summary of monitoring results, including a discussion of historical trends.
b. Summary of management actions during the period covered by the report.
c. A discussion, supported by monitoring results, of whether management actions are achieving progress in meeting MOs.
d. Summary of proposed management actions.
e. Summary of any plan component changes, including addition or modification of MOs, during the period covered by the report.

7. Provide for the periodic re-evaluation of the entire plan by the managing entity.

APPENDIX J

Arvin-Edison Water Storage District
Groundwater Level Monitoring Program

The Arvin-Edison Water Storage District conducts a groundwater level survey biannually (spring & fall). The United States Bureau of Reclamation (USBR) provides a schedule and list of wells with known measuring point elevations to be measured and provided as Attachment A.

The Arvin-Edison Water Storage District conducts the biannual surveys by measuring wells both by wire and acoustic sounders. The results are submitted to the USBR and to the District's contract engineers to produce groundwater maps. A map of the USBR well run is provided as Attachment B.

The District also conducts a monthly groundwater level survey of its own wells. A list of the District's wells including location, well completion and perforation depths is provided as Attachment C. These surveys are performed using airlines within the wells when able.

Attachment A

United States Department of the Interior

BUREAU OF RECLAMATION
South-Central California Area Office
2666 North Grove Industrial Drive, Suite 106
Fresno, California 93727-1551

IN REPLY REFER TO:

SCC-439
RES-3.10

Arvin-Edison Water Storage District
PO Box 175
Arvin, CA. 93203

Subject: Semiannual Groundwater Measurement Schedule - Fall 2000
South-Central California Area Office (Friant Dam)

Ladies and Gentlemen:

The Semiannual Groundwater Measurement Program for Spring 2001 ([redacted]) will start on ***October 2,*** and extend through the following two weeks. Please schedule your observation and measuring programs accordingly.

As you know numerous agencies, utilize this data for various studies and reports. To ensure consistency of collected data, please performing all data collection within the allotted time frame.

Please return all the enclosed data collection forms when completed to:

Bureau of Reclamation
Friant Dam
Attention: ***Bruce Russell***
PO Box 267
Friant, CA. 93626

Thank you for your support and participation. If you should have any questions, please contact Bruce Russell at (559) 822-2211 or for the hearing impaired at (559) 487-5397.

Sincerely,

P. Bruce Russell
Hydrologic Technician
Friant Dam

Enclosures

3-WS
V 10-24-72

SHEET NO. 1 OF 9
OBS ______

GROUND-WATER MEASUREMENTS

AGENCY NO. 5644 AGENCY Arvin-Edison W.S.D.

USBR Well Number						Tape Reading		Date			N M	Q M	Remarks
Twp.	Range	Sec.	Tr.	No.	BM	at M.P.	at W.S.	Month	Day	Year			
219S	218E	~~311~~	~~A~~	~~011~~	~~M~~						6		
		~~316~~	~~J~~	~~013~~	~~M~~						6		
	219E	~~312~~	~~A~~	~~012~~	~~M~~						6		
		313	N	011	M	2184 8		012	018	011			
		~~314~~	~~C~~	~~011~~	~~M~~						3		
		316	N	011	M	4114		012	018	011		9	
310S	218E	112	J	012	M	~~—~~					2		
	219E	013	K	011	M	2191 9		012	018	011			
		015	D	013	M	3104		013	018	011		9	
		015	F	011	M								
		015	H	011	M	3106		013	019	011		9	
		016	A	011	M	2710 3		013	018	011			
		016	E	013	M	2813 7		013	018	011			
		018	K	011	M	3317 1		013	018	011			NCBR OBS. Well
		~~018~~	~~M~~	~~011~~	~~M~~	~~—~~		013	018	011	2		
		~~019~~	~~J~~	~~011~~	~~M~~	~~—~~		013	018	011	6		
		110	N	014	M	~~—~~		013	018	011	2		
		111	N	011	M	2317 6		012	018	011			
		115	L	013	M	4110 4		013	018	011			
		116	F	012	M	~~—~~		013	018	011	3		
		~~116~~	~~J~~	~~011~~	~~M~~	~~—~~					4		
310S	219E	116	J	012	M	3166		013	018	011		9	

NO MEASUREMENT

0. MEASUREMENT DISCONTINUED
1. PUMPING
2. PUMP HOUSE LOCKED
3. TAPE HUNG UP
4. CAN'T GET TAPE IN CASING
5. UNABLE TO LOCATE WELL
6. WELL DESTROYED
7. SPECIAL
8. CASING LEAKING
9. TEMPORARILY INACCESSIBLE

QUESTIONABLE MEASUREMENT

0. CAVED OR OTHER OBSTRUCTION
1. PUMPING
2. NEARBY PUMPING
3. CASING LEAKING
4. PUMPED RECENTLY
5. AIR GAUGE MEASURE
6. M.P. CHANGE
7. RECHARGE NEAR WELL
8. OIL IN CASING
9. ACOUSTICAL SOUNDER

3-WS
V 10-24-72

SHEET NO. 2 OF 9
OBS ________

GROUND-WATER MEASUREMENTS

AGENCY NO. 5644 AGENCY Arvin-Edison W. S. D.

USBR Well Number						Tape Reading		Date			N	Q	
Twp.	Range	Sec.	Tr.	No.	BM	at M.P.	at W.S.	Month	Day	Year	M	M	Remarks
3101S	2191E	116	L	011	M	3316		013	015	011		9	AEN-01
		117	A	011	M	3127		013	114	011		9	
		117	A	012	M	3134		013	114	011		9	
		119	J	011	M	2710		013	114	011		9	
		210	L	011	M			013	114	011	1		
		211	G	011	M	3514		013	015	011		9	AEN-02
		211	J	011	M	3417		013	114	011		9	
		212	A	013	M			013	114	011	1		
		212	C	013	M			013	114	011	4		
		213	E	013	M	2612		012	018	011		9	
		216	J	012	M	4126		012	018	011		9	
		~~216~~	~~R~~	~~011~~	~~M~~			013	015	011	4		
		217	F	011	M			013	114	011	1		
		217	M	011	M	3514		013	015	011		9	AEN-03
		219	A	011	M	2917		013	015	011		9	
		219	H	011	M			013	114	011	5		
		310	A	012	M			013	114	011	1		
		310	R	012	M			013	114	011	2		
		~~311~~	~~A~~	~~012~~	~~M~~			013	114	011	4		
		314	A	011	M	3714		013	015	011		9	AEN-04
		314	P	012	M	3135		013	114	011		9	
3101S	2191E	316	K	011	M	3914 1		012	018	011			
		[redacted]											AE Hydrograph

NO MEASUREMENT

0. MEASUREMENT DISCONTINUED
1. PUMPING
2. PUMP HOUSE LOCKED
3. TAPE HUNG UP
4. CAN'T GET TAPE IN CASING
5. UNABLE TO LOCATE WELL
6. WELL DESTROYED
7. SPECIAL
8. CASING LEAKING
9. TEMPORARILY INACCESSIBLE

QUESTIONABLE MEASUREMENT

0. CAVED OR OTHER OBSTRUCTION
1. PUMPING
2. NEARBY PUMPING
3. CASING LEAKING
4. PUMPED RECENTLY
5. AIR GAUGE MEASURE
6. M.P. CHANGE
7. RECHARGE NEAR WELL
8. OIL IN CASING
9. ACOUSTICAL SOUNDER

GROUND-WATER MEASUREMENTS

AGENCY NO. 5644 AGENCY Arvin-Edison W.S.D.

USBR Well Number						Tape Reading			Date			N M	Q M	Remarks
Twp.	Range	Sec.	Tr.	No.	BM	at M.P.		at W.S.	Month	Day	Year			
1					12	34	37	39 41	26		31	32	33	
310S	219E	316	L	011	M	333			02	08	011		9	
	310E	019	E	011	M	239	3		012	08	011			
		019	Q	011	M	196	5		012	018	011			
		118	B	012	M	2115	2		02	018	011			
		119	E	011	M	169	9		012	018	011			
		311	M	011	M	—			012	018	011	6		
311S	219E	011	D	011	M	3159	0		013	13	011		9	
		012	D	011	M	3173	0		013	113	011		9	AEN-05
		012	M	011	M	3144	0		013	113	011		9	
		013	A	012	M	—			013	113	011			
		013	C	011	M	3125	0		013	113	011		9	
		014	A	013	M	3123	0		013	113	011		9	
		014	P	011	M	—			013	113	011			
		015	A	012	M	3105	0		013	113	011		9	
		015	E	011	M	3102	0		013	113	011		9	
		017	A	011	M	—			013	113	011			
		018	H	012	M	2193	0		013	113	011		9	
		019	B	011	M	—			013	113	011			
		019	L	012	M	31110	0		013	113	011		9	
		110	K	011	M	3212	0		013	113	011		9	
		111	B	011	M	3146	0		013	113	011		9	
311S	219E	111	D	011	M	—			03	016	011			AEN-14

NO MEASUREMENT

0. MEASUREMENT DISCONTINUED
1. PUMPING
2. PUMP HOUSE LOCKED
3. TAPE HUNG UP
4. CAN'T GET TAPE IN CASING
5. UNABLE TO LOCATE WELL
6. WELL DESTROYED
7. SPECIAL
8. CASING LEAKING
9. TEMPORARILY INACCESSIBLE

QUESTIONABLE MEASUREMENT

0. CAVED OR OTHER OBSTRUCTION
1. PUMPING
2. NEARBY PUMPING
3. CASING LEAKING
4. PUMPED RECENTLY
5. AIR GAUGE MEASURE
6. M.P. CHANGE
7. RECHARGE NEAR WELL
8. OIL IN CASING
9. ACOUSTICAL SOUNDER

i-WS
i 10-24-72

SHEET NO. 4 OF 9
OBS ________

GROUND-WATER MEASUREMENTS

AGENCY NO. 5644 AGENCY Arvin-Edison W. S. D.

USBR Well Number						Tape Reading		Date			N	Q	
Twp.	Range	Sec.	Tr.	No.	BM	at M. P.	at W. S.	Month	Day	Year	NM	QM	Remarks
31/15	219E	112	M	011	M	3513		013	113	011		9	
		114	L	011	M	3012		013	113	011		9	
		117	H	012	M	2177		013	113	011		9	
		~~211~~	~~J~~	~~012~~	~~M~~								
		213	B	011	M	2910		013	113	011		9	
		~~213~~	~~K~~	~~011~~	~~M~~			013	113	011	9		
		~~213~~	~~N~~	~~011~~	~~M~~			013	113	011	4		
		215	C	011	M	21919		013	113	011		9	
		~~216~~	~~G~~	~~012~~	~~M~~								
		216	R	011	M								
		217	C	011	M	1147		013	113	011		9	
		~~311~~	~~D~~	~~011~~	~~M~~								
		~~311~~	~~E~~	~~011~~	~~M~~								
		314	A	011	M	21610		013	017	011		9	
		314	C	013	M			013	017	011			
		315	D	011	M			013	017	011			
		315	K	011	M	21410		013	017	011		9	
		316	G	011	M	21115		013	017	011		9	
	310E	016	E	011	M	31718		013	113	011		9	
		~~017~~	~~D~~	~~011~~	~~M~~								
		116	G	011	M	31610		012	210	011		9	
31/15	310E	116	N	011	M	21918		012	210	011		9	
		[redacted]		01									AE - Piezo (Deep)

NO MEASUREMENT

0. MEASUREMENT DISCONTINUED
1. PUMPING
2. PUMP HOUSE LOCKED
3. TAPE HUNG UP
4. CAN'T GET TAPE IN CASING
5. UNABLE TO LOCATE WELL
6. WELL DESTROYED
7. SPECIAL
8. CASING LEAKING
9. TEMPORARILY INACCESSIBLE

QUESTIONABLE MEASUREMENT

0. CAVED OR OTHER OBSTRUCTION
1. PUMPING
2. NEARBY PUMPING
3. CASING LEAKING
4. PUMPED RECENTLY
5. AIR GAUGE MEASURE
6. M.P. CHANGE
7. RECHARGE NEAR WELL
8. OIL IN CASING
9. ACOUSTICAL SOUNDER

S-WS
V 10-24-72

SHEET NO. 5 OF 9
OBS ____

GROUND-WATER MEASUREMENTS

(A)GENCY NO. 5644 AGENCY Arvin-Edison W.S.D.

USBR Well Number						Tape Reading		Date			N M	Q M	Remarks
Twp.	Range	Sec.	Tr.	No.	BM	at M.P.	at W.S.	Month	Day	Year			
1					12	34 37	37 41	26		31	32	33	
311S	310E	117	K	011	M	21917		012	210	011		9	
		118	H	011	M	3012		013	113	011		9	
		118	K	013	M	3019		013	113	011		9	
		~~118~~	~~L~~	~~011~~	~~M~~								
		211	G	011	M			012	210	011	4		
		~~211~~	~~P~~	~~011~~	~~M~~								
		219	N	011	M	21810		012	210	011		9	
		310	D	011	M	21214		012	210	011		9	
		310	J	011	M	21312		012	210	011		9	
		310	R	011	M	21410		012	210	011		9	
		311	C	012	M	21219		012	210	011		9	
		311	H	012	M			012	210	011	1		
		312	C	011	M			012	210	011	1		
12S	218E	113	F	011	M			013	112	011	1		
		114	H	011	M			013	017	011	5		
		211	R	011	M	1170		013	018	011		9	
		213	H	011	M			013	018	011	4		
		213	L	011	M	21311		013	018	011		9	
		213	R	011	M	21015		013	018	011		9	
		~~214~~	~~J~~	~~011~~	~~M~~								
		215	B	011	M			013	012	011	1		
312S	218E	215	B	012	M	21113		013	012	011		9	

NO MEASUREMENT

0. MEASUREMENT DISCONTINUED
1. PUMPING
2. PUMP HOUSE LOCKED
3. TAPE HUNG UP
4. CAN'T GET TAPE IN CASING
5. UNABLE TO LOCATE WELL
6. WELL DESTROYED
7. SPECIAL
8. CASING LEAKING
9. TEMPORARILY INACCESSIBLE

QUESTIONABLE MEASUREMENT

0. CAVED OR OTHER OBSTRUCTION
1. PUMPING
2. NEARBY PUMPING
3. CASING LEAKING
4. PUMPED RECENTLY
5. AIR GAUGE MEASURE
6. M.P. CHANGE
7. RECHARGE NEAR WELL
8. OIL IN CASING
9. ACOUSTICAL SOUNDER

5-WS
V 10-24-72

SHEET NO. 6 OF 9
OBS ________

GROUND-WATER MEASUREMENTS

AGENCY NO. 5644 AGENCY Arvin-Edison W. S. D.

USBR Well Number						Tape Reading		Date			NM	QM	Remarks
Twp.	Range	Sec.	Tr.	No.	BM	at M.P.	at W. S.	Month	Day	Year			
31215	218E	215	J	012	M			013	018	011			
		215	J	013	M			013	018	011			
		215	P	013	M			013	018	011			
		216	A	013	M	21112		013	018	011		9	
		218	H	011	M			013	112	011	4		
		311	R	011	M			013	114	011	1		
		314	R	011	M	21617		013	018	011		9	
		315	E	011	M			013	018	011	2		
	219E	012	G	011	M			013	017	011	2		
		012	N	011	M	2128		013	112	011		9	
		~~013~~	~~Q~~	~~011~~	~~M~~								
		015	R	011	M			013	112	011	2		
		018	F	012	M			013	112	011	1		
		019	F	011	M	2312		013	112	011		9	
		110	C	011	M			013	015	011	5		
		111	R	013	M	2145		013	015	011		9	
		112	P	011	M	11819		013	015	011		9	
		~~115~~	~~H~~	~~011~~	~~M~~								
		116	J	012	M			013	112	011	9		
		116	L	011	M			013	112	011	1		
		116	R	012	M	3118		013	011	011		9	
31215	219E	117	G	012	M	21217		013	112	011		9	

NO MEASUREMENT

0. MEASUREMENT DISCONTINUED
1. PUMPING
2. PUMP HOUSE LOCKED
3. TAPE HUNG UP
4. CAN'T GET TAPE IN CASING
5. UNABLE TO LOCATE WELL
6. WELL DESTROYED
7. SPECIAL
8. CASING LEAKING
9. TEMPORARILY INACCESSIBLE

QUESTIONABLE MEASUREMENT

0. CAVED OR OTHER OBSTRUCTION
1. PUMPING
2. NEARBY PUMPING
3. CASING LEAKING
4. PUMPED RECENTLY
5. AIR GAUGE MEASURE
6. M.P. CHANGE
7. RECHARGE NEAR WELL
8. OIL IN CASING
9. ACOUSTICAL SOUNDER

-S-WS
REV 10-24-72

SHEET NO. 7 OF 9
OBS ____

GROUND-WATER MEASUREMENTS

AGENCY NO. 5644 AGENCY Arvin-Edison W. S. D.

USBR Well Number: Twp.	Range	Sec.	Tr.	No.	BM	Tape Reading: at M. P.	at W. S.	Date: Month	Day	Year	N M	Q M	Remarks
1					12	34 37	39 41	26		31	32	33	
31215	2191E	117	G	013	M	TT		013	112	011	1		
		117	R	012	M	21414		013	112	011		9	
		118	H	011	M	TT		013	112	011	1		
		118	H	012	M	21811		013	112	011		9	
		119	P	012	M	2133		013	018	011		9	
		~~119~~	~~P~~	~~013~~	~~M~~	TT		013	018	011	4		
		210	H	011	M	21119		013	112	011		9	
		212	B	012	M	21816		013	112	011		9	
		217	M	011	M	TT		013	112	011	4		
		218	C	012	M	21719		013	112	011		9	
		219	F	011	M	21319		03	018	011		9	
		310	R	011	M	TT		013	018	011	1		
		311	N	011	M	21916		013	018	011		9	
		312	F	012	M	21917		013	018	011		9	
		313	F	011	M	21917		013	112	011		9	
		313	G	011	M	21919		013	112	011		9	
31215	3101E	~~016~~	~~C~~	~~011~~	~~M~~	TT							
111N	119W	013	P	011	S	3113						9	
		~~016~~	~~E~~	~~012~~	~~S~~	TT		~~[illegible]~~					
		016	H	011	S	21811		013	017	011		9	
		017	F	011	S	51010		013	017	011		9	
111N	119W	017	P	011	S	51019		013	017	011		9	

NO MEASUREMENT

0. MEASUREMENT DISCONTINUED
1. PUMPING
2. PUMP HOUSE LOCKED
3. TAPE HUNG UP
4. CAN'T GET TAPE IN CASING
5. UNABLE TO LOCATE WELL
6. WELL DESTROYED
7. SPECIAL
8. CASING LEAKING
9. TEMPORARILY INACCESSIBLE

QUESTIONABLE MEASUREMENT

0. CAVED OR OTHER OBSTRUCTION
1. PUMPING
2. NEARBY PUMPING
3. CASING LEAKING
4. PUMPED RECENTLY
5. AIR GAUGE MEASURE
6. M.P. CHANGE
7. RECHARGE NEAR WELL
8. OIL IN CASING
9. ACOUSTICAL SOUNDER

3-WS
V 10-24-72

SHEET NO. 8 OF 9
OBS ________

GROUND-WATER MEASUREMENTS

AGENCY NO. 5644 AGENCY Arvin-Edison W.S.D.

USBR Well Number						Tape Reading		Date			N	Q	Remarks
Twp.	Range	Sec.	Tr.	No.	BM	at M.P.	at W.S.	Month	Day	Year	M	M	
1					12	34 37	39 41	26		31	32	33	
111W	119W	017	R	013	S	4172		013	018	011		9	
″	″	019	F	011	S	41218		013	018	011		9	
″	″	110	N	011	S	31619		013	018	011		9	
″	″	112	A	011	S	41112		013	018	011		9	
″	″	113	J	011	S	—					1		
″	″	115	G	011	S	3112		013	018	011		9	
″	″	115	N	011	S	31515		013	018	011		9	
″	″	117	F	012	S								
″	″	118	R	011	S								
″	″	~~119~~	~~H~~	~~011~~	~~S~~								
″	″	211	Q	011	S	—		013	017	011	4		
″	″	212	E	011	S	31317		013	017	011		9	
″	″	212	G	011	S	3145		013	017	011		9	
″	″	214	H	011	S								
″	210W	~~011~~	~~K~~	~~011~~	~~S~~								
″	″	014	G	011	S	21319		013	114	011		9	
″	″	014	H	011	S	21816		013	114	011		9	
″	″	015	J	012	S	2111		013	114	011		9	
″	″	019	C	011	S	21513		013	114	011		9	
″	″	111	Q	011	S	31112		013	114	011		9	
112W	118W	310	N	011	S	31417		013	017	011		9	
112W	119W	216	R	012	S	—		013	112	011	4		

NO MEASUREMENT

0. MEASUREMENT DISCONTINUED
1. PUMPING
2. PUMP HOUSE LOCKED
3. TAPE HUNG UP
4. CAN'T GET TAPE IN CASING
5. UNABLE TO LOCATE WELL
6. WELL DESTROYED
7. SPECIAL
8. CASING LEAKING
9. TEMPORARILY INACCESSIBLE

QUESTIONABLE MEASUREMENT

0. CAVED OR OTHER OBSTRUCTION
1. PUMPING
2. NEARBY PUMPING
3. CASING LEAKING
4. PUMPED RECENTLY
5. AIR GAUGE MEASURE
6. M.P. CHANGE
7. RECHARGE NEAR WELL
8. OIL IN CASING
9. ACOUSTICAL SOUNDER

-9-WS
EV 10-24-72

SHEET NO. 9 OF 9
OBS ______

GROUND-WATER MEASUREMENTS

GENCY NO. 5644 AGENCY Arvin-Edison W. S. D.

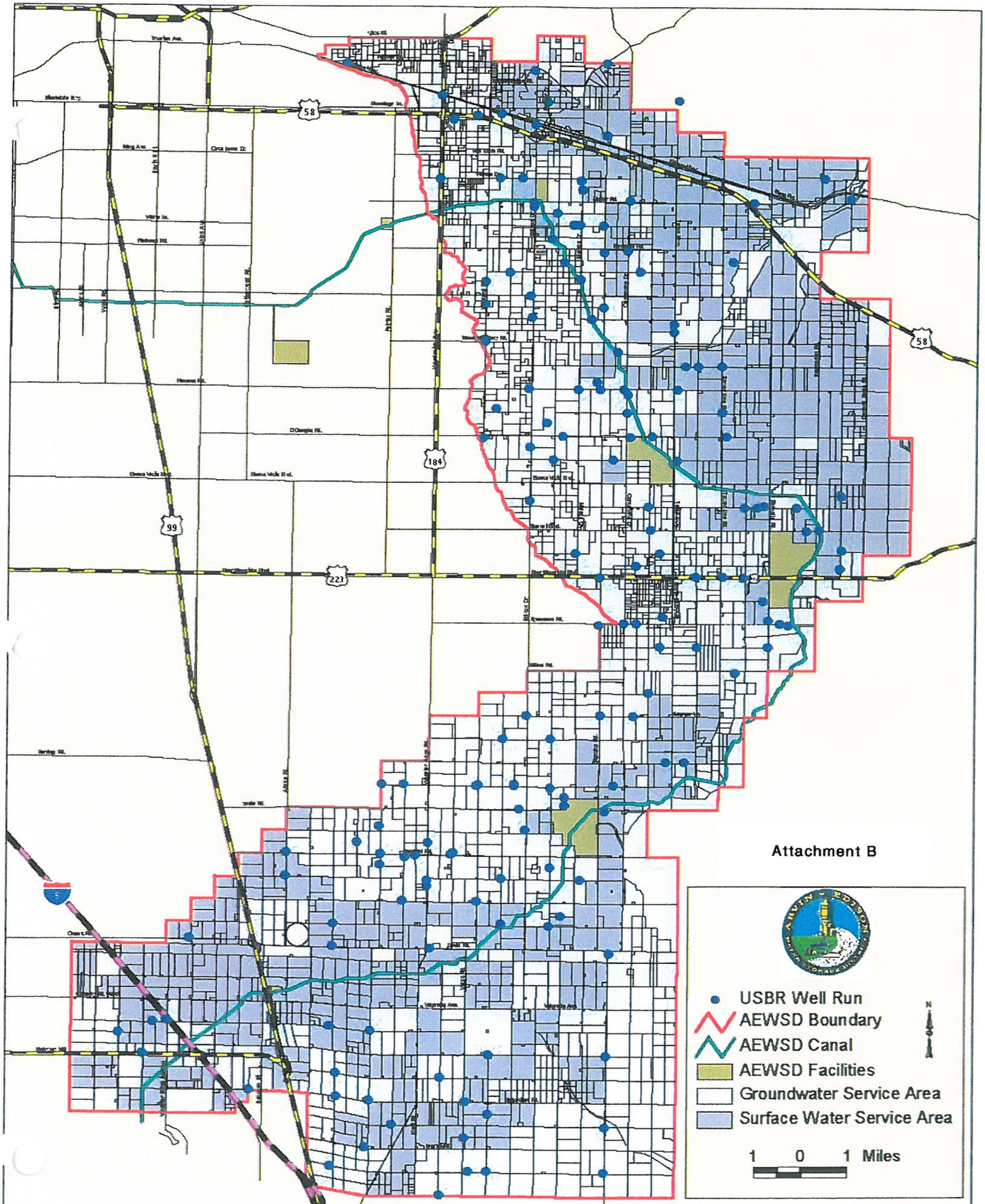
USBR Well Number						Tape Reading		Date			N M	Q M	Remarks
Twp.	Range	Sec.	Tr.	No.	BM	at M. P.	at W. S.	Month	Day	Year			
1					12	34 37	39 41	26		31	32	33	
112W	119W	312	K	011	S	31610		013	016	011		9	
		313	E	011	S	31413		013	016	011		9	
		314	R	011	S	31015		013	016	011		9	
		316	P	011	S	31713		013	016	011		9	
		316	Q	011	S	31712		013	016	011		9	
		316	R	012	S	—		013	016	011	4		
	210W	219	R	011	S	—		013	112	011	1		
		312	R	011	S	21015		013	112	011		9	
		313	F	011	S	—		013	112	011	3		
		313	P	011	S	21013		013	112	011		9	
		314	B	011	S	31018		013	112	011		9	
		~~316~~	~~P~~	~~011~~	~~S~~	—							
112W	210W	316	G	011	S	31110		013	112	011		9	

NO MEASUREMENT

0. MEASUREMENT DISCONTINUED
1. PUMPING
2. PUMP HOUSE LOCKED
3. TAPE HUNG UP
4. CAN'T GET TAPE IN CASING
5. UNABLE TO LOCATE WELL
6. WELL DESTROYED
7. SPECIAL
8. CASING LEAKING
9. TEMPORARILY INACCESSIBLE

QUESTIONABLE MEASUREMENT

0. CAVED OR OTHER OBSTRUCTION
1. PUMPING
2. NEARBY PUMPING
3. CASING LEAKING
4. PUMPED RECENTLY
5. AIR GAUGE MEASURE
6. M. P. CHANGE
7. RECHARGE NEAR WELL
8. OIL IN CASING
9. ACOUSTICAL SOUNDER



Attachment B
USBR Well Run
AEWSD Boundary
AEWSD Canal
AEWSD Facilities
Groundwater Service Area
Surface Water Service Area
1 0 1 Miles
58
184
99
223
5

Attachment C

AEWSD		Location					Well Completion				Perforations	
Field	AE Well #	Twp.	Rng.	Sec.	40 Ac.	Well #	MP Elev.	Bowl Depth	Total Depth	Airline Depth	Start	End
Sycamore Wells	1	31 S.	30 E.	29	M	1	475.00	500	800	500	400	800
	2	31 S.	30 E.	29	L	1	495.20	570	876	570	420	852
	4	31 S.	30 E.	29	F	1	504.85	550	858	550	420	852
	5	31 S.	30 E.	29	F	2	489.09	530	827	530	420	816
	6	31 S.	30 E.	29	E	1	478.87	510	876	510	420	852
	7	31 S.	30 E.	29	F	3	491.20	510	830	510	420	816
	8	31 S.	30 E.	29	F	4	505.56	510	860	570	420	852
	9	31 S.	30 E.	29	B	1	503.60	530	886	530	420	852
	10	31 S.	30 E.	29	C	1	495.30	510	850	510	420	852
	11	31 S.	30 E.	29	D	2	483.50	490	880	490	420	876
	12	31 S.	30 E.	20	Q	1	506.83	530	860	530	456	864
	13	31 S.	30 E.	20	K	1	495.00	510	850	510	408	816
	14	31 S.	30 E.	20	L	1	486.25	490	810	490	408	816
	15	31 S.	30 E.	20	J	1	505.51	590	820	590	408	816
	16	31 S.	30 E.	20	H	1	506.25	530	888	530	456	864
	17	31 S.	30 E.	20	H	2	485.25	590	820	590	408	816
	18	31 S.	30 E.	20	G	1	492.30	570	820	500	408	816
	20	31 S.	30 E.	29	N	2	468.13	490	804	490	408	780
	21	31 S.	30 E.	29	E	2	476.65	490	856	490	420	852
	22	31 S.	30 E.	30	H	1	461.92	490	792	490	408	768
	23	31 S.	30 E.	30	A	2	459.03	490	788	490	420	768
	24	31 S.	30 E.	29	D	1	470.13	490	780	490	420	768
	25	31 S.	30 E.	19	J	2	463.70	490	777	490	408	768
	26	31 S.	30 E.	20	N	1	469.28	490	816	490	408	792
	28	31 S.	30 E.	20	M	1	474.04	490	782	560	408	768
	29	31 S.	30 E.	20	L	2	486.62	510	787	510	408	768
	31	31 S.	30 E.	20	C	2	478.82	470	725	470	408	720
	32	31 S.	30 E.	20	G	2	486.17	500	739	490	408	720
	33	31 S.	30 E.	20	G	3	491.80	490	780	490	408	768
	34	31 S.	30 E.	20	H	3	502.04	550	781	550	408	768
	35	31 S.	30 E.	20	C	1	487.00	N/A	N/A	NA	NA	NA
	36	31 S.	30 E.	20	D	1	476.00	520	730	530	450	710
	37	31 S.	30 E.	20	E	1	481.00	540	820	550	450	800
Tejon Wells	71	32 S.	29 E.	21	H	1	495.00	600	1050	600	528	1044
	72	32 S.	29 E.	22	E	1	495.00	600	1045	600	528	1044
	73	32 S.	29 E.	22	C	1	495.00	600	1018	600	516	1044
	74	32 S.	29 E.	21	G	2	484.00	600	1084	600	528	1044
	75	32 S.	29 E.	21	H	2	482.00	600	1045	600	528	1044
	76	32 S.	29 E.	21	A	1	482.00	580	996	580	576	1008
	77	32 S.	29 E.	22	D	1	487.00	600	1066	600	504	1032
	78	32 S.	29 E.	15	N	1	487.00	600	1038	600	492	1020
	79	32 S.	29 E.	15	P	1	487.00	600	1032	600	529	1032
	80	32 S.	29 E.	21	B	1	467.74	600	996	600	504	972
	81	32 S.	29 E.	21	B	2	456.66	600	925	600	504	972
	82	32 S.	29 E.	16	R	3	472.46	580	996	580	504	972
	83	32 S.	29 E.	16	R	4	462.46	600	996	604	504	972
	84	32 S.	29 E.	15	N	2	473.87	580	955	580	504	972
	86	32 S.	29 E.	21	J	1	501.00	640	996	640	504	972
	87	32 S.	29 E.	21	R	1	502.49	600	984	600	504	960
	88	32 S.	29 E.	28	A	1	497.26	600	948	600	504	924
	89	32 S.	29 E.	21	Q	1	476.59	620	996	620	504	972
	90	32 S.	29 E.	21	J	2	483.41	600	996	600	504	972
	91	32 S.	29 E.	21	G	1	461.79	600	996	580	504	972
	92	32 S.	29 E.	22	N	1	531.00	650	996	660	590	960
	93	32 S.	29 E.	22	M	1	521.00	640	996	650	570	1030
	94	32 S.	29 E.	22	E	2	514.00	660	996	660	580	1030
	95	32 S.	29 E.	22	P	1	546.00	660	996	670		
	96	32 S.	29 E.	22	L	1	541.00	645	996	650		
North Canal	AEN-01	30 S.	29 E.	16	L	1	513.81	450	840	450	480	816
	AEN-02	30 S.	29 E.	21	G	1	513.97	450	840	450	480	816
	AEN-03	30 S.	29 E.	27	M	1	513.22	450	840	450	480	816
	AEN-04	30 S.	29 E.	34	A	1	508.96	450	864	480	480	840
	AEN-05	31 S.	29 E.	2	D	1	510.84	450	864	450	480	840
	AEN-06	31 S.	29 E.	11	C	1	508.27	540	920	532	550	880
	AEN-07	31 S.	29 E.	11	C	2	505.09	540	1010	562	570	970
	AEN-08	31 S.	29 E.	11	B	1	511.26	560	970	562	580	930
	AEN-09	31 S.	29 E.	11	E	1	496.68	560	990	562	580	950
	AEN-10	31 S.	29 E.	11	E	2	496.21	560	1040	562	580	1000
	AEN-11	31 S.	29 E.	11	K	1	505.52	562	1020	562	580	980
	AEN-12	31 S.	29 E.	11	Q	1	496.20	540	1030	562	570	990
	AEN-13	31 S.	29 E.	11	J	1	505.19	540	1000	612	630	960
	AEN-14	31 S.	29 E.	11	D	1	NA	410	N/A	410	NA	NA

APPENDIX K

ARVIN-EDISON WATER STORAGE DISTRICT

MEMORANDUM

DATE: January 31, 2000

TO: Steve Collup

CC: Howard Frick

FROM: Steve Lewis & Tim Long SHL Timothy A. Long

RE: Summary of Groundwater Quality Monitoring Program

GENERAL DESCRIPTION

The District's Water Quality Survey is an annual sampling of groundwater involving roughly 30 farm wells and 25 District wells for a total of 55 to 60 wells per year. The Engineering Department identifies and monitors areas within the District with water quality issues, and the results of groundwater analyses have shown considerable variability in historical water quality trends within the District. This variability is geographical and reflects the aquifer's response to climatological variations (droughts and floods) as well as to District activities such as spreading and groundwater extraction. Our sampling objectives for conducting the survey are 1) to obtain a representative sampling of District wells, 2) to obtain a representative sampling of private farm wells from the geologic sub-areas within the District, and 3) to maintain continuity of historical data.

PROGRAM COSTS

The annual survey requires approximately two weeks or 80 man-hours to complete the fieldwork portion and an additional two weeks to tabulate and review laboratory results. Laboratory analytical costs are approximately $70/per sample. The cost to the District, excluding wages, is approximately $5,000 each year.

GROUNDWATER QUALITY ISSUES

The USGS in Water Supply Paper 1656 (1964) identified certain areas of inferior groundwater quality in the Eastern part of the Edison-Maricopa portion of the Southern San Joaquin Valley. Specifically, Arvin-Edison Water Storage District boundaries encompass sections of land with elevated nitrates (NO_3), boron (B) and salinity (NaCl). General irrigation analysis tests for these and other water quality indicators. A review of the levels of these various constituents shows patterns of variability that appear to reflect hydrological as well as District and farming operations influences. For example, boron levels have increased in successive drought years in some areas, and water quality in the vicinity of spreading basins have shown improvement following large spreading efforts.

LIST OF ATTACHMENTS

- Program Summary
- Map-Farm Well Water Quality Sample Locations
- Sample Water Analysis

SHL:sh\lewis\grdwtrsummary.doc

PROGRAM SUMMARY

Procedures and Materials:

- 1 Qt. Plastic Sample Bottles (provided by Laboratory)
- Cooler with Ice
  1. Determine that the sample tap to be used is upstream of any chemicals injected into the system to prevent contamination, and that the well has been running for at least 10 minutes before a sample is drawn.
  2. Note the location, date & time, analyses to be performed (General Irrigation), and who performed the sampling on both the bottle and the laboratory's *Chain of Custody* form. Include District's purchase order number (P.O. #) on report and include the proper District accounting routing number for billing purposes. The Arvin-Edison Water Storage District's accounting routing number are as follows: **56375-030** (for samples from District's well fields). **58375-030** (for private farm well samples).
  3. Rinse the bottle 3 times with the water to be sampled before sampling. Fill bottle to overflowing.
  4. Rinse cap and seal bottle. Place bottle on ice in cooler.
  5. Return samples to lab within 48 hours. Samples must be continuously refrigerated while in District possession.

District Wells

Consideration in obtaining representative samples from District groundwater wells is a priority and accounts for a minimum of 25 groundwater samples. A comprehensive District well groundwater quality survey is recommended at least once every 5 years. The annual minimum should include the following wells for continuity in historical data from each of the following District groundwater pumping facilities:

North Canal *(Map 1, Edison, Calif. Quadrangle):*
- AEN-1
- AEN-2
- AEN-3
- AEN-4
- AEN-5

Sycamore Spreading Works Wells *(Map 2, Sycamore Well Field)*
- AE-01
- AE-08
- AE-13
- AE-17
- AE-22
- AE-26
- AE-32
- AE-36

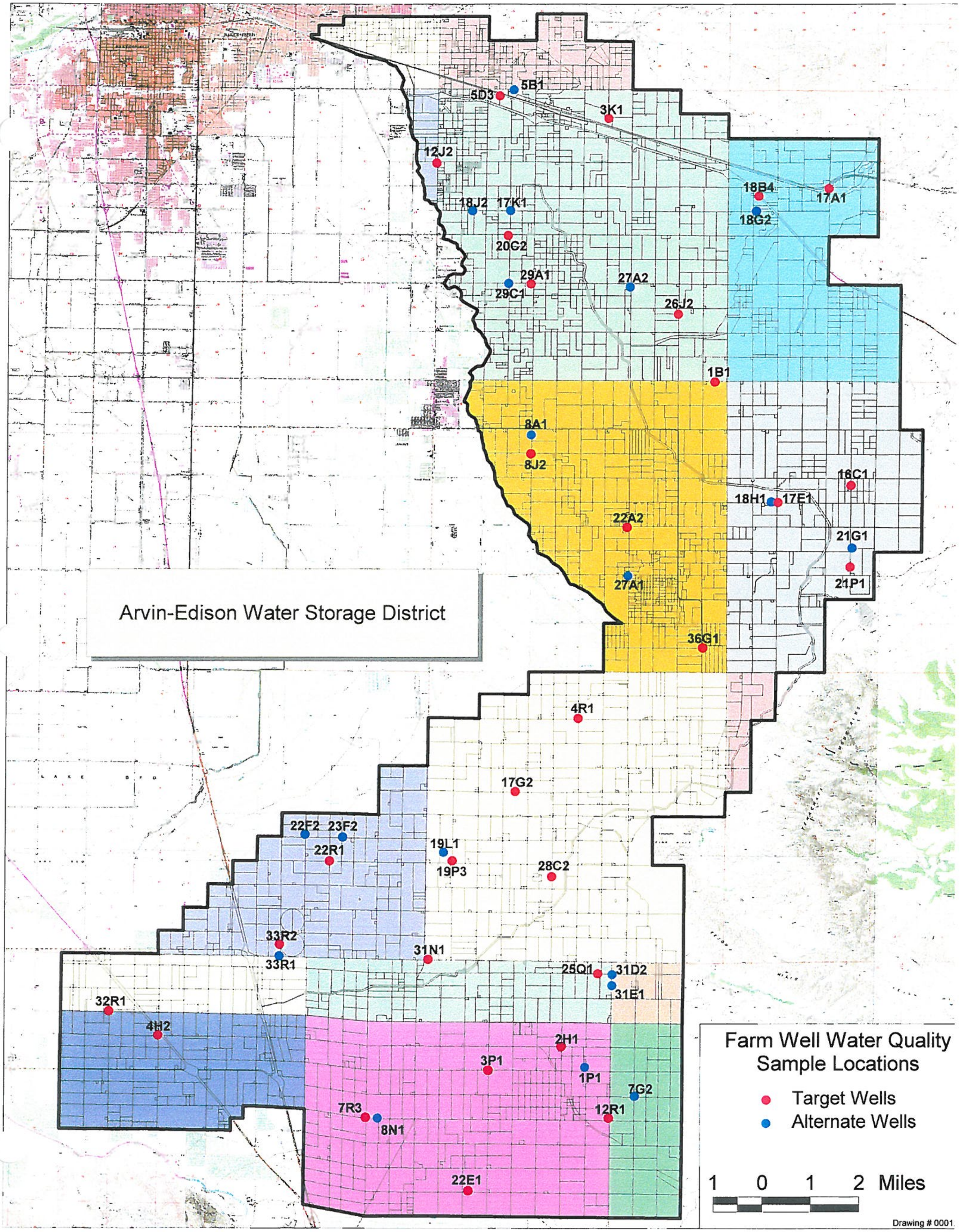
Tejon Spreading Works *(Map 3, Tejon Well Field)*
- AE-77
- AE-79
- AE-80
- AE-82
- AE-90
- AE-92
- AE-96

North Canal Spreading Works *(Map 4, North Canal Spreading Works)*
- AEN-08
- AEN-09
- AEN-12
- AEN-13
- AEN-14

Farm Wells

A list of private agricultural farm wells was produced to insure historical continuity in water quality data *(Map 5, Farm Well Water Quality Sample Locations (1993-1999))*. This list also targets representative samples from the 4 water producing geologic sub-areas, and areas of poor water quality within the District *(Maps 6–8)*. The target list of Agricultural Farm wells with preferred alternative wells is as follows *(Map 9, Farm Well Water Quality)*:

Target	Alternate
• 11/19-07R3	11/19-08N1
• 11/19-12R1	11/18-07G2
• 11/19-22E1	
• 11/19-03P1	
• 11/19-02H1	11/19-01P1
• 11/20-04H2	
• 12/19-25Q1	12/18-31D2 or 31E2
• 12/20-32R1	
• 32/28-33R2	32/28-33R1
• 32/28-22R1	32/28-22F2 or 23F2
• 32/29-31N1	
• 32/29-04R1	32/29-03Q1
• 32/29-17G2	32/29-17R2
• 32/29-28C2	32/29-27D1
• 32/29-19P3	32/29-19L1
• 31/29-36G1	
• 31/29-01B1	
• 31/29-08J2	31/29-08A1
• 31/29-22A2	31/29-27A1
• 31/30-17E1	31/30-18H1
• 31/30-16C1	
• 31/30-21P1	31/30-21G1
• 30/30-18B4	30/30-18G2
• 30/30-17A1	
• 30/29-03K1	
• 30/29-05D3	30/29-05B1
• 30/29-20C2	30/29-17K1
• 30/29-29A1	30/29-29C1
• 30/29-26J2	30/29-27A2
• 30/28-12J2	30/29-18J2



Arvin-Edison Water Storage District
Farm Well Water Quality Sample Locations
Target Wells
Alternate Wells
1 0 1 2 Miles
5D3
5B1
3K1
12J2
18B4
17A1
18G2
18J2
17K1
20C2
29A1
29C1
27A2
26J2
1B1
8A1
8J2
16C1
18H1
17E1
22A2
21G1
27A1
21P1
36G1
4R1
17G2
22F2
23F2
19L1
22R1
19P3
28C2
33R2
33R1
31N1
25Q1
31D2
31E1
32R1
4H2
2H1
3P1
1P1
7G2
7R3
8N1
12R1
22E1
Drawing # 0001

ZALCO LABORATORIES, INC.
Analytical & Consulting Services

4309 Armour Avenue
Bakersfield, California 93308

(661) 395-0539
FAX (661) 395-3069

Arvin Edison Water Storage District
P O Box 175
Arvin, CA 93203

Laboratory No: 9907294-6
Date Received: 07/22/99
Date Reported: 08/01/99

Attention: Tim Long

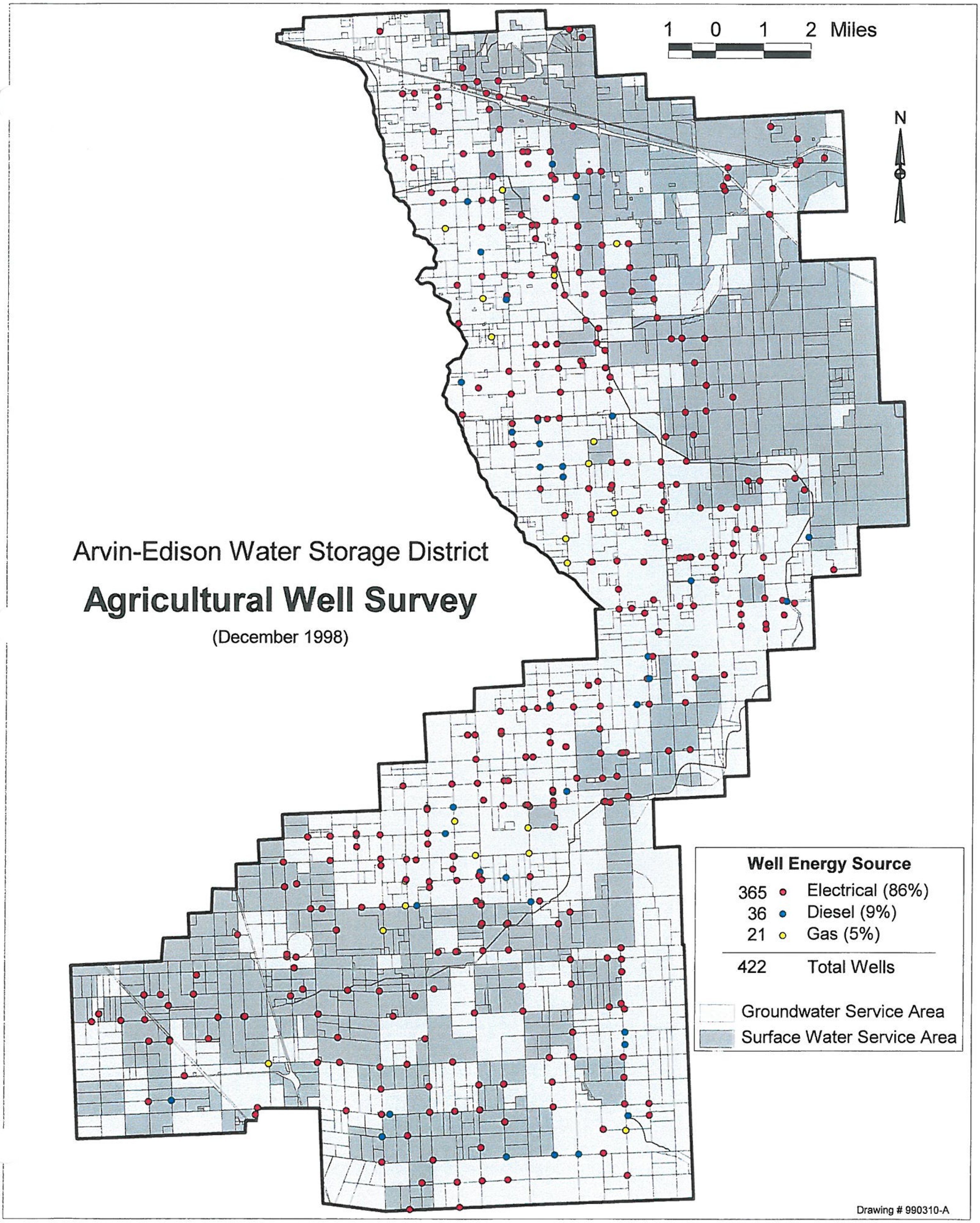
Sample Identification: AEN-03
Sampled by Ryan Kroeger on 07/21/99 at 14:00

IRRIGATION WATER ANALYSIS

pH	8.3
Electrical Conductivity, EC (millimhos/cm @ 25 C)	1.04

Constituents	mg/l	meq/l
Calcium, Ca	110	5.49
Magnesium, Mg	33	2.71
Sodium, Na (calculated)	56	2.42
Potassium, K	9.9	0.25
Alkalinity as:		
Hydroxide, OH	0	0
Carbonate, CO3	0	0
Bicarbonate, HCO3	270	4.36
Chloride, Cl	63	1.78
Sulfate, SO4	140	2.96
Nitrate, NO3	110	1.77
Totals (Sum)	650	21.74
Boron, B	0.11	
Total Dissolved Solids, (Grav)	650	
Calculated Hardness, CaCO3	410	
Sodium Adsorption Ratio, SAR	1.2	
Exchangeable Sodium Percentage, ESP	0.5	
Cation/Anion Balance, %	0.43	
Sodium, Na (determined), mg/l	60	
Langelier Scale Index	1.39	
Gypsum Requirement, lbs/ac-ft	0	

John Zaletel
for Jim Etherton
Laboratory Director

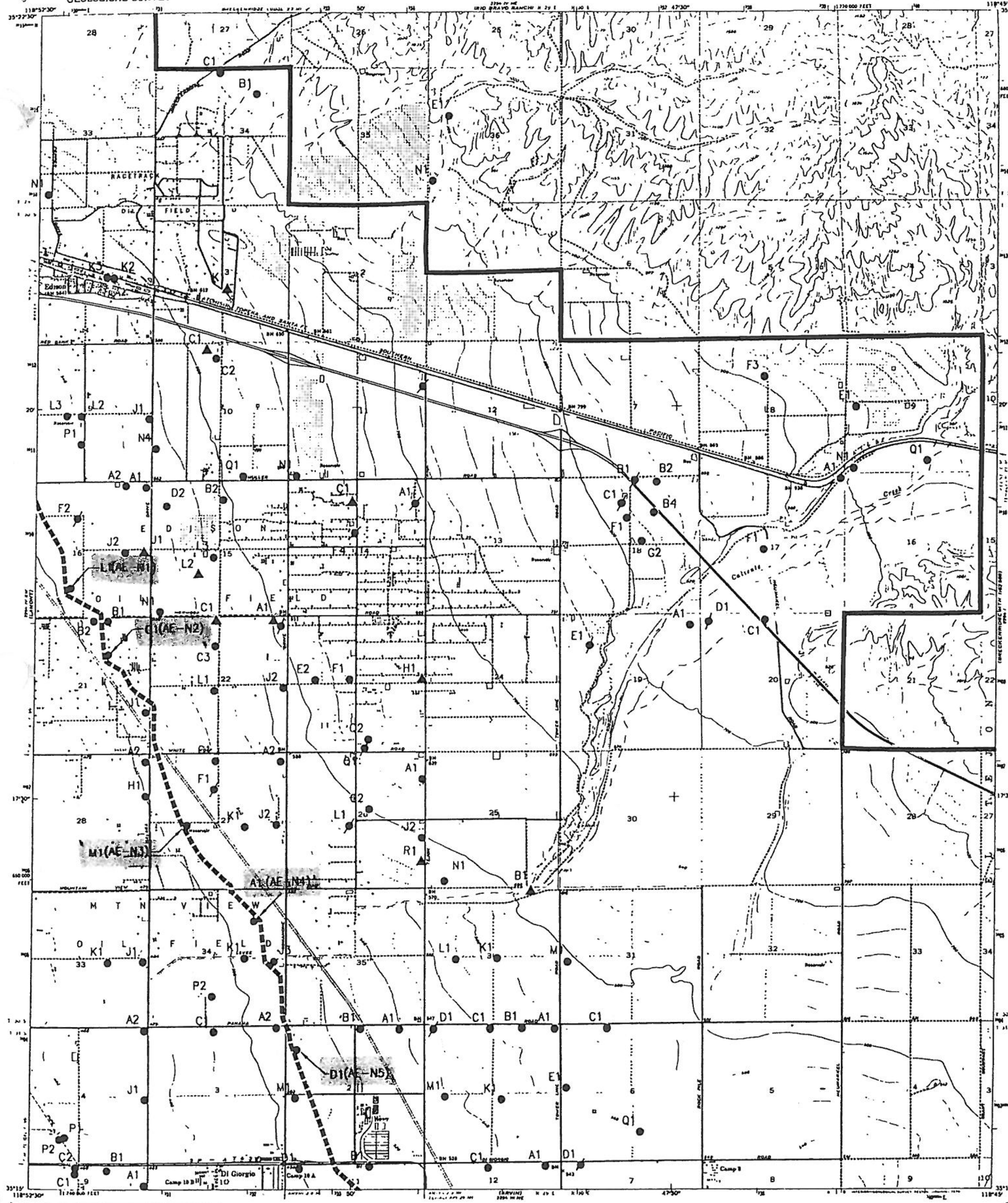


Arvin-Edison Water Storage District
Agricultural Well Survey
(December 1998)
1 0 1 2 Miles
N
Well Energy Source
365 Electrical (86%)
36 Diesel (9%)
21 Gas (5%)
422 Total Wells
Groundwater Service Area
Surface Water Service Area
Drawing # 990310-A

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

EDISON QUADRANGLE
CALIFORNIA—KERN CO
7.5 MINUTE SERIES (TOPOGRAPHIC)



LEGEND

- ACTIVE AG WELL
- ABANDONED AG WELL
- ACTIVE DOMESTIC WELL
- ABANDONED DOMESTIC WELL

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DASHED LINES REPRESENT HALF INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U S GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

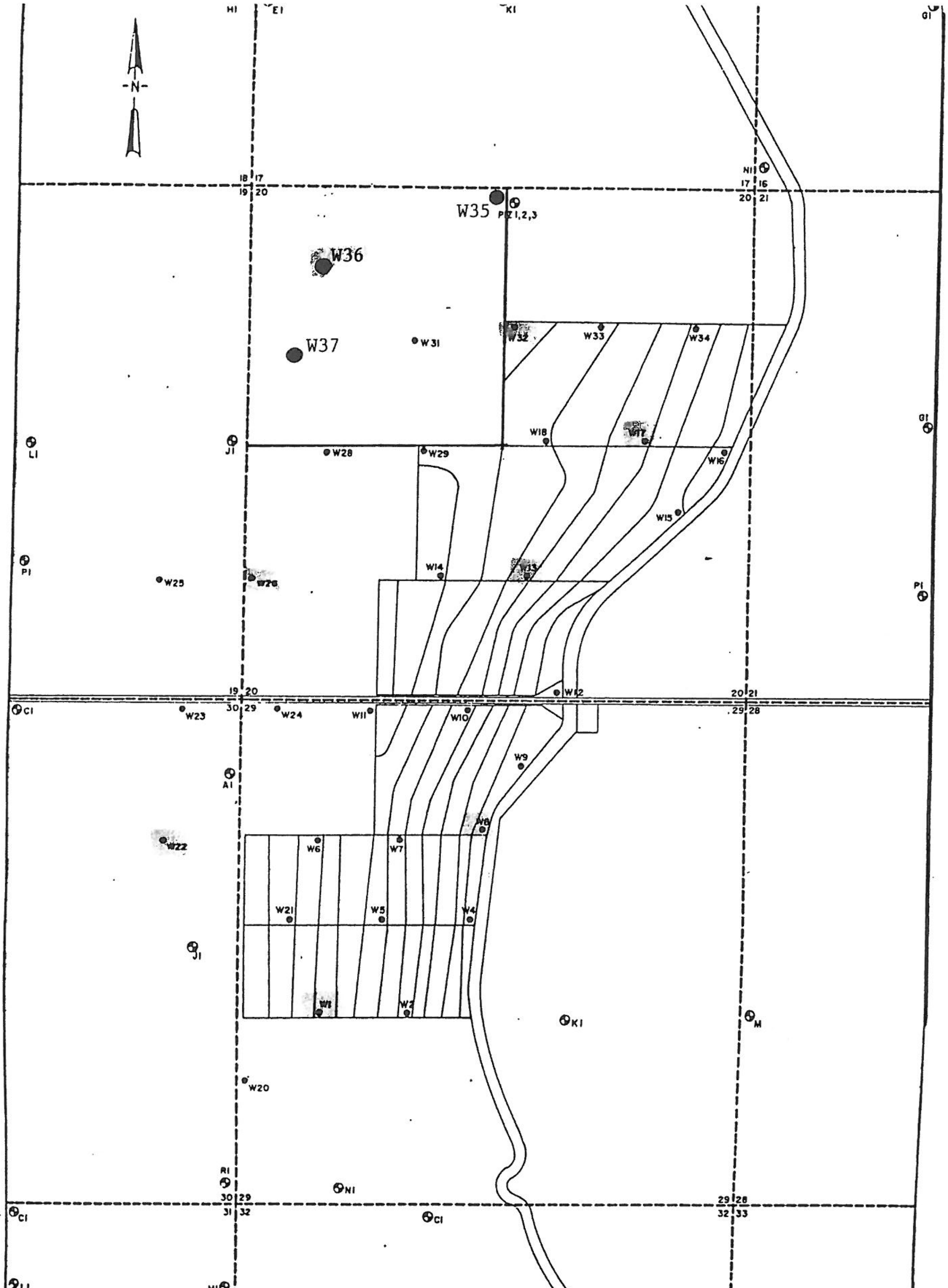
WESTWIDE MAPS CO.
213 624 2679
111 WEST SEVENTH ST.
LOS ANGELES, CALIF. 90014

QUADRANGLE LOCATION

ROAD CLASSIFICATION
Heavy-duty — Light-duty
Medium-duty — Unimproved dirt
State Route

MAP 1

EDISON, CALIF.
N3515—W11845/7.5
1954
PHOTOREVISED 1968 AND 1973
AMS 2254 IV NE—SERIES V895



NOTE: DRAWING ALSO SHOWS THE FARM WELLS WHERE STATIC WATER LEVELS ARE MEASURED WHEN THE DISTRICT HAS ACTIVATED ITS WELL FIELD.

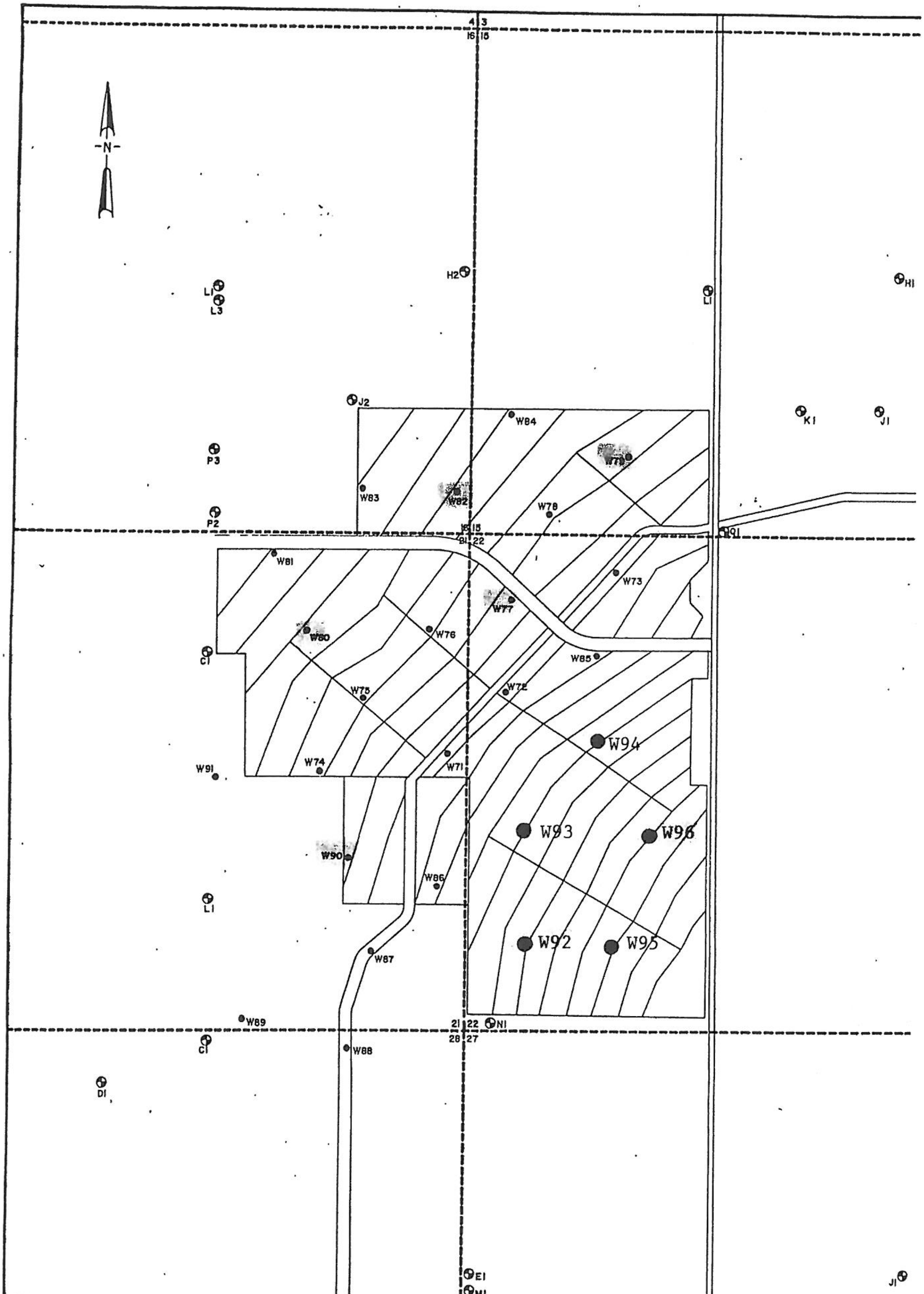
DRAWN BY: VC STRONG 2/11/75

MAP 2

ARVIN-EDISON WATER STORAGE DISTRICT

SYCAMORE WELL FIELD

WELL LOCATIONS



NOTE: DRAWING ALSO SHOWS THE FARM WELLS WHERE STATIC WATER LEVELS ARE MEASURED WHEN THE DISTRICT HAS ACTIVATED ITS WELL FIELD.

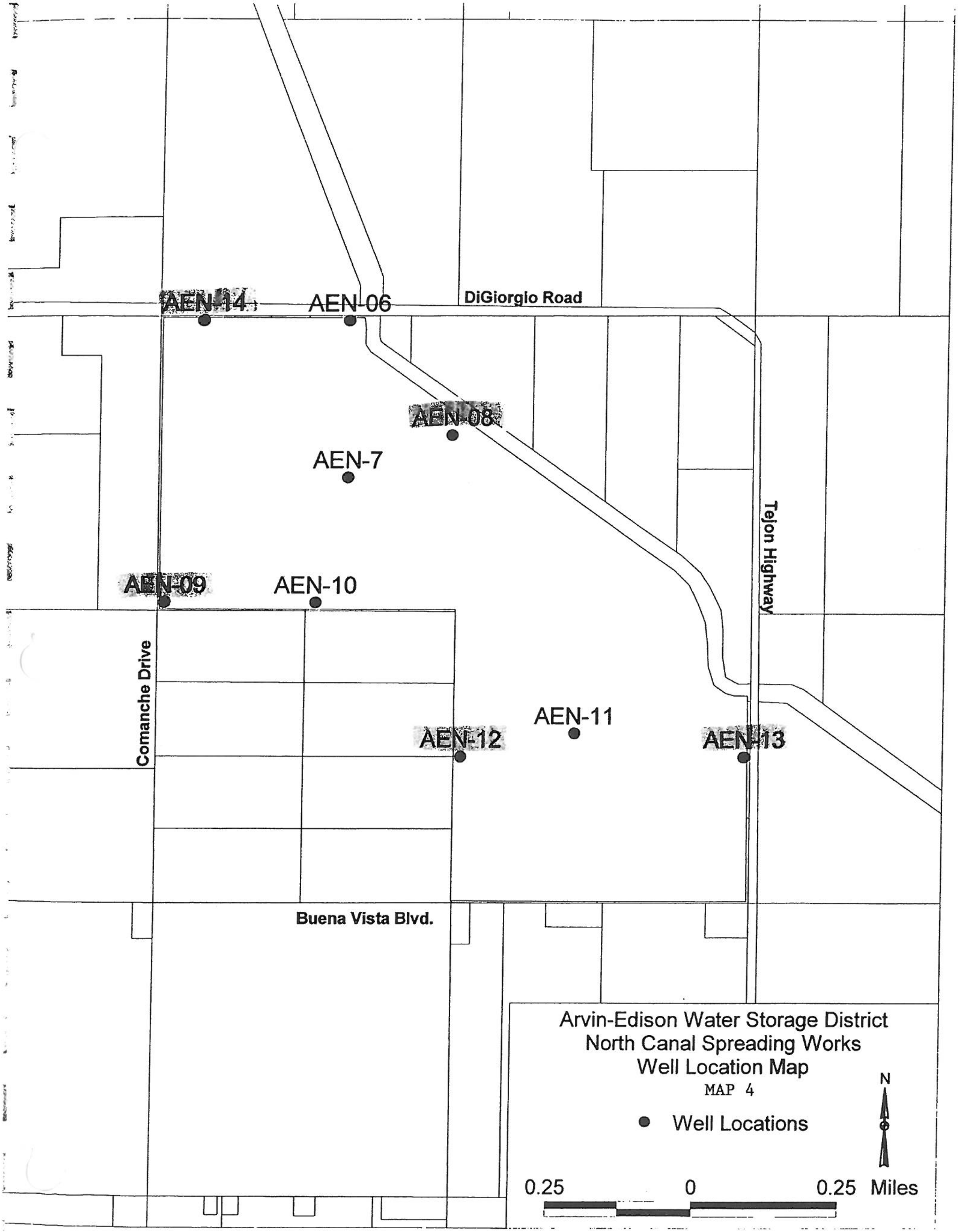
MAP 3

DRAWN BY: VC STRONG 2/11/75

ARVIN-EDISON WATER STORAGE DISTRICT

TEJON WELL FIELD

WELL LOCATIONS

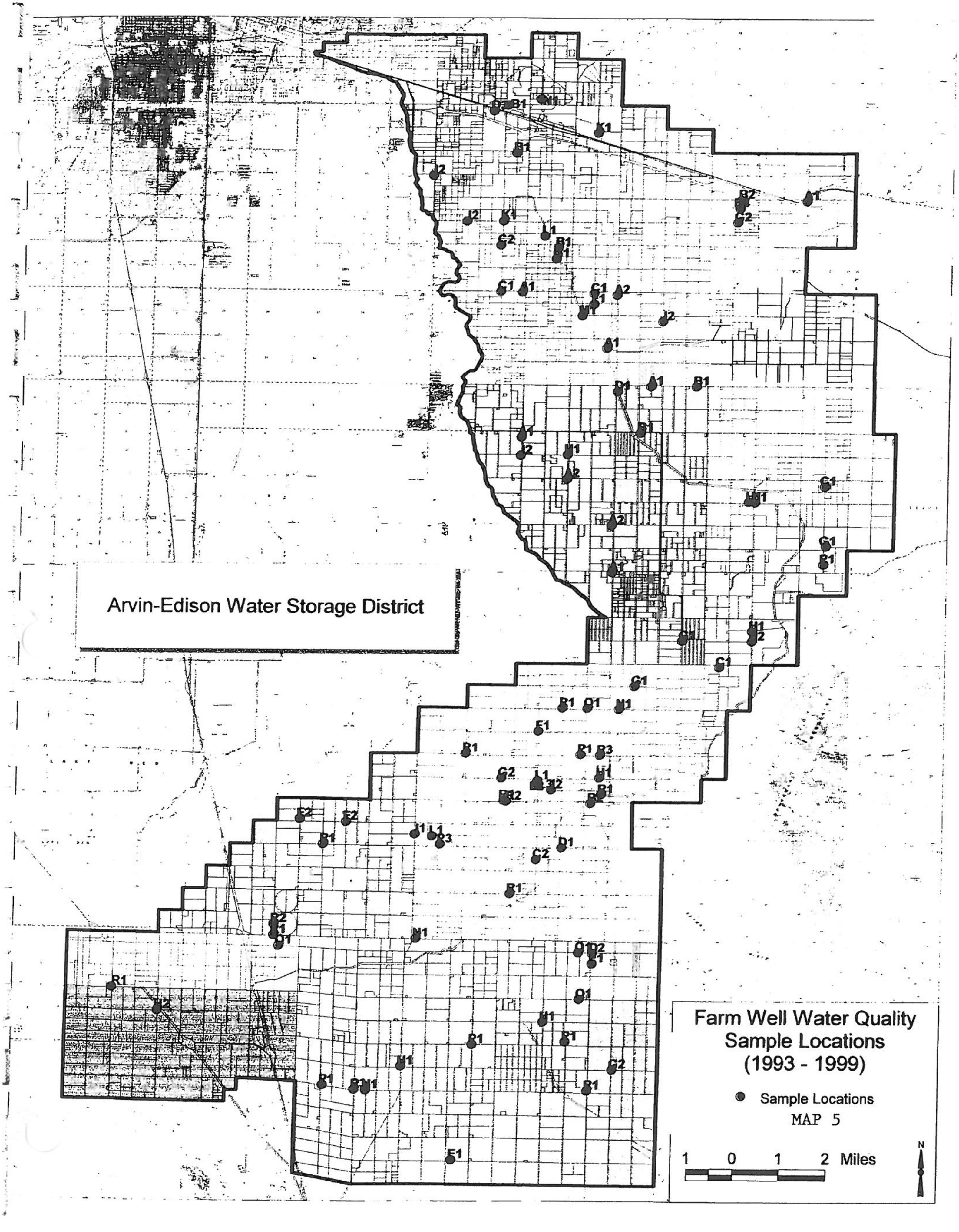


DiGiorgio Road
AEN-14
AEN-06
AEN-08
AEN-7
AEN-09
AEN-10
Tejon Highway
Comanche Drive
AEN-11
AEN-12
AEN-13
Buena Vista Blvd.
Arvin-Edison Water Storage District
North Canal Spreading Works
Well Location Map
MAP 4
Well Locations
N
0.25
0
0.25
Miles

Farm Wells

The target list of private agricultural farm wells below was produced to insure historical continuity in water quality data *(Map 5, Farm Well Water Quality Sample Locations (1993-1999))*, as well as gathering representative samples from the 4 water producing geologic sub-areas, and areas of poor water quality within the District *(Maps 6–8)*, the groundwater wells below represent a target list of Agricultural Farm wells with preferred alternative wells *(Map 9, Farm Well Water Quality)*:

Target	Alternate
• 11/19-07R3	11/19-08N1
• 11/19-12R1	11/18-07G2
• 11/19-22E1	
• 11/19-03P1	
• 11/19-02H1	11/19-01P1
• 11/20-04H2	
• 12/19-25Q1	12/18-31D2 or 31E2
• 12/20-32R1	
• 32/28-33R2	32/28-33R1
• 32/28-22R1	32/28-22F2 or 23F2
• 32/29-31N1	
• 32/29-19P3	32/29-19L1
• 32/29-04R1	32/29-03Q1
• 32/29-17G2	32/29-17R2
• 32/29-28C2	32/29-27D1
• 32/29-19P3	32/29-19L1
• 31/29-36G1	
• 31/29-01B1	
• 31/29-08J2	31/29-08A1
• 31/29-22A2	31/29-27A1
• 31/30-17E1	31/30-18H1
• 31/30-16C1	
• 31/30-21P1	31/30-21G1
• 30/30-18B4	30/30-18G2
• 30/30-17A1	
• 30/29-03K1	
• 30/29-05D3	30/29-05B1
• 30/29-20C2	30/29-17K1
• 30/29-29A1	30/29-29C1
• 30/29-26J2	30/29-27A2
• 30/28-12J2	30/29-18J2


Arvin-Edison Water Storage District
Farm Well Water Quality
Sample Locations
(1993 - 1999)
Sample Locations
MAP 5
1 0 1 2 Miles
N

APPENDIX L

BEFORE THE BOARD OF DIRECTORS OF
ARVIN-EDISON WATER STORAGE DISTRICT

IN THE MATTER OF: RESOLUTION NO. 01-25

AUTHORIZING THE INVESTIGATION OF WATER MANAGEMENT OPPORTUNITIES WITH KERN DELTA WATER DISTRICT

WHEREAS, Arvin-Edison Water Storage District (Arvin-Edison) and Kern Delta Water District (Kern Delta) are special districts, organized under the laws of the State of California, serving Kern County, with service areas of approximately 132,000 acres and 125,000 acres, respectively; and

WHEREAS, the goals of both districts are to provide a reliable, affordable water supply to landowners and to improve groundwater conditions; and

WHEREAS, the districts are located adjacent to one another, share a common boundary, and overly a contiguous groundwater basin; and

WHEREAS, water service within both districts are dependent upon conjunctive use of the underlying groundwater supplies and imported surface water supplies to meet their predominantly agricultural areas; and

WHEREAS, Arvin-Edison has contracted for a Friant-Kern Central Valley Project supply of up to 351,675 acre-feet per year, and Kern Delta has contracted for a State Water Project supply of up to 25,500 acre-feet per year and administers pre-1914 Kern River water rights under which it has historically imported up to 225,000 acre-feet per year; and

WHEREAS, the districts combined, operate various water conveyance facilities totaling approximately 180 miles of canals and 180 miles of pipelines, with interties with the California Aqueduct, Cross Valley Canal, Friant-Kern Canal, and Kern River, and

WHEREAS, both districts have constructed or are in the process of constructing groundwater banking facilities to be operated for the benefit of district landowners and third parties, with Arvin-Edison's capability to bank and/or extract at 150,000 acre-feet per year and Kern Delta's capacity to bank and/or extract projected to be at 60,000 acre-feet per year; and

WHEREAS, Arvin-Edison has contracted with Metropolitan Water District of Southern California (MWD) to provide water banking services to MWD and Kern Delta is currently negotiating a contract to also provide water banking services to MWD; and

WHEREAS, the districts have the combined capability to transfer or exchange water and/or otherwise pursue opportunities to coordinate water management activities with various State, Federal, and local agencies, as well as environmental groups, and private parties throughout the State of California; and

WHEREAS, the districts desire to investigate programs of mutual benefit, which will further enhance their individual and collective abilities to manage their various water supplies and reduce their costs.

NOW, THEREFORE, BE IT RESOLVED that this Board of Directors has directed staff and consultants to explore, investigate, and identify mutually beneficial activities that may be implemented with Kern Delta within the following broad categories:

a) **Coordinated Use of Groundwater Basin:** Coordinated use of the groundwater basin underlying the two districts to meet existing and future water supply needs for the districts' landowners and joint use of groundwater banking facilities for the districts' mutual benefit, as well as benefits for third parties.

b) **Joint Regulation of Surface Water Supplies:** Transfers/Exchanges between the two districts of available water resources to maximize the water supply reliability and groundwater benefit while minimizing cost; and

c) **Facilities Use and Interconnections:** Use existing and proposed conveyance facilities throughout and between the two districts to enhance water delivery operations, reduce losses, maximize deliveries and minimize cost.

All the foregoing being on motion of Director Valpredo, seconded by Director Moore, and authorized by the following vote, to wit:

AYES: Directors' Frick, Moore, Fanucchi, Fry, Johnston, Valpredo, and Lehr.

NOES: None

ABSTAIN: None

ABSENT: Directors' Giumarra and Camp.

I HEREBY CERTIFY that the foregoing resolution is the resolution of said District as duly passed and adopted by said Board of Directors on the 9th day of October 2001.

WITNESS my hand and seal of said Board of Directors this 9th day of October 2001.

JOHN C. MOORE
Secretary-Treasurer
of the Board of Directors

APPENDIX M

ARVIN-EDISON WATER STORAGE DISTRICT

SUMMARY OF DISTRICT TOURS - Jan '99 to Present

Year	DATE	VISITOR(S)	REPRESENTING
1999	2/5	Jon Parnell	Cross Valley Canal Manager
	3/15	District Managers	Friant Districts: D.E.I.D., K.T./R.G., and S.W.I.D.
	3/24	BDAC Committee	Cal-Fed Process
	7/27	Lindsay Beck	State Water, New South Wales, Australia
	9/16	Jo-Ellen McChesney	Chief Consultant - CA Water, Parks & Wildlife
	10/13	Water District Officials	Country of Spain
	11/3	Managers & Directors	Stockton East Water District
	11/10	Gary Shanks	CA Dept. of Water Resources
	11/18	Bill Luce & Staff	USBR - Fresno
	12/16	Manager & Directors	James Irrigation District
	12/20	Randy McFarland	Friant Waterline Publisher
2000	1/12	Bruce Babbitt & staff	U.S. Dept of the Interior
	2/9	Directors and Staff	California and Kern County Farm Bureaus
	4/18	David Behar	NRDC Environmental Consultant
	5/10	Cliff Trotter, Steve Murray	Tasmanian Delegation
	5/18	Water Quality Staff	MWD - Pump-In Guidelines Workgroup
	5/18	Lou Barbich & Staff	Barbich, Longcrier, Hooper & King Accountancy
	6/23	Conner, Langiano & Staff	P.G. & E.
	7/12	John Burke & Staff	USBR Water Acquisition Program Team
	10/18	Mark Ysusi, Vicki Fry et al	Azurix and BE Sacramento Staff
	10/25	CSUB ElderCollege	Presentation at Sycamore Canyon and N. Canal site tour
	11/1	Water Officials	Egyptian delegation - USBR Fresno coordinated tour
	12/1	Executive Staff and Directors	Metropolitan W.D. and Friant Water Users Authority
	12/6	Management and Staff	Cadiz Land Company and Sunworld, Inc.
2001	2/14	Representatives	Michigan Sugarbeet Growers Assoc. UC Coop. Extension.
	2/21	Management and Directors	Kings County Water District
	4/12	Mayor & City Manager	City of Orange Cove
	5/23	Minister, staff and press	Ministry of the Environment, Catalonia, Spain. UC tour.
	7/26	Water Officials	Yunnan Province, China
	8/17	Directors and Staff	Kings River Water Assoc. and MWD Staff
	11/2	Management	Hawaiian Commercial & Sugar Company
	11/5	General Manager & Staff	Friant Water Users Authority
	11/21	Management & Consultants	KDWD & MWD, including tour of proposed KD facilities
	12/18	UCD Graduate Students	w/Gary Perez, FWUA
2002	1/30	Dennis Keller	FT-A CVC Exchange Group
	2/8	Directors and Staff	Texas Water Development Board
	3/20	Management	North Kern WSD
	5/17	Staff	USBR - Fresno and Asacramento Offices
	7/25	Dave Sundig and Georgina Moreno	UCB and Claremont College Economists
	11/4	Mike Day, Manager	Provost & Pritchard Bakersfield Office
2003	3/28	Officials and Management	Rural Water Supply of Ministry of Water Resources of China
	4/3	Directors, Staff & Consultants	Kings River Water Assoc. and MWD Staff
	4/21 *	Directors, Staff & Consultants	San Luis Obispo County - Water Officials

*Planned

5/5/2003