

FINAL

ENVIRONMENTAL IMPACT

REPORT

RE : USE AND DISPOSITION OF PROPERTY AND WATER
RIGHTS ACQUIRED BY THE CITY OF BAKERSFIELD
FROM
TENNECO WEST, INC., IN SETTLEMENT OF LITIGATION

VOLUME I

SEPTEMBER 29, 1975

THOMAS M. STETSON
CIVIL AND CONSULTING ENGINEERS

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September 29, 1975

REPLY TO: San Francisco

Mr. Harold Bergen, City Manager
City of Bakersfield
1501 Truxtun Avenue
Bakersfield, CA 93301

Dear Mr. Bergen:

We are pleased to present our Final Environmental Impact Report Re: Use and Disposition of Property and Water Rights Acquired by the City of Bakersfield from Tenneco West, Inc., in Settlement of Litigation.

The report describes the property, water rights and appurtenant facilities acquired; the proposed plan for the use and disposition of such water rights, properties and facilities; the environmental setting of the area involved; and the environmental impact.

The geologic conditions including geologic hazards, oil and mineral resources, and the historical monuments sections of this report were prepared by William H. Park, Registered Geologist, of Bryant-Park and Associates, Inc.

The biological conditions section of this report was abstracted from two reports (included as Appendix A) by Dr. George E. Lawrence, Professor, Bakersfield College, prepared specifically for this environmental impact report. Dr. William H. Wake, Professor, California State College, Bakersfield, prepared the archeological characteristics section.

The City of Bakersfield Planning Commission held a public hearing on the Draft Environmental Impact Report in the City Council Chambers at 7:30 p.m. on August 18, 1975, and received comments from persons present at that hearing. In addition, written comments were received by the Planning Commission prior to, during and after that public hearing. The Planning Commission, at the August 18, 1975, public hearing, granted an extension of time to September 8, 1975, in which to file additional written comments.

Appendix B of the Final Environmental Impact Report presents copies of all written comments received and summaries of verbal comments presented at the public hearing. It also includes a recapitulation of the comments and the responses to those comments.

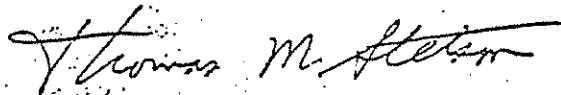
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Mr. Harold Bergen, City Manager
September 29, 1975
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No comments were received which required changes in Volume II, Legal Supplement, of the Draft Environmental Impact Report. Therefore, that volume has not been reprinted. All comments, responses and errata sheet for Volume I have been printed on green paper and are bound in this Volume I of the Final Environmental Impact Report.

Sincerely yours,


Thomas M. Stetson

TMS:krk

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Chapter II

DESCRIPTION OF PROJECT

The following is from the Guidelines for Implementation of the California Environmental Quality Act of 1970 as amended on February 18, 1975.

15141. Description of Project. The description of the project shall contain the following information but should not supply extensive detail beyond that needed for evaluation and review of the environmental impact.
- (a) The precise location and boundaries of the proposed project shall be shown on a detailed map, preferably topographic. The location of the project shall also appear on a regional map.
 - (b) A statement of the objectives sought by the proposed project.
 - (c) A general description of the project's technical, economic, and environmental characteristics, considering the principal engineering proposals and supporting public service facilities.

The project of the City of Bakersfield is summarized as follows:

- A. The delivery of Kern River water for irrigation purposes under long-term contracts with four irrigation districts in Kern County.
- B. The sale of portions of the Beardsley Canal and Calloway Canal to North Kern Water Storage District.
- C. Operation of Kern River Canal and Irrigating Company and Ashe Water Service area of the Kern Island Water Company as public utilities.

- D. To the extent that available Kern River water is not purchased by the four long-term contractors such water shall be sold on a short-term basis.
- E. The City of Bakersfield assumes the obligations and benefits of the existing Tenneco contracts relating to the Kern River.
- F. All other facilities and properties acquired will be utilized for the delivery or conservation of water as demands for such use occur.

Project Area

The project area is located in the Kern County portion of the San Joaquin Valley and consists of the area occupied by the four water districts contracting for water service from the City, the service areas of the Kern Island Water Company and Kern River Canal and Irrigating Company, the Rosedale-Rio Bravo Water Storage District, Lake Isabella, Kern River Park, the 2,760 acres of land along the Kern River between Renfro Road and Interstate Highway 5, and other lands in Kern County that may be served under the rights and facilities acquired by the City of Bakersfield. The project area is shown on Plate 2. (in pocket at rear of report).

The main portion of the North Kern Water Storage District is located on the north side of the Kern River between Bakersfield and McFarland and is comprised of about 61,850 acres of land. The southerly portion of the North Kern Water Storage District is known as the Pioneer Improvement District and is located astride the Kern River between Bakersfield and Tupman. All of the contracted Kern River water will be delivered to the northern portion of the district. The northern portion of the district is shown on Plate 2.

The Cawelo Water District, shown on Plate 2, is located on the easterly side of U. S. Highway 99 between Bakersfield and McFarland. The District covers an area of approximately 46,800 acres.

The Kern-Tulare Water District is located in the northerly portion of Kern County and extends into southern Tulare County. The total District area is about 30,580 acres of which about 23,090 acres are located within Kern County. The contracted Kern River water is designated for the Kern County portion of the Kern-Tulare Water District.

The Rag Gulch Water District is comprised of an area of about 6,030 acres located immediately west of the Kern-Tulare Water District in northern Kern County and southern Tulare County. About fifty-five percent of the district lands are located within Kern County and the remainder is in southern Tulare County. The contracted Kern River water is designated for the Kern County portion of the Rag Gulch Water District.

The Rosedale-Rio Bravo Water Storage District, encompassing approximately 43,000 acres, is located immediately west of urban Bakersfield on the northerly side of the Kern River.

The service area of Kern Island Water Company includes lands in the southern and western portions of Improvement District

No. 4 (urban Bakersfield) and agricultural lands to the south, southeast and southwest of Bakersfield. The lands within the service area total about 106,560 acres.

The service area of Kern River Canal and Irrigating Company is located on the north side of the Kern River, adjacent to the City of Bakersfield. It includes an area of about 6,000 acres. All of the above described districts and service areas are shown on Plate 2.

The properties acquired by the City of Bakersfield, including the utilities, the canal systems and land and water rights are discussed in subsequent sections of this report and the principal features are shown on Plates 3, 4 and 5. The environmental features of the project area are discussed in Chapter III.

Project Objectives

The two utility canal companies and their appurtenant properties, all water rights and Lake Isabella storage rights of Tenneco, the 2,760 acres of land along the Kern River between Renfro Road and Interstate Highway 5, and the various equipment of Tenneco were acquired by the City of Bakersfield in consideration of settlement of its 1970 lawsuit and an agreement to make a compromised payment to Tenneco of \$17.9 million.

Therefore, the objective sought by the proposed project may be briefly stated as follows:

Primarily the four long-term contracts will permit the issuance of revenue bonds. Rather than issue general obligation bonds, which would be an obligation of the City's property owners, a non-profit corporation has been formed which can issue revenue bonds to raise the necessary funds to make the compromise payment for the facilities and property involved. Such revenue bonds would be secured by the four long-term agricultural water contracts for the sale of a portion of the otherwise unobligated Kern River water. In addition thereto, revenue from the remaining properties would be pledged to satisfy the obligations incurred by the non-profit corporation.

In designing a project to achieve the above objectives, other uses and dispositions were necessary in order to secure the necessary proposed contracts with the four agricultural districts.

Project Description

The City will deliver Kern River water for irrigation purposes under long-term contracts to the four irrigation districts for use in Kern County. In the aggregate, those districts are now largely dependent upon groundwater. The four contracts will be for a term of at least 35 years, each beginning with the 1976 irrigation season and will supply Kern River water to supplement and replace some of the existing groundwater service. Letters of intent for long-term irrigation water service have been executed

with the following districts for the annual quantities of Kern River water indicated.

<u>District</u>	<u>Annual delivery (Acre-Feet)</u>
Rag Gulch Water District	3,000
Cawelo Water District	27,000
Kern-Tulare Water District	20,000
North Kern Water Storage District	20,000

Copies of the letters of intent are included in Volume II, Legal Supplement. The contracts with these four districts will incorporate the principles of the letters of intent.

The basic price of such water shall be \$20 per acre-foot per year at the point of diversion of the Kern River. That price will be reflected in a fixed annual payment which shall prevail throughout the 35-year term of the contract. Each contracting district shall be responsible for transporting its purchased water to the place of use within its district or for exchanging such Kern River water for other water to be supplied to the district.

Each of the four contractors will have the right of first refusal to purchase available surplus water from the City at reasonable rates under then existing conditions. Each contract is subject to extensions of time contingent upon the needs of the City for such water. The water shall be used for irrigation,

spreading and stock watering purposes only and within Kern County.

The North Kern Water Storage District is given priority to delivery of 20,000 acre-feet per year subject only to deliveries of water legally required to meet prior existing agreements or consumer rights arising from an existing public utility. Deliveries of Kern River water to North Kern will be made to storage at Lake Isabella.

In addition to the basic 20,000 acre-feet per year, provision is made that North Kern can borrow approximately 10,000 acre-feet per year and pay it back to the City whenever mutually agreeable.

North Kern Water Storage District will purchase from the City for a sum of \$150,000 the ownership of the portion of the Beardsley Canal from the Kern River to Seventh Standard Road and the ownership of the portion of the Calloway Canal from the Kern River to Seventh Standard Road. The City will retain certain water conveyance rights in each of those canals.

The Kern River Canal and Irrigating Company serves Kern River water for irrigation in a certificated area under the jurisdiction of the California Public Utilities Commission. There is no proposed change in this service. However, in the event the City determines to devote the property, water or water rights thereof

to other than its existing public utility commitment or for other than City's use, or proposes to sell all or any portion thereof, the North Kern Water Storage District shall have a right of first refusal to acquire it.

The Ashe Water Service area will continue to be operated as a public utility.

There would be sales of surplus water to long-term agricultural contractors in accordance with the letters of intent. Additional water, if and when available, will be sold on an annual or short-term contractual basis. To the extent that such additional water is available, the City intends to enter into annual or short-term agreements for the sale of such water.

All other facilities and properties acquired by the City, including canals and the 2,760 acres of flood plain lands, will be utilized for the delivery and conservation of water as demands for such use occur.

The City of Bakersfield assumes the obligations and benefits of the existing Tenneco contracts, the most significant of which are included in the Legal Supplement of this report and as briefly described in the following paragraphs.

The Kern River Water Service Agreement of August 31, 1961 (Document No. 12, Legal Supplement), between several canal companies (Anderson, James, Joyce, Pioneer and Plunket) and Rosedale-Rio Bravo Water Storage District is an obligation acquired by the City of Bakersfield from Tenneco. Under that agreement the canal companies agreed to furnish Rosedale-Rio Bravo an average of at least 10,000 acre-feet per year of Kern River water. The agreement is to continue until terminated by mutual consent of the parties.

The agreement recognized that the quantity of water to be delivered would vary from year to year but provided that the cumulative annual average quantity delivered as of the end of any calendar year would never be less than 10,000 acre-feet. There are various provisions in the agreement which relate to minimum and maximum quantities of annual deliveries.

The City of Bakersfield intends to comply with the terms of that agreement to supply the Rosedale-Rio Bravo Water Storage District an average of at least 10,000 acre-feet per year of Kern River water for groundwater replenishment.

Other water service agreements assumed by the City of Bakersfield include (1) an agreement of March 17, 1934 (Document No. 7, Legal Supplement), between the County of Kern, party of the first part, and Miller and Lux, Incorporated, and Kern County

Land Company, parties of the second part, and (2) an agreement of June 9, 1964 (Document No. 17, Legal Supplement), between the County of Kern and Pioneer Canal, Inc.

The March 17, 1934, agreement provides for the delivery of Kern River water to form and maintain a 20-acre lake at Hart Memorial Park. The water to maintain the lake is limited to a diversion of not to exceed 15 cubic feet per second (cfs). The agreement is apparently in perpetuity, since no term is stated and there is no provision for cancellation by the parties. Therefore, it is assumed that so long as the 20-acre lake exists, Kern River water up to a flow of 15 cfs will be supplied to maintain the lake.

The June 9, 1964, agreement provides for the delivery of Kern River water to replenish water lost from Ming Lake in Kern River Park by evaporation and seepage. The agreement is subject to cancellation by either party on six months written notice.

In addition, the City assumed Tenneco's interest in the November 8, 1963 (Document No. 14, Legal Supplement), Agreement for Establishment and Maintenance of Minimum Recreation Pool of 30,000 acre-feet in Isabella Reservoir.

Chapter III

DESCRIPTION OF ENVIRONMENTAL SETTING

The following is from the Guidelines for Implementation of the California Environmental Quality Act of 1970 as amended on February 18, 1975.

15142. Description of Environmental Setting. An EIR must include a description of the environment in the vicinity of the project, as it exists before commencement of the project, from both a local and regional perspective. Knowledge of the regional setting is critical to the assessment of environmental impacts. Special emphasis should be placed on environmental resources that are rare or unique to that region. Specific reference to related projects, both public and private, both existent and planned, in the region should also be included, for purposes of examining the possible cumulative impact of such projects.

The existing environment of the area which will be affected by the use and disposition of the acquired property and water rights of Tenneco can be described by considering the physical, biological, cultural, archeological and historical characteristics. The areas affected are situated in the southern portion of the San Joaquin Valley, which includes the urban Bakersfield area.

Physical Characteristics

This section describes the environment in the vicinity of the project as it exists before commencement of the project.

Existing Project Environment

The property and facilities are separately described in this section.

Kern Island Water Company. The Kern Island Water Company is the successor of the former Kern Island Irrigating Company which was formed in 1870. In accordance with Decision No. 71684 of the California Public Utilities Commission, four canal companies, namely Stine, Buena Vista, Farmers and East Side, merged with Kern Island on December 30, 1966. At the time of the merger, the name of Kern Island Canal Company was changed to Kern Island Water Company. Each of the above companies, except East Side Canal Company, owned rights to divert water from the Kern River. Therefore, after the merger, the rights were transferred to Kern Island Water Company.

The Kern Island Water Company is primarily a purveyor of water for agricultural use, although it also supplies water for domestic consumption. The Company is under the jurisdiction of the California Public Utilities Commission. The areas served with irrigation water by the canal companies, namely Kern Island, Stine, Farmers, Buena Vista and East Side, are shown on Plate 3. Although Plate 3 shows that some of the urban development in the Bakersfield area is included in the service area of the canal companies, such urban development is no longer served by the canal companies. In other words, prior to urbanization such lands within the service areas received water for irrigation. After urbanization the water was transferred to other agricultural lands away from the city.

The service area of Kern Island Water Company is supplied with surface water through the East Side, Kern Island, Farmers,

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THOMAS M. STETSON

Stine and Buena Vista Canals. From these canals water is delivered through a system of smaller canals, laterals and ditches to the farm lands. The acreage of lands within the service area of each canal company, as shown on Plate 3, is as follows:

<u>Canal Company</u>	<u>Gross Service Area (Acres)</u>
East Side	6,360
Kern Island	50,740
Farmers	10,210
Stine	21,940
Buena Vista	<u>17,310</u>
Total	106,560

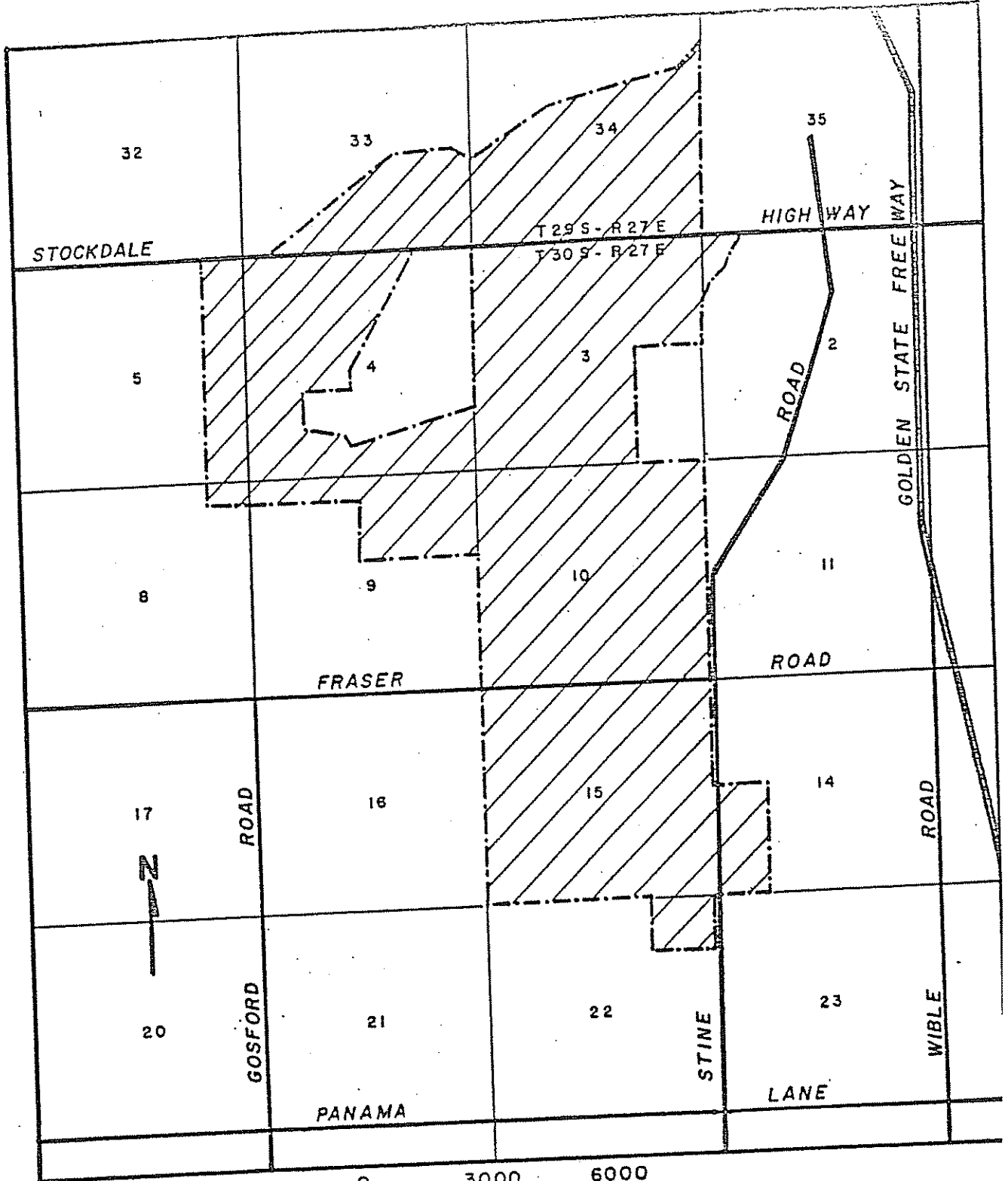
It is reported in the Kern Delta Water District's Draft Environmental Impact Report, entitled "Proposed Plan for Utilization of Supplemental Water," dated May 1974, that the District has entered into an agreement with Kern Island Water Company for distribution of water. The District intends to exchange about 30,000 acre-feet of its State Project water entitlement for a similar amount of Buena Vista Water Storage District's Second Point entitlement of Kern River water. According to the Kern Delta Water District's environmental impact report, the agreement with Kern Island Water Company would provide the means of transporting the exchanged Kern River water through Kern Island's facilities into the District for irrigation and groundwater recharge.

The City is not familiar with the details of the Buena Vista Water Storage District exchange agreement, but it is understood that such an agreement has been executed for 15,000 acre-feet per year and negotiations have not yet been finalized for the additional 15,000 acre-feet per year.

Ashe Water Service Area. Kern Island Water Company, in addition to serving water to agricultural lands, provides water to domestic users both within and outside of the City of Bakersfield. The area served with domestic water is shown on Plate 3. The service area is relatively small and is known as the Ashe Water Service Area. It is operated as a completely separate system from the irrigation utility operations of Kern Island Water Company. No Kern River water is used directly in the Ashe system. It is supplied entirely from groundwater produced by seven wells. Ashe Water Service Area is included in the acquisition by the City from Tenneco.

An enlarged map of the service area is shown as Plate 4. The Ashe Water Service provides water to about 2,200 connections. The water for the service area is supplied exclusively from groundwater. In 1973, the groundwater production from seven wells totaled about 2,500 acre-feet.

Kern River Canal and Irrigating Company. The Kern River Canal and Irrigating Company was incorporated in 1892 as a successor to Kern River Water and Irrigating Company. The company is under the jurisdiction of the California Public Utilities Commission. It is a supplier of agricultural water and its service area is located north of the Kern River, as shown on Plate 3. The service area is about 6,000 acres. The company has rights to divert water from the Kern River. Water is conveyed through the Beardsley Canal to the company's service area and distributed to farm lands via smaller canals, laterals, and ditches.



T 29 S - R 27 E
T 30 S - R 27 E

STOCKDALE

HIGHWAY

GOLDEN STATE FREE WAY

FRASER

ROAD

GOSFORD ROAD

ROAD

STINE

PANAMA

LANE

WIBLE

0 3000 6000 FEET

SOURCE: KERN ISLAND WATER COMPANY

ASHE WATER SERVICE AREA 008009

The company owns the Beardsley Weir on the Kern River and the Beardsley Canal from the Kern River to Seventh Standard Road. These facilities through a 1952 agreement with the North Kern Water Storage District, are utilized jointly by the Kern River Canal and Irrigating Company and the North Kern Water Storage District.

Tenneco Properties. The term "Tenneco Properties" is used to identify the non-utility properties of Tenneco, acquired by the City of Bakersfield. The Kern County Land Company, predecessor of Tenneco, constructed a lined canal on the south side of the Kern River in 1962. The canal was in service by early 1963. The canal extends from a point in Section 33 (T29S/R27E) in the channel of the Kern River, near the outlet of the Friant-Kern Canal, in a southwesterly direction along the southerly side of the Kern River to a point in Section 24 (T30S/R25E) in the channel of the Kern River approximately one-half mile downstream of Second Point of Measurement. This conduit is generally referred to as the Kern River Canal.

The Kern River Canal is concrete lined except for about one-half mile at the lower end, which is unlined. The canal was constructed to deliver to the Second Point of Measurement the Kern River entitlements of Buena Vista Water Storage District and other Second Point and Lower River interests. The locations of the Kern River Canal and Second Point of Measurement, as well as other canals acquired by the City from Tenneco, are shown on Plate 5.

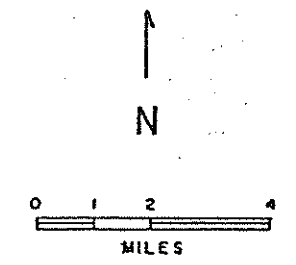
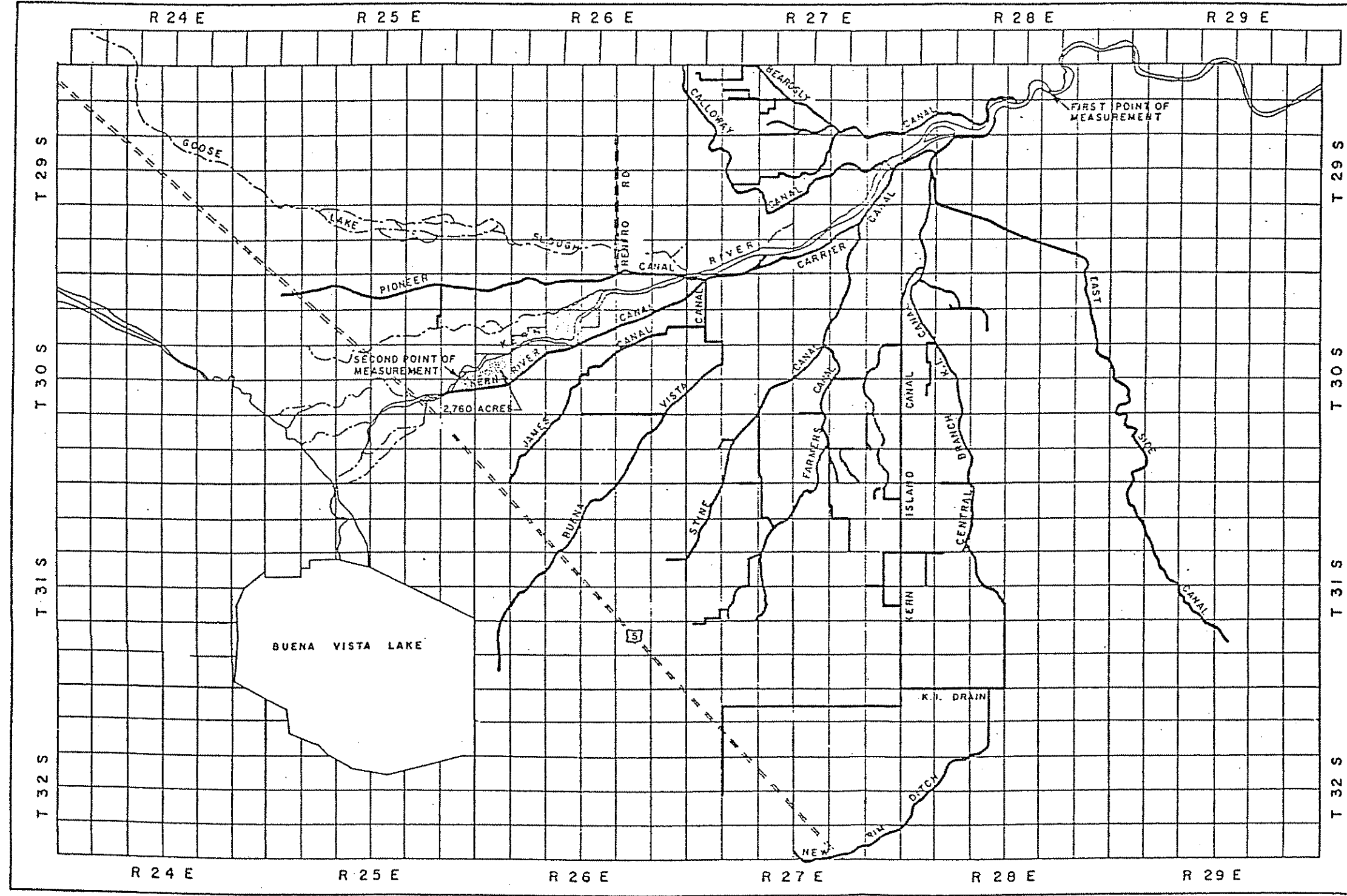
Among other Kern River facilities owned by Tenneco and its subsidiaries are the following: Carrier Canal System, Calloway Weir and Calloway Canal. The general locations of the canals and facilities owned by Tenneco are shown on Plate 5.

Practically all of the acquired canals, with the exception of the Kern River Canal, are unlined. The seepage loss in the unlined canals generally varies with the magnitude of flow in the canals. The U. S. Geological Survey (USGS) ^{1/} conducted a series of inflow-outflow measurements in the principal canals in the Bakersfield area in May and June of 1955. The purpose of the study was to determine rates of infiltration from the unlined canals in that area. The measurements were made in selected reaches of the Carrier Canal, Stine Canal, Buena Vista Canal and East Side Canal under varying flow levels.

It was found that the range of seepage loss increased with the flow. The calculations of seepage loss were based on measurements of flow in the canals at various locations. The results of the USGS study indicated that seepage losses in the unlined canals were significant.

Flood Plain Lands. Included in the acquisition by the City of Bakersfield are flood plain lands along the Kern River

^{1/} Davis, G.S., Lofgren, G. E., and Mack S., 1964, Use of Groundwater Reservoir for Storage of Surface Water in the San Joaquin Valley, California; U. S. Geological Survey, Water Supply Paper 1618.



CANAL SYSTEM AND PROPERTY

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 WEST COVINA ALBUQUERQUE SAN FRANCISCO

channel. The land area, amounting to approximately 2,760 acres, includes a reach of the Kern River channel and lands adjacent to the channel. It extends from Renfro Road to Interstate Highway 5. The area is presently undeveloped. It is the City's present plan to keep most of the acquired land in its present natural state and to possibly use portions of it for groundwater replenishment operations. The extent and location of the area is shown on Plate 5

Water Rights. The water rights consist of groundwater rights, surface water rights and storage rights in Isabella Reservoir. The water rights of the Kern River have been the subject of much controversy in the past. In addition they have been the subject of numerous legal actions.

The disposition of the water rights of the Kern River were partially adjudicated in the action of Lux v. Haggin 69 Cal. 255 (1886). Thereafter a contract and agreement known as the "Miller-Haggin Agreement", dated 28 July 1888, was entered into between Henry Miller, et al, and James B. Haggin, et al. This agreement attempted to allocate the water rights of the Kern River. In addition it provided that the agreement shall be perpetual and shall at all times be construed as a covenant running with the land owned or claimed by any of the parties thereto. This agreement was further considered in that certain judgment known as the "Shaw Decree" rendered August 6, 1900, by the Superior Court of the State of California in and for the County of Kern, Honorable Lucien Shaw, Judge, in that certain action No. 1901, entitled "Farmers Canal Company, et al, v. J. R. Simmons, et al." The findings and decree in said case are included as document No. 6 in the Legal Supplement.

The Miller-Haggin agreement was further interpreted and partially construed in the case of Title Insurance, etc. Co. v. Miller and Lux, Inc. 183 Cal. 71, 76 (1920). In addition owners and claimants of water rights have executed amendments to the "Miller-Haggin" as well as other agreements, all of which now form the "law of the river."

Groundwater Rights. Groundwater rights acquired by the City of Bakersfield are in two categories, as follows: (1) the rights as the overlying owner of the 2,760 acres of land along the Kern River between Renfro Road and Interstate Highway 5, and (2) the rights based on the historic production of groundwater by the wells of the Ashe Water Service area. The overlying rights of the 2,760 acres have not historically been used. The rights based on production from the wells of Ashe Water Service area have never been adjudicated or quantified. However, the pumping history of those wells would probably be used in quantifying the rights if and when they are adjudicated.

Surface Water Rights. Both Kern Island Water Company and Kern River Canal and Irrigating Company own rights to divert water from the Kern River. The diverted water is conveyed by canals to the service areas to meet the water requirements of the agricultural lands within the service areas. The surface water rights of the utility companies and Tenneco are summarized hereinafter.

The Kern Island Water Company's rights to divert water from the Kern River are based on rights of Kern Island Canal, Farmers Canal, Stine Canal and Buena Vista Canal. These canal companies divert water from the Kern River on the basis of priority of appropriation. In other words, the allocation of entitlements to the canal companies depends on the daily, natural flow quantities at First Point of Measurement.

The Kern Island Canal is entitled to take the first 300 cubic feet per second (cfs) of natural Kern River flow at the First Point of Measurement. The quantities in excess of 300 cfs are divided among the priorities junior to the Kern Island Canal. The diversion rights of the above canal companies for months when there are no Second Point and Lower River entitlements are shown in Table III-1.

Table III-1

DIVERSION RIGHTS OF CANAL COMPANIES OWNED
BY KERN ISLAND WATER COMPANY
(Cubic Feet per Second)

<u>Canal Company</u>	<u>Flow at First Point ^{1/}</u>	<u>Diversion Right</u>
Kern Island	300	300
Buena Vista	410.5	80
Stine	700.5	150
Farmers	880.5	150
Buena Vista	2,516.5	90
Kern Island	3,162.5	56

1/ River stage required to achieve full right.

At such times that there are Second Point and Lower River entitlements, usually March to August, the amount of the computed natural flow at First Point of Measurement for allocation to the canal companies is adjusted. The adjustment is based on the 1964 amended Miller-Haggin Agreement, 1/ Shaw Decree 2/ and the Kern River Water Rights and Storage Agreement. 3/

Table III-2 presents the quantities of Kern River water diverted by the Kern Island Water Company and others which have entitlements to Kern River water for the period 1962 through 1974. The data were compiled and furnished by the Kern County Canal and Water Company.

As shown in Table III-2, the average annual diversion by the Kern Island Water Company for the 13-year period was about 158,000 acre-feet. It constitutes about 20 percent of the total flow of the Kern River at the First Point of Measurement.

Most of the service area of the Kern Island Water Company is located within the boundaries of the Kern Delta Water District. The average annual quantity of water supplied by Kern Island Water Company to customers of each canal company within the District is tabulated below. The data represent the average annual deliveries to customers for the period 1955 through 1971. These data

1/ Document No. 15, Legal Supplement.

2/ Document No. 6, Legal Supplement.

3/ Document No. 13, Legal Supplement.

Table III-2

KERN RIVER DIVERSIONS
1962 THROUGH 1974
(Acre-Feet)

Year	Kern River Flow ^{1/}	Second Point ^{2/}	North Kern Storage District	Kern Island Water Company	Kern River Canal and Irrigating Company	Kern River Tenneco Inc. ^{4/}	Private ^{3/}
1962	607,848	151,826	187,525	134,091	13,307	92,518	3,581
1963	676,237	115,089	205,190	158,692	18,670	149,320	4,276
1964	361,624	59,125	56,137	135,879	10,732	75,562	767
1965	634,303	115,436	147,653	147,585	15,628	163,507	3,414
1966	504,506	98,276	112,226	135,296	12,780	114,114	2,713
1967	1,465,855	543,963	323,572	183,445	26,998	358,608	5,254
1968	497,026	96,555	61,430	156,534	14,889	133,066	3,298
1969	2,313,769	1,088,892	310,430	168,092	24,693	697,611	4,567
1970	601,254	115,363	110,103	176,907	16,469	152,649	4,077
1971	442,651	92,415	39,360	156,575	9,032	123,802	3,807
1972	311,292	9,183	65,084	138,663	0	82,126	2,677
1973	785,133	198,706	163,226	176,660	20,436	172,401	4,026
1974	745,903	168,952	183,347	186,059	21,023	145,098	4,697
Average	765,185	219,522	151,176	158,037	15,743	189,260	3,627

1/ At First Point of Measurement.

2/ Diversion to Second Point parties.

3/ Consists of diversion rights of the Old South Fork, Castro and Wilson Canals.

4/ Includes diversions to Rosedale-Rio Bravo Water Storage District.

Source: Kern County Canal and Water Company

were obtained from the Kern Delta Water District report entitled "Engineering Report Setting Forth a Plan for Utilization of Supplemental Water," April 1974.

<u>Canal Company</u>	<u>Acre-Feet</u>
East Side	6,700
Kern Island	86,200
Farmers	2,700
Stine	2,400
Buena Vista	6,000
	<hr/>
Total	104,000

The Kern River Canal and Irrigating Company rights to divert water from the Kern River are based on the rights of the Beardsley, Lerdo and McCord Canals. The diversion rights of these canals are based on priority of appropriation. Table III-3 presents the diversion rights of Kern River Canal and Irrigating Company when there are no Second Point and Lower River entitlements. The entitlement of the Kern River Canal and Irrigating Company consists of a portion of the diversion right of each of the three aforementioned canal companies, as shown in Table III-3.

The annual diversions by Kern River Canal and Irrigating Company for the period from 1962 through 1974 are shown in Table III-2. As indicated in Table III-2, the average diversion for the 13-year period was about 15,700 acre-feet. That constitutes about two percent of the total Kern River Flow at First Point of Measurement.

Table III-3

DIVERSION RIGHTS OF KERN RIVER
CANAL AND IRRIGATING COMPANY
(Cubic Feet per Second)

<u>Canal Company</u>	<u>Flow at First Point 1/</u>	<u>Total Diversion Right</u>	<u>KRC&IC Portion</u>
Beardsley and Lerdo	1190.5	60	42
McCord, Lerdo and Beardsley	1376.5	100	49
Beardsley	3106.5	240	168

1/ Flow required to achieve full right.

Tenneco has rights to divert water from the Kern River based on the following: (1) 74.04 percent of the diversion right of Castro Canal, (2) 37.5 percent of the diversion right of Wilson Canal, (3) 20 percent of the diversion right of Calloway Canal, (4) 20 percent of the diversion right of Railroad Canal, and (5) Kern River Canal entitlement. (It also has rights to divert water not diverted by North Kern Water Storage District under right of use conveyed to North Kern in the January 1, 1952, agreement.)

The above canal companies divert water from the Kern River on the basis of priority of appropriation. In other words, the diversions, priorities and quantities depend on the quantities of natural flow at First Point of Measurement. The diversion rights of the aforementioned canal companies and the respective shares of Tenneco's entitlement are shown in Table III-4 for months when there are no Second Point and Lower River entitlements. In months when there are Second Point or Lower River entitlements the amount of the computed natural flow at First Point of Measurement for allocation to the canal companies is adjusted. The adjustment is based on the amended Miller-Haggin Agreement 1/, Shaw Decree 2/, and Kern River Water Rights and Storage Agreement. 3/

1/ Supra Note 1, Page III-10

2/ Supra Note 2, Page III-10

3/ Supra Note 3, Page III-10

Table III-4

DIVERSION RIGHTS OF CANAL COMPANIES
AND TENNECO'S ENTITLEMENT
FOR MONTHS OF NO SECOND POINT AND LOWER RIVER ENTITLEMENT
(Cubic Feet per Second)

<u>Canal Company</u>	<u>Flow at First Point^{1/}</u>	<u>Diversion Right</u>	<u>Tenneco's Portion</u>
Castro	320.0	20	14.81
Wilson	1,250.5	10	3.75
Calloway	2,226.5	850	170.00
Railroad	2,426.5	200	40.00

The Kern River entitlement for the Second Point water users is generally available during the months of March through August. The Kern River entitlement for the Lower River water users, namely Hacienda Water District and Tulare Lake Basin Water Storage District, are available on an average of about 25 percent of the years. That is, such water occurs usually in years of above-average runoff. In years when Kern River water was available under the Lower River rights, it would most often occur in the months of April through July. Therefore, when the Kern River flow is subject to diversion for Second Point entitlement and Lower River entitlement, the flows at First Point as shown in Table III-4 are first adjusted to reflect the Second Point entitlement, Lower River entitlement and river losses required to deliver the Second Point entitlement water undiminished to Second Point of Measurement. Generally, when Lower River entitlement occurs there is sufficient water in the river channel that losses attributable to the Lower River entitlement are minimal.

^{1/} Flow required to achieve full right.

The entitlement of Kern River Canal is derived from the river losses salvaged by transporting the Second Point entitlement water through the River Canal to Second Point of Measurement. The quantity of salvage is computed on the basis of historic river losses which occurred in delivering water to Second Point of Measurement.

Tenneco's theoretical entitlement from Castro, Wilson, Calloway, Railroad and Kern River Canal rights was computed for the period 1896 through 1972. The computations of the individual entitlements are based on natural flow of the Kern River at First Point of Measurement. Flows from January 1896 through March 1954 were not regulated and therefore are considered to be natural flow. Since April, 1954, the Kern River flow has been regulated by Lake Isabella. During the period of regulation, the Kern River natural flows at First Point of Measurement were reconstructed by the Kern River Watermaster.

In addition to the aforementioned firm rights, Kern County Land Company, as a predecessor of Tenneco, owned diversion rights of the following canal companies: James, Anderson, Meacham, Plunket, Joyce, Johnson, Pioneer, 30 percent of Beardsley, James and Dixon, McCaffrey, 51 percent of McCord, 80 percent of Calloway and 80 percent of Railroad. The Kern County Land Company was also entitled to 4.563 percent of the Second Point entitlement. 1/

1/ Document No. 10, Legal Supplement.

However, according to the January 1, 1951, Agreement for Use of Water Rights between North Kern Water Storage District and Kern County Land Company and its subsidiary canal companies, the North Kern Water Storage District has the right in perpetuity to divert water of the Kern River under the rights of the above-mentioned companies up to specified maximum monthly quantities as set forth in Table III-5. In other words, the North Kern Water Storage District has the first priority to water of the canal companies as set forth in the agreement, but the canal companies continue to own the right to divert any water under those rights which is not diverted by the District and any water available under those rights in excess of the quantities shown in Table III-5. Such rights of those canal companies were acquired by the City of Bakersfield.

The average annual theoretical entitlement of Tenneco from the Castro, Wilson, Calloway, Railroad and Kern River Canal rights for water supply conditions as they occurred from 1896 through 1972 was calculated. The canal entitlements in excess of North Kern Water Storage District's maximum monthly diversion rights were also computed. However, it was assumed that North Kern would divert all water to which it was entitled. The resulting theoretical Tenneco entitlement is shown in Table III-6.

As indicated previously, the Kern River Canal was not constructed until 1962 and the Canal began service by early 1963.

Table III-5

MAXIMUM MONTHLY DIVERSION ALLOWED NORTH KERN
WATER STORAGE DISTRICT 1/

<u>Month</u>	<u>Maximum Diversion (Acre-Feet)</u>
January	32,800
February	34,200
March	41,200
April	44,000
May	46,800
June	48,200
July	52,400
August	49,600
September	44,000
October	38,400
November	35,600
December	32,800
Total	500,000

Table III-6

AVERAGE ANNUAL THEORETICAL ENTITLEMENT
OF TENNECO
1896 THROUGH 1972

<u>Canal</u>	<u>Entitlement (Acre-Feet)</u>
Castro	3,570
Wilson	280
Calloway	8,220
Railroad	1,360
Kern River Canal	102,770
Excess of NKWSD	7,500
Total	123,700

1/ Document No. 8, Legal Supplement

The entitlement derived from the Kern River Canal is the major portion of Tenneco's total entitlement. The annual entitlement of the Kern River Canal for the historic period of record, 1963 through 1974, is tabulated below:

<u>Year</u>	<u>Kern River Canal Entitlement (Acre-Feet)</u>
1963	100,824
1964	53,726
1965	88,163
1966	72,147
1967	202,941
1968	83,299
1969	383,682
1970	97,240
1971	80,092
1972	42,271
1973	141,235
1974	129,656
Average	122,940

Storage Rights. According to the 1964 contract 1/ with the United States, the conservation storage space available in Isabella Reservoir for storage of irrigation water was allocated 68 percent to North Kern Water Storage District and 32 percent to Buena Vista Water Storage District, with an option to Tulare Lake Basin Water Storage District and Hacienda Water District to purchase 20 percent of the storage space from North Kern. Through an agreement 2/ between North Kern Water Storage District and Kern County Canal and Water Company, one-half of the North Kern storage space in Isabella Reservoir is owned by the

1/ Document No. 18, Legal Supplement.

2/ Document No. 16, Legal Supplement

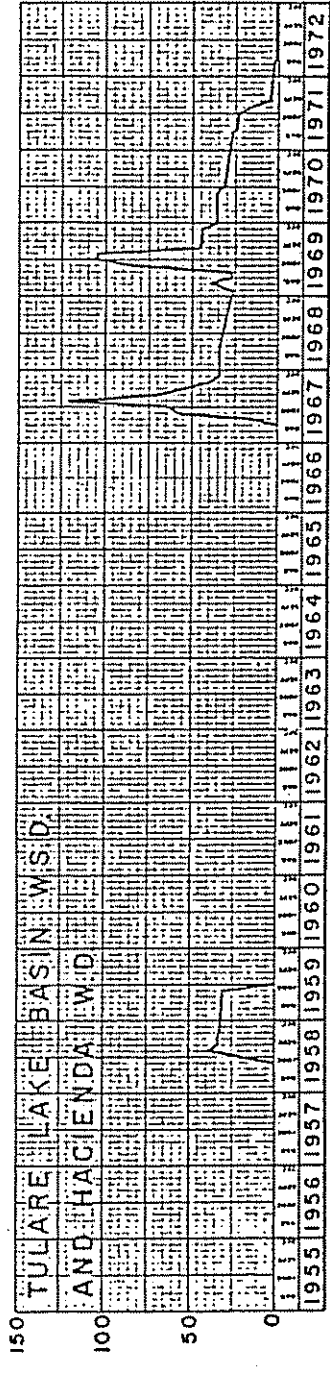
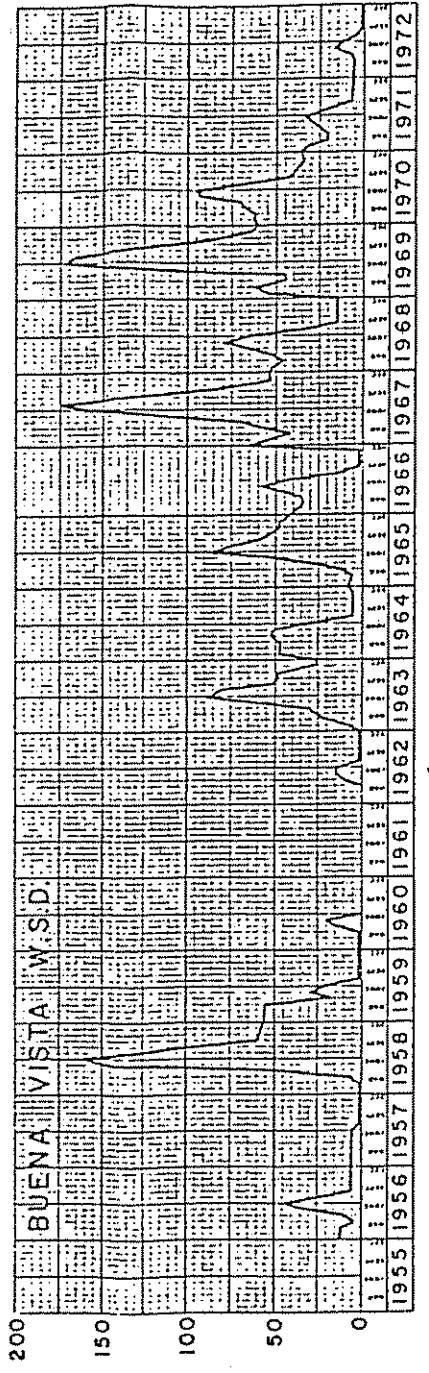
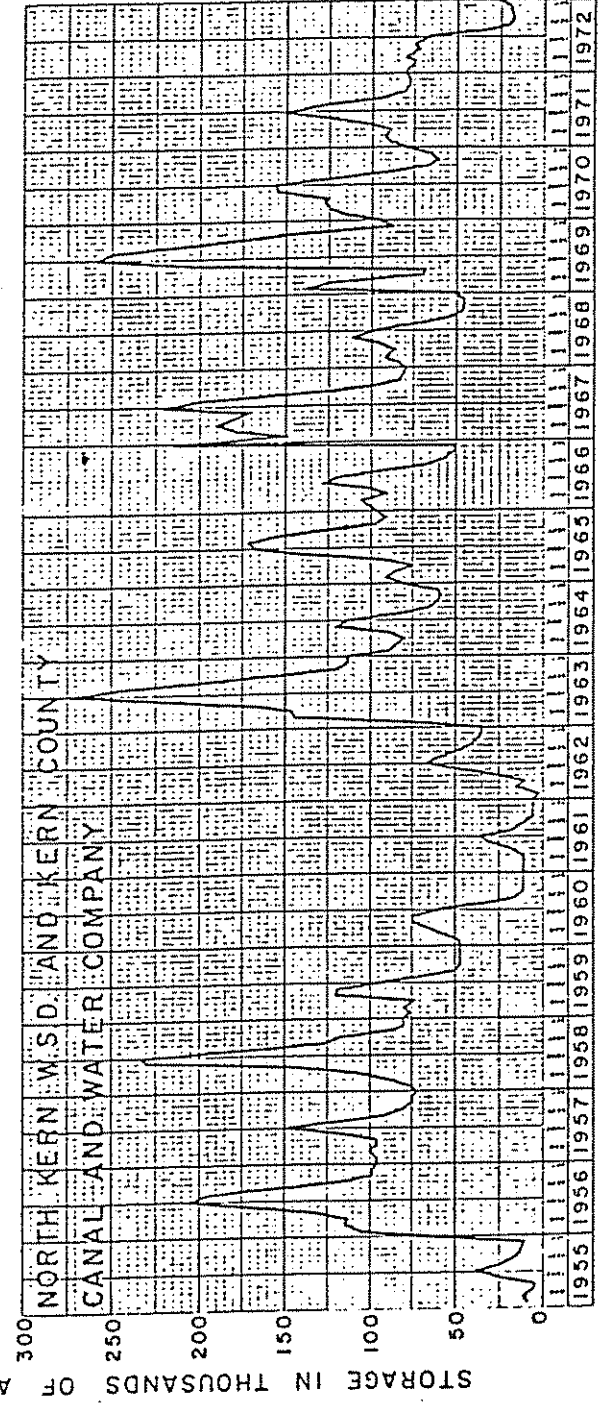
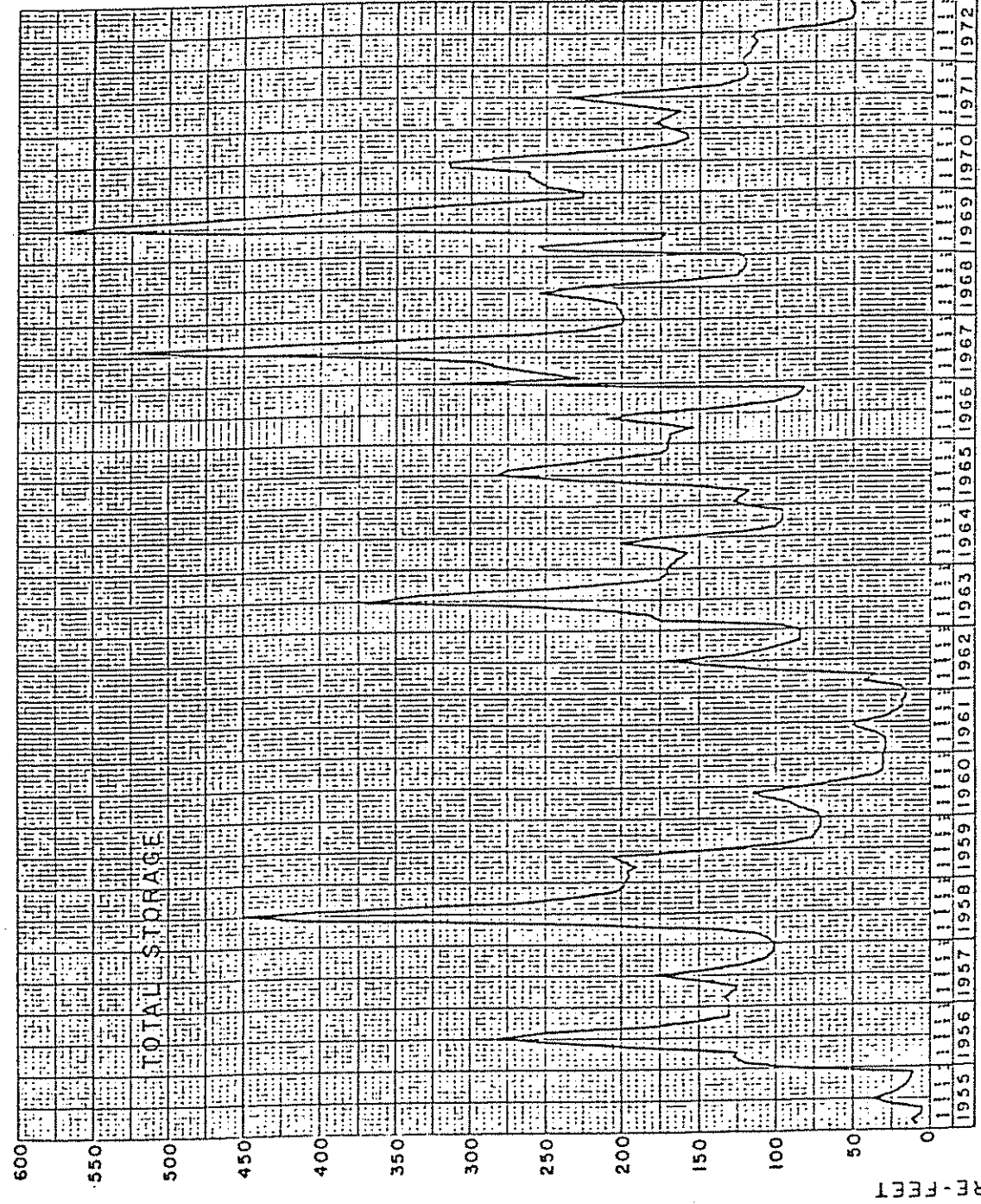
THOMAS M. STETSON

Kern County Canal and Water Company (Tenneco).

The historic storage in Isabella Reservoir, that used by the North Kern Water Storage District and Kern County Canal and Water Company, Buena Vista Water Storage District, and Tulare Lake Basin Water Storage District and Hacienda Water District is shown by hydrographs on Plate 6. Each party may have water in storage in excess of or less than its allocated quantity, depending upon the availability of water and storage space. The hydrograph representing North Kern's storage includes water of Tenneco and its subsidiaries. Although neither Kern Island Water Company nor Kern River Canal and Irrigating Company own storage rights in Isabella Reservoir, Tenneco has at times stored water for the two companies, primarily during the irrigation season. The arrangements were made on a year to year basis and Tenneco charged the companies for use of such storage space.

The option of Tulare Lake and Hacienda to purchase 20 percent of the storage space from North Kern and Tenneco expired on October 23, 1974. Although the option to purchase was not exercised, the contract 1/ grants in perpetuity to Tulare Lake and Hacienda the right to rent up to 20 percent of the storage space in Isabella Reservoir from North Kern and Tenneco. Under such conditions the effective storage space for Tenneco would be reduced to 24 percent of the total conservation storage in

1/ Document No. 18, Legal Supplement



STORAGE HYDROGRAPHS, ISABELLA RESERVOIR

Isabella Reservoir at such times that the full 20 percent of storage space was rented. At such times that storage space is not rented by Tulare Lake and Hacienda, Tenneco's share will be 34 percent of the conservation storage space.

Construction of Isabella Reservoir was completed by the U. S. Army Corps of Engineers in 1954, to regulate the Kern River for flood control, water conservation and recreation purposes. The maximum storage capacity in Isabella Reservoir is about 570,000 acre-feet including a minimum recreation pool of 30,000 acre-feet. The maximum annual carry-over storage, including recreation, is 170,000 acre-feet. According to the Corps of Engineers reservoir regulation manual, the total quantity of irrigation and recreation water in storage for the months of November through January cannot exceed 170,000 acre-feet. The quantity of such water in storage in other months of the year can vary from 170,000 to as much as 570,000 acre-feet.

The United States allocated for the joint use of flood control, recreation and incidental uses, 35,000 acre-feet of storage space in Isabella Reservoir. That included the 30,000

acre-feet for the minimum recreation pool. The County of Kern has an interest in the development, management and operation of facilities for recreation use at Isabella Reservoir. According to an agreement between the County of Kern and the Kern River interests, ^{1/} for the purpose of maintaining the 30,000 acre-feet minimum recreation pool, the County will receive replenishment water to compensate for seepage, evaporation and flood control losses. Under that agreement, the irrigation interests with storage rights in Isabella Reservoir are to replenish the losses in the minimum recreation pool to maintain it at 30,000 acre-feet by not withdrawing stored water below that level unless all parties agree to such withdrawal. Kern County, among other things, agreed that:

"It [Kern County] will not oppose any contention by the Irrigators that there is no unappropriated water available in the Kern River for appropriation."

Cawelo Water District. The Cawelo Water District, as shown on Plate 2, is located on the east side of the San Joaquin Valley in Kern County. The District extends in a north-south direction between the cities of Bakersfield and McFarland and is bounded on the west by U. S. Highway 99. The District was formed in January 1965 for the primary purpose of providing supplemental agricultural water to the lands within the District.

The Cawelo Water District contracted with the Kern

1/ Document No. 14, Legal Supplement.

County Water Agency to receive 45,000 acre-feet annually of State Project water. The water delivery is scheduled for 26,500 acre-feet in 1976 building up to 45,000 acre-feet by 1990. Cawelo's entitlement of State Project water will be delivered from the California Aqueduct through the Cross-Valley Canal and Cross-Valley Canal Extension. From the terminus of the Cross-Valley Canal Extension the water will be conveyed by pipeline to the Beardsley Canal. The capacity of the Beardsley and Lerdo canals is being increased to carry the district's State water into the district. The water will be pumped from the Lerdo Canal into the district's distribution facilities. 1/

The area of the Cawelo Water District is about 46,800 acres. About 41,570 net acres of the district lands are considered irrigable. Approximately 37,360 net acres were reported to be under full irrigation as of October 1973. The land use in the Cawelo Water District in October of 1973 as reported by Boyle Engineering, is shown in Table III-7.

The projected growth in irrigated acreage is reported by Boyle Engineering as follows:

1/ Boyle Engineering Corporation, 1974, Supplemental Engineering and Economic Report on Proposed Irrigation Project Based on Amended Plan of Irrigation Works as Modified December, 1973, Cawelo Water District.

Table III-7
 LAND USE IN CAWALO WATER DISTRICT
 AS OF OCTOBER 1973
 (Acres)

	<u>Gross Area</u>	<u>Net Area</u>
Irrigated Crops		
Citrus	8,790	8,520
Almonds	5,630	5,460
Figs	1,360	1,320
Olives	620	600
Pistachios	1,640	1,580
Stone Fruit	450	440
Walnuts	20	20
Grapes	2,750	2,670
Row and Field Crops	<u>17,270</u>	<u>16,750</u>
	38,530	37,360
Dry Farmed or Partial Irrigation	3,180	3,080
Undeveloped Lands		
Irrigable	1,170	1,130
Non-irrigable	<u>1,435</u>	
	2,605	
Commercial, Residential and Public Lands	2,485	
Total	<u>46,800</u>	

Source: Boyle Engineering Corporation, 1974, Supplemental Engineering and Economic Report on Proposed Irrigation Project Based on Amended Plan of Irrigation Works as Modified December 1973, Cawelo Water District.

<u>Irrigated Crops</u>	<u>Net Area (Acres)</u>	
	<u>October 1973.</u>	<u>Projected 1990</u>
Citrus	8,520	9,000
Almonds	5,460	11,000
Figs	1,320	2,000
Olives	600	600
Pistachios	1,580	2,400
Stone Fruit	440	750
Wine Grapes	2,670	4,750
Row and Field Crops	16,750	11,070
	37,360	41,570

The net irrigated area is estimated to increase by about 4,200 acres by 1990. The applied water requirement for 1973 was estimated by Boyle Engineering to be about 118,540 acre-feet. Similarly, the projected applied water requirement by 1990 was reported to be about 129,640 acre-feet.

All water for irrigation of lands in the District is supplied from groundwater. The groundwater levels beneath the Cawelo Water District are declining at an average rate of 10 feet per year with greater rates beneath some portions of the district. It is estimated that the present groundwater overdraft beneath the District lands is about 50,000 to 60,000 acre-feet per year. ^{1/}

Kern-Tulare Water District. The Kern-Tulare Water District is located in the northeastern portion of the San Joaquin Valley portion of Kern County and extends into southern Tulare County.

^{1/} Boyle Engineering Corporation, 1973, Environmental Impact Report, Proposed Irrigation Project, Cawelo Water District, Final Draft.

The District was formed in March 1974 to contract for a supplemental imported water supply, participate in the Cross-Valley Canal, and construct conveyance facilities for distribution of imported water to lands within the District.

The Kern-Tulare Water District is presently a participant in the Cross-Valley Canal project. The Kern County Water Agency has offered the District a contract for purchase of surplus State water. Such surplus State water would be conveyed through the Cross-Valley Canal to a point near Bakersfield where the water would be diverted through a turnout into the Arvin-Edison Canal for delivery to the Arvin-Edison Water Storage District. Boyle Engineering reported that the District's supply of surplus State water would average about 40,000 acre-feet per year. The District plans to exchange the 40,000 acre-feet of State water with the Arvin-Edison Water Storage District for up to 44,000 acre-feet of that district's Class 1 and Class 2 water from the Friant-Kern Canal. The Friant-Kern Canal exchange water would be delivered from the Friant-Kern Canal to Kern-Tulare Water District lands by means of facilities planned for construction by the Kern-Tulare Water District.

The total District area is about 30,580 acres of which about 23,090 acres are located within Kern County. Only the Kern County portion of the Kern-Tulare Water District is considered to be within the City's project area. Of the gross area of 23,090 acres located within Kern County, about 21,500 net acres

are considered to be irrigable. About 13,980 net acres of land were reported to be irrigated in the Kern County portion of the District as of January 1974. Present land use within the Kern County portion of the District, as of January 1974, is shown on Table III-8.

The projected growth in irrigated acreage within the Kern County portion of the district is reported by Boyle Engineering to be as follows:

<u>Irrigated Crops</u>	<u>Net Area (Acres)</u>	
	<u>January 1974</u>	<u>Projected 1995</u>
Almonds	8,390	10,366
Oranges	4,744	4,744
Lemons	490	800
Olives	179	179
Walnuts	52	52
Grapes	126	280
Total	13,981	16,421

The net irrigated area is projected to increase by about 2,440 acres by 1995. The applied water requirement for 1974 was estimated by Boyle Engineering to be about 46,970 acre-feet. The projected requirement by 1995 within the Kern County portion of the District was reported to be about 49,460 acre-feet. (It is indicated that irrigation efficiencies will improve by 1995.)

All water for irrigation of lands in the District is now supplied from groundwater. It is reported by Boyle Engineering

Table III-8

LAND USE IN KERN COUNTY PORTION OF
KERN-TULARE WATER DISTRICT
AS OF JANUARY 1974

(Acres)

	<u>Gross Area</u>	<u>Net Area</u>
Irrigated Crops		
Almonds	8,703	8,390
Oranges	4,921	4,744
Lemons	508	490
Olives	186	179
Walnuts	54	52
Grapes	130	126
	<hr/>	<hr/>
	14,502	13,981
Dry Farmed	5,785	5,499
Undeveloped Lands		
Irrigable	2,100	2,020
Non-irrigable	700	
	<hr/>	
Total	23,087 ^{1/}	

1/ Public lands not included.

Source: Boyle Engineering Corporation, 1974, Engineering and Economic Report in Support of Application to District Securities Division of California State Treasurer's Office for Approval of Proposed Irrigation Project, Kern-Tulare Water District.

that because of the insufficiency of factual data the annual overdraft on groundwater by the district cannot be accurately determined. However, based on a specific yield of 10 percent and an average annual decline of water levels of 12.5 feet, the overdraft was estimated by Boyle Engineering in 1974 to be approximately 38,000 acre-feet per year for the entire District. The present rate of overdraft in the Kern County portion of the District is herein estimated to be about 28,500 acre-feet per year.

Rag Gulch Water District. The Rag Gulch Water District is located immediately west of the Kern-Tulare Water District in northern Kern County and southern Tulare County. The District was organized in January 1955 to secure a supplemental water supply from the Central Valley Project for delivery to District lands. On September 13, 1973, the District executed an agreement with the Kern County Water Agency to participate in the Cross-Valley Canal. The agreement allows the use of the canal for District purposes for a maximum annual delivery of 13,300 acre-feet. The District anticipates that it will use the capacity in the Cross-Valley Canal for delivery of surplus State water and surplus Central Valley Project water to the Arvin-Edison Water Storage District in exchange for some of that district's Friant-Kern Canal water.

The District comprises an area of about 6,033 acres. Approximately 55 percent of the total District area is located within Kern County. Only the Kern County portion of the Rag Gulch Water District is considered to be within the project area.

About 84 percent of the total District area is considered to be irrigable. The land use and cropping pattern within the District and within the Kern County portion of the District, as reported for 1974, are shown in Table III-9.

Approximately 12 percent of the irrigable lands within the District were either dry farmed or left fallow in recent years because of the inadequate supply of water. With adequate supplemental water the presently dry-farmed areas would be developed for vineyard, citrus and deciduous fruit crops.

Historically, water for irrigation of lands in the District has been supplied from the groundwater basin. The groundwater source has been supplented from time to time over the past 21 years with the delivery of water from the Friant-Kern Canal. Surplus Central Valley Project water, when available, is pumped from the canal and conveyed to the lands within the District by means of a pipeline to supplement the groundwater supply. Estimates of annual water delivery from the Friant-Kern Canal to the Kern County portion of the Rag Gulch Water District for water years 1953-54 through 1972-73 are shown on Table III-11.

Groundwater elevations beneath the District lands have continued to decline because the average annual withdrawal of groundwater has exceeded the average annual recharge. In the past ten years, the average rate of decline has been greater in the Kern County portion of the District than within the Tulare

Table III-9

LAND USE IN RAG GULCH WATER DISTRICT IN 1974

(Acres)

	<u>District</u>	<u>Net Area</u>	
		<u>Kern County Portion of District</u>	
Irrigated Crops			
Grapes	3,474	1,300	<u>1/</u>
Citrus	329	267	
Almonds	438	438	
Cherries	8	0	
Row and field crops	728	640	<u>1/</u>
	<hr/>	<hr/>	
	4,977	2,645	
Irrigable Lands <u>2/</u>	667		
Roads, Farmsteads, Reservoir and Misc.	389		
	<hr/>		
Total	6,033		

1/ Estimated from land use map.

2/ Not presently irrigated.

Source: Bookman and Edmonston Engineering Inc., 1974, Final Environmental Impact Report on Plan of Irrigation Works for Rag Gulch Water District, Kern-Tulare Counties.

County portion of the District. The average rate of decline for the entire District ranged from 5 to 10 feet per year over the last 15 years.

It is reported by Bookman and Edmonston ^{1/} that the current needs of the District for supplemental water for irrigated agriculture are in excess of 13,000 acre-feet per year.

North Kern Water Storage District. The northern portion of the North Kern Water Storage District, comprised of about 61,850 acres of land, is located on the north side of the Kern River about six miles northwest of Bakersfield. The District is bounded on the south by Seventh Standard Road, on the west by the Shafter-Wasco Irrigation District and on the east by the Cawelo Water District. The District extends north from Seventh Standard Road about 18 miles to the vicinity of the City of McFarland. The District is bounded on the north by the Southern San Joaquin Municipal Utility District.

The North Kern Water Storage District diverts water from Kern River through the Beardsley-Lerdo and Calloway Canals for the purpose of irrigation and groundwater recharge. In addition, groundwater pumped from wells supplements the surface delivery of irrigation water. Those lands within the District which are entitled to receive surface delivery from the Kern River supply are

^{1/} Bookman and Edmonston Engineering Inc., 1974, Final Environmental Impact Report on Plan of Irrigation Works for Rag Gulch Water District, Kern-Tulare Counties.

referred to as Class I lands. Class II lands are generally irrigated by groundwater pumped from privately owned wells.

The North Kern Water Storage District includes an irrigable area of about 55,000 acres. Practically all of the irrigable areas are fully developed at the present time.

Prior to 1948, about 20,000 acres were irrigated from the groundwater supply and 15,500 were irrigated from the Kern River supply. In 1950, the Board of Directors of the District formulated a plan of development 1/ to provide an adequate water supply for the District. Under this plan the District would augment its supply of Kern River water by acquiring additional water from the diversion rights owned by the Kern County Land Company. The development plan also included modification of the then existing canals, construction of additional canals and spreading ponds and construction of 50 District wells. The wells were planned to supply water to canal-irrigated areas (Class I lands) in years of below-normal Kern River supply.

As indicated previously, the irrigable lands are divided into two categories, Class I and Class II. Presently, the Class I lands, consisting of 28,000 acres, are irrigated from the Kern River supply and from wells operated by the District. The Class II lands, consisting of 27,000 acres, are irrigated by water pumped

1/ Report to State Engineer on Feasibility of Project by Board of Directors, 1950, North Kern Water Storage District.

from privately owned wells. However, when there is a sufficient supply of water from the Kern River to meet all the needs of the Class I lands, Kern River water is made available to Class II lands for direct use. Kern River supplies in excess of demands of Class I and II lands are diverted into spreading grounds for replenishment of the groundwater basin. In some years, a small amount of runoff from Poso Creek is utilized for spreading.

During the five-year period, 1965 to 1970, water levels have generally risen in the southern part of the District while declining as much as 40 feet in the northern portion of the District.

Kern Delta Water District. The Kern Delta Water District is located within Kern County about eight miles southwest of Bakersfield. The District is bounded by the Arvin-Edison Water Storage District on the east, the Wheeler Ridge-Maricopa Water Storage District on the south, the Buena Vista Water Storage District and Pioneer Improvement District of North Kern Water Storage District on the west, and by Improvement District No. 4 on the north. The Kern Delta Water District covers an area of approximately 125,000 acres. The area of the District is shown on Plate 2.

About 72 percent of the District's total area is served by the Kern Island Water Company. The Company serves Kern River water for agricultural use through an extensive gravity canal

system. The balance of the water requirement of the District is pumped from wells by individual land owners. In 1972 the District executed an agreement with the Kern County Water Agency to receive supplemental State Project water. The water delivery is scheduled to be 17,600 acre-feet in 1976, building up to 30,000 acre-feet by 1990 and thereafter.

The irrigated crops within the District, as of August 1969, were reported by Boyle Engineering to be as follows: 1/

<u>Irrigated Crops</u>	<u>Net Area (Acres)</u>
Cotton	28,700
Alfalfa	25,100
Grain	11,900
Potatoes	1,000
Milo	8,700
Grapes	4,200
Pasture	2,600
Sugar Beets	3,400
Vegetables	2,700
 	<hr/>
Total	88,300

The net area of undeveloped irrigable lands was reported to be about 16,700 acres, indicating that the total net irrigable area within the District is about 105,000 acres. The balance of the District area is non-agricultural and unsuitable for growing crops:

1/ Boyle Engineering Corporation, 1969, Engineering and Economics Report in Support of Application to California District Securities Commission for Approval of Proposed Irrigation Project, Kern Delta Water District.

According to a report by Boyle Engineering, ^{1/} the total gross area presently devoted to irrigated agriculture within the District is about 105,600 acres. The present water requirement of these lands was estimated to be 359,000 acre-feet annually. The agricultural water demands are met by surface deliveries of Kern River water and groundwater pumping. According to the Boyle Engineering report, annual deliveries by the Kern Island Water Company to areas within the District averaged about 104,000 acre-feet from 1955 through 1971. The balance of the water requirement was obtained from the groundwater basin. Groundwater pumpage was estimated in 1974 to be about 250,000 to 260,000 acre-feet per year. The present amount of groundwater overdraft within the District was estimated by Boyle Engineering to be 75,000 to 80,000 acre-feet annually.

Rosedale-Rio Bravo Water Storage District. The Rosedale-Rio Bravo Water Storage District is located in Kern County about five miles west of the City of Bakersfield. The District encompasses about 43,000 acres of land. The irrigable area of the District is estimated to be 37,000 acres of which about 25,100 acres were devoted to irrigated agriculture in 1971.

The Rosedale-Rio Bravo Water Storage District was formed in 1959. In 1962 the District constructed groundwater

^{1/} Boyle Engineering Corporation, 1974, Engineering Report Setting Forth a Plan for Utilization of Supplemental Water, Kern Delta Water District.

recharge facilities. For the purpose of importing supplemental State Project water, the District executed a contract with the Kern County Water Agency in 1966. The State water delivery is scheduled to be 20,000 acre-feet in 1976, building up to 35,000 acre-feet by 1990 and thereafter. The District is a participant in the construction of the Cross-Valley Canal. Deliveries from the Cross-Valley Canal will be diverted into spreading basins for the purpose of groundwater recharge.

The irrigated crops within the District, as of 1971 and projected for 1990, were reported by Boyle Engineering to be as follows: 1/

<u>Irrigated Crops</u>	<u>Net Area (Acres)</u>	
	<u>1971</u>	<u>1990</u>
Cotton	9,488	12,000
Alfalfa	11,534	12,000
Deciduous	508	2,000
Grapes	29	2,000
Vegetable, double-cropped	---	3,000
Miscellaneous Field Crops	3,392	2,000
Sugar Beets	145	2,000
Total	25,096	35,000

Presently, all water for irrigation of lands in the District is supplied from the groundwater basin. Prior to operation of the District's recharge program, groundwater extractions exceeded the natural recharge by about 40,000 to 50,000 acre-feet per year. The District receives water for recharge purposes from

1/ Official Statement, 1974, Bond Series A, Rosedale-Rio Bravo Water Storage District.

the Kern River through a water service agreement with Tenneco^{1/} and from the Friant-Kern Canal through a short-term water service agreement with the Bureau of Reclamation. The quantities of water sold to Rosedale-Rio Bravo Water Storage District by Tenneco during the period 1963 to 1974 are tabulated below:

<u>Calendar Year</u>	<u>Deliveries (Acre-feet)</u>
1963	64,912
1964	15,261
1965	57,552
1966	12,577
1967	66,454
1968	24,430
1969	85,358
1970	21,883
1971	9,614
1972	6,159
1973	74,997
1974	32,156

The percolation program has resulted in reduction in the rate of decline of the water table from about 8 to 10 feet per year to about 2 to 3 feet per year.

County of Kern Recreation Areas. The County of Kern maintains seven recreation areas along or in the vicinity of the Kern River. Lake Isabella and Kern River Park, which includes Lake Ming and Hart Memorial Park, are directly related to the City's project because of the agreements (Documents Nos. 7, 14, and 17, Legal Supplement) succeeded to by the City. The other County Parks use Kern River water, groundwater or other water.

^{1/} Document No. 12, Legal Supplement

Riverside Park is located immediately downstream of Kernville on the right bank of the Kern River. It is comprised of about five acres of land and is fully developed. It uses Kern River water for irrigation of park lands and obtains domestic water from a local water purveyor.

The County's recreation facilities at Lake Isabella are maintained with water from the Kern River in accordance with the November 8, 1963, Agreement for Establishment and Maintenance of Minimum Recreation Pool of 30,000 Acre-Feet in Isabella Reservoir (Document No. 14, Legal Supplement). Under that agreement, the water that was consumed on formerly developed lands which are now inundated by the reservoir is dedicated to evaporation and seepage losses from the recreation pool. This assures that a minimum recreation pool of 30,000 acre feet will be maintained.

Kern River Park is northeast of Bakersfield, along a reach of some five miles of the Kern River. It includes the Kern River Golf Course, Lake Ming, and Hart Memorial Park. Lake Ming covers an area of 105 acres, the Hart Memorial Park Lake covers about 20 acres, and there are almost 300 acres of land under irrigation in the park.

Domestic water is furnished by a well and by pumping from the Kern River. The water for the lakes and the irrigated areas is furnished from the Kern River, although a well supplies

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some of the irrigated areas. The agreements to which the City has succeeded (Documents 7 and 17, Legal Supplement) form the basis of supplying Kern River water to Kern River Park.

There are two County parks in Bakersfield, Metropolitan Recreation Center and Beach Park. Both are supplied with groundwater from deep wells.

The Buena Vista Golf Course and Andy Noon Park occupies about 160 acres overlooking the California Aqueduct and Buena Vista Lake. It is located in Sections 7 and 18 (T31S/R25E) on the northerly side of Buena Vista Lake. Groundwater is supplied for irrigation from a deep well. Domestic water is furnished by the West Kern County Water District.

The Buena Vista Aquatic Recreation Area occupies some 1,600 acres in the northeasterly portion of Buena Vista Lake. It is comprised of two lakes connected by a siphon under the Kern River channel. The lakes cover about 960 acres. Domestic and irrigation water is supplied by wells from the groundwater basin. Water for the lakes, to supply evaporation and seepage losses, has been from the California Aqueduct supplied under an agreement with the Kern County Water Agency.

Topographic Setting

The Kern County portion of the San Joaquin Valley occupies the southern portion of the Tulare Lake Basin, which is the southernmost drainage basin of the San Joaquin Valley. In years of normal or above normal Kern River flow, water that is not diverted or infiltrated to the groundwater basin flows to Buena Vista Lake. During periods of large floods, the low divide between Buena Vista and Tulare Lakes can be overtopped with water flowing to Tulare Lake. The Tulare Lake Basin is a closed basin with interior drainage except during periods of excessive storm runoff.

The San Joaquin Valley floor is relatively flat and is bounded on the east by the Sierra Nevada and its foothills, on the south by the San Emigdio and Tehachapi mountains and on the west by the Coast Range. The terrain slopes gently in a south to southwesterly direction toward Buena Vista and Kern Lake Beds, the terminal drainage basins for the south end of the Valley, and thence northwesterly along the trough of the valley toward San Francisco Bay.

Elevations within the San Joaquin Valley floor of Kern County vary from about 460 feet above sea level at the First

Point of Measurement on the Kern River to 288 feet in the bed of Buena Vista Lake.

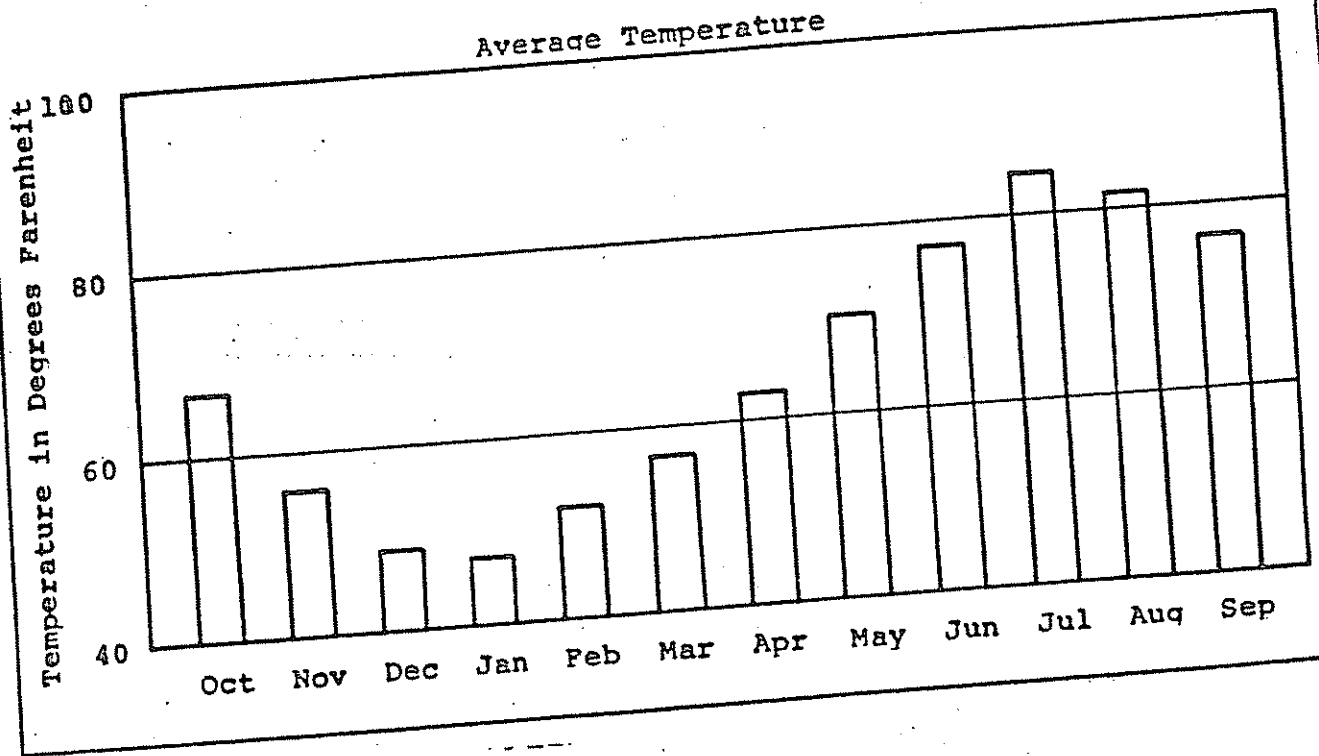
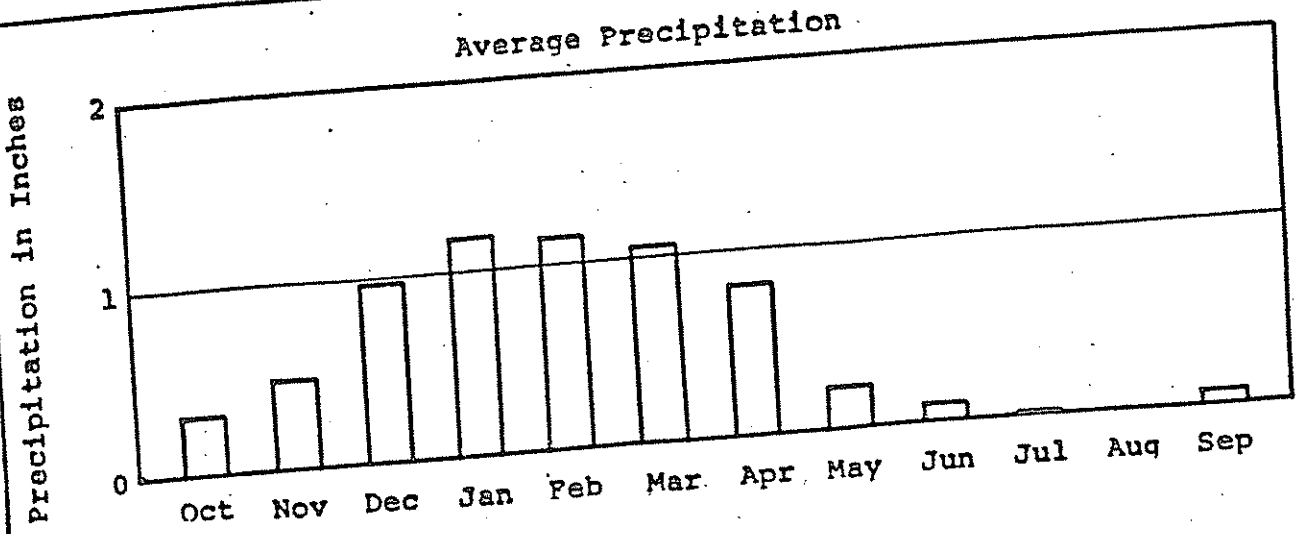
Climatic Conditions

The climate of the area is arid with hot summers and mild winters. The average monthly temperature in Bakersfield ranges from 47.4° F. in January to 84.3° F. in July. The summers are relatively cloudless. The average length of the growing season is about 300 days. In the winter months fog occurs mostly at night but sometimes it prevails for two to three weeks continuously. Annual precipitation at Bakersfield averages about six inches with ninety percent of the annual precipitation occurring during the six months from November through April. The average monthly precipitation and temperature at Bakersfield are shown on Plate 7.

Evaporation rates in the area are generally high reaching more than 100 inches annually. This is caused by the warm temperatures and low humidities. Summer humidities range from 20 to 35 percent in the area. Winds are generally light and they are frequently from the northwest.

Surface Water Conditions

There are three major sources of surface water supply available to the area. They are: (1) the Kern River, (2) the Central Valley Project and (3) the State Water Project.



AVERAGE MONTHLY PRECIPITATION AND TEMPERATURE AT BAKERSFIELD

Intermittent streams that flow from foothill watersheds provide relatively minor amounts of surface water. The quality of surface water available in the project area is also discussed in this section.

Kern River. Historically, the Kern River has been the principal source of surface water to the Kern County portion of the San Joaquin Valley. The Kern River, which heads in the vicinity of Mt. Whitney in the Sierra Nevada, has a drainage area of 2,420 square miles near Bakersfield. It flows in a south and southwesterly direction, entering the valley north-east of Bakersfield. Minor intermittent streams contribute relatively small quantities of surface water to the valley during storm periods.

The average annual flow of the Kern River (regulated since April 1954 by Isabella Dam) at the First Point of Measurement (located about 5 miles upstream of Bakersfield) during the 21-year period, 1954 through 1974, was about 659,200 acre-feet. Peak flows normally occur during April, May and June with low flows occurring from August to February. The annual regulated flow of the Kern River at First Point of Measurement as reported by the Kern River Watermaster is shown in Table III-10 for the period 1954 through 1974. Also shown in Table III-10 is the estimated natural flow at First Point of Measurement.

Table III-10

ESTIMATED NATURAL FLOW AND
REGULATED FLOW OF KERN RIVER AT FIRST POINT
OF MEASUREMENT
(Acre-Feet)

<u>Calendar Year</u>	<u>Estimated Natural Flow</u>	<u>Regulated Flow</u>
1954	531,500	505,400 ^{1/}
1955	444,300	367,800
1956	840,900	755,500
1957	444,300	445,900
1958	1,104,800	967,500
1959	258,000	353,200
1960	300,000	324,000
1961	177,600	177,000
1962	697,700	607,800
1963	801,400	676,200
1964	339,300	361,600
1965	720,400	634,300
1966	678,600	504,500
1967	1,396,200	1,465,900
1968	453,800	497,000
1969	2,461,400	2,313,800
1970	589,500	601,300
1971	427,500	442,700
1972	268,400	311,300
1973	979,700	785,100
1974	818,600	745,900
Averages	701,600	659,200

1/ Partially regulated.

In most years there is no flow in the Kern River channel in the vicinity of Bakersfield due to the many upstream diversions. During wet years, some water flows in the river toward Buena Vista Lake, thus providing an opportunity for percolation of water to the groundwater basin.

Central Valley Project. The Central Valley Project is a development of the United States Bureau of Reclamation. Water from that project is delivered to the Kern County area from the Friant-Kern Canal. This canal begins at Friant Dam and Millerton Lake and flows southerly to its terminus at the Kern River near Bakersfield. Some of the agricultural districts in Kern County have contracts with the United States Bureau of Reclamation for delivery of Friant-Kern Canal water. All contracts are for delivery of irrigation water. The annual entitlements within the County are for 203,000 acre-feet of Class I water (firm supply) and up to 413,000 acre-feet of Class II water (non-firm supply). The average annual supply to Kern County from the Central Valley project had been estimated to be about 400,000 acre-feet, yet to date the maximum annual delivery was 394,600 acre-feet. The annual deliveries from the Friant-Kern Canal to the agricultural districts in Kern County for water years 1953 through 1973 are shown in Table III-11.

State Water Project. State Project water is supplied from the flows in the Sacramento-San Joaquin Delta and releases of water

Table III-11

CENTRAL VALLEY PROJECT WATER DELIVERED TO KERN COUNTY
(Acre-Feet)

Water Year	Delano- Earlhart ID ¹	Southern San Joaquin MUD	Rag Gulch WD 2/ Wasco ID	Shafter	Rosedale- Rio Bravo WSD	Buena Vista WSD	Arvin- Edison WSD	Others	TOTAL
1953-54	14,200	92,600	5,300	0	0	0	0	0	112,100
1954-55	19,600	106,200	1,300	0	0	0	0	900	128,000
1955-56	25,300	122,400	5,900	0	0	94,200	0	300	248,100
57	24,100	116,000	3,100	1,700	0	4,300	0	32,100	181,300
58	21,800	99,200	5,100	29,600	0	52,300	3,000	10,100	221,100
59	23,100	102,000	7,700	42,300	0	0	0	400	168,500
60	17,200	98,900	0	48,100	0	0	0	700	164,900
1960-61	12,800	75,500	0	35,400	0	0	0	1,000	124,700
62	23,300	125,800	2,500	45,300	9,800	21,200	0	1,000	228,900
63	24,500	126,500	5,000	46,500	15,900	19,700	0	0	238,100
64	19,600	115,000	900	54,200	0	0	0	1,300	191,000
65	24,000	129,300	2,800	50,100	8,800	27,700	0	1,200	243,900
1965-66	20,700	115,400	700	51,400	3,000	3,000	24,900	1,100	220,200
67	22,800	126,600	5,200	50,100	16,900	8,500	59,300	15,500	304,900
68	17,100	97,700	800	46,000	0	0	73,600	1,000	236,200
69	20,900	112,000	5,000	46,000	0	0	164,500	0	348,400
70	22,600	132,100	1,200	56,600	0	9,500	145,300	0	367,300
1970-71	19,900	112,000	0	56,300	8,400	8,000	129,100	1,800	335,500
72	18,600	107,300	0	58,300	0	0	84,500	0	208,700
73	19,700	116,100	4,300	58,900	38,800	0	156,800	0	394,600

1/ Represents 14.8 percent of water delivered to district to account for the Kern County portion.

2/ Assumes that all water delivered through 1957-58 was used in Kern County portion of District. After 1957-58, it is assumed that 55 percent of delivered water was used in Kern County.

Source: California Department of Water Resources

stored in Oroville Reservoir on the Feather River. Water is diverted from the Sacramento River and delivered through a system of aqueducts which now or will in the future serve Alameda and Santa Clara Counties (South Bay Aqueduct); Napa and Solano Counties (North Bay Aqueduct); San Joaquin Valley (California Aqueduct); San Luis Obispo and Santa Barbara Counties (Coastal Branch of California Aqueduct); and southern California, south of the Tehachapi Mountains (California Aqueduct and its East and West branches). State Project water has been delivered to Kern County for the past several years.

On November 12, 1963, the voters of Kern County ratified a master contract between the Kern County Water Agency and the State of California for water from the California Aqueduct. The Agency in turn has allocated the contracted supply of water among its member units. The contract embodies a buildup schedule of annual deliveries reaching a maximum annual entitlement of 1,253,400 acre-feet in 1990 and thereafter. 1/ The total entitlement of the Agency and the allocations to member units for selected years are shown in Table III-12. Additional surplus waters from the State Water Project will be available to the Agency from time to time. The actual quantities of State Project water delivered to the member units of the Kern County Water Agency for the period 1968 through 1973 are presented in Table III-13.

1/ Includes 100,000 acre-feet of surplus water.

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1/ Includes 100,000 acre-feet of surplus water.

Table III-12

ALLOCATION OF STATE PROJECT WATER
TO MEMBER UNITS OF
KERN COUNTY WATER AGENCY

(Acre-Feet)

<u>Member Units</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990 and thereafter</u>
Belridge WSD	88,400	123,200	150,600	163,000
Berrenda Mesa WD	115,100	137,500	155,200	163,200
Buena Vista WSD	36,200	50,500	61,700	66,800
Buttonwillow ID	40,300	66,000	66,000	66,000
Cawelo WD	24,400	34,000	41,600	45,000
Kern Delta WD	16,300	22,700	27,700	30,000
Lost Hills WD	76,100	106,000	129,800	140,400
Pond-Poso ID	30,000	50,100	50,100	50,100
Rosedale-				
Rio Bravo WSD	18,500	25,600	31,700	35,000
Semitropic WSD	0	2,700	44,300	67,000
Tehachapi				
Cummings Co. WD	3,500	5,800	10,600	20,000
Tejon-Castac WD	700	1,100	1,600	2,000
Improvement				
District No. 4	35,000	47,700	62,900	77,000
West Kern County WD	13,800	17,500	21,200	25,000
Wheeler Ridge-				
Maricopa WSD	164,300	228,800	280,000	302,900
Totals	<u>662,600</u>	<u>919,200</u>	<u>1,135,000</u>	<u>1,253,400</u> ^{1/}

^{1/} Includes 100,000 acre-feet of surplus water.

Table III-13

DELIVERIES FROM STATE WATER PROJECT IN KERN COUNTY
(Acre-Feet)

	1968	1969	1970	1971	1972	1973	1974
Buttonwillow ID	---	---	---	---	---	2,600	55,900
Berrenda Mesa WD	71,700	52,200	72,100	98,500	107,900	94,800	103,100
Lost Hills WD	31,000	24,400	48,800	47,500	73,300	88,600	87,500
Belridge WSD	24,800	63,900	69,600	63,800	72,400	74,600	119,600
Buena Vista WSD	---	---	10,300 ^{1/}	14,700 ^{1/}	43,800 ^{2/}	5,600	20,900
Rosedale-Rio Bravo WSD	---	---	3,900 ^{1/}	3,200 ^{1/}	0	0	0
Improvement District No. 4	---	---	---	6,400 ^{1/}	14,100 ^{1/}	9,900 ^{1/}	23,500 ^{1/}
West Kern Co. WD	---	---	---	3,100 ^{1/}	6,300 ^{1/}	3,500 ^{1/}	0
Kern Delta WD	---	---	---	2,600 ^{1/}	0	3,900 ^{1/}	15,000 ^{1/}
Wheeler Ridge-Maricopa WSD	---	---	---	101,500	149,500	174,500 ^{2/3/}	195,200
Tehachapi-Cummings WD	---	---	---	---	---	---	5,000
Others	---	---	---	19,200	23,500	47,100 ^{2/}	20,700
TOTALS	127,500	140,500	204,700	360,500	490,800	505,100	646,400

- 1/ Deliveries through exchange.
- 2/ Includes both exchange and contract water.
- 3/ Received 25 acre-feet for system testing.

Source: Kern County Water Agency

The Kern County Water Agency considers that the importation of State Project water under the Agency's program will substantially reduce the overdraft in the southern portion of the San Joaquin Valley. To assess the effects of State water supply on future overdraft, groundwater levels, water quality and adequacy of supply, the Kern County Water Agency in cooperation with the State Department of Water Resources has developed a digital model of the basin. One of the functions of the model will be to evaluate the effects of the imported State Project water on overdraft.

Tenneco's Water Supply and Disposal. Tenneco's surface water supply acquired by the City consists entirely of Kern River water. This water is presently used entirely within Kern County, primarily for agricultural purposes.

Present Water Supply. Tenneco and its subsidiaries, Kern Island Water Company and Kern River Canal and Irrigating Company, divert water from the Kern River under various water right priorities. The actual quantities diverted during the 13-year period from 1962 through 1974 are shown in Table III-14. The average annual diversion of 189,260 acre-feet by Tenneco includes deliveries to Rosedale-Rio Bravo Water Storage District under a contractual arrangement (Document No. 12, Legal Supplement).

Place of Use.. The water diverted by Kern Island Water Company is used within that utility's service area. The service

Table III-14

HISTORIC DIVERSIONS OF KERN RIVER
WATER BY TENNECO AND ITS
SUBSIDIARIES
(Acre-Feet)

Calendar Year	Flow of Kern River ^{1/}	Kern Island Water Company	Kern River Canal and Irrigating Co.	Tenneco
1962	607,850	134,090	13,310	92,520
1963	676,240	158,690	18,670	149,320
1964	361,620	135,880	10,730	75,560
1965	634,300	147,580	15,630	163,510
1966	504,500	135,300	12,780	114,110
1967	1,465,850	183,440	27,000	358,610
1968	497,030	156,530	14,890	133,070
1969	2,313,770	168,090	24,690	697,610
1970	601,250	176,910	16,470	152,650
1971	442,650	156,580	9,030 ^{2/}	123,800
1972	311,290	138,660	0 ^{2/}	82,130
1973	785,130	176,660	20,440	172,400
1974	745,900	186,060	21,020	145,100
13-year average	765,180	158,040	15,740	189,260
12-year average (excluding 1969)	636,130	157,200	15,000	146,900

^{1/} Regulated flow of Kern River at First Point of Measurement.

^{2/} 1971 and 1972 were two consecutive years of low water supply in the Kern River. Kern River Canal and Irrigating Company purchased from Tenneco an additional 5,167 acre-feet in 1971 and 9,945 acre-feet in 1972.

Source: Kern County Canal and Water Company

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area is shown on Plate 3. The diversions by Kern Island Water Company are used in areas southerly of the river. Water diverted by Kern River Canal and Irrigating Company is used in areas north of the river within that company's service area, which is also shown on Plate 3.

Unlike Kern Island Water Company and Kern River Canal and Irrigating Company, Tenneco was not required to deliver its water to specific areas of use. Tenneco's entitlement was historically diverted at various locations and the water delivered to Tenneco customers and Tenneco lands in various areas within Kern County.

Table III-15 shows the amount of water delivered to some of the Tenneco customers during the period 1970 through 1974. However, Table III-15 does not provide a complete breakdown on the smaller sales. Some of those are aggregated as deliveries through specified canals, meaning that the purchaser received his water from the canals indicated. The amounts of water diverted for use on certain Tenneco lands and for operational purposes are also shown on Table III-15.

Water was sold by Tenneco to various individuals and entities on an availability basis. Some of the individuals who

Table III-15
 TENNECO'S DIVERSIONS AND SALES OF KERN RIVER WATER TO WATER USERS IN KERN COUNTY
 (Acre-Feet)

Water User	1970	1971	1972	1973	1974	1975
North Kern Water Storage District	87,092	58,630	26,279	50,409	40,000	
J. G. Boswell Co.	8,767	11,419	11,290	12,504	3,708	
Rosedale-Rio Bravo Water Storage District ^{2/}	21,883	16,544	6,159	74,997	32,156	
Buena Vista Farms, Inc.	1,200	---	---	---	---	
Buena Vista Water Storage District	4,217	---	---	2,747	11,494	
Arvin-Edison Water Storage District	231	1,737	---	11,532	12,326	
West Kern County Water District	---	1,340	4,245	---	---	
Kern River Canal & Irrigating Company	---	5,167	9,945	636	---	
Kern Island Water Company	---	---	1,172	---	---	
Kern County Water Agency	---	6,432	5,918	---	---	
Kern Delta Water District	---	1,269	2,250	---	---	
Lake Ming ^{2/}	790	790	790	790	790	
Delivered through East Side Canal to Private Users	---	---	2,987	2,108	3,094	
Delivered through Kern Island Canal to Private Users	13,484	3,807	1,818	4,150	5,842	
Delivered through Farmers Canal to Private Users	35	---	---	---	---	
Delivered through Beardsley Canal to Private Users	922	628	807	1,968	3,022	
Delivered through Castro Canal to Private Users (from Farmers Canal)	38	14	104	---	---	
Delivered through Kern River Canal to Private Users	---	2,763	---	---	13,155	
Tenneco Lands in James Canal Area	8,169	9,523	4,968	7,676	7,884	
Tenneco Lands in Plunket Canal Area	2,483	1,131	1,541	808	713	
Tenneco Lands in Pioneer Canal Area	---	---	---	1,326	10,914	
Operational Loss in Section 19 (T309/R26E)	1,671	2,608	1,365	750	---	
Operational Releases	1,667	---	488	---	---	
Total Diversion	152,649	123,802	82,126	172,401	145,098	

^{1/} Sales were made by Kern County Canal and Water Company.
^{2/} Water was delivered under terms of 1961 agreement.

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008061

purchased water from Tenneco in the past may have the opportunity to make purchases from the City in the future. It is indicated by Tenneco that the Tenneco lands which received Kern River water for irrigation will buy river water from the City on an availability basis and/or utilize groundwater.

Water for the North Kern Water Storage District is diverted to the Beardsley Canal and is used within the District. The J. G. Boswell Co. received its water on the west side of the valley in Section 19 (T30S/R26E), or at Second Point of Measurement, conveyed through the Kern River Canal. Water for the Rosedale-Rio Bravo Water Storage District is delivered from the Kern River Canal to Rosedale's diversion headworks on the Kern River in Section 1 (T30S/R26E) and is used for spreading within the District. The deliveries to Rosedale-Rio Bravo were made to meet the average annual commitment of 10,000 acre-feet based on the agreement of 1961 and surplus water delivered under that agreement.

Water for Buena Vista Farms, Inc., was delivered by the Kern River Canal to the Second Point of Measurement, or Section 19 (T30S/R26E), for use in the Buena Vista Lake area. Similarly, the sale of water to Buena Vista Water Storage District was conveyed by the Kern River Canal to Second Point of Measurement for use within that District. The water sold to the Arvin-Edison Water Storage District was delivered from the Kern River Canal to the Arvin-Edison Canal. Water for the West Kern County Water

District was conveyed by the Kern River Canal to the Second Point of Measurement. From that point the District conveyed the water through the river channel and canals for spreading and subsequent recovery.

Water sold to Kern River Canal and Irrigating Company was diverted from the Kern River to the Beardsley Canal and was used within the Company's service area. The diversions to Kern Island Water Company were made from the river at Rocky Point Weir in Section 9 (T29S/R28E) to the Kern Island Canal system for delivery in the Kern Delta Water District. The water for the Kern County Water Agency was released to the Kern River channel for spreading.

In delivering water to the various entities and individuals, Tenneco made such delivery with agreements that no water rights whatsoever accrued to the customers. The agreements indicated that the water supply constituted a one-time delivery and it could be discontinued on short notice. 1/ The delivery locations varied from one point to another depending upon demand by customers, availability of supply and feasibility of conveyance. Most of the water sold was utilized for irrigation. Such water was conveyed mainly in lined canals. Therefore the seepage losses were small. Tenneco utilized some of the unlined canals owned by the utility canal companies for delivery of some of the water. The water was delivered at times when the canals were being used

1/ Document No. 19, Legal Supplement.

by others, thus minimizing canal losses.

Surface Water Quality. Of the three principal sources of surface water, Kern River and Friant-Kern Canal water are of better quality than State Project water. The quality of the Kern River water near Bakersfield is excellent. Table III-16 presents a summary of analyses of numerous samples collected from 1963 through 1970. The quality of all of the constituents shown are within the recommended limits for domestic use. The total dissolved solids range from about 50 to 135 milligrams per liter (mg/l), which is well below the 500 mg/l limit for desirable water as established by the United States Public Health Service Drinking Water Standards. The total hardness of Kern River water is less than 60 mg/l and would be considered as soft by the U. S. Geological Survey's hardness classification of waters.

Criteria for chemical quality of water for irrigation use have been developed by the Regional Salinity Laboratories of the U. S. Department of Agriculture in cooperation with the University of California. Under those criteria Kern River water is Class I irrigation water, which is regarded as safe and suitable for most plants under most conditions of soil and climate. The bacterial quality of Kern River Water is good but would require chlorination and filtration.

The quality of Friant-Kern Canal water is also excellent

Table III-16

KERN RIVER WATER QUALITY
NEAR BAKERSFIELD
(1963-1970)

<u>Constituents</u>	<u>Number of Analyses</u>	<u>Concentration (mg/l)</u>		
		<u>Minimum</u>	<u>Average</u>	<u>Maximum</u>
Calcium	45	7.3	15.8	26
Magnesium	13	0.7	2.0	3.0
Sodium	53	4.8	11.2	20
Potassium	13	1.2	1.8	2.7
Carbonate	53	0	0	1
Bicarbonate	52	32	62	94
Sulfate	13	4.4	7.3	13
Chloride	52	1.8	4.7	11
Nitrate	13	0.2	1.3	3.6
Flouride	3	-	0.4	-
Boron	52	0.0	0.1	0.3
Phosphate	6	0.00	0.12	0.20
Silica	6	6.3	10.6	14
Total Hardness	52	24	42	56
Total Dissolved Solids	45	52	89	135
Specific Conductance (micromhos)	53	69	138	210
Percent Sodium (%)	43	25	37	50
pH	40	6.9	7.7	8.3

Source of Data: California Department of Water Resources

THOMAS M. STETSON

and is well within the recommended limits for domestic use and Class I irrigation water. Table III-17 presents a 1971 analysis of the chemical quality of Friant-Kern Canal water near the Kern River. The bacterial quality of Friant-Kern water is good but would require chlorination and filtration for domestic use.

The chemical quality of State Project water is not as good as either Kern River water or Friant-Kern Canal water. However, it appears to meet the Drinking Water Standards and would be considered Class I irrigation water. A summary of the chemical quality of certain constituents comprising State Project water sampled near the Buena Vista pumping plant during 1972 and the water quality objectives of State Project water are tabulated below:

<u>Constituent</u>	<u>1972 Concentrations (mg/l)</u>			<u>Quality Objectives</u>
	<u>Minimum</u>	<u>Average</u>	<u>Maximum</u>	<u>Monthly Averages (mg/l)</u>
Total Dissolved Solids	145	226	318	440
Total Hardness	76	97	131	180
Chloride	31	57	91	110
Sulfate	23	35	68	110
Boron	0.1	0.2	0.3	0.6
Percent Sodium	41	48	56	50

Table III-17

FRIANT-KERN CANAL WATER QUALITY
NEAR KERN RIVER

<u>Constituent</u>	<u>Concentration (mg/l), March 1971</u>
Calcium	4.5
Magnesium	1.0
Sodium	4.5
Potassium	0.8
Carbonate	0
Bicarbonate	23
Sulfate	4.0
Chloride	1.0
Nitrate	0
Total Dissolved Solids	26
Specific Conductance (micromhos)	44

Source: Leeds, Hill and Jewett, Inc., 1973, Environmental
Impact of the Cross-Valley Project; Kern County
Water Agency.

The discharge of oil field waste brines to Poso Creek adversely affects the surface water quality during low flow periods. The California Regional Water Quality Control Board, Central Valley Region, in reviewing the water quality situation in the Poso Creek Subarea adopted Resolution No. 71-122 on November 23, 1970. It was pointed out in the resolution that:

"The present water quality problem of greatest magnitude in the Poso Creek Subarea is that of increasing salinity in groundwater resulting from the discharge of oil field waste waters to Poso Creek and to facilities which allow percolation into the subarea. A potential problem is the long-term deep percolation of irrigation water into the subarea which is essentially a closed basin. The quality of irrigation water which percolates past the crop root zone is generally considered to be several times the concentration of the applied irrigation water."

The salinity buildup from the above sources will have an adverse effect on irrigated agriculture which is dependent on groundwater. According to Resolution No. 71-122, new water quality discharge requirements were expected to go into effect about two years after the adoption of the Resolution.

Groundwater Conditions

Groundwater presently meets nearly two-thirds of the total water demands of the Kern County portion of the San Joaquin Valley. In recent years over 2,000,000 acre-feet of groundwater was pumped annually. 1/ This section will discuss the effects of

1/ Kern County Water Agency, Report on 1973 Water Conditions, Improvement District No. 4, Bakersfield, California, October 1, 1973

these extractions and future extractions on the groundwater levels and groundwater quality.

Hydrogeology. The project area, including the urban Bakersfield area, lies within the Kern County portion of the San Joaquin Valley. The San Joaquin Valley is a topographic and geologic structural basin filled by thick deposits of sedimentary material eroded from the adjacent mountains and deposited by streams. Unconsolidated continental sedimentary deposits form the principal aquifer underlying the San Joaquin Valley. These deposits, which include stream alluvium and lake beds, are more permeable than the consolidated rocks of the adjacent mountains.

The presence of thick, relatively impervious Tulare Lake bed deposits near the northern boundary of Kern County allows the Kern County portion of the San Joaquin Valley to be treated as a separate groundwater basin. It is, for the most part, surrounded by relatively impervious rocks and deposits. To the east, the groundwater basin boundary is formed by the Sierra Nevada and its foothills, to the south by the San Emigdio and Tehachapi mountains and to the west by the Coast Range. These relatively impervious rocks and deposits limit the underflow of groundwater out of Kern County.

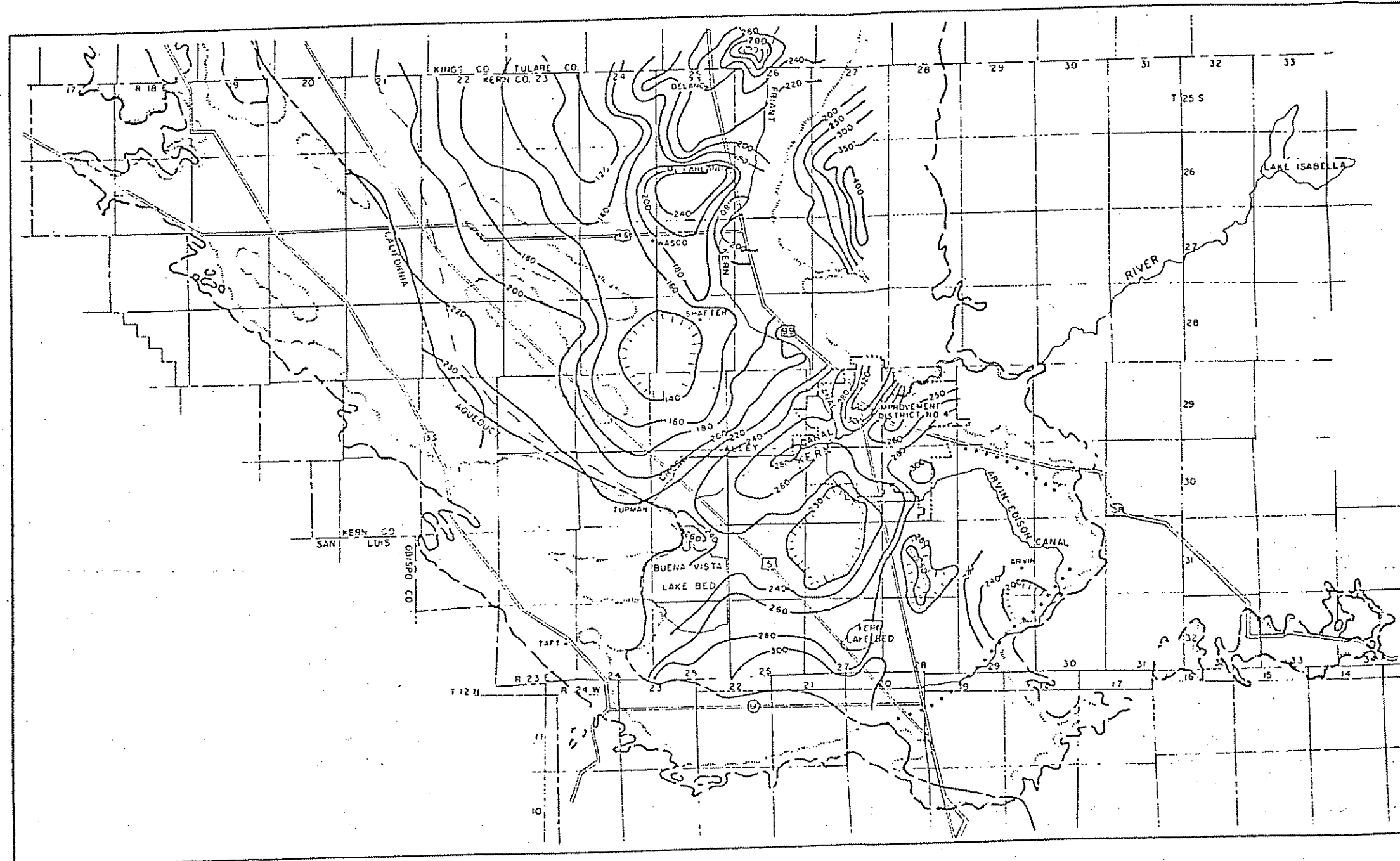
The groundwater reservoir is a series of permeable sand

and gravel lenses interbedded with less permeable finer materials. The less permeable materials limit the vertical movement of water which results in semi-confined pressure conditions overlain by unconfined conditions. As a result of the semi-confined pressure conditions the water levels in wells in adjacent areas may differ considerably depending upon the portion of the aquifer penetrated by the wells.






Recharge to the Kern County portion of the San Joaquin Valley groundwater basin is primarily seepage from streams, unlined canals, excess irrigation water and municipal and domestic waste water. The major source of recharge is from the Kern River which carries runoff from precipitation and snow melt from the Sierra Nevada. Smaller streams draining the surrounding mountains provide some recharge to the groundwater basin. Imported water, where applied for irrigation, also locally recharges the basin.

Precipitation falling on most of the valley is less than eight inches. Thus deep penetration of rainfall seldom occurs and is not a significant source of recharge.

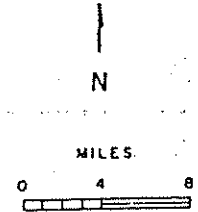
The water table configuration of the unconfined aquifer for Spring 1972 is shown on Plate 8 by contours of equal elevation of the groundwater surface. Plate 8 indicates that there are at least six areas in which there are major depressions in the groundwater surface, as follows: (1) a large area of depressed water



EXPLANATION

-  FOOTHILL LINE
-  BEDROCK LINE
-  LINES OF EQUAL ELEVATION OF GROUNDWATER SURFACE IN UNCONFINED AND SEMI-CONFINED AQUIFERS, FEET ABOVE MEAN SEA LEVEL
-  GROUNDWATER BARRIER
-  IMPROVEMENT DISTRICT NO. 4 BOUNDARY

SOURCE: LEEDS, HILL AND JEWETT, INC., 1973, ENVIRONMENTAL IMPACT OF THE CROSS VALLEY PROJECT; KERN COUNTY WATER AGENCY.



BASE MAP ADAPTED FROM CALIFORNIA DEPARTMENT OF WATER RESOURCES

GROUNDWATER ELEVATIONS UNCONFINED AQUIFER SPRING 1972

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WEST COVINA SAN FRANCISCO

THOMAS M. STETSON

levels west and southwest of Shafter including the northern portion of Rosedale-Rio Bravo Water Storage District; (2) near the Kern-Tulare County line west of Delano; (3) south of the westerly portion of Improvement District No. 4; (4) westerly of Arvin; (5) southerly of Arvin; and (6) an area which trends northeast-southwest through the northeastern portion of Improvement District No. 4.

The two principal areas of higher water surface elevations are located in the Delano-Wasco area, including the northern portion of the North Kern Water Storage District, and beneath the Kern River. The groundwater mound in the Delano-Wasco area results from seepage from canals and the application of Central Valley Project and other water for irrigation. The groundwater mound beneath the Kern River results primarily from the infiltration of Kern River water and seepage from unlined canals. Groundwater in the Kern and Buena Vista Lake beds is at relatively shallow depths. The area of shallow water table is shown on Plate 9B, the geologic hazards map (in pocket at rear of report).

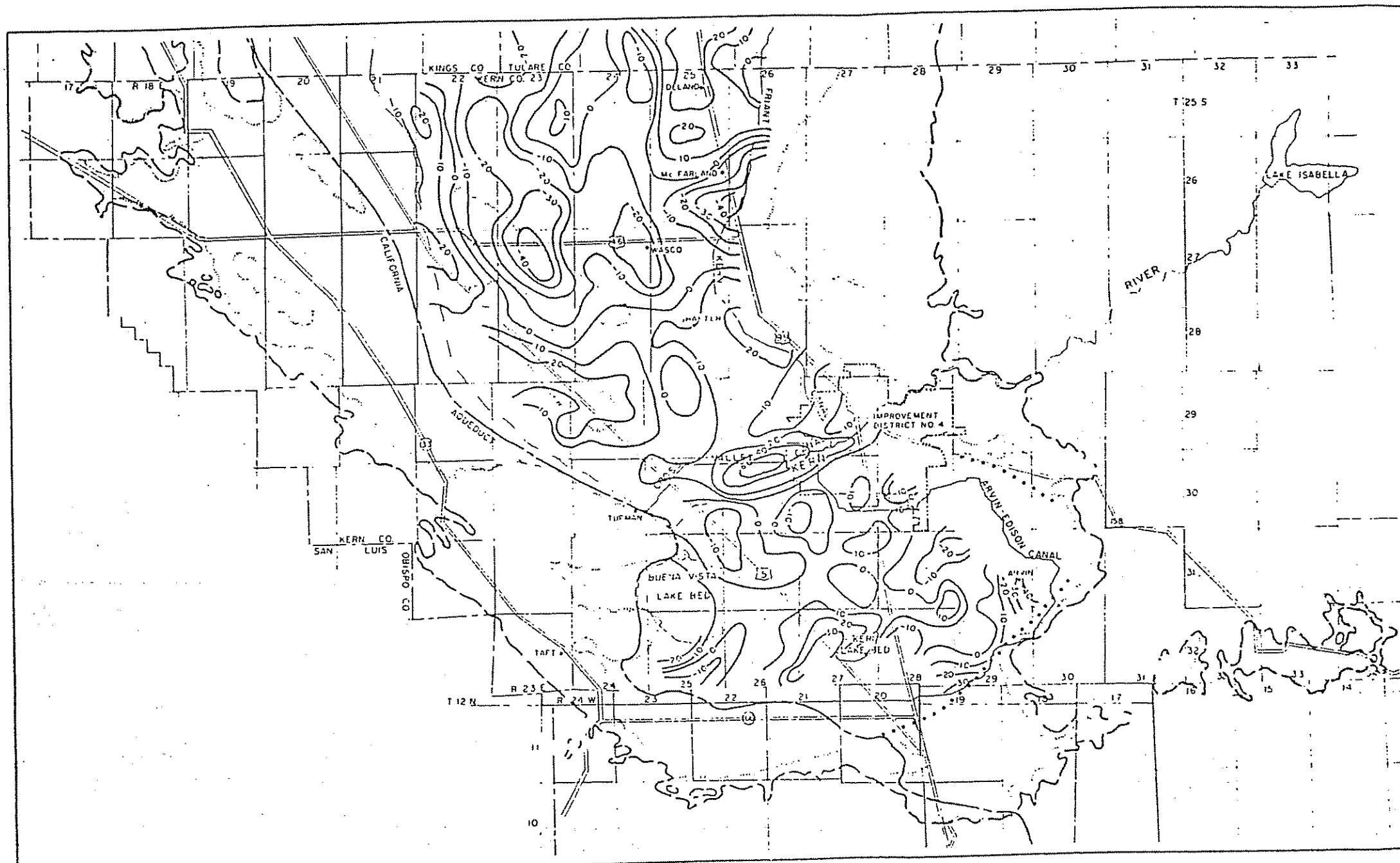
The California Department of Water Resources has published change in water level elevation maps covering the period from at least 1921 through 1970. In recent years these maps present the water level changes for five-year periods, such as 1955-60, 1960-65 and 1965-70. Plate 10 presents the State's most recently published map showing changes in groundwater levels in the unconfined aquifer from Spring 1965 to Spring 1970. Plate 10

indicates that throughout much of the Kern County portion of the San Joaquin Valley the groundwater levels increased during that period. South of the Kern River, in Improvement District No. 4, the water levels generally increased about 10 to 40 feet. During approximately the same period (1964-65 through 1969-70) Kern River flow at the First Point of Measurement was about 150 percent of the average flow since the Kern River was regulated in 1954. The amount of flow of the Kern River through Improvement District No. 4 is an important factor in groundwater recharge and groundwater level responses.

Although water levels throughout much of the valley portion of Kern County increased in elevation there were many areas where water levels declined. The most severe declines occurred in the northern portion of the county including the northern portion of the North Kern Water Storage District, where the decline was as much as 40 feet in some portions of the District. Declines also occurred in the southeasterly portion of Improvement District No. 4. The groundwater levels beneath the Cawelo Water District are declining at an average rate of 10 feet per year with greater rates beneath some portions of the District. 1/ The average groundwater level decline beneath the Rosedale-Rio Bravo Water Storage District averaged five feet per year during the period 1955 through 1972. 2/ Average annual water level declines of 5 to 15 feet occurred beneath the Kern-Tulare Water District during

1/ Supra note 1, Page III-25.

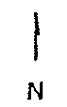
2/ Leeds, Hill and Jewett, Inc., 1973, Environmental Impact of the Cross-Valley Project: Kern County Water Agency.



EXPLANATION

- FOOT-HILL LINE
- BEDROCK LINE
- LINES OF EQUAL CHANGE OF WATER LEVELS IN UNCONFINED AND SEMI-CONFINED AQUIFERS, FEET
- GROUNDWATER BARRIER
- IMPROVEMENT DISTRICT NO. 4 BOUNDARY

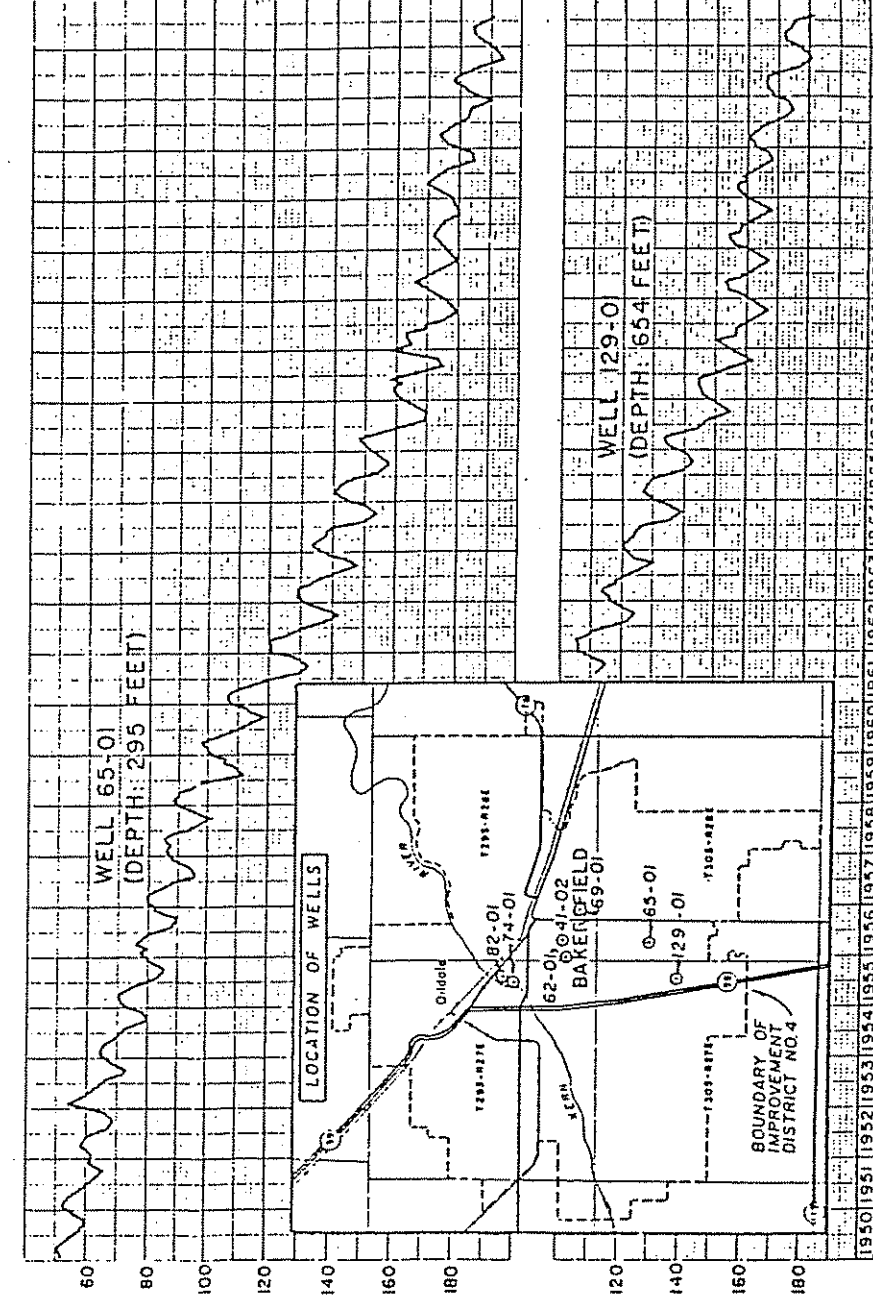
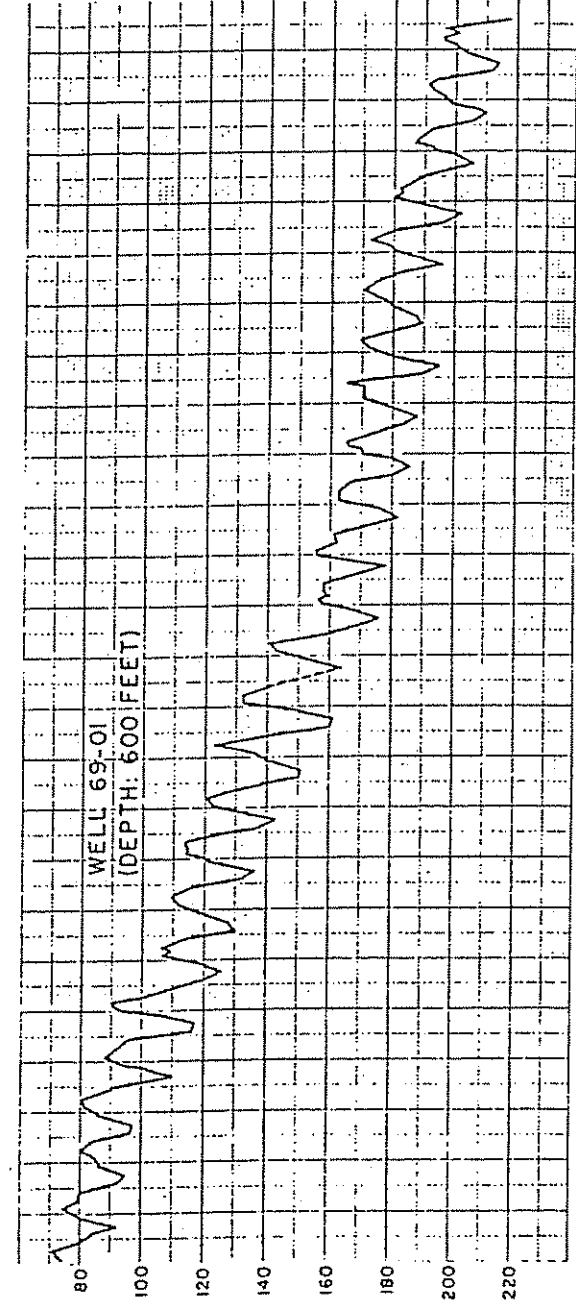
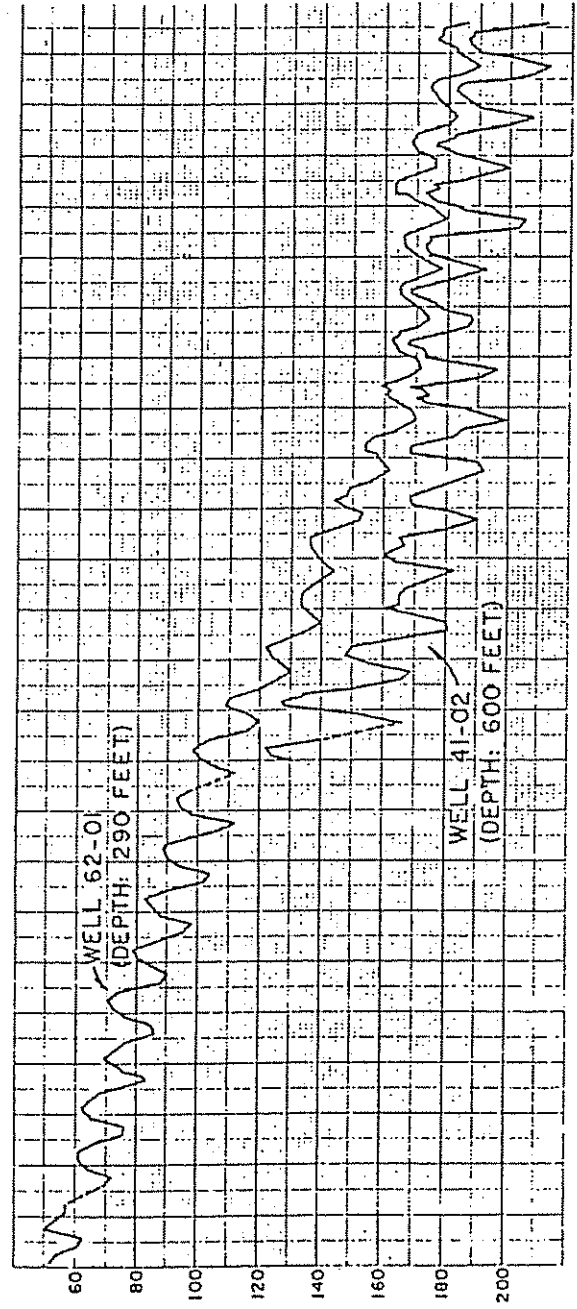
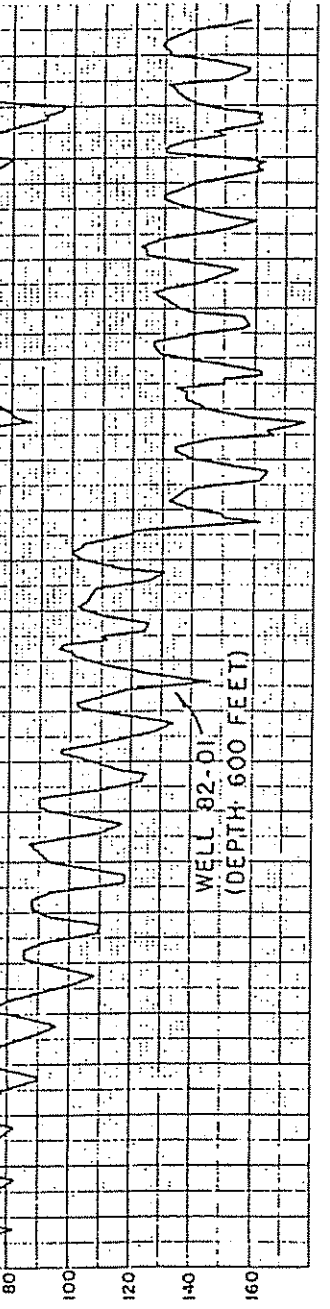
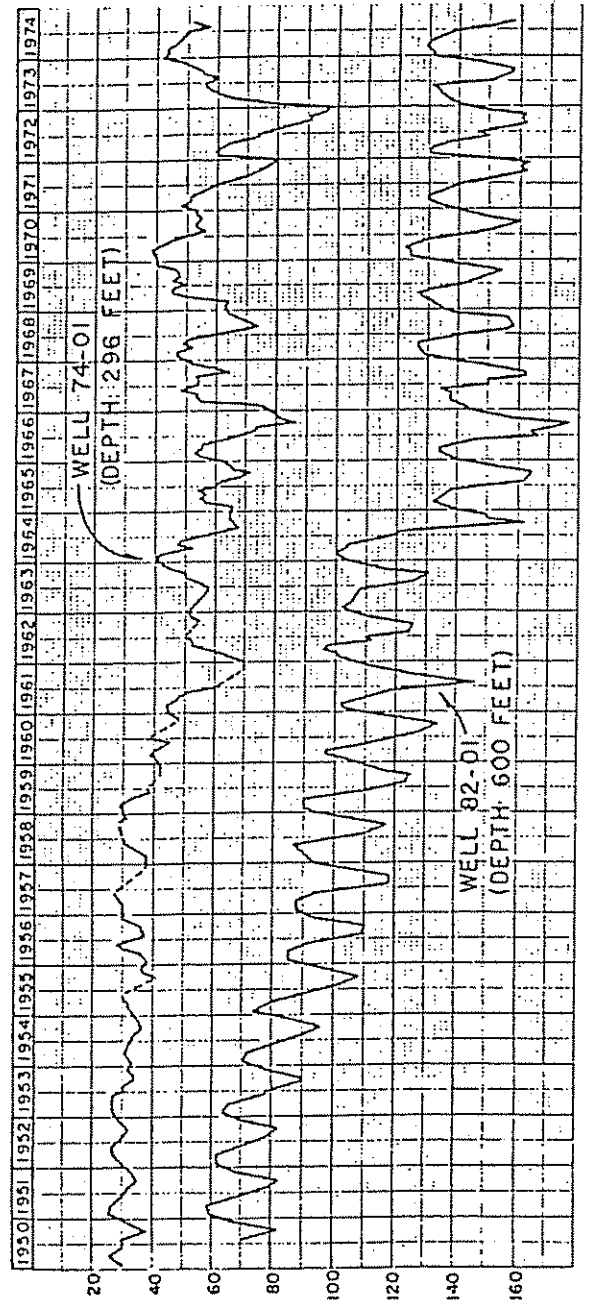
SOURCE: CALIFORNIA DEPARTMENT OF WATER RESOURCES, BULLETIN NO. 130-70, VOLUME IV.



BASE MAP ADAPTED FROM CALIFORNIA DEPARTMENT OF WATER RESOURCES

**WATER LEVEL CHANGE
UNCONFINED AQUIFER
SPRING 1965 TO SPRING 1970**

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WELL HYDROGRAPHS, URBAN BAKERSFIELD AREA

in the Kern River channel. The urban water demand of Improvement District No. 4 for that study was taken from a May 19, 1972, Leeds, Hill & Jewett, Inc., study. ^{1/} The urban demand and scheduled importations of State Project water used for the study were as follows:

<u>Year</u>	<u>Urban Water Demand (Acre-Feet)</u>	<u>Annual Importation of State Water (Acre-Feet)</u>
1975	77,400	35,000
1980	82,100	47,700
1985	86,700	62,900
1990	91,400	77,000

The water demand not met by treated State Project water was assumed to be met from groundwater with much of the pumping concentrated near the Kern River spreading area to maximize recapture of the spread State Project water.

The results of that study generally indicated that groundwater levels would continue to decline in the central portion of the urban area but at a slower rate than had occurred in the past. For example, during the 20-year period from 1950 to 1970 the change in water level maps prepared by the State indicated an average annual water level decline in the central portion of the urban area of 2-1/2 to 3-1/2 feet per year. The study by this office indicated that for the 20-year period 1970 to 1990 an average annual water level decline of 1 to 2 feet per year would prevail in the same area.

^{2/} "Urban Bakersfield Improvement District No. 4, Supplemental Water Supply Project, Estimated Costs and Repayment Plan," Letter to Board of Directors of Kern County Water Agency, May 19, 1972.

Over a long period of time groundwater levels have generally been declining in the Kern County portion of the San Joaquin Valley. These long-term declines indicate that groundwater uses exceed recharge and that an overdraft condition prevails. It has been estimated 1/ that the safe yield of the basin is approximately 650,000 acre-feet per year and that the 1973 overdraft on the groundwater basin is about 550,000 acre-feet per year. The portion of the total basin overdraft allocated to Improvement District No. 4 has been estimated 1/ at 65,000 acre-feet per year. This estimate was based upon an acreage criterion which does not appear to be reasonable. Estimates based upon pumping from the groundwater basin indicate that the overdraft allocated to the Improvement District should be about 30,000 acre-feet or less per year.

Generally, in addition to declining groundwater levels and higher associated pumping costs, the overdraft condition also results in water quality degradation, land subsidence and the associated permanent reduction of groundwater storage capacity due to compaction of the aquifers. Within Improvement District No. 4 at least two of these effects of overdraft are known to have occurred--higher pumping costs and water quality degradation. It has been reported 2/3/ that excessive pumping has resulted in land

1/ Supra Note 2, Page III-64.

2/ Supra Note 1, Page III-35

3/ Supra Note 1, Page III-32.

subsidence and subsurface movement of saline waters beneath both Kern-Tulare and Rag Gulch Water Districts. Subsidence within the Kern-Tulare Water District due to groundwater pumping has ranged from 0.5 to 1.5 feet for the period 1962 to 1970.

Groundwater Quality. Groundwater quality in the Kern County portion of the San Joaquin Valley is in most areas generally suitable for both agricultural and domestic uses. However, in recent years the quality has been deteriorating in many areas. 1/

During the middle and late 1950's the total dissolved solids of the groundwater were generally less than 1,000 mg/l throughout most of the Kern County portion of the San Joaquin Valley. At that time the main area in which the total dissolved solids exceeded 1,000 mg/l was along the western and southwestern margins of the basin. Two smaller areas in which the total dissolved solids exceeded 1,000 mg/l occurred along the eastern portion of the basin south of Arvin and east of the urban Bakersfield area.

The areas underlain by groundwater with total dissolved solids of 1,000 mg/l or greater increased significantly during the period from the middle 1950's to the late 1960's. In the western and southwestern portions of the basin, the total dissolved solids concentration not only increased in areas where it

1/ Supra Note 2, Page III-64

had previously exceeded 1,000 mg/l but the degradation encroached eastward. In addition, many small areas in the northern and central portions of the valley area of Kern County that were not reported to be underlain by groundwater with a total dissolved solids in excess of 1,000 mg/l in the middle and late 1950's were reported to have such quality by 1970. These include an area located about 15 miles northwest of McFarland; the area in the immediate vicinity of McFarland; the area between Wasco and Shafter, which includes a part of the North Kern Water Storage District; and a fairly large area located about six miles east and southeast of Shafter within the southern portion of the North Kern Water Storage District and the central portion of Cawelo Water District.

The area of poorer quality water east of the urban Bakersfield area showed limited westward expansion. However, as reported by the Kern County Water Agency, 1/ the general groundwater quality beneath the eastern and northeastern portions of Improvement District No. 4 has been degrading as a result of the overdraft condition of the basin. Elsewhere in the urban Bakersfield area there appeared to be only a slight increase in the concentration of various constituents in the past fifteen years.

Generally, the water underlying the valley portion of the urban Bakersfield area is of good to fair quality. The total dissolved solids of the groundwater throughout most of the valley

1/ Supra Note 1, Page III-60.

portion of the urban area range from 200 to 300 mg/l. However, in some areas the total dissolved solids exceed 500 mg/l with nearly 1,000 mg/l estimated at one well. The hardness of the groundwater in the urban Bakersfield area can be generally classed as moderately hard by the U. S. Geological Survey hardness classification. In a few isolated areas the hardness is less than 60 mg/l and would be classed as soft. The groundwater beneath a significant portion of the urban area exhibits a hardness greater than 120 mg/l and thus would be considered hard.

Table III-18 presents a summary of analyses from California Water Service Company wells located throughout the valley portion of the Urban Bakersfield area. These analyses are from water samples collected from 1969 through 1971 and do not include analyses from wells located in a small area underlain by extremely poor quality water.

Adverse Salt Balance. Recent estimates ^{1/} indicate that the surface streams, imported Central Valley Project water and waste brines annually contribute approximately 140,000 tons of salt to the groundwater basin underlying the Kern County portion of San Joaquin Valley. The salt balance of the basin is in an adverse condition since the amount of salt added to the groundwater is greater than the amount removed. The salts accumulate when the applied water is consumed by plants. The salts remain in the soil

^{1/} Supra Note 2, Page III-64.

Table III-18

GROUNDWATER QUALITY
VALLEY PORTION OF THE
URBAN BAKERSFIELD AREA
(1969-1971)

<u>Constituents</u>	<u>Concentrations (mg/l)</u>		
	<u>Minimum</u>	<u>Average</u>	<u>Maximum</u>
Calcium	16	31	56
Magnesium	0	4	8
Sodium	17	23	31
Potassium	1.4	2.5	3.4
Sulfate	13	21	33
Chloride	9	17	68
Nitrate	0	4	11
Fluoride	0.07	0.14	0.21
Boron	0.0	0.2	0.11
Phosphate	0.00	0.03	0.11
Silica	17	23	30
Manganese	0.00	0.00	0.02
Iron	0.00	0.02	0.17
Iodine (ppb)	4	16	47
Total Hardness	44	95	162
Estimated Total Dissolved Solids	120	190	310
Specific Conductance (micromhos)	181	294	479
pH	7.1	7.8	8.4

Source: California Water Service Company data

and most are subsequently leached to the groundwater where they accumulate.

The importation of State Project water is expected to contribute large quantities of additional salts to the groundwater basin. Besides the application of the additional quantity of imported water, the State Project water on the average probably will contain two to nine times the quantity of salt per acre-foot of Kern River water and Friant-Kern Canal water, respectively. Therefore, unless drain systems and adequate measures for disposal are provided, the adverse salt condition is expected to accelerate with the increasing application of State Project water.

Air Quality

The areas affected by the City of Bakersfield project are within the boundaries of the San Joaquin Valley air basin as designated by the California Air Resources Board. Air quality has been monitored in the Bakersfield area since 1964. The Bakersfield Air Monitoring Station (Chester Avenue) reports average concentrations for oxidant, carbon monoxide, nitrogen dioxide, nitric oxide, oxides of nitrogen, and hydrocarbons.

The maximum hourly average for the month and the monthly average of the daily maximum hourly average of oxidants, carbon monoxide, nitrogen dioxide, nitric oxide and oxides of nitrogen for February and July 1973 are shown in Table III-19. An hourly

Table III-19

CONCENTRATION OF SPECIFIED AIR CONTAMINANTS AT BAKERSFIELD
CHESTER AVENUE AIR MONITORING STATION

	Oxidant (ppm)	Carbon Monoxide (ppm)	Nitrogen Dioxide (ppm)	Nitric Oxide (ppm)	Oxides of Nitrogen (ppm)	Particulate Matter ^a / (ug/m ³)h ^b	Lead (ug/m ³) h ^b
February 1973							
Maximum Hourly Average	0.05	8	0.06	0.28	0.33	208 ^d / 150 ^e / 1.75 ^d / 1.13 ^f / 1.04 ^f	
Average of Maximum Hourly Averages	0.03	4	0.04	0.13	0.16		
July 1973							
Maximum Hourly Average	0.15	10	0.11	0.17	0.27	176 ^d / 150 ^e / 1.48 ^d / 1.04 ^f	
Average of Maximum Hourly Averages	0.11	4	0.08	0.08	0.15		
Ambient Air Quality Standards ^g / California Federal (Primary)	0.10 0.08	40 35	0.25 b/ c/ c/	c/ c/	c/ c/	100 ^f / 260 ^f / 1.5 c/	

h/ Micrograms per cubic meter.
i/ Average of four 24-hour samples.
j/ For a 30-day average.

Source: California Air Resources Board

- a/ One hour average.
- b/ No standard set for one-hour average, annual average 0.05 ppm.
- c/ No standard prescribed.
- d/ Maximum 24-hour sample collected during month.
- e/ Average of five 24-hour samples.
- f/ For 24-hour sample.
- g/ Concentration determined by high-volume air sampling method

average represents the average concentration for a 60 minute period. There would be 24 such measurements each day. The daily maximum hourly average is the highest of the 24 hourly averages reported during the day. One-hour average Federal and State ambient air standards are also shown for comparison. No State or Federal standards have been prescribed for nitric oxide and oxides of nitrogen.

As reported by the California Air Resources Board, hydrocarbon analyzers used by the air monitoring station are standardized against propane, while the State and Federal standards require correction for methane. The concentration of the gaseous contaminants in agricultural areas of the southern San Joaquin Valley are generally less than those measured for the City of Bakersfield.

The air monitoring station usually measures the suspended particulate matter every sixth day over a 24-hour period. The maximum 24-hour measurements and the monthly means for the suspended particulates are also shown in Table III-19. The data in Table III-19 indicate that the maximum hourly average of the particulates in both February and July 1973 exceeded State standards. The station also measures the concentration of lead several times each month. The maximum 24-hour measurements and the monthly means are shown in Table III-19.

There is sufficient evidence to indicate that the presence of pollutants in the air is hazardous to human health. The increase in human respiratory ailments is generally related to high

pollutant content of the air. In addition, the pollutants affect the quality of the environment and have a marked effect on crop yields. Air pollution causes necrosis, or bleaching, on plant leaves thus reducing the effective leaf area for the functioning of photosynthesis, respiration and transpiration. Therefore, increased pollutants in the air will result in health hazards as well as economic losses.

Geological Conditions

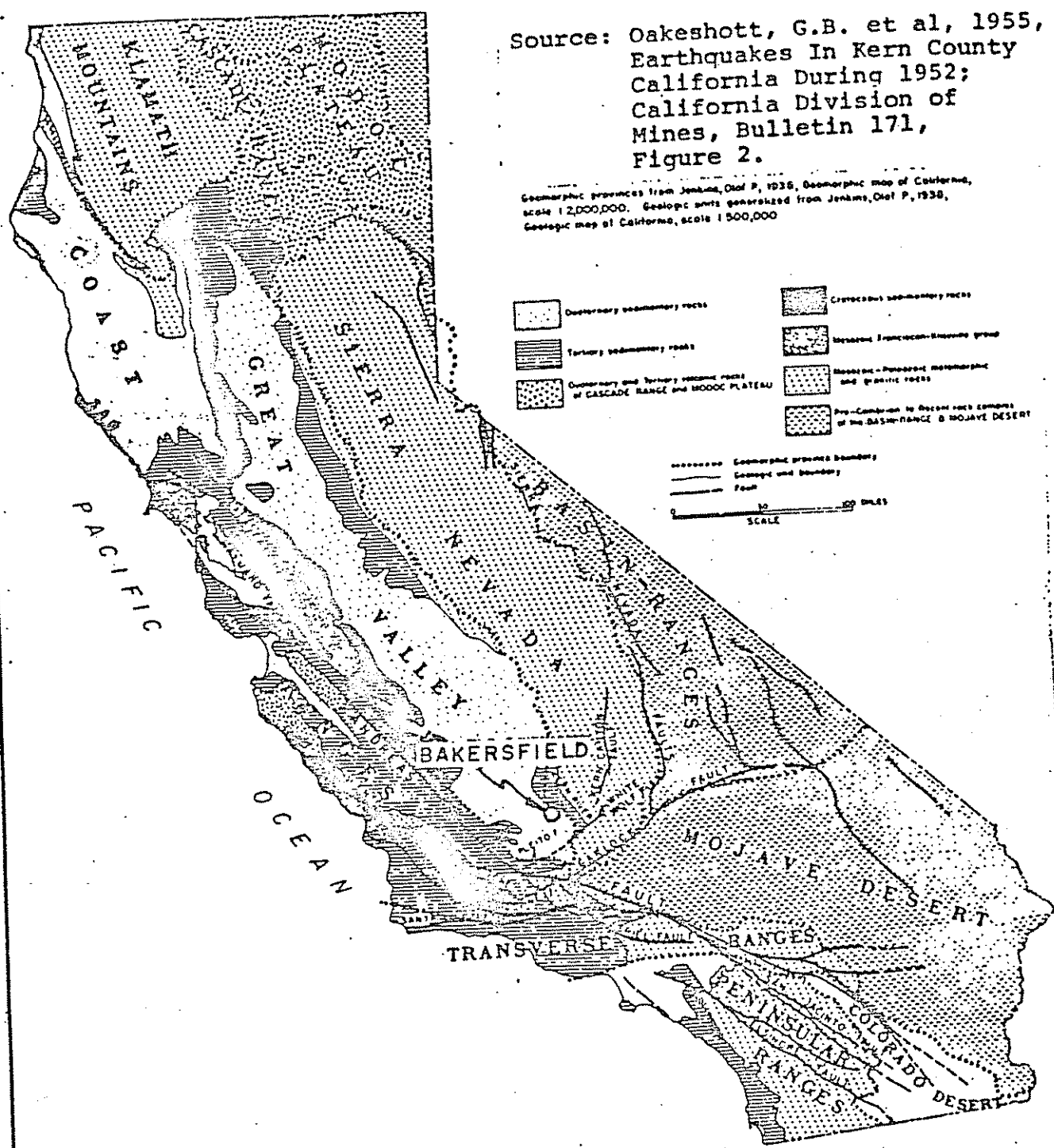
Geologically, the project area is situated at the south end of the Great Valley Geomorphic Province, as shown on Plate 12. This province is a large northwesterly trending geosyncline or structural trough between the Coast Range of mountains on the west and the Sierra Nevada on the east. It extends from the San Emigdio Range on the south to an area north of Redding, a distance of approximately 600 miles. Its width averages about 50 miles.

Geographically the province is divided at the Delta region into the Sacramento Valley to the north and the San Joaquin Valley to the south. Geologically, the dividing line is generally considered to be the Stockton Arch.

Historic Geology. The Great Valley of California, which is almost entirely surrounded by mountains, is one of the most notable structural depressions on earth. Evidence of its existence as a marine basin as long ago as late Jurassic is present in the early folding of the Sierra Nevada (120 to 130 million years ago). During the

Source: Oakeshott, G.B. et al, 1955,
 Earthquakes In Kern County
 California During 1952;
 California Division of
 Mines, Bulletin 171,
 Figure 2.

Geomorphic provinces from Jenks, Osl P, 1936, Geomorphic map of California,
 scale 1:2,000,000. Geologic units generalized from Jenks, Osl P, 1938,
 Geologic map of California, scale 1:500,000



GEOLOGIC MAP OF CALIFORNIA SHOWING PRINCIPAL FAULTS
 IN RELATION TO GEOMORPHIC PROVINCES AND GENERALIZED
 GEOLOGIC UNITS

THOMAS M. STETSON

Cretaceous period and much of the Cenozoic era, the basin extended over most of the area now occupied by the Coast Ranges. Near the close of the Pliocene epoch, continuing through the Pleistocene epoch, compressional forces in the area of the Coast Ranges elevated the mountains out of the sea to gradually form the enclosure of the Great Valley Geosyncline.

Erosion from both the Sierra Nevada and Coast Ranges resulted in the deposition of immense thicknesses of sediments in the valley. The axis of the syncline in the southern San Joaquin Valley is much closer to the Coast Ranges than the Sierra Nevada. Streams flowing westerly from the Sierra Nevada have a much greater volume than those draining from the west. The structural features in conjunction with the dominance of drainage from the east side have given the valley an asymmetrical form.

Heavily laden streams from the Sierra Nevada have built very prominent alluvial fans along margins of the San Joaquin Valley. Two of these fans are so extensive that they reach all the way across the valley to form dams that restrict drainage to the north. The Kern River fan grew westward to the McKittrick Hills to form a barrier to drainage from the Buena Vista Basin to the south. The Kings River fan merged with one which was developed by Los Gatos Creek from the west to form the Tulare Lake Basin.

Stratigraphy. The thickness of sediments underlying the area varies from about 3,300 feet in the northern portion near Jasmin and 7,000

THOMAS M. STETSON

feet near First Point of Measurement on the Kern River to more than 35,000 feet in the Buena Vista-Kern Lake Area. These beds, ranging in age from Cretaceous to Holocene, rest unconformably upon a crystalline basement complex. Near Jasmin, Morton and Sons drilled Well No. "Quinn" 1-16, in Section 16 (T25S/R27E) to a total depth of 3,317 feet. Granite basement complex was encountered at that depth. Sediments ranging in age from Eocene to Holocene were penetrated during the drilling operations. In the Kern River Oil Field, Standard Oil Company of California drilled Well No. "KCL 26" 1-11, in Section 9 (T29A/R28E) to a total depth of 6,986 feet. Granite basement was found at the bottom of the hole. The typical stratigraphic column in this area is approximately as follows:

<u>Formation</u>	<u>Age</u>	<u>Thickness</u>
Recent Sediments	Recent	150' +
Kern River-Chanac	Pleistocene-Pliocene	1,750' +
Santa Margarita	Upper Miocene	200' +
Fruitvale Shale and	Middle Miocene	800' +
Round Mountain Silt	Lower Miocene	650' +
Olcese	Lower Miocene	650' +
Freeman-Jewett	Lower Miocene	1,500' +
Vedder	Eocene	1,300' +
Famosa	Jurassic?	-
Basement Complex		

Regionally the beds dip gently to the southwest toward the axis of the syncline. The beds thicken rapidly in this direction accompanied with lithologic changes in facies and formation names.

The Ohio Oil Company drilled Well No. "KCL-A" 72-4, in Section 7 (T32S/R26E) in the Paloma Oil Field in the early 1950's. This well, located near the axis of the geosyncline, was drilled to

a total depth of 21,482 feet. Until recently it was the deepest well ever drilled in California. Sedimentary beds ranging in age from Holocene to Lower Miocene were penetrated. The bottom of the hole was in Santos Shale of Lower Miocene age.

Structure. The south end of the San Joaquin Valley is bordered on the west, east and south by three major fault systems all of which have been seismically active in Recent geologic time. These are the San Andreas, Breckenridge-Kern Canyon and the Garlock faults, respectively, as shown on Plate 13.

The San Andreas Fault extends from the Gulf of California at least as far north as Cape Mendocino. It has a northwest-southeast trend parallel to the crest of the Coast Range. It has been active in historic time along its entire length as indicated on Plate 14. Movement along this fault is in a right strike-slip direction, with the western block, or Pacific Plate, being displaced northerly in relation to the eastern block, or Continental Plate. The rate of movement is about 2 inches per year. It has been estimated that the total lateral displacement since Cretaceous time has been approximately 300 miles.

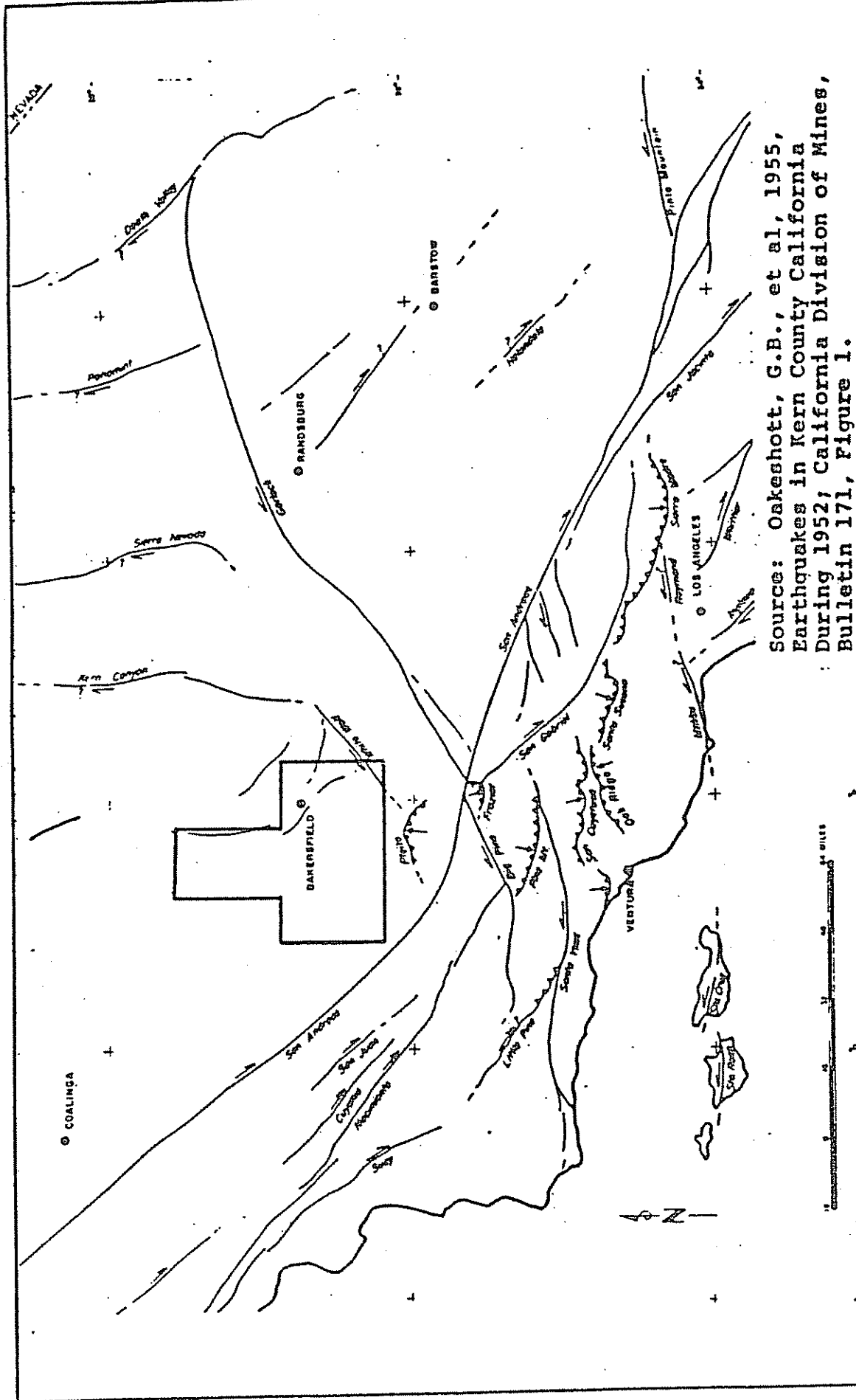
The Breckenridge-Kern Canyon Fault is located in the southern Sierra Nevada to the east of the valley. It trends northerly from the south end of Walker Basin to the north of Mount Whitney, a distance of almost 100 miles. It is a high angle reverse fault with a total vertical displacement of probably as much as 4,000

feet. Seismic activity during historic time, as shown on Table III-20, and fresh appearing escarpments and gun-sights along the fault fit the description of an historically active fault as defined by the California Division of Mines and Geology. ^{1/}

The Garlock Fault extends easterly from its point of intersection with the San Andreas Fault, near Lebec, for a distance of approximately 150 miles. An apparent offset of dike swarms along the zone suggests left lateral displacements of as much as 40 miles. Recent movement of up to 2,000 feet is indicated by offset streams and fresh appearing escarpments. Although very few earthquakes take place along the Garlock fault, triangulation data indicate that deformation is occurring along the zone a few miles east of its intersection with the San Andreas Fault.

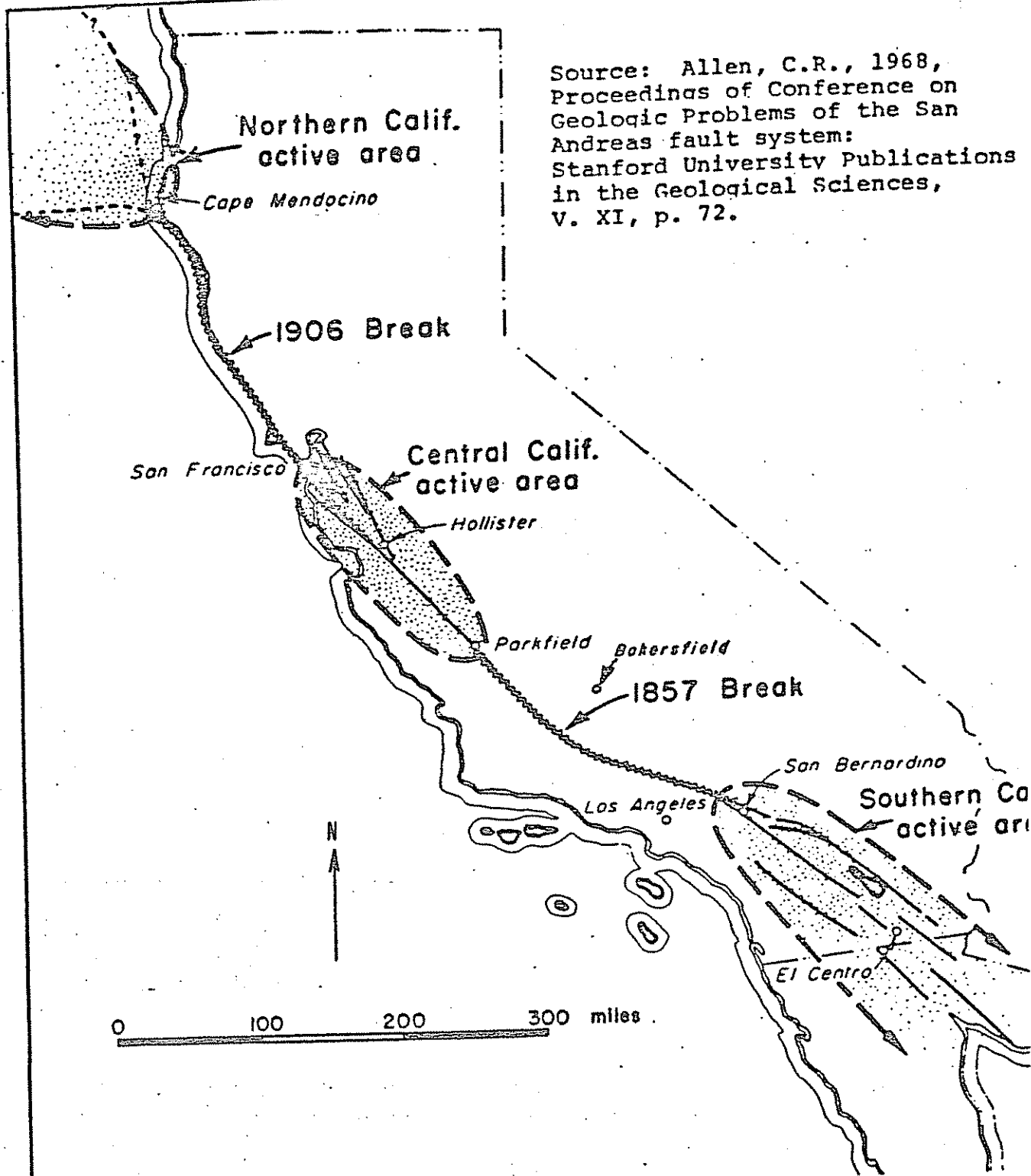
All three of these fault zones appear to be directly related to the uplifting of the mountain ranges in which they are located and the down-warping of the intermediate land mass which constitutes the San Joaquin Valley portion of the Great Valley Geosyncline. The forces which have resulted in the formation of these major fault zones and the continuing movement along them have had great influence locally in the valley floor in the form of folding and faulting of the thick section of sedimentary beds and the underlying basement complex. Numerous small faults exist within or near the area of interest as shown on Plates 9A and 9B (in pocket at rear of report).

^{1/} California Division of Mines and Geology, 1973, Urban Geology; Bulletin 198.



Source: Oakeshott, G.B., et al, 1955,
 Earthquakes in Kern County California
 During 1952; California Division of Mines,
 Bulletin 171, Figure 1.

FAULT MAP OF SOUTHERN CALIFORNIA (Arrows tentatively indicate principal component of relative movement)



Source: Allen, C.R., 1968, Proceedings of Conference on Geologic Problems of the San Andreas fault system: Stanford University Publications in the Geological Sciences, V. XI, p. 72.

AREAS OF CONTRASTING SEISMIC BEHAVIOR ALONG THE SAN ANDREAS FAULT ZONE IN CALIFORNIA

Table III-20

KERN CANYON FAULT SEISMIC HISTORY
(Probable Epicenters On or Near Fault)

<u>Date</u>	<u>Location and Nature of Shock</u>	<u>Intensity</u>	
		<u>MM</u> ^{1/}	<u>M</u> ^{2/}
1868	Near headwaters of Kern River, strong shock	-	-
1907	Near Isabella, weak shock	-	-
1-30-26	Kern Canyon above Old Kernville	VII?	-
3-12-29	Upper Kern Canyon near Kern Lake	IV	-
9-10-29	Kern Canyon near Edison Power Plant #3	II	-
1930	Near Old Kernville-2 small shocks	-	-
1931	Near Old Kernville-2 shocks	IV	-
4-19-32	Kern Canyon	-	3.5
7-25-32	Kern Canyon, west side	VI	-
1-19, 1-21-33	Near Old Kernville	III	-
4-28-33	Kern Canyon near Edison Power Plant #3	IV	-
1-07-39	Near Old Kernville	IV	-
8-10-42	Near Old Kernville, 3 moderate shocks	-	3.0
5-19-43	Near Old Kernville	-	2.2

1/ Magnitude on Modified Mercalli Intensity
2/ Gutenberg-Richter Scale

The most recently active of these is the White Wolf Fault, located four miles southeast of the project area. This fault traverses the southeast end of the San Joaquin Valley from Wheeler Ridge to northeast of Caliente, a distance of at least 33 miles. It is a high angle reverse fault with a left strike-slip component. Data from oil wells in the North Tejon area indicate total vertical displacement to be in the order of 10,000 feet.

On July 21, 1952, the well known Kern County Earthquake occurred as a result of movement along the White Wolf Fault. The initial shock had a magnitude of 7.7 with the epicenter located near Wheeler Ridge about 28 miles south of Bakersfield. The ground ruptured discontinuously along most of the length of the fault with maximum vertical displacements of about three feet. Severe damage occurred in the cities of Tehachapi and Arvin, southeasterly of the project area. It has been estimated that total agricultural losses, including crop damage, cost of releveling land, disrupted or damaged irrigation pipe, ditches, water wells and tank failures, was \$23,595,000. Most of these losses were within or adjacent to the project area. No known damage occurred, however, to the project canal system as a result of this earthquake.

Table III-21 is a list of known faults in excess of six miles in length which appear on Plates 9A and 9B. These are classified in three groups as follows:

Table III-21

MAJOR KNOWN FAULTS WITHIN THE AREA

<u>Name of Fault</u>	<u>Last Known Movement</u>	<u>Fault Type</u>	<u>Evidence of Existence</u>	<u>Length (Miles)</u>	<u>Possible Magnitude</u>
1. HISTORICALLY ACTIVE FAULTS					
Kern Front	Creeping	Normal	Surface	6 [±]	-
New Hope	Creeping	Normal	Surface	2 [±]	-
White Wolf	1952	Left Lateral	Surface	33 [±]	7.5 to 8.0
2. QUATERNARY DISPLACEMENT, WITHOUT HISTORIC RECORD (6 Miles or More in Length)					
Edison East		Normal	Surface	8 [±]	6.0
Edison West		Normal	Surface	6 [±]	6.0
Elk Hills		Normal	Surface	6 [±]	6.0
Hodgeman Ranch		Normal	Surface	8 [±]	6.0
McVan		Normal	Surface	7 [±]	6.0
Pond-Poso		Normal	Surface	45 [±]	7.0
Unnamed Fault Paralleling Highway 65		Normal	Surface	16 [±]	6.5
3. FAULTS DISPLACING ONLY PRE-QUATERNARY ROCKS (6 Miles or More in Length)					
Greeley-Rio Bravo	Miocene	Normal	Subsurface	32 [±]	
Jewett Thrust	Miocene	Normal	Subsurface	10 [±]	
Jewett	Miocene	Normal	Surface & Subsurface	7 [±]	