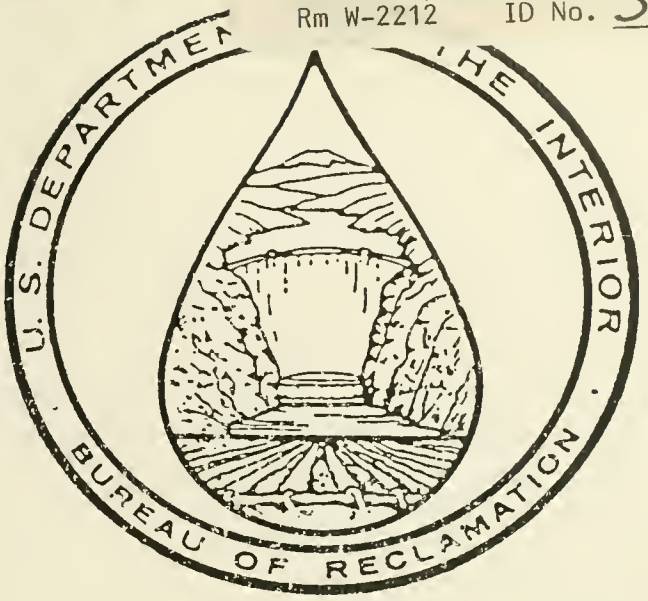


WEST SAN JOAQUIN VALLEY AGRICULTURAL SETTING

JUNE 1988

DELIVERY ORDER NO. 8-PD-20-05230/001

CONTRACT NO. 7-CS-20-05230

Boyle Engineering Corporation
consulting engineers / architects
Suite 305
2277 Fair Oaks Boulevard
Sacramento, California 95825
916 / 922-8287

WEST SAN JOAQUIN VALLEY AGRICULTURE

PREPARED FOR

BOYLE ENGINEERING, INC.

BY

RAYMOND W. GAINES
ECONOMICS CONSULTANT
JUNE 1988

TABLE OF CONTENTS

TABLES

FIGURES

WEST SAN JOAQUIN VALLEY AGRICULTURE

EXECUTIVE SUMMARY

This report documents the results of a survey of agricultural development on the western side of California's San Joaquin Valley. The productive capacity of the land (when irrigation water is provided) and the resulting economic and social effects are discussed along with the attendant problems of irrigation and disposal of excess drainage water.

The report is organized into six chapters, with the first providing an introduction to the area. Chapter I discusses the geography, climate, land and other factors which make the San Joaquin Valley a very productive agricultural area. Chapter I also shows that very little production would be possible in the area without irrigation.

Chapter II provides the setting for the surveys by presenting a discussion on the history of irrigated agriculture, present land use, water resources, and the history of agricultural drainage. The interest in farming and early efforts to obtain irrigation supplies help to provide the setting for the survey.

Water resources of the Central Valley Basin, are also discussed in Chapter II. Additionally, Chapter II outlines the

construction of water development projects which culminate decades of efforts to supply water to the basin.

The necessity for drainage management of agricultural lands to maintain their productivity is also a part of the setting for the survey. This section of Chapter II includes a discussion of the difficulties encountered in disposal of the drainage flows, including the attempt to use the San Luis Drain and Kesterson Reservoir for that purpose.

Chapter III provides a description of present agricultural development on the west side of the San Joaquin Valley. The lands which are farmed and the crops that they produced during the 1984-1986 period are discussed. Organization of the survey area into five sub-areas encompassing a total of 66 water districts plus a significant unincorporated acreage comprise a part of the discussion in Chapter III.

Tabular presentations show the acreage irrigated in each district and sub-area, along with the water requirements and gross crop value. It is determined that the Federal and State projects provide approximately 3.6 million acre-feet of water to the study area each year which represents a full or partial supply to about 1.5 million acres. The crops which are produced are valued at about $1.4 billion.

Chapter III also lists the acreages of crops produced in each sub-area during the 1984-1986 period. The acreage, crop value per acre, and gross value for each crop category are tabulated. The crop categories include cereal grains, forage crops, miscellaneous field crops, vegetables, nursery, seeds, fruits, nuts, and family gardens and orchards.

Crop yields and prices and trends in crop acreage also comprise a part of Chapter III. Farm characteristics such as the numbers of full-time and part-time farms, acreage, farm size, and farm population, are tabulated. Estimates of the agricultural investment and farm employment in the survey area are also included in Chapter III.

Chapter IV is a survey of the characteristics of the irrigation water supply in terms of source and quantity, quality, and cost. It is concluded that even though the imported supplies are of high quality they carry heavy loads of salt which may be degrading the soil and ground-water supplies in some areas because of inadequate surface and sub-surface drainage.

Irrigation water costs vary widely among the districts and sub-areas, depending mainly upon the source of supply and the amount of service (such as pumping) which is provided. The costs to the farmers are discussed by sub-area in Chapter IV.

Agricultural drainage water is the subject of Chapter V. It identifies the location of drainage problem areas and discusses the effect of inadequately drained lands on crops, soils and ground-water.

Drainage problem characteristics in terms of quantity and quality are presented in Chapter V. Imported irrigation water introduces only minor amounts of trace elements such as selenium, arsenic, boron, chromium, and molybdenum. However, these and others occur naturally in west San Joaquin Valley soils. Such substances are of concern because they are toxic, or potentially toxic, when concentrated in the soil, water, or food chain, which seems to be occurring in some parts of the valley. Concentration of these and other trace elements found in irrigation drainage water samples is discussed in Chapter V.

Present efforts being undertaken by individual farmers as well as water districts to dispose of drainage water comprises part of Chapter V. Continuation of many of the present disposal methods appears to be uncertain.

Economic activity generated by agricultural production on west-side lands is the subject of Chapter VI. Benefits to the area, the State, and the Nation are discussed. Part of the effects can be measured monetarily, while others can only be estimated qualitatively.

Economic linkages between the farms and off-farm activities are evaluated by use of multipliers developed for various crops by the California Department Of Water Resources. Input-output analyses were prepared by the Department in development of the individual multipliers. It was found that $1,447 million earned on west-side farms in 1985 increased in value to about $4,544 million as it progressed through channels of processing, trade, and commerce. This represents an increase in value to about $3.14 for each dollar earned at the farm level.

Off-farm employment generated by west-side agricultural production is also evaluated in Chapter VI. Multipliers developed by the Department were also used for the employment evaluation. It was found that the equivalent of about 4,368 full-time jobs were created off-farm by the west-side agricultural production in 1985. This represents an average of one full-time off-farm job for each $331,285 produced at the farm.

CHAPTER I

INTRODUCTION

GEOGRAPHY AND CLIMATE

California's Central Valley Basin is principally formed by two approximately parallel mountain ranges, the Sierra Nevada on the east and the Coast Range on the west. These two ranges converge at Mount Shasta in the north and are joined by the Tehachapi Mountain Range in the south. The resulting basin is nearly 500 miles long, averages 120 miles in width, and includes about one-third of the State of California. The main valley floor, comprising nearly one-third of the basin area is a gently sloping, practically unbroken alluvial plain about 400 miles long and averaging 45 miles in width. The Sacramento River drains the northern portion of the basin and the San Joaquin River drains somewhat more than half of the southern portion. These two streams flow toward each other, join in the Sacramento - San Joaquin Delta, and find a common outlet to the ocean through San Francisco Bay. Runoff in the remainder of the area (extreme southern portion) drains into Tulare Lake which is a closed basin within the Central Valley. Most of the Tulare Basin water is now used for irrigation or evaporates, but historically, overflow would occur from Tulare Lake to the San Joaquin River during years of high runoff. The last such spill occurred in 1878.

Water supplies within the Central Valley Basin occur neither seasonally nor geographically in accordance with desired patterns for agricultural and municipal uses. Specifically, the San Joaquin Valley contains about two-thirds of the agricultural land but receives about one-third of the water, while the Sacramento Valley has only one-third of the land, but two-thirds of the water.

Rainfall on the main valley floor is relatively light, decreasing from an average of about 23 inches at Red Bluff in the north to about 6 inches at Bakersfield in the south. Eighty five percent of the precipitation occurs from November through April.

In a general way, stream run-off follows the trend of precipitation. Over nine-tenths of the total run-off comes from the Sierra Nevada, with less than one-tenth from the Coast Range. Winter rainfall on the Coast Range and the foothills of the Sierra Nevada causes immediate run-off, most of which occurs from December through April. Snow storage in the High Sierra delays the major portion of the run-off from that area until April, May and June. One-half of the normal annual run-off into the valley occurs during these three months, but by mid-summer the natural flow in most streams has ended or diminished to little more than a trickle. Only the major rivers flow year around.

The average annual run-off in the basin is about 33 million acre-feet, but individual years may vary from one-fourth to twice the

average amount. Also, successions of wet or dry years frequently occur during which the run-off is considerably above or below average. During the period 1928-1934, only about 55 percent of the average run-off occurred. Large reservoirs were constructed to regulate seasonal and year-to-year variations in stream run-off.

The west side of the San Joaquin Valley (south from the Delta to the vicinity of Bakersfield) is particularly deficient in moisture, although when irrigated the lands are productive. Precipitation is very light because this area lies in a rain shadow of the Coast Range. However, the range is not high enough to accumulate snow for significant stream run-off. Agricultural production in this area is almost totally dependent upon irrigation.

The average frost free period on the valley floor exceeds seven and one-half months and the remaining winter months are mild with an average of less than 15 days per year having minimum temperatures below 32 degrees. The moderate winter climate enables the production of citrus fruits, the less hardy deciduous fruits, and other specialized crops which require mild winters and long growing seasons.

LAND AND AGRICULTURE

Although the soils are fertile, very little agricultural production is possible in this arid area without the application

of irrigation water. Use of irrigation supplies, however, in conjunction with the fertile soil and favorable climatic conditions enables more than 200 crops to be grown commercially within the valley. At least 125 of these contribute significantly to the food supply and economy of the area, the State, and the Nation. Fresno, Tulare, and Kern Counties are the nation's highest producers of agricultural commodities. Several of the other San Joaquin Valley counties are also among the nation's top ten producers. Crops grown in large quantities include more than 20 types of vegetables; 20 fruit and nut crops; 12 field and seed crops; and 5 forage crops.

Introduction of irrigation also introduced new problems, not the least of which is the drainage of irrigated lands and mobilization and concentration of salts and trace elements. The problems, as well as the benefits, which arise from irrigation of lands on the west side of the San Joaquin Valley are discussed later in the report.

CHAPTER II

SETTING

HISTORY OF IRRIGATED AGRICULTURE

Many of the gold-seekers who entered the Central Valley in 1849 and the years which followed soon abandoned the pursuit of gold in favor of farming. Early efforts were made to dry-farm valley lands, but the limited amounts and seasonal nature of the rainfall doomed such efforts to failure, except in very limited instances where short-season, winter grown crops such as some vegetables and grains were marginally successful. Limited production of grapes and some orchard crops such as almonds was also possible, but most such dry-farm enterprises were limited to the northern and eastern portions of the valley where rainfall was more abundant. The extremely dry western portion of the San Joaquin Valley received little interest from these early-day agriculturalists.

It was soon realized that irrigation provided much higher yields and permitted a vastly expanded choice of crops that could be grown. Thus it is not surprising that interest in water problems of the Central Valley began with the earliest history of California as a State. The first legislature enacted a law in 1850 requiring the Surveyor General to prepare plans for improving navigation, providing drainage, and furnishing

irrigation water. During the succeeding 70 years many investigations and reports were made, and many irrigation projects were constructed. However, the facilities were developed primarily by irrigation districts and individuals and were localized in nature. That is, they were not designed to provide major transfer of water supplies from one region or basin to another.

In addition to use of the available surface supplies, the local developments included installation of thousands of deep wells to utilize the underground water supplies for irrigation. Eventually the ground water extraction exceeded the recharge, resulting in a steady lowering of the ground water table, which continues to the present time in practically all irrigated areas not served sufficiently by surface supplies.

This practice of "mining" the ground water results in serious problems because as the wells are drilled deeper, the pumping energy costs go higher. Eventually, part of the pumping must end as the water supply is depleted or the depth to the water becomes so great that the cost of extraction exceeds the economic benefit.

Another serious problem resulting from the overdraft of ground water is land subsidence, wherein the soil in the underground aquifers becomes compacted when the water is removed. The compaction allows the surface terrain to settle into a lower

level than it occupied before the compaction occurred. Changing the level of the land results in serious misalignment of structures such as canals, pipelines, roads, railroads, and well casings. Subsidence also causes dislocation of buildings from their foundations, cracks in walls, and failure of doors and windows to fit properly.

IMPORT WATER

The Delta-Mendota Canal is located in the foothills of the Coast Range on the western side and at the north end of the San Joaquin Valley. It receives water from the Tracy Pumping Plant which pumps from the Sacramento-San Joaquin Delta to the headworks of the canal from where it flows southward by gravity for 117 miles before joining the San Joaquin River near Mendota. Full and supplemental irrigation supplies of about 1.1 million acre-feet are provided to more than 300,000 acres in this area each year.

The Delta-Mendota and San Luis Canals are of particular interest. These Federal facilities, combined with the State's California Aqueduct, provide irrigation water along the west side of the San Joaquin Valley for its full length from near Tracy to south of Bakersfield. About 66 districts receive service from the three canals.

San Luis Dam and Reservoir, the associated pumping plants, and the San Luis Canal are jointly owned by the Federal and State governments. However, individual shares of the water supply are

owned separately by each agency, which, in turn provides irrigation supplies to separate and distinct service areas.

San Luis Dam and Reservoir are located in the foothills of the Coast Range about 100 miles south of the Delta. The State project transports water generally during the November through April period from the Delta through the California Aqueduct for storage in San Luis Reservoir, and the Federal Central Valley Project uses the Delta-Mendota Canal for the same purpose. Water released from the reservoir, as well as water pumped directly from the Delta, are transported through the San Luis and Delta-Mendota Canals and the California Aqueduct to the Federal and State service areas along the west side of the San Joaquin Valley. The Federal project, including the San Luis and Delta-Mendota Canals, provide more than 2.6 million acre-feet annually to about 950,000 acres. The State project serves about 1.0 million acre-feet to approximately 475,000 acres.

DRAINAGE

Adequate drainage is necessary to maintain an appropriate salt balance in the soil and to keep the water table below the root zone of the plants. Hundreds of miles of buried pipelines have been installed to provide drainage for about 160,000 acres of irrigated lands along the west side of the San Joaquin Valley.

Some lands are more susceptible to drainage problems than others, with those near the valley trough, or at the lowest elevations generally most vulnerable. This occurs because drainage flows

from irrigated lands on the up-slope side tend to migrate down-slope. Thus, the drainage problem areas lie predominantly along the eastern side of the service area.

Adequate drainage of lands is as essential to long-term crop production as irrigation. The San Luis Drain, a feature of the Federal San Luis Unit, was originally designed to receive saline flows from the on-farm drainage systems and transport them northward for disposal in the San Joaquin Delta. The completed drain would have been a concrete-lined canal extending from the southern edge of the Federal service area to a discharge point in the Delta. Kesterson Regulating Reservoir was intended to be an in-line facility composed of earth dikes to pond the drainage water in interconnected cells for regulation of releases into the Delta. Regulated releases would have permitted mixing of the saline drainage flows with Delta waters at the most favorable times in an attempt to minimize any adverse effects on Delta water quality.

About 85 miles of the San Luis Drain and about 25 percent of the Kesterson Reservoir were completed in the early 1970's. While the upper reaches of the San Luis Drain and Kesterson Reservoir were under construction, concerns were intensified that discharge of the drainage flow into the Delta would result in widespread environmental damage. Consequently it was decided to temporarily terminate the drain at Kesterson Reservoir and utilize that facility for spreading the drainage flows for evaporation. This

type of operation was considered feasible for a limited period of time while the volume of drainage water gradually increased. In the meantime, additional study was to determine if ultimate disposal in the Delta was feasible, and if not, what alternatives were available.

With the passage of several years, continued evaporation of drainage flows at Kesterson resulted in increased concentration of dissolved substances in the effluent. Included among the dissolved substances, in minute amounts, is the element selenium, which occurs naturally in some soils in the San Joaquin Valley.

In very small amounts selenium is not considered harmful. However, concentration of the drain flows in Kesterson Reservoir resulted in levels which were toxic to certain types of waterfowl which used the reservoir. Environmental concerns were then magnified, especially since it was thought by some officials that selenium poisoning of waterfowl at Kesterson Reservoir might be in violation of migratory bird treaties the United States has with Canada and Mexico.

As a result of adverse, however localized, concerns, the Secretary of the Interior ordered the San Luis Drain and Kesterson Reservoir closed in 1985. Following negotiations, complete closure was delayed until mid-1986.

Environmental concerns have blocked the planned discharge of drainage waters into the Delta and/or the ocean. Some farmers and districts have constructed evaporation ponds while efforts to find other solutions continue. If a permanent solution is not found, a loss of production on thousands of acres will result.

CHAPTER III

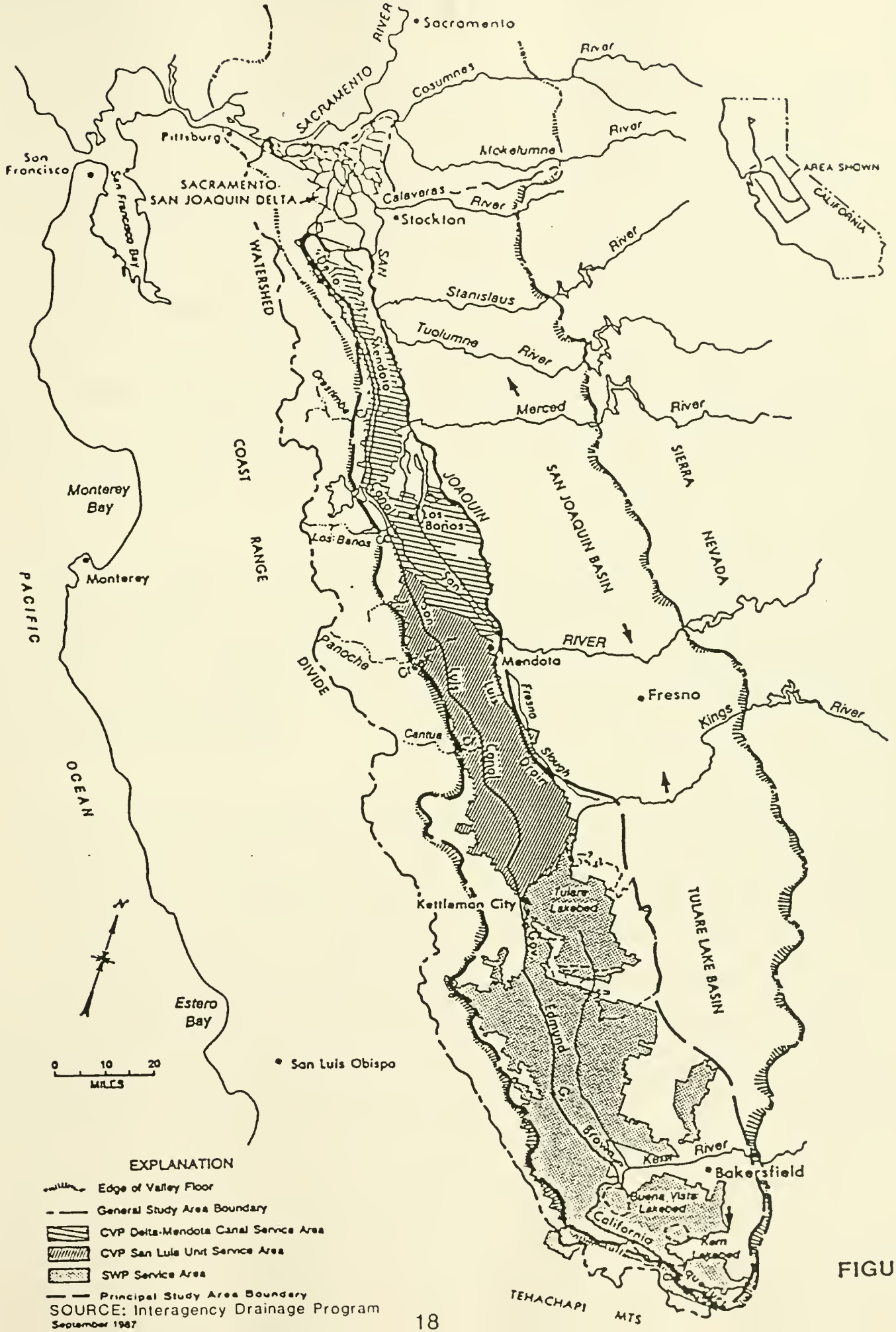
PRESENT AGRICULTURAL DEVELOPMENT IN THE WEST SIDE OF THE SAN JOAQUIN VALLEY

CROPS

Chapter I of this survey noted that more than 200 crops are grown commercially in California and that at least 125 of those contribute significantly to the food supply and economy of the State and the nation. The west side of the San Joaquin Valley contributes to the production of most, if not all, of those crops. Crop reports for the Delta-Mendota and San Luis Canals and the California Aqueduct service areas list dozens of crops which receive irrigation water from those facilities. These west-side lands and the crops they produce, along with the resulting economic and social effects are the subject of this chapter. The survey area is identified on Figure I.

The combined Federal and State projects provide approximately 3.6 million acre-feet of irrigation water each year to 66 individual water service districts. The project water provides a full or supplemental supply to about 1.4 million acres, which produce crops valued at approximately $1.4 billion. Additionally at least 0.2 million acres of unincorporated lands which receive non-project supplies are included in the survey area.

PROGRAM STUDY AREA



SOURCE: Interagency Drainage Program
September 1987

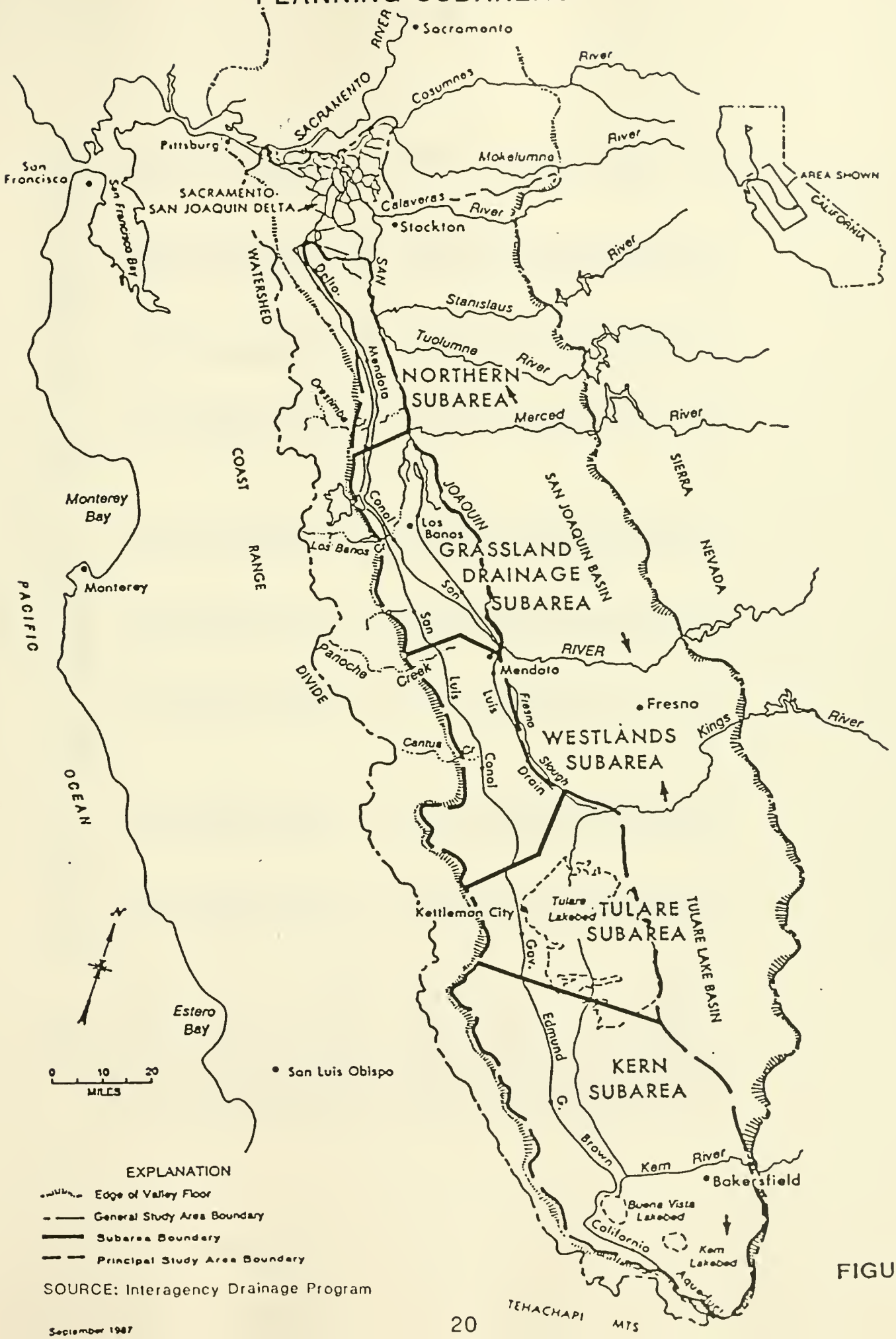
FIGURE I

The total area, which extends the entire length of the west side of the San Joaquin Valley, is divided into five sub-areas for purposes of the description. The first is designated as the Northern Sub-area. It extends from Tracy south to Merced County. The second is the Grassland Sub-area, which includes the area from the Merced County line south to the Westlands Water District. The third is the Westlands Sub-area, which includes the Westlands Water District and adjacent lands. The fourth is Tulare, which extends from the southern boundary of Westlands to the Kern County line, and the fifth is Kern County.

Figure II shows the location of the five planning sub-areas. The water districts in each sub-area are identified in Table 1. Table 1 also displays data for each district and each sub-area the irrigated acreage, water service, and gross crop revenues for the period 1984-1986.

Care should be exercised when interpreting data in Table 1 by sub-area and project totals. Certain variables such as addition and deletion of temporary supplies for some districts could cause misinterpretation of sub-area totals. Also 1986 data on irrigated acreages and gross crop returns for Sub-areas IV and V are missing because they have not yet been compiled. Another important consideration is the fact that not all of the irrigation water is supplied by the Federal and State projects.

PLANNING SUBAREAS



EXPLANATION

- Edge of Valley Floor
- General Study Area Boundary
- Subarea Boundary
- Principal Study Area Boundary

SOURCE: Interagency Drainage Program

FIGURE II

TABLE 1
Irrigated Acreage, Water Service, and Gross Crop Return By
District and Geographical Sub-area

DISTRICT AND SUB-AREA	1984 Irrigated Acreage(1) (acres)	1984 Water Service(2) (acre-ft)	1984 Gross Crop Value(3) ($1,000)	1985 Irrigated Acreage(1) (acres)	1985 Water Service(2) (acre-ft)	1985 Gross Crop Value(3) ($1,000)	1986 Irrigated Acreage(1) (acres)	1986 Water Service(2) (acre-ft)	1986 Gross Crop Value(3) ($1,000)
SUB-AREA NO. I									
Banta-Carbona I.D.	16638	20166	14452	16796	21082	14077	16266	24389	15364
Central Calif. I.D.	19941	89325	N/A	19028	87439	17583	19942	80949	18783
Del Puerto W.D.	3510	13345	4002	3507	13858	4132	3507	10807	3749
El Soylo W.D.	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hospital W.D.	9747	32829	11966	9797	33009	8774	9829	25350	9206
Kern Canon W.D.	2424	7930	2478	2380	8165	2720	2380	6393	2187
Oak Flat W.D.	2648	7344	2676	2648	6197	2648	NA	5354	NA
Orestimba W.D.	5331	18566	3567	5231	15341	4235	5012	17313	5359
Patterson W.D.	6443	22175	7111	6279	23238	6787	7395	19538	8059
Plain View W.D.	5674	22166	5672	5516	18678	5410	4925	14612	3960
Salado W.D.	2894	9791	3087	2894	9366	2893	2846	9851	3318
Sunflower W.D.	4104	16227	3665	4104	15341	3320	4053	13405	4292
West Stanislaus W.D.	20891	67960	22283	21100	54879	25122	21536	56904	26003
Foothill W.D.	3216	13900	3088	3243	12357	3288	3243	11456	2836
Unicorporated Area(4)	--	--	--	--	--	--	--	--	--
Sub-total	103461	341724	84047	102523	318950	100989	100934	296321	103116
SUB-AREA NO. II									
Broadview W.D.	9062	25262	7651	8812	26164	6832	8169	18095	8555
Centinella W.D.	684	2435	645	662	2538	648	662	1706	506
Davis W.D.	1518	5294	1451	1437	4888	1397	1345	3837	1399
Eagle Field W.D.	1389	4283	1546	1356	4334	884	1356	4494	1410
Laguna W.D.	307	800	136	378	800	229	322	800	180
Landsdale W.D.	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercy Springs W.D.	2594	10247	1397	2140	8490	1182	1017	5237	609
Mustang W.D.	4057	15386	3653	3957	14547	3515	3953	12983	3342
Oro Loma W.D.	1001	6230	644	992	6165	580	1002	5846	566
Pacheco W.D.	3598	10775	3524	3100	8854	3605	3500	10080	3111
Panoche W.D.	33794	101911	31906	33794	91804	31906	33415	89319	30153
Quinto W.D.	2286	9489	2279	2286	9150	2417	2261	7862	1341
Romero W.D.	953	3442	956	1091	4358	911	1108	3102	653
San Luis W.D.	47252	114894	59542	44109	123460	57924	42297	106597	42287
Widren W.D.	716	2990	644	765	3029	649	765	2201	465
Central Calif. I.D.	113000	506175	NA	107822	495485	99684	113003	458710	106436
San Luis Canal Co.	43500	162950	NA	41600	165522	NA	43500	165903	NA
Firebaugh Canal Co.	20800	73204	NA	19800	64995	NA	20800	75910	NA
Unincorporated Area(	41731	112900	NA	39917	112900	NA	41731	112900	NA
Sub-Total	328242	1168667	115974	314018	1147483	212363	320206	1085582	201013

TABLE 1 (continued)
Irrigated Acreage, Water Service, and Gross Crop Return By
District and Geographical Sub-area

DISTRICT AND SUB-AREA	1984 Irrigated Acreage(1) (acres)	1984 Water Service(2) (acre-ft)	1984 Gross Crop Value(3) ($1,000)	1985 Irrigated Acreage(1) (acres)	1985 Water Service(2) (acre-ft)	1985 Gross Crop Value(3) ($1,000)	1986 Irrigated Acreage(1) (acres)	1986 Water Service(2) (acre-ft)	1986 Gross Crop Value(3) ($1,000)
SUB-AREA NO.III									
Fresno Slough W.D.	1161	3626	955	1139	3618	763	1139	3618	728
James I.D.	22557	51531	13607	21473	49150	16045	20289	32835	14842
Pleasant Valley I.D.	320	2193	242	320	1085	231	320	3284	232
Tranquillity I.D.	9084	31292	6397	8710	30274	6587	8350	24647	5214
Westlands W.D.	546139	1408984	561516	546182	1158529	578184	513389	1241449	624496
Unincorporated Area(4)	--	--	--	--	--	--	--	--	--
Sub-total	579261	1497626	582717	577824	1242656	601810	543487	1305833	645512
SUB-AREA NO. IV									
Alpaugh I.D.	5179	7739	3044	5205	10898	3534	5139	9944	3024
Angiola W.D.	NA	NA	--	NA	NA	--	NA	40000	--
Atwell Island W.D.	5829	7494	3399	4287	8308	2669	3977	6663	1978
Corcoran W.D.	NA	NA	--	NA	77000	--	NA	NA	--
Dudley Ridge W.D.	19714	64600	19714	17804	62009	17804	NA	51152	--
Empire WestsideI.D.	NA	NA	--	2800	5197	2800	NA	11400	--
Hacienda W.D. (5)	NA	NA	--	NA	NA	--	NA	NA	--
Kings County W.D.(5)	NA	NA	--	NA	NA	--	NA	NA	--
Laguna I.D. (5)	NA	NA	--	NA	NA	--	NA	70000	--
Lakeside I.D. (5)	NA	NA	--	NA	54600	--	26524	18200	--
Megla W.D. (5)	NA	NA	--	NA	NA	--	NA	NA	--
Saylor W.D.(5)	NA	NA	--	NA	NA	--	NA	NA	--
Stinson W.D.(5)	NA	NA	--	NA	NA	--	NA	NA	--
Stratford I.D.(5)	NA	NA	--	NA	NA	--	NA	NA	--
Devils Dan W.D.	2075	20845	2075	5160	18194	2064	NA	17271	--
Tulare Lk. Basin W.D	1918	8843	7224	66984	215680	39355	NA	NA	NA
Unincorporated Area(4)	--	--	--	--	--	--	--	--	--
Sub-total	34715	109521	35456	102240	451886	68226	NA	224630	NA

TABLE 1 (continued)
Irrigated Acreage, Water Service, and Gross Crop Return By
District and Geographical Sub-area

DISTRICT AND SUB-AREA	1984 Irrigated Acreage(1) (acres)	1984 Water Service(2) (acre-ft)	1984 Gross Crop Value(3) ($1,000)	1985 Irrigated Acreage(1) (acres)	1985 Water Service(2) (acre-ft)	1985 Gross Crop Value(3) ($1,000)	1986 Irrigated Acreage(1) (acres)	1986 Water Service(2) (acre-ft)	1986 Gross Crop Value(3) ($1,000)
SUB-AREA NO. V									
Belridge W.S.D.	49400	150920	(6)	50770	145213	(6)	NA	149134	--
Berenda Mesa W.D.	44440	133159	(6)	43873	119703	(6)	NA	118298	--
Buena Vista W.S.D.	78070	83319	29083	30590	92000	(6)	NA	1438	--
Cawelo W.D.	9349	NA	(6)	9620	NA	(6)	NA	NA	--
Green Valley W.D.	1904	2557	1492	1410	2175	972	379	50	285
Henry Miller W.D.	17988	64067	(6)	17265	50320	(6)	NA	45355	--
Kern-Delta W.D.	NA	NA	(6)	NA	NA	(6)	NA	8384	--
Lost Hills W.D.	57963	147190	(6)	50096	129298	(6)	NA	105636	--
North Kern W.S.D.	NA	NA	(6)	NA	NA	(6)	NA	1713	--
Rosedale-Rio Bravo W.S.D.	9950	25331	(6)	10423	31700	(6)	NA	35457	--
Semitropic W.S.D.	69837	209173	(6)	66920	201417	(6)	6798	16280	3462
Shafter-Wasco I.D.	29396	73423	86092	30789	63236	99844	30710	76891	95413
West Kern W.D.	NA	NA	(6)	NA	NA	(6)	NA	20901	--
Wheeler-Ridge-Maricopa W.S.D.	74717	223765	(6)	100274	198820	(6)	NA	1213	--
Kern Co. (S.W.P.)	NA	NA	359838	NA	NA	366682	NA	NA	NA
Unincorporated Area(4)	--	--	--	--	--	--	--	--	--
Sub-total	443014	1112904	476505	412030	1033882	467498	NA	580750	NA
TOTAL	1488693	4230442	1294699	1508635	4194857	1450886	NA	3493116	NA

NOTES: "NA" denotes "data not available at this time".
"--" denotes "data are non-existent".

(1) - Acreage irrigated fully or partially from Federal Central Valley Project or California State Water Project supplies.
(2) - Irrigation water supplied by the Federal Central Valley Project and or California State Water Project.
(3) - Gross crop revenues from lands irrigated fully or partially from Federal Central Valley Project supplies.
(4) - The Grasslands Water District provides project water only for the enhancement of water fowl.
(5) - These districts are included in the Kings County State Water Project totals.
(6) - Included in the Kern County State Water Project total.

Sources of Data: (1) Central Valley Project monthly water distribution reports; (2) "Management of the California State Water Project Appendix F, San Joaquin Valley Post-Project Economic Impact"; and (3) Supplemental data supplied by the San Joaquin Valley Interagency Drainage Program.

The project supplies are supplemental in many districts where groundwater and other surface waters are also used.

Unpublished Bureau of Reclamation (USBR) data indicate that project service areas also received about 285,000 acre-feet from non-project sources in Sub-areas I, II and III in 1982. Comparable data for the 1984-1986 period are not available. Nor is any such data available for Sub-areas IV and V.

Data for unincorporated lands are included in Table 1 only for Sub-area II because no statistical records exist for the remaining sub-areas for the 1984-1986 period. However, unpublished data indicate that in 1982 about 30,000 acre-feet were utilized in unincorporated parts of Sub-area I, 113,000 acre-feet in Sub-area II, and 166,000 acre-feet in Sub-area III. Unincorporated areas total about 110,000 acres in these three Sub-areas. Comparable data are not available for Sub-areas IV and V.

Table 2 depicts acreages and gross crop values per acre and per acre-foot for nine crop categories, or groups. These data are presented for each sub-area, as well as the entire survey area for the period 1984-1986 (except for 1986 for Sub-areas IV and V). The data indicate that gross crop returns remained relatively stable during this period in all areas except Sub-area IV. In Sub-areas I, II, III, and V the gross revenues per acre

TABLE 2
Sub-Area Crop Reports

SUB-AREA AND CROP CATEGORY(1)	1984 Acreage (acres)	1984 Value Pr.Acre (dollars)	1984 Gross Value(2) ($1,000)	1985 Acreage (acres)	1985 Value Pr.Acre (dollars)	1985 Gross Value(2) ($1,000)	1986 Acreage (acres)	1986 Value Pr.Acre (dollars)	1986 Gross Value(2) ($1,000)
SUB-AREA NO. I									
Cereal Grains	4361	272	1187	9669	321	3107	9144	226	2067
Forage Crops	8173	665	5439	16032	599	9608	19333	433	8374
Misc. Field Crops	20007	548	10956	24936	570	14211	24019	677	16271
Vegetables	22343	1452	32442	27835	1297	36098	24063	1460	35136
Nursery	106	8717	924	109	7606	829	10	3000	30
Seeds	5	600	3	30	67	2	153	549	84
Fruits	10619	1550	16457	11912	1675	19953	11400	1761	20080
Nuts	18206	769	13955	18266	776	14177	18049	1162	20981
Family Gardens & Orchards	2	500	1	2	500	1	4	2750	11
Sub-Total	83822		81364	108791		97986	106175		103034
SUB-AREA NO. II									
Cereal Grains	12320	338	4166	43104	352	15175	26023	322	8383
Forage Crops	9085	722	6561	35315	555	19606	51266	435	22315
Misc. Field Crops	53571	873	46773	94980	744	70703	89589	747	66964
Vegetables	24348	1677	40824	36386	1814	66000	34338	1760	60432
Nursery	--	--	--	14	--	398	--	--	--
Seeds	1833	685	1255	3270	657	2147	5505	421	2319
Fruits	3202	3411	10923	12831	2562	32878	10314	3373	34786
Nuts	5599	980	5485	5179	950	4919	5697	1015	5780
Family Gardens & Orchards	--	--	--	--	--	--	12	--	36
Sub-Total	109958		115987	231079		211826	222744		201015

TABLE 2 (continued)
Sub-Area Crop Reports

SUB-AREA AND CROP CATEGORY(1)	1984 Acreage (acres)	1984 Value Pr.Acre (dollars)	1984 Gross Value(2) ($1,000)	1985 Acreage (acres)	1985 Value Pr.Acre (dollars)	1985 Gross Value(2) ($1,000)	1986 Acreage (acres)	1986 Value Pr.Acre (dollars)	1986 Gross Value(2) ($1,000)
SUB-AREA NO. III									
Cereal Grains	85636	363	31070	89093	271	24117	70639	204	14408
Forage Crops	13042	547	7130	12539	599	7505	12101	552	6682
Misc. Field Crops	336551	873	293927	324195	724	234599	277803	697	193755
Vegetables	106285	1918	203840	122029	2260	275839	144831	2437	352930
Nursery	--	--	--	1016	27500	27940	1048	28000	29344
Seeds	25787	925	23848	23429	685	16056	31575	553	17451
Fruits	8192	914	7491	8236	500	4117	7974	1659	13229
Nuts	9971	1546	15412	10773	1058	11402	11083	1592	17711
Family Gardens & Orchards	--	--	--	--	--	--	--	--	--
Sub-Total	585464		582718	591310		601575	557054		645510
SUB-AREA NO. IV									
Cereal Grains	2793	296	826	18378	261	4805	NA	--	--
Forage Crops	4662	597	2784	3852	599	2308	NA	--	--
Misc. Field Crops	17110	673	11512	63540	649	41235	NA	--	--
Vegetables	3351	1749	5862	1816	2688	4882	NA	--	--
Nursery	--	--	--	--	--	--	NA	--	--
Seeds	820	870	713	8459	678	5735	NA	--	--
Fruits	4424	2552	11288	4760	1735	8258	NA	--	--
Nuts	1565	1579	2471	1395	720	1005	NA	--	--
Family Gardens & Orchards	--	--	--	--	--	--	NA	--	--
Sub-Total	34725		35456	102200		68228	NA	--	--

TABLE 2 (continued)
Sub-Area Crop Reports

SUB-AREA AND CROP CATEGORY(1)	1984 Acreage (acres)	1984 Value Pr.Acre (dollars)	1984 Gross Value(2) ($1,000)	1985 Acreage (acres)	1985 Value Pr.Acre (dollars)	1985 Gross Value(2) ($1,000)	1986 Acreage (acres)	1986 Value Pr.Acre (dollars)	1986 Gross Value(2) ($1,000)
SUB-AREA NO. V									
Cereal Grains	46797	291	13627	39866	261	10419	NA	--	--
Forage Crops	40487	640	25915	34140	638	21766	NA	--	--
Misc. Field Crops	234283	677	158673	183151	732	134027	NA	--	--
Vegetables	23844	2379	56725	24594	2861	70330	NA	--	--
Nursery	2924	18208	53241	3122	23052	71967	NA	--	--
Seeds	3739	859	3212	2968	682	2024	NA	--	--
Fruits	55466	1997	110764	54144	2305	124831	NA	--	--
Nuts	38603	1292	49856	40331	795	32078	NA	--	--
Family Gardens & Orchards	24	18717	4492	19	2947	56	NA	--	--
Sub-Total	446167		476505	382335		467498	NA	--	--
TOTAL									
Cereal Grains	151907	335	50876	200110	288	57623	NA	--	--
Forage Crops	75449	634	47829	101878	597	60793	NA	--	--
Misc. Field Crops	661522	789	521841	690802	716	494775	NA	--	--
Vegetables	180171	1885	339693	212660	2131	453149	NA	--	--
Nursery	3030	17876	54165	4261	23735	101134	NA	--	--
Seeds	32184	902	29031	38156	680	25964	NA	--	--
Fruits	81903	1916	156923	91883	2068	190037	NA	--	--
Nuts	73944	1179	87179	75944	837	63581	NA	--	--
Family Gardens & Orchards	26	17280	4493	21	2714	57	NA	--	--
Total - All Crops	1260136		1292030	1415715		1447113	NA	--	--

(1) Crops in each category are identified at end of table.
(2) Discrepancies in totals result from rounding.

Notes: Acreages and grass crop values do not include water service and crop production on lands provided with supplies for water rights exchange. These acreages primarily include the San Luis Canal Company, the Firebaugh Canal Company, and unincorporated lands of Sub-area II.

Sources: (1) Annual Crop Reports of the Central Valley Project, and
(2) "Management of the State Water Project, Appendix F, San Joaquin Valley Post-Project Economic Impact", published by the California Department of Water Resources, 1984 and 1985.

CROP LISTING BY CATEGORY FOR TABLE 2

Crop Category	Crops
Cereal Grains	Barley, corn, oats, rice, sorghums (sorgo, kaffir, etc.), wheat, other cereals.
Forage Crops	Alfalfa hay, other hay, irrigated pasture, silage or ensilage, crop residue (beet tops, stubble, stalks, straw), other forage.
Misc. Field Crops	Beans (dry and edible), cotton (lint), cotton (seed), sugar beets, other miscellaneous field crops.
Vegetables	Asparagus, beans (processing), beans (fresh market), broccoli, cabbage, carrots, cauliflower, celery, corn (sweet, processing), corn (sweet, fresh market), cucumbers, greens (kale, etc.), lettuce, melons (cantaloupe, honey ball, honeydew, watermelon), onions (dry), onions (green), peas (green, processing), peas (green, fresh market), peppers (all kinds), potatoes (early), potatoes (late), squash, tomatoes (canning), tomatoes (fresh market), other vegetables.
Nursery	All nursery stock, turf sod, Jojoba.
Seeds	Alfalfa, clover (all kinds), corn, grass (all kinds), lettuce, onion, pea, potato (all kinds).
Fruits	Apples, apricots, berries (all kinds), cherries, citrus (grapefruit, lemons, limes, oranges, tangerines), dates, grapes, (wine, table, raisin), olives, peaches, pears, prunes, plums, other fruits.
Nuts	Almonds, pecans, walnuts, other nuts.

varied by about 15 percent during the 3-year period, while the total area acreage showed practically no change.

The per acre gross crop values for Sub-area IV were indicated to be about 35 percent lower in 1985 than in 1984. Sharply increased acreages in field crops without commensurate increases in crop revenues accounted for most of the reduction in per acre gross crop value. Specifically, field crop acreages increased nearly six fold from 14,367 to 84,777 acres, while gross revenues increased only about five fold. Simultaneously, revenues from almonds and pistachio nuts declined by about 40 percent while the acreage increased by about 13 percent. Reasons for these dramatic changes in this particular sub-area are not apparent.

Crops included in each category are listed at the end of Table 2. Most crops, with the notable exception of cotton, are distributed throughout the survey area. Cotton production is generally limited to the southern half of Sub-area II and Sub-areas III, IV, and V because of climatic factors.

The major crops produced on the west side of the San Joaquin Valley, along with representative yields and prices are shown in Table 3. The indicated yields and prices are representative of those which might reasonably be expected in the area, but they are not necessarily averages.

TABLE 3
YIELDS AND PRICES OF MAJOR WESTSIDE CROPS

Crop(1)	Production Unit	Yield(2)	Prices(2) 1984 ($/Unit)	1985 ($/Unit)	1986 ($/unit)
Cereal Grains					
Wheat	Bu.	90.00	3.96	3.08	2.56
Barley	Bu.	80.00	2.98	2.54	2.28
Forage Crops					
Alfalfa Hay	Ton	7.50	83.00	82.38	86.22
Field Crops					
Beans, Dry	Cut	22.00	37.00	20.60	25.76
Cotton, Lint	Bale	2.25	321.60	292.80	290.09
Cotton, Seed	Ton	.75	120.00	100.00	100.00
Sugar Beets	Ton	26.00	30.50	30.00	30.00
Safflower	Acre	---	389.00	277.00	---
Vegetables					
Broccoli	Cwt.	100.00	23.10	21.90	20.90
Carrots	Cwt.	300.00	10.25	10.50	12.20
Lettuce	Cwt.	300.00	9.50	40.00	11.80
Cantaloupe	Cwt.	200.00	11.20	3.50	12.40
Onions, Dry	Cwt.	300.00	4.20	9.05	10.77
Peppers	Cwt.	175.00	36.15	22.44	22.44
Potatoes	Ton	20.00	225.00	182.00	---
Tomatoes (canning)	Ton	30.00	49.00	51.40	51.00
Tomatoes (fresh mkt)	Cwt.	350.00	23.70	12.25	22.20
Seeds					
Alfalfa Seed	Cwt.	7.50	104.00	96.00	96.00
Fruits					
Apricots	Ton	4.50	834.00	657.06	354.00
Oranges	Ton	10.00	277.00	449.00	---
Grapes (table)	Ton	6.00	764.00	624.00	307.00
Grapes (wine)	Ton	7.50	95.29	90.50	194.00
Olives	Ton	4.00	467.00	450.00	473.00
Peaches	Ton	10.00	400.00	217.13	217.50
Nuts					
Almonds	Ton	.70	1,560.00	803.56	4,400.00
Walnuts	Ton	1.50	460.00	690.00	737.00
Pistachios	Ton	1.00	1,850.00	2,860.00	---

(1) - The indicated crops are only those with primary acreages along the west side of the San Joaquin Valley.
(2) - The indicated yields and prices are representative of those obtained in the west side San Joaquin Valley.
Abbreviations: Bu. = bushel; Cwt. = 100 lbs; Bale = 500 lbs; Ton = 2,000 lbs.
Sources: (1) Central Valley Project Annual Crop Report, and (2) California Department of Water Resources publictions titled "Management of the State Water Project, Appendix, F San Joaquin Valley Post-Project Economic Import", 1984 and 1985.

Wheat is the most widely produced cereal grain in the area, but significant acreages of barley are also found. Other cereals such as field corn, rice, oats, sorghums, and others are also grown, but these acreages are small by comparison. The cereal grains are usually planted in rotation with field crops, alfalfa, and vegetables, so the acreages fluctuate from year to year. Cereal crop acreages also fluctuate because of significant price changes that frequently occur. Gross crop revenue per acre from cereal grains are generally lower than for any of the other crop categories, but the necessity for crop rotation and ease of entering into and exiting from grain production result in about 10-15 percent of the acreage producing cereals each year.

Alfalfa hay is by far the most widely produced forage crop in the area, but smaller acreages of other hay, irrigated pasture, silage, crop residue, and other types of forage are also found. Alfalfa hay is a reliable cash crop, but its most important use is in crop rotation and soil improvement programs that are practiced by most farmers. Alfalfa, being a legume, has the unique ability to take nitrogen from the air and deposit it in the soil in forms readily available to plants, thereby improving the fertility. Alfalfa in the crop rotation also helps to control certain soil pests and diseases and improves soil porosity and humus. Thus, the forage crops, primarily alfalfa hay, comprise about 5-10 percent of the acreage in the westside survey area each year.

Cotton, which is included with miscellaneous field crops, is by far the most significant crop produced on the west side of the San Joaquin Valley. It occupies about 40 percent of the acreage in the survey area and returns between 25 and 30 percent of the gross crop revenue. Other field crops are also produced, however, with the more significant ones being dry beans, sugar beets, and safflower. Total field crop acreage covers about 50 percent of the area.

Vegetables comprise the largest category in terms of number of crops, with the greater production being in tomatoes and cantaloupes. Broccoli, carrots, lettuce, onions, peppers, and potatoes also occupy significant acreages. Generally, vegetables produce very high incomes per acre; however, vegetable production is very risky, with market conditions often fluctuating widely. Availability of farm workers at crucial times and uncertain weather conditions and high production costs are additional factors that make some growers reluctant to produce vegetables, which occupy about 14 to 15 percent of the acreage.

Grapes is the most significant fruit crop in the west-side survey area. Wine varieties predominate, but table and raisin grape vineyards are also found. Other fruit crops consist of apricots, oranges, lemons, grapefruit, olives, peaches, nectarines, and several others occupying small acreages. All fruits represent between six and seven percent of the irrigated acreage in the survey area. Gross returns are often high, but development of an

orchard or vineyard necessitates a very high investment and many years of growth before bearing age is reached.

Nut crops consist mainly of almonds, with lesser acreages of walnuts and pistachios also found. As in the case of fruits, returns to nut crops are often high, but development of orchards is a long and expensive process, which is a deterrent to expansion of the acreages. Also, a risk of losing the large investment in orchards exists because over planting in an area or unexpected competition from imports can cause price reductions which drive producers from the business. Nut orchards now occupy between five and six percent of the survey area.

Seed crops in the area consist mostly of alfalfa seed, with only insignificant acreages of others being found. Returns from production of alfalfa seed are higher than for many of the other crops in the area, but the market is somewhat limited and competition is strong from other areas. Still, alfalfa is highly favored in crop rotations, and seed production is generally more remunerative than alfalfa hay. Seed crops occupy about two to three percent of the irrigated land.

Nursery produces a far higher return per acre than any other crop. However, the market is limited and production is possible only by highly specialized operators. Nurseries now occupy far less than one percent of the area. Expansion would be very

expensive, markets uncertain, and experienced operators difficult to obtain.

One of the crop categories which is listed is family gardens and orchards, although only a few acres are included in this category. Nevertheless, it does contribute to the food supply and economy of some of the farm families in the area and deserves mention as one of the uses of irrigation water.

TRENDS IN CROP ACREAGE

Acreage trends are difficult to establish for the various crop categories because of vagaries in the reporting data. Particularly, the addition and deletion of temporary project supplies from year to year causes fluctuation in acreages which could make identification of trends difficult. For example, a three fold increase in irrigated acreage in Sub-area IV plus a 15 percent decrease in Sub-area V between 1984 and 1985 causes concern that the data might not be reflecting true changes in irrigated acreage. The differences in service from project supplies as reflected in the available data are probably accurate, but other irrigation water sources were likely to have been used when project water was not provided.

Even though uncertain data may make apparent trends doubtful, some acreage changes have occurred which should be noted. Some of the more significant changes are identified below.

In Sub-area I, only minor changes were recorded in acreages of the various crop categories between 1985 and 1986. The entire sub-area acreage decreased by about two percent during the same period.

Sub-area II showed a decline of about 40 percent in cereal grain acreage from 1985 to 1986, and an increase of about 45 percent in forage crops during that period. The whole sub-area acreage decreased by about four percent.

In Sub-area III, miscellaneous field crops declined by almost 59,000 acres, or about 17 percent between 1984 and 1986. Cereal grain acreage also declined by about 17 percent, while vegetables increased by 36 percent, or almost 39,000 acres. Seed crops also increased by 22 percent, while the whole sub-area acreage declined by about five percent.

Uncertainties regarding acreage data in Sub-area IV have already been discussed. However, the available information indicates that between 1984 and 1985 cereal grains increased by 658 percent; miscellaneous field crops increased by 371 percent; vegetables declined by 46 percent; and seed crops increased by 1,031 percent. Total acreage for the full sub-area increased by 294 percent during the same period.

Between 1984 and 1985 Sub-area V had indicated declines of 15 percent in cereal grains, 16 percent in forage crops and 22

percent in miscellaneous field crops. No significant increases were reported, and the full sub-area declined by almost 64,000 acres, or 14 percent.

The following tabulation shows the indicated changes in crop acreages for the entire West San Joaquin Valley survey area for the period 1984 - 1985.

CROP CATEGORY	ACREAGE CHANGE (acres)	PERCENT CHANGES (percent)
Cereal Grains	+ 48,203	+ 32
Forage Crops	+ 26,429	+ 35
Misc. Field Crops	+ 29,280	+ 4
Vegetable Crops	+ 32,489	+ 18
Nursery	+ 1,231	+ 41
Seed Crops	+ 5,972	+ 19
Fruit Crops	+ 9,980	+ 12
Nut Crops	+ 2,000	+ 3
Family Gardens & Orchards	- 5	- 19
TOTAL	+155,579	+ 12

The same cautions expressed earlier in this chapter should be exercised when using data from the above tabulation.

FARM CHARACTERISTICS

Characteristics regarding farm numbers and sizes and full or part-time status, as well as farm populations, are shown in Table 4 for each district, sub-area, and the total west-side survey

TABLE 4
FARM CHARACTERISTICS - 1986(1)

Sub-Area	District	No. of Farms(2) Full Time	No. of Farms(2) Part Time	Avg. Farm Size Full Time (ACRES)	Avg. Farm Size Part Time (ACRES)	Farm Population(2) Full Time	Farm Population(2) Part Time
I	Banta-Carbona	75	19	225	16	610	5
	Del Puerto	20	4	168	90	40	1
	Hospital	33	5	333	28	47	10
	Kern Canon	13	--	200	--	20	--
	Patterson	88	219	59	16	352	648
	Plain View	35	8	158	23	78	14
	Salado	17	2	167	63	15	1
	West Stanislaus	104	5	213	20	222	10
	Central California	651	279	174	86	1224	800
	Orestimba	23	4	224	50	5	1
	Sunflower	16	--	298	--	25	--
	Sub-Total	1075	545	202	44	2638	1490
II	Broadview	15	--	618	--	30	--
	Centinella	1	--	835	--	1	--
	Davis	6	--	301	--	11	--
	Eagle Field	1	--	1436	--	1	--
	Foothill	12	1	275	47	24	1
	Laguna	1	--	574	--	5	--
	Mercy Springs	3	--	1116	--	5	--
	Mustang	9	3	488	67	21	2
	Oro Loma	2	--	555	--	2	--
	Pacheco	6	--	725	--	120	--
	Panoche	55	--	656	--	182	--
	Quinto	6	4	429	28	10	9
	Romero	2	--	580	--	6	--
	San Luis	79	16	655	103	250	38
	Widren	4	--	199	--	1	--
	Sub-Total	202	24	629	61	669	50
III	Fresno Slough	8	--	159	--	24	--
	James	50	4	431	5	472	10
	Pleasant Valley	1	--	321	--	3	--
	Tranquility	48	2	208	20	189	5
	Westlands	210	--	2677	-	546	--
	Sub-total	325	6	759	13	1234	15
IV	Alpaugh	47	30	133	11	90	30
	Atwell Island	5	1	1276	20	13	1
	Lakeside	279	20	99	5	700	50
	Other Kings County	136(3)	--	681(4)	--	--	--
	Sub-Total	467	51	548	12	803	81
V	Green Valley	3	--	973	--	1	--
	Semitropic	25	--	2116	--	1	--
	Shafter-Wasco	313	30	102	36	1095	105
	Other Kern Co.	233(5)	--	1473(4)	--	---	--
	Sub-Total	579	30	1,166	36	1097	105
	TOTAL	2648	626	661	33	6,441	1741

(1) - Data for 1986 unless otherwise noted.
(2) - Data from annual district crop reports, except as noted.
(3) - Computed from 1982 Census of Agriculture data on farm size in Kings County and 1985 project acreage reports.
(4) - Farm sizes from 1982 Census of Agriculture.
(5) - Computed from 1982 Census of Agriculture data on farm sizes in Kern County and 1985 project acreage reports.

area for 1986. Comparison of the 1986 data in Table 4 with similar information compiled for 1984 shows that full time farm numbers in the study area declined by 127, or about five percent during the 1984-1986 period. Part-time farm numbers decreased by seven, or about one percent during the same time span.

The average size of full-time farms decreased by about 48 acres, or seven percent, during the 1984-1986 period, while average part-time farm sizes were declining by one acre, or three percent. Significantly, however, the population residing on full-time farms remained practically unchanged, while the part-time farm population increased by 292, or about 20 percent.

The 1982 Census of Agriculture reports a decline of about 13 percent in the average size of all California farms, along with an increase of 13 percent in the number of farms, between 1978 and 1982. Similar information from the 1982 census shows that the six counties which encompass the west-side survey area followed the State trend. Individual changes appear in the following tabulation.

	1978-1982 Change	
COUNTY	NO. OF FARMS	SIZE OF FARMS
	(% change)	(% change)
San Joaquin	+ 4	- 4
Stanislaus	+ 8	- 8
Merced	+ 1	- 9
Fresno	+ 7	- 6
Kings	+ 3	- 9
Kern	+16	-14

Special care should be exercised when comparing the above data with those for the west-side survey area because different time periods are involved.

The agricultural economy was favorable during the early years of the 1978 - 1982 period, and the so-called "agricultural depression" had barely commenced in 1982. However, the 1984 - 1986 period reflects a time when the agricultural economy was much more depressed, and it might not be representative of the long-term future.

Regardless of the economy, the 3-year period (1984-1986) is probably too short to identify any strong trends which might be developing. However, it does appear that the number of farms is declining in the survey area along with irrigated acreages in some areas. This is in contrast to the counties'increasing numbers for the earlier period shown above.

FIXED AGRICULTURAL INVESTMENT

Fixed investments in agricultural enterprises, i.e., those that could not be readily removed from the premises, are shown for each sub-area and the total survey area in table 5. The investments per acre, including land, are summarized in the tabulation which follows:

SUB-AREA	AVERAGE INVESTMENT PER ACRE (Dollars)
No. I	3,471
No. II	2,858
No. III	3,351
No. IV	2,699
No. V	2,237
TOTAL	2,974

The per acre values of land and buildings in each sub-area were derived from county averages in the 1982 Census of Agriculture. Permanent planting investments represent inventory values, which assume one-half of the useful life, or 50 percent of the original value remains unused. Grapes and almonds are considered to be representative of all fruit and nut crops, respectively. The original costs of vineyard and orchard establishment were taken from crop enterprise efficiency studies prepared by the University of California Agricultural Extension Service. The vineyard and orchard establishment costs are estimated at $ 3,600 per acre for grapes and $ 6,100 per acre for almonds. The respective inventory values (50 percent of the original establishment cost) would be $ 1,800 and $ 3,050 per acre as indicated in Table 5.

Irrigation systems are considered to be of the row or flood types for general crops, and as such they are valued at $115 per acre for establishment, or $58 as the inventory value, which assumes

TABLE 5

FIXED AGRICULTURAL INVESTMENT

Sub Area	Item	Average Value Per Acre: Land & Build(1) ($/acre)	Permanent Plantings(2) ($/acre)	Irrigation System(3) ($/acre)	Drainage Structures(3) ($/acre)	Acres Irrigated(4) (acres)	Total Investment ($1,000)
I	General Crops	2925	---	58	75	191211	584723
	Fruits	2925	1800	375	75	18011	93206
	Nuts	2925	3050	375	75	16354	105074
	Sub-Total	---	---	---	--	225576	783003
II	General Crops	2410	---	58	75	92311	234747
	Fruits	2410	1800	375	75	3703	17274
	Nuts	2410	3050	375	75	7329	43314
	Sub-Total	---	---	---	--	103343	295335
III	General Crops	3121	---	58	75	537997	1750642
	Fruits	3121	1800	375	75	7974	42828
	Nuts	3121	3050	375	75	11083	73381
	Sub-Total	---	---	---	--	557054	1866851
IV	General Crops	2421	---	58	75	96045	245299
	Fruits	2421	1800	375	75	4760	22234
	Nuts	2421	3050	375	75	1395	8260
	Sub-Total	---	---	---	--	102200	275793
V	General Crops	1449	---	58	75	287860	455395
	Fruits	1449	1800	375	75	54144	200316
	Nuts	1449	3050	375	75	40331	199598
	Sub-Total	---	---	---	--	382335	855309
	TOTAL	---	---	---	--	---	4076291

(1) - From 1982 "Census of Agriculture".

(2) - Inventory value. Original investment costs from enterprise costs studies for grapes and almonds prepared by the University of California Agricultural Extension Service.

(3) - Inventory value. Original cost estimates developed by Bureau of Reclamation.

(4) - From Table 2.

that 50 percent of the system's useful life remains at the time of inventory. Drip systems are considered to be representative for vineyards and orchards and are valued at $750 per acre for establishment, or $375 as the inventory value. Drainage systems are originally priced at $150 per acre, with an inventory value of $ 75. The original costs of all of the irrigation and drainage facilities were developed by the U.S. Bureau of Reclamation for lands in the general area.

FARM EMPLOYMENT

Little reliable labor information is available for California farms. However, data provided for unemployment insurance purposes provide an approximate census of all persons who do farm work in California. Table 6 presents an approximation of farm labor and wage rates in California and the United States during selected periods in 1985 and 1986. The Table 6 data were compiled by the California Crop and Livestock Reporting Service and published in its June 16, 1986, issue of "California Field Crop Review".

The data in Table 6 are general in nature, but should provide indicators of farm labor activity in the west side of the San Joaquin Valley. It shows that the number of hired workers on California farms during the week April 6-12, 1986, is estimated at 197,000 workers, which is five percent above the number employed a year earlier. Hired workers averaged 42.5 hours on the job during the week, compared to 43.0 hours a year earlier.

TABLE 6 (1)

FARM LABOR AND WAGE RATES

WORKERS

	All Farm Workers	Non-Salaried: Self-Employed	Non-Salaried: Unpaid	Hired: Number of Workers	Hired: Expected to Work 150 Day or More	Hired: Expected to Work 149 Days or More
			(Thousands)			
California (a)						
Apr. 6-12, 1986	206	43	11	152	120	32
Jan. 12-18, 1986	190	46	8	136	106	30
Oct. 6-12, 1985	257	48	13	196	116	80
July 7-13, 1985	269	51	16	202	134	68
Apr. 7-13, 1985	217	48	9	160	130	30
United States (a)(b)						
Apr. 6-12, 1986	2718	1337	471	910	684	226
Apr. 6-12, 1986	N/A	N/A	N/A	N/A	N/A	N/A
Oct. 6-12, 1985	2956	1362	579	1015	617	398
July 7-13, 1985	3570	1448	749	1373	695	678
Apr. 7-13, 1985	2821	1413	501	907	659	248
California (d)						
Apr. 6-12, 1986	252	44	11	197	154	43
Jan. 12-18, 1986	245	48	8	189	151	38
Oct. 6-12, 1985	300	49	13	238	142	96
July 7-13, 1985	340	52	16	272	184	88
Apr. 7-13, 1985	245	49	9	187	150	37

(a) - excludes agricultural service workers.
(b) - excludes Alaska.
(c) - data not available; only seven states surveyed.
(d) - includes agricultural service workers.

Source: California Crop and Livestock Reporting Service in "California Field Crop Review", June 16,1986.

TABLE 6 (2)

FARM LABOR AND WAGE RATES

HOURS WORKED PER WORKER

	Self-Employed	Unpaid	Hired
California (a)			
Apr. 6-12, 1986	34.2	26.6	43.4
Jan. 12-18, 1986	34.3	29.0	41.1
Oct. 6-12, 1985	36.3	31.2	40.9
July 7-13, 1985	44.0	39.0	43.4
Apr. 7-13, 1985	38.2	35.1	44.1
United States (a)(b)			
Apr. 6-12, 1986	43.6	34.7	38.8
Jan. 12-18, 1986(c)	N/A	N/A	N/A
Oct. 6-12, 1985	47.9	38.6	38.6
July 7-13, 1985	49.6	40.0	37.6
Apr. 7-13, 1985	44.2	35.7	40.1
California (d)			
Apr. 6-12, 1986	34.6	26.6	42.5
Jan. 12-18, 1986	34.4	29.0	38.3
Oct. 6-12, 1985	36.6	21.2	40.2
July 7-13, 1985	44.1	39.0	41.9
Apr. 7-13, 1985	38.3	35.1	43.0

(a) - excludes agricultural service workers.
(b) - excludes Alaska.
(c) - data not available; only seven states surveyed.
(d) - includes agricultural service workers.

Source: California Crop and Livestock Reporting Service in "California Field Crop Review", June 16,1986.

TABLE 6 (3)

FARM LABOR AND WAGE RATES

FARM RATES (e) - HIRED WORKERS

	Type of Work					Method of Pay			
	Field	Livestock	Field and Livestock(f)	Supervisor	Other	Hourly	Piece Rate	Other	All
	(Dollars Per Hour)								
California (a)									
Apr. 6-12, 1986	5.04	5.66	5.13	8.75	6.65	5.07	6.60	7.50	5.61
Jan. 12-18, 1986	4.98	5.47	5.05	8.30	6.20	4.85	6.45	7.20	5.49
Oct. 6-12, 1986	5.16	5.60	5.21	7.94	5.82	4.86	6.66	7.10	5.51
July 7-13, 1985	4.83	5.00	4.85	8.35	5.91	4.75	6.35	6.70	5.24
Apr. 7-13, 1985	5.31	4.81	5.22	8.09	6.22	4.91	6.92	6.66	5.57
United States (a) (b)									
Apr. 6-12, 1986	4.58	4.26	4.46	7.24	4.80	4.52	6.18	4.92	4.71
Jan. 12-18, 1986 (c)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Oct. 6-12, 1986	4.47	4.24	4.40	7.07	4.51	4.41	5.51	4.62	4.56
July 7-13, 1985	4.07	3.97	4.05	6.86	4.34	4.18	4.73	4.31	4.24
Apr. 7-13, 1985	4.53	3.94	4.28	6.96	4.56	4.37	5.61	4.64	4.52
California (d)									
Apr. 6-12, 1986	5.46	5.71	5.49	9.10	7.04	5.46	6.70	8.09	5.94
Jan. 12-18, 1986	5.13	5.62	5.18	8.46	6.61	4.91	6.24	7.43	5.59
Oct. 6-12, 1986	5.30	5.61	5.33	8.14	6.44	4.99	6.66	7.71	5.71
July 7-13, 1985	5.03	5.04	5.03	8.29	6.44	4.80	6.23	7.01	5.42
Apr. 7-13, 1985	5.27	4.98	5.23	8.09	6.56	4.91	6.91	6.73	5.60

(a) - excludes agricultural service workers.
(b) - excludes Alaska.
(c) - data not available; only seven states surveyed.
(d) - includes agricultural service workers.
(e) - value of any perquisites provided are not included in wage rates.
(f) - field.

Source: California Crop and Livestock Reporting Service in "California Field Crop Review", June 16,1986.

Average wages paid hired workers in 1986 were $5.94 per hour, six percent above the $5.60 averaged during April 1985.

Different crops have varying labor requirements. Also, pay for hired workers is usually in accordance with the task performed. The average number of jobs required per farm and rates of pay on a year-round equivalent basis for work on various types of farm enterprises in California in 1984 is presented in the tabulation below. These data were compiled by Martin, Mamer, Mason, and Cartwright, and presented in their article titled, "California Farm Employment and Wages in 1984", published in "California Agriculture", November - December, 1987.

TYPE OF FARM	JOBS REQUIRED (jobs per farm)	AVERAGE ANNUAL WAGES ($ per job)
Cash Grains	5.8	10,834
Field Crops	10.1	12,029
Vegetables & Melons	33.6	13,192
Fruits & Nuts	9.2	8,148
Horticulture Spec.	21.4	13,186
General Crop Farm	11.9	11,136
All Crops	12.2	10,637

As already indicated, these statistical data are for the entire State and might not be directly applicable to more localized areas. Comparable data for the west side of the San Joaquin

Valley are not available. Some limited data for the counties which encompass the study area are available and presented below:

Agricultural Employment By Type Of Worker

Average Annual Estimates - 1986

County	Regular (jobs)	Seasonal (jobs)	Total (jobs)
San Joaquin	2,650	6,020	8,670
Stanislaus	2,030	3,740	5,770
Merced	1,950	4,870	6,820
Fresno	10,420	20,910	31,330
Kings	1,410	2,250	3,660
Tulare	6,170	17,680	23,850
Kern	9,410	13,350	22,760
TOTAL	34,040	68,820	102,860

In 1983 the average hourly wage rate for farm workers in California was $5.12 per hour. This amount had increased to $5.60 in 1985 and $5.94 in 1986. Insufficient statistical data are available to establish a trend, but the indicated increases seem to support a belief that farm wage rates are gradually increasing.

CHAPTER IV

CHARACTERISTICS OF THE IRRIGATION WATER SUPPLY

SOURCE AND QUANTITY

The productive capability of lands in the San Joaquin Valley was discussed in earlier chapters of this survey. Those chapters indicated that irrigation is necessary to realize the productive potential of those lands, and discussed the continuing effort to obtain adequate supplies of irrigation water. Much has been accomplished in this regard, and vast acreages are now irrigated from supplies pumped from underground as well as from streams that flow into the area. However, a large part of the supply is made available through importation from other drainage basins. Use of imported supplies is especially important on the west side of the valley in the five sub-areas which encompass the lands evaluated in this report.

The Delta-Mendota Canal and California Aqueduct both transport water from the Sacramento-San Joaquin Delta to the San Luis Reservoir where it is stored for later use in areas in the southern part of the survey area. The Delta-Mendota Canal also directly serves the more northern lands lying between the Delta and San Luis Reservoir. The San Luis Canal and California

Aqueduct supply the lands farther south. Mostly, but not entirely, lands in the three northernmost sub-areas are served from the Federal Central Valley Project, while the two southernmost sub-areas are served by California's State Water Project. Acreages served, by district, from 1984-1986 are indicated in Table 1. All of those supplies originated in the Sacramento and Trinity River drainage basins.

Computations were made from data in Table 1 which indicate that an average of 2.81 acre-feet per acre were provided by the Federal and State projects to the lands that they served during 1984-1985 (1986 is omitted because of incomplete statistical data). Based upon an estimated average requirement of 3.0 acre-feet per acre, the two projects supplied almost 94 percent of the irrigation water used in the survey area. The remainder was obtained from groundwater pumping and diversion from in-basin streams. Most of the non-project surface supplies are obtained from the Kern, Kings, and San Joaquin Rivers. However, available data do not permit an estimate of the non-project quantities, which may fluctuate drastically because of variations in annual precipitation. During 1982, groundwater supplied about five percent of the total requirement in Sub-area I and II and about six percent in Sub-area III. Diversions from the San Joaquin River comprised the remainder of the non-project supply in Sub-areas I and II, while diversions from the Kings River served the remainder of Sub-Area III. Comparable data for Sub-areas IV and V are not available.

IRRIGATION WATER QUALITY

Data on the quality of water supplied to the survey area through facilities of the Central Valley Project and State Water Project were provided by the Interagency Drainage Program. The following tabulation depicts the average concentrations of total dissolved solids, as well as several of the trace elements. The averages represent values measured over variable time periods.

Fed or State Project Supply	TDS (mg/L)	B (ug/L)	Total Se (ug/L)	Total Mo (ug/L)	Total Cr (ug/L)	Total As (ug/L)
Sub-area I						
DMC intake	300	224	1	3	3	4
SJR @ Vernalis	334-595	-	-	-	-	-
Sub-area II						
DMC check 10	320	179	-	-	-	-
Sub-area III						
Calif Aqued nr Kettleman	289	208	-	-	-	-
Sub-area IV	289	108	-	-	-	-
Sub-area V	271	175	-	-	-	-

All irrigation water supplies carry large tonnages of salt which are added to the soil or ground water. This point is demonstrated by the following quotation from the Kern County Water Agency's "Water Supply Report, 1986."

> "The ground water basin in the Kern County portion of the San Joaquin Valley has no outflow, except in extremely wet years. Consequently, new salts introduced into the basin with imported water supplies are retained in the basin. The

ground water is the recipient of these salts in the form of recharge waters or return flows from irrigation, municipal and industrial users.

Surface water supplies over the usable ground water basin in 1986, some 2,712,500 acre-feet, carried about 435,500 tons of new salts into the ground water basin. This volume of salt is about 68,200 tons more than was introduced in 1985. It should be noted that SWP water carries about twice as much salt as local supplies. Following is a table of salt loads by surface water source:

Source	Volume	Avg.TDS	Salt Load
SWP Over G.W. Basin	553,800 AF	258 ppm	194,200 Tons
Kern River	1,334,500	72	130,600
Minor Streams	32,600	264	11,700
Other Local Supplies	207,000	224	63,200
CVP Over G.W. Basin	584,500	45	35,800
TOTAL	2,712,400 AF		435,500 Tons

Ground water pumped and used for irrigation will become degraded as salts are leached from the crop root zones. A portion (averaging 20 to 30 percent in this basin) of applied water percolates through the soil profile to the ground water. This smaller volume of water carries most of the salts once held by the total volume applied, resulting in a concentration of the salts. The introduction of local drainage projects would help reduce this build-up of salts by removing some near-surface accumulations in the perched water areas".

IRRIGATION WATER COST

Costs of irrigation water vary widely among the various districts and sub-areas. Selective sampling was carried out to determine representative charges to the water users at the farm headgate.

The costs indicated below are considered typical, but they do not necessarily represent the average of the highest or lowest rates that may be found.

The differences in water rates result from various causes such as the cost of the water to the district, the cost of distribution to the farms, and costs for pumping. Some districts also utilize groundwater and/or surface flows from in-basin streams, in addition to the Central Valley Project and State Water Project supplies, which causes cost variations. Furthermore, some users of Central Valley Project water must now pay the full cost under provisions of the Reclamation Reform Act of 1982, while others still receive substantial subsidies in their rates.

Sampling indicates that representative rates to farmers in Sub-area I would range from $16.50 to $18.00 per acre-foot with additional assessments of $10.00 per acre in some instances. Except for the areas served with water rights exchange supplies, typical rates in Sub-area II would range from about $19.50 to $25.00 per acre-foot with additional assessments varying from $1.00 to $25.00 per acre. Sub-area III rates range from $17.85 per acre-foot up to $50.00 for full cost service. The charges vary among individuals.

Most of the districts in Sub-areas IV and V typically charge the farmers about $45.00 to $50.00 per acre-foot for irrigation service. However, in high cost districts at the upper end of the scale, rates ranging from $87.00 to $127.00 per acre-foot are found.

No data are available to indicate the cost of water in the unincorporated areas. However, information developed in 1982 indicates that ground water pumping costs about $50 per acre-foot at a surface elevation of 200 feet and increases by $20 per acre-foot for each 100 foot rise in elevation until a cost of $130 per acre-foot is reached at the 600 foot level.

CHAPTER V

AGRICULTURAL DRAINAGE WATER

LOCATION OF DRAINAGE PROBLEM AREAS

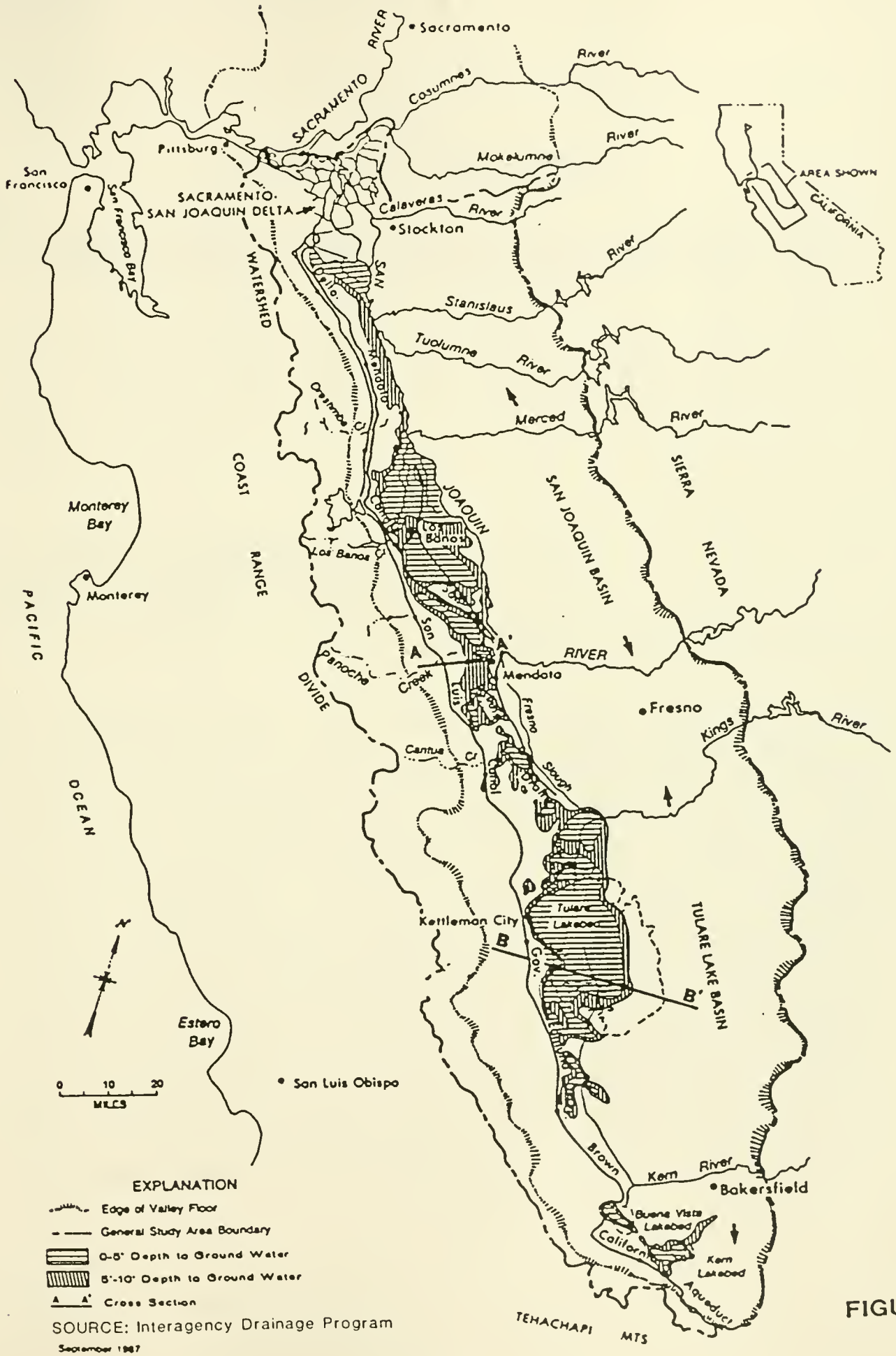
Other chapters of this report discuss the need for drainage management in order to maintain productivity. Failure to remove the excess water results in water-logging in areas where ground-water levels are high or where tilled soils are underlain by shallow, tight clays that do not readily allow deep percolation. Water-logging of the soil reduces or eliminates crop production by depriving the plants' roots of needed oxygen and also by concentrating salts in the soil within the plant root zones.

Approximately 500,000 acres of west-side agricultural lands are currently affected by ground-water levels that have risen to within five feet of the land surface due to irrigation. The areas most affected by these conditions are identified by Figure III.

DRAINAGE PROBLEM CHARACTERISTICS - QUANTITY AND QUALITY

Data in Table 7 indicate that in 1982 about 17,580 acre-feet were drained from 23,980 acres in Sub-area I. Similarly, in 1982, about 46,600 acre-feet were drained from 53,180 acres in Sub-area II.

LANDS AFFECTED BY HIGH GROUND WATER LEVELS



SOURCE: Interagency Drainage Program

September 1987

FIGURE

TABLE 7

SUBSURFACE AGRICULTURAL DRAINAGE

Sub-Area	Area (Acres)	Volume (Acre Ft.)	TDS (mg/L)	B (mg/L)	Se (ug/L)	Mo (ug/L)	As (ug/L)	Cr (ug/L)
I[a]	23,980	17,580	1,900	1.8	2.9	4.3	2.2	18.0
II[a]	53,130	46,600	5,560	12.8	209.0	23.0	1.5	37.6
III[a]	5,320	3,450	14,190	23.4	642.0	245.0	2.3	34.4
IV[b]								
V[b]								

a/ Based on 1982 USBR data.
b/ Data not available for Sub-areas IV and V.
SOURCE: Interagency Drainage Program.

Many substances which occur naturally in the rocks and soils originating from the Coast Range are commonly found in shallow ground-water and drainage water extracted from the land. Only minor amounts of such substances are brought in with imported irrigation supplies. Some of these substances, including selenium, arsenic, boron, chromium, and molybdenum are toxic, or potentially toxic, when concentrated or accumulated in the soil, water, or food chain. They are of concern because of their potential adverse effects on plants, animals, and public health. Table 8 depicts the concentration of many of these substances in water samples collected at various sites within the survey area.

TABLE 8

DRAINAGE WATER CONCENTRATIONS OF TRACE ELEMENTS[a]

Constituents	Minimum	Maximum	Median
Arsenic	<1	50	<1
Boron	40	84,000	6,500
Cadmium	<1	4	<1
Chromium	<1	800	2
Copper	<1	510	6
Iron	<3	360,000	250
Lead	<1	73	<1
Manganese	<1	9,000	80
Mercury	<0.1	1.6	<0.1
Molybdenum	<1	1,500	13
Nickel	<1	900	16
Selenium	<1	4,700	25
Silver	<1	10	<1
Zinc	<3	1,000	11

---

[a] Data Collected by USBR and USGS during 1984-86 from 40 sites (observation wells, farm drain sumps, and collector drains) in the Federal water service area and Kings County.

SOURCE: Interagency Drainage Program.

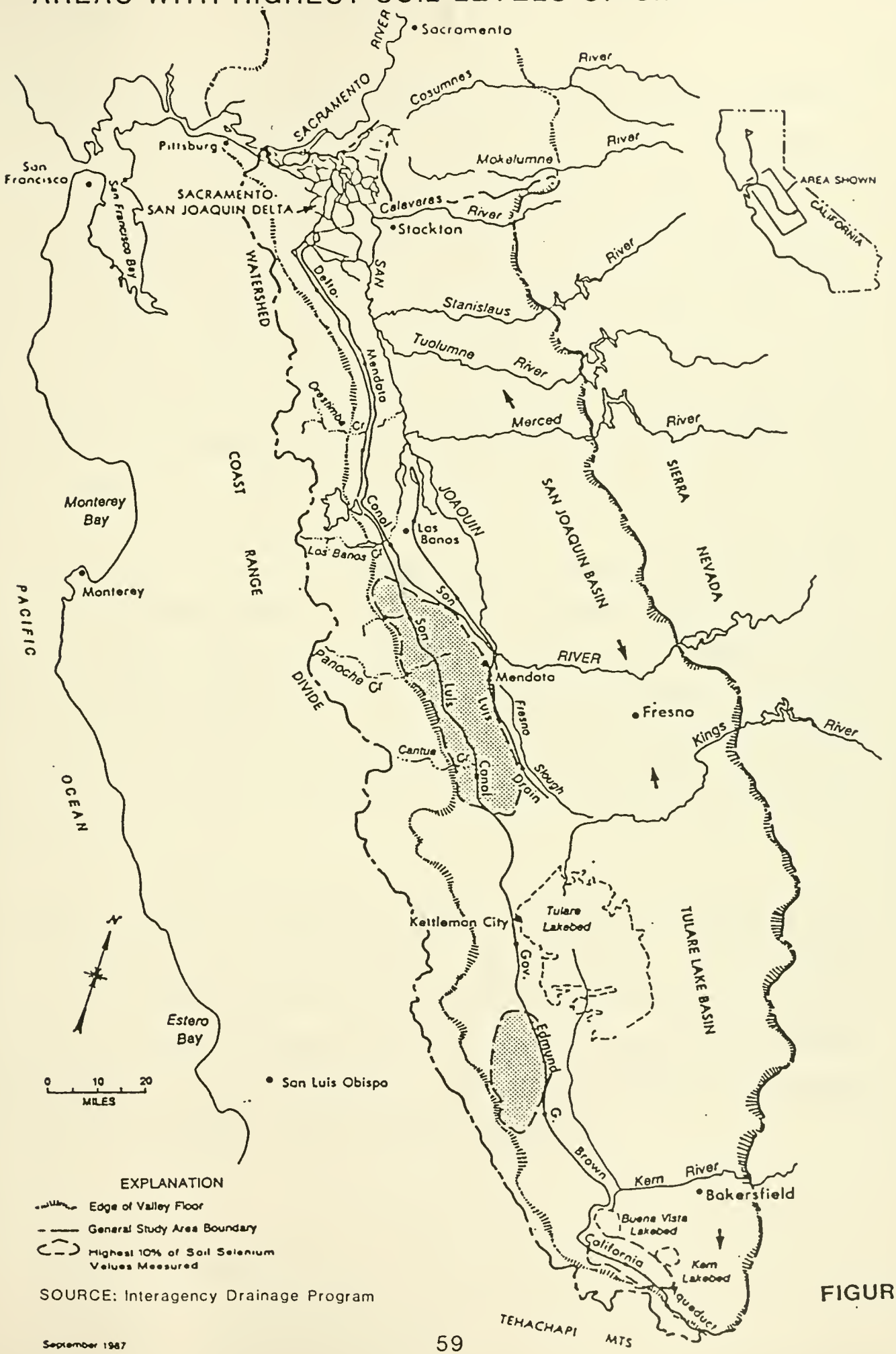
The element selenium is of particular concern because it is known to have caused deformities and deaths among waterfowl at the Kesterson National Wildlife Refuge. Figure IV identifies the areas of highest selenium concentration. Table 7 depicts concentrations of some of the substances of concern in sub-areas I, II, and III. Similar data for Sub-areas IV and V are not available.

DRAINAGE MANAGEMENT

Individual farmers as well as district organizations in the study area are now employing various methods for managing drainage water. Some of the methods are temporary, at best, and might now be causing reduced crop yields and possibly permanent damage to the soil productivity, as well as significant environmental impacts. The most prominent methods for each sub-area are discussed below.

In Sub-area I, an estimated 17,000 acre-feet of sub-surface drainage water is discharged annually into the San Joaquin River. These discharges originate primarily in the Newman, Patterson, and New Jerusalem Drainage Districts which are located, respectively, in the southern part of Stanislaus County, the central part of Stanislaus County, and the southern part of San Joaquin County.

AREAS WITH HIGHEST SOIL LEVELS OF SELENIUM



SOURCE: Interagency Drainage Program

FIGURE IV

September 1987

In Sub-area II, drainage management facilities provide the means for removing subsurface drainage water from about 53,000 acres. The surface collector drains in this area convey both subsurface and tailwater (surface drainage) flows originating throughout the Grasslands area to Salt and Mud Sloughs, which in turn discharge into the San Joaquin River. These combined drainage flows are often used to supplement other irrigation water supplies. Prior to 1985, when the selenium contained in drainage water was first suspected of adversely affecting waterfowl, much of the drainage water was used to augment wetland water sources.

In Sub-area III, the drainage management area has been primarily limited to the removal of subsurface drainage water from about 42,000 acres in the Mendota area. Prior to 1986, drainage flows were collected from about 5,000 acres through on-farm tile drains and several hundred miles of collector drains within the 42,000 acre area, and then conveyed by the San Luis Drain to Kesterson Reservoir.

Since June 1986, the San Luis Drain and Kesterson Reservoir have been closed and no longer receive drainage water. The collector system has been plugged at one-fourth mile intervals. However, on-farm drainage systems provide a limited means for drainage management. In most instances, the drainage water is recycled into the individual farm irrigation supplies.

There are also individual on-farm evaporation ponds in other locations within Sub-area III. Many of those ponds are disposing of water with relatively high selenium content, with the concentrations approaching or exceeding the toxic waste criteria for selenium. The continuation of this type of disposal system without treatment or special pond design is uncertain.

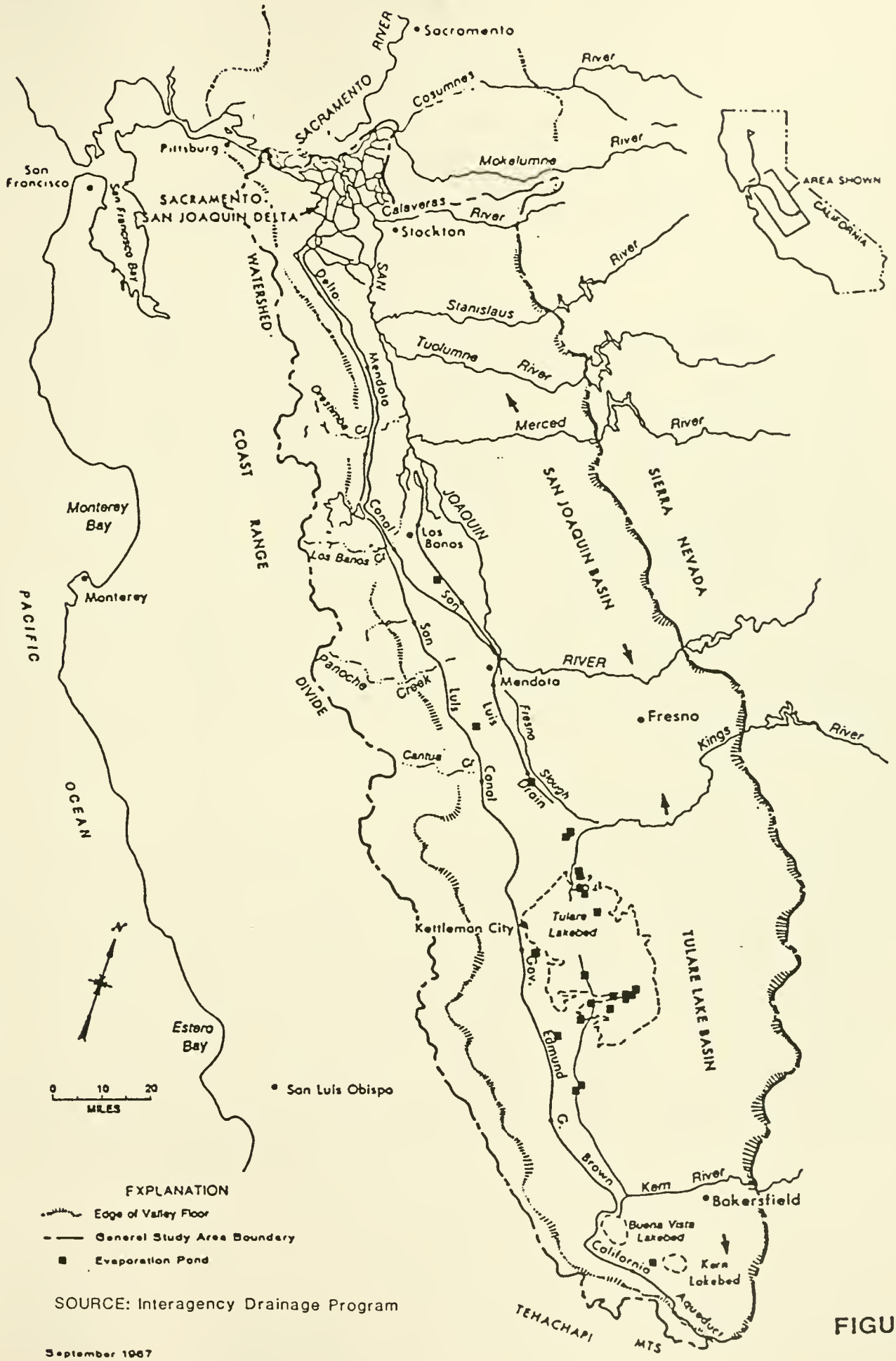
In Sub-area IV, the primary method of disposing of agricultural drainage water is by evaporation. The largest concentration of evaporation ponds (4,500 acres) is the complex serving the Tulare Lake Drainage District lands. These ponds are located north of, and adjacent to, the Kern National Wildlife Refuge.

Consequently, the concentrations of trace elements in the ponds, along with concentrations of selenium in invertebrates and bird tissue are being carefully monitored. Continuation of this method of drainage disposal in this sub-area is under investigation by the Interagency Drainage Program as well as individual State and Federal agencies.

Some drainage water in Sub-area IV is discharged into the Kings River, from which it is reused with irrigation supplies. Also, some high groundwater problems within the South Fork Kings River area which result from both river seepage and on-farm water management are mitigated by reuse of the drainage water as an irrigation supply.

In Sub-area V, some evaporation ponds have been constructed to serve individual farms and/or water districts. Locations of the major evaporation ponds in the San Joaquin Valley are identified in Figure V.

EVAPORATION PONDS IN THE SAN JOAQUIN VALLEY



SOURCE: Interagency Drainage Program

September 1967

FIGURE V

CHAPTER VI

AGRICULTURALLY RELATED ECONOMIC ACTIVITY

GENERAL

Irrigated lands in the San Joaquin Valley contribute to the economy of the area, the State, and the Nation. Part of the economic effects can be measured monetarily, while others can only be evaluated qualitatively. Nevertheless, all are very real and make their own contribution to the economy in diverse ways and in widely scattered areas. It is realized, of course, that many factors other than water are involved in agricultural production. However, without an adequate supply of irrigation water, very little production would occur on the west side of the San Joaquin Valley.

Broadening and strengthening of the tax base is one of the most far-reaching economic effects, but at the same time one that is seldom recognized. Income from agricultural production pays Federal and State income taxes, State sales taxes, property taxes, special-use taxes, and permits. Payment of many other taxes, including Federal transportation, corporation, manufacturers' excise, and other hidden taxes also result from agricultural production.

West side farms provide large quantities of commodities for use in foreign exchange. This contributes significantly toward the United States effort to maintain a favorable balance of trade with foreign countries. In turn, a favorable balance strengthens the value of the United States dollar, in relation to other currencies, which results in lower costs for imported goods.

A dependable supply of irrigation water can reduce risks to the grower and lessen the chance of failure. Stabilized production also benefits the consumer by providing a steady flow of food products in the market place. In turn, a steady, reliable food supply contributes to long-term price stability.

Among other economic effects that are often overlooked are increases in land values resulting from irrigation development, diminished land subsidence, and stabilization of ground-water basins. Dollar amounts attributable to these various effects are not readily available by specific areas. However, each contributes to the economy in its own way and should be recognized even though monetary evaluations are not available.

ECONOMIC LINKAGES

Table 1 shows the gross farm income for each west-side district receiving irrigation water from the Federal and State project facilities. Table 2 depicts similar data for the various crop categories from which the income is derived.

The idea that specific changes in farm production will "ripple" through the economy is generally understood and accepted. For example, cotton produced on the farm not only provides income for the farmer. It also creates economic activity and employment in the transportation, textile, garment manufacturing, and retail industries, as well as others. Input-output models are considered to be one of the more reliable indicators of this so-called ripple effect.

In 1980 the California Department of Water Resources published the results of an exhaustive array of input-output studies. From those studies, multipliers were derived that can be applied to gross incomes of the West San Joaquin Valley crops to determine the ripple effect creditable to those crops. The multipliers may be found in the Department's Bulletin 210, titled "Measuring Economic Impacts, The Application Of Input-Output Analysis To California Water Resources Problems", published in March 1980. Table 9 demonstrates the application of the multipliers to the west-side crops' incomes and the resultant ripple effect or economic linkages. The year 1985 was chosen for the demonstration in Table 9 because gross crops value data are not complete for 1986. The multipliers used in Table 9 reflect not only the inter-industry direct and indirect effects, but also induced effects resulting as income is earned by households and in turn re-injected into the economy in the form of personal consumption expenditures.

TABLE 9
INCREASE IN GROSS CROP VALUE THROUGH PROCESSING
AND TRADE CHANNELS - 1985

SUB - AREA	CROP CATEGORY	GROSS VALUE [1]	MULTIPLIER [2]	FORWARD LINKAGE [3]
		($1,000)		($1,000)
No. I	Cereal Grains [4]	13950	2.83	39479.
	Forage Crops [5]	23156	2.87	66458.
	Misc. Field Crops [6]	47258	3.05	144137.
	Vegetables	54530	3.00	163590.
	Nursery	1227	3.09	3791.
	Seeds [7]	2	2.90	6.
	Fruits [8]	41841	3.24	135565.
	Nuts [9]	12368	3.23	39949.
	Total	194332		592974.
No. II	Cereal Grains [4]	4332	2.83	12260.
	Forage Crops [5]	6058	2.87	17386.
	Misc. Field Crops [6]	37656	3.05	114851.
	Vegetables	47568	3.00	142704.
	Nursery	0	.00	0.
	Seeds [7]	2147	2.90	6226.
	Fruits [8]	10990	3.24	35608.
	Nuts [9]	6728	3.23	21731.
	Total	115479		350766.
No. III	Cereal Grains [4]	24117	2.83	68251.
	Forage Crops [5]	7505	2.87	21539.
	Misc. Field Crops [10]	234599	3.39	795291.
	Vegetables	275839	3.00	827517.
	Nursery	27940	3.09	86335.
	Seeds [7]	16056	2.90	46562.
	Fruits [8]	4117	3.24	13339.
	Nuts [9]	11402	3.23	36828.
	Total	601575		1895663.
No. IV	Cereal Grains [4]	4805	2.83	13598.
	Forage Crops [5]	2308	2.87	6624.
	Misc. Field Crops [10]	41235	3.39	139787.
	Vegetables	4882	3.00	14646.
	Nursery	0	.00	0.
	Seeds [7]	5735	2.90	16632.
	Fruits [8]	8258	3.24	26756.
	Nuts [9]	1005	3.23	3246.
	Total	68228		221288.

TABLE 9 (continued)
INCREASE IN GROSS CROP VALUE THROUGH PROCESSING
AND TRADE CHANNELS - 1985

SUB - AREA	CROP CATEGORY	GROSS VALUE [1]	MULTIPLIER [2]	FORWARD LINKAGE [3]
		($1,000)		($1,000)
No. V	Cereal Grains [4]	10419	2.83	29486.
	Forage Crops [5]	21766	2.87	62468.
	Misc. Field Crops [10]	134027	3.39	454352.
	Vegetables	70330	3.00	210990.
	Nursery	71967	3.09	222378.
	Seeds [7]	2024	2.90	5870.
	Fruits [8]	124831	3.24	404452.
	Nuts [9]	32078	3.23	103612.
	Total	467442		1493608.
TOTAL	Cereal Grains	57623	2.83	163073.
	Forage Crops	60793	2.87	174476.
	Misc. Field Crops	494775	.00 [11]	1648416.
	Vegetables	453149	3.00	1359447.
	Nursery	101134	3.09	312504.
	Seeds	25964	2.90	75296.
	Fruits	190037	3.24	615720.
	Nuts	63581	3.23	205367.
	Grand Total:	1447056		4554299.

Footnotes:

[1] From Table 2
[2] From California Department of Water Resources, Bulletin 210, March 1980, titled "Measuring Economic Impacts, The Application of Input-output Analysis to California Water Resources Problems", page 92
[3] Economic impact of agricultural production
[4] Cereal grains are represented by wheat
[5] Forage crops are represented by hay and pasture
[6] Miscellaneous field crops are represented by dried beans in Sub-areas I and II
[7] Seed crops are represented by grass seed
[8] Fruit crops are represented by non-citrus fruit
[9] Nut crops are represented by almonds
[10] Miscellaneous field crops are represented by cotton in Sub-areas III, IV, and V
[11] Composite multipliers for cotton and dry beans.

Table 9 indicates that the $1,447 million earned on west-side farms in 1985 increased to about $4,544 million as it moved through channels of processing and trade. This represents an increase in value to $3.14 for each dollar earned at the farm level. The validity of this analysis is supported by a study titled, "Economic Impact Of Agricultural Production And Processing In Stanislaus County". That study, which was prepared by the University of California Agricultural Extension Service in March 1981, developed a weighted average multiplier of 3.2 for agricultural production in Stanislaus County.

In addition to the direct, indirect, and induced economic effects which are included in the above evaluations, another category also exists. This additional category includes the backward-linkages which represent economic activity generated by the farms before the crops are harvested. It includes purchases of goods and services for crop production. Such items include fertilizers, spray and crop dusting materials, fuel, seed, farm machinery, and payment for custom operations. Although these backward-linkages support large amount of farm-related business activities, no monetary measure is available for their evaluation.

OFF-FARM EMPLOYMENT

On-farm employment is discussed in Chapter III. Labor requirements for off-farm agriculturally related activities are not covered in Chapter III, but they comprise a large segment of

the associated economic linkages. Measurement of labor requirements through such linkages is possible for the west-side crops by use of multipliers developed from input-output models.

Labor requirements for each crop, based upon each million dollars of production, are found on page 100 of the California Department Of Water Resources Bulletin 210, as already referenced in this chapter. Application of the multipliers to the west-side crops is demonstrated in Table 10. The indicated labor requirements represent the totals from the farm through all processing and trade channels.

According to data in Table 10, the equivalent of about 4,368 full-time jobs resulted from agricultural production on west side farms in 1985. This represents an average of one off-farm job for each $331,285 produced at the farm. Cotton production resulted in 1,857 jobs, or about 42 percent of the total. Vegetable crops provided 942 jobs, or 22 percent of the total. Contributions by the other crop categories appear in Table 10.

TABLE 10
LABOR REQUIREMENTS FOR CROPS THROUGH
PROCESSING AND TRADE CHANNELS - 1985

SUB - AREA	CROP CATEGORY	GROSS VALUE [1] ($1,000)	MULTIPLIER [2]	LABOR REQUIREMENT [3] (person-yr)
No. I	Cereal Grains [4]	13950	3.75	52.
	Forage Crops [5]	23156	4.31	100.
	Misc. Field Crops [6]	47258	3.98	188.
	Vegetables	54530	2.08	113.
	Nursery	1227	1.50	2.
	Seeds [7]	2	5.53	0.
	Fruits [8]	41841	1.60	67.
	Nuts [9]	12368	2.44	30.
	Total	194332		552.
No. II	Cereal Grains [4]	4332	3.75	16.
	Forage Crops [5]	6058	4.31	26.
	Misc. Field Crops [6]	37656	3.98	150.
	Vegetables	47568	2.08	99.
	Nursery	0	.00	0.
	Seeds [7]	2147	5.53	12.
	Fruits [8]	10990	1.60	18.
	Nuts [9]	6728	2.44	16.
	Total	115479		337.
No. III	Cereal Grains [4]	24117	3.75	90.
	Forage Crops [5]	7505	4.31	32.
	Misc. Field Crops [10]	234599	3.98	934.
	Vegetables	275839	2.08	574.
	Nursery	27940	1.50	42.
	Seeds [7]	16056	5.53	89.
	Fruits [8]	4117	1.60	6.
	Nuts [9]	11402	2.44	28.
	Total	601575		1795.
No. IV	Cereal Grains [4]	4805	3.75	18.
	Forage Crops [5]	2308	4.31	10.
	Misc. Field Crops [10]	41235	5.27	217.
	Vegetables	4882	2.08	10.
	Nursery	0	.00	0.
	Seeds [7]	5735	5.53	32.
	Fruits [8]	8258	1.60	13.
	Nuts [9]	1005	2.44	2.
	Total	68228		302.

TABLE 10 (continued)
LABOR REQUIREMENTS FOR CROPS THROUGH
PROCESSING AND TRADE CHANNELS - 1985

SUB - AREA	CROP CATEGORY	GROSS VALUE [1] ($1,000)	MULTIPLIER [2]	LABOR REQUIREMENT [3] (person-yr)
No. V	Cereal Grains [4]	10419	3.75	39.
	Forage Crops [5]	21766	4.31	94.
	Misc. Field Crops [10]	134027	5.27	706.
	Vegetables	70330	2.08	146.
	Nursery	71967	1.50	108.
	Seeds [7]	2024	5.53	11.
	Fruits [8]	124831	1.60	200.
	Nuts [9]	32078	2.44	78.
	Total	467442		1382.
TOTAL	Cereal Grains	57623	3.75	215
	Forage Crops	60793	4.31	262
	Misc. Field Crops	494775	.00 [11]	2195
	Vegetables	453149	2.08	942
	Nursery	101134	1.50	152
	Seeds	25964	5.53	144
	Fruits	190037	1.60	304
	Nuts	63581	2.44	154
	Grand Total:	1447056		4368.

Footnotes:

[1] From Table 2
[2] From California Department of Water Resources, Bulletin 210, March 1980, titled "Measuring Economic Impacts, The Application of Input-output Analysis to California Water Resources Problems", page 100
[3] Labor requirement resulting from agricultural production
[4] Cereal grains are represented by wheat
[5] Forage crops are represented by hay and pasture
[6] Miscellaneous field crops are represented by dried beans in Sub-areas I and II
[7] Seed crops are represented by grass seed
[8] Fruit crops are represented by non-citrus fruit
[9] Nut crops are represented by almonds
[10] Miscellaneous field crops are represented by cotton in Sub-areas III, IV, and V
[11] Composite multipliers for cotton and dry beans.

EPILOGUE

The survey of agriculture in the west side of the San Joaquin Valley which is presented in this report was prepared primarily from data provided by the Interagency Drainage Program. Such data represents the best which was available at the time or could be obtained within the limited period available for completion of the survey. However, the information is incomplete in some respects and not as strong as would be desired in others.

For example, the crop acreages and values in 1986 are not available for Sub-areas IV and V. Also, incomplete data and the short (3-year) period covered by the survey make identification of trends in crop acreages difficult. More complete information on the source, quantity, and quality of irrigation water in the various sub-areas would also have been desirable.

Even with the shortcomings in some data, the survey provides an insight into the extent and importance of agriculture in the West San Joaquin Valley. It also identifies some of the problems being encountered in efforts to maintain the productive capacity of the lands.

The survey also provides an insight into the agriculturally related economic activities of the area. Of special interest is the off-farm "ripple" effect resulting from economic linkages to the farms. Other aspects of the area's agricultural development,

representing a wide spectrum of interests, are also included in the survey and detailed in the report.

LIST OF REFERENCES

1. Central Valley Project annual crop reports, 1984, 1985, and 1986; U.S. Bureau of Reclamation.

2. Central Valley Project water distribution reports, 1984, 1985, and 1986; U.S. Bureau of Reclamation.

3. "California Field Crop Review", June 16, 1986; California Crop and Livestock Reporting Service.

4. "Management of the California State Water Project, Appendix F, San Joaquin Valley Post-Project Economic Impact", 1984 and 1985; California Department of Water Resources.

5. Martin, Mamer, Mason, and Cartwright; "California Farm Employment and Wages"; published in "California Agriculture", November-December 1987.

6. "Measuring Economic Impacts, The Application of Input-Output Analysis to California Water Resources Problems"; Bulletin 210, March 1980; California Department of Water Resources.

7. Supplemental water supply and quality data furnished by the Interagency Drainage Program.

8. "U.S. Census of Agriculture"; 1977 and 1982.