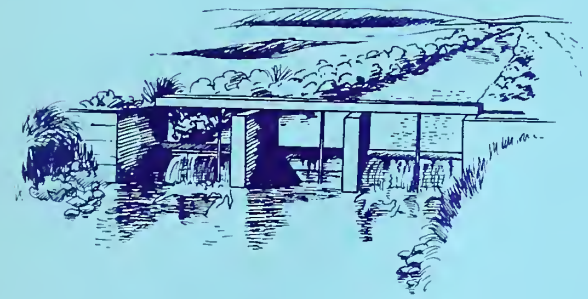
MENDOTA-GUSTINE STUDY

Fresno and Merced Counties, California



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California

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INTRODUCTION

The Mendota-Gustine Study was initiated as a result of a request from the Westside Association of Resource Conservation Districts made in 1969.

The purpose of the study was to assess the water associated problems in the western Fresno and Merced counties and to recommend possible solutions.

The study covers approximately 662 square miles within the central San Joaquin Valley. The area is bounded on the east by the San Joaquin River and on the west by the Diablo Mountain Range and extends from Mendota in Fresno County to Gustine in Merced County as shown on Figure 1.

The study covers two distinct areas of interest. The area producing drainage water (453 square miles) referred to as the irrigated area and the area that has a potential use for water (209 square miles) for summer irrigation, referred to as the pasture and wildlife area, also shown in Figure 1.

The San Joaquin Valley drains generally from south to north, and the irrigated area is upslope of the pasture and wildlife area. This results in the surface and subsurface flow from the irrigated areas draining through the pasture and wildlife areas to reach the San Joaquin River and ultimately the Bay and Ocean.

This surface and subsurface water can be beneficially reused, within certain limitations, in the pasture and wildlife area before ultimate disposal. This report attempts to point out existing areas

generating surface and subsurface water, location of potential use of this water and some specific limitations to this reuse.

The study area contains many irrigation districts, water districts, canal companies, and drainage districts and is represented by the Panoche, Firebaugh, Poso, Grasslands, Los Banos, San Luis, Gustine-Romero, and Stevinson Resource Conservation Districts. (See Figures 9 and 10.)

A drainage study advisory committee was formed with a representative from each entity to provide guidance and assist in establishing the scope and intensity of this report. The many districts and companies opened their files and records completely and assisted in gathering and providing needed data. Interpretation of the data was done in close cooperation with field personnel of these districts and companies.

SUMMARY

The reuse of water from irrigated areas is practicable for wildlife habitat and native pasture improvement. The amount of water and silt entering the San Joaquin River can also be greatly reduced by this reuse.

Drainage yield and quality from the irrigated areas were estimated for the years 1990 and 2020. The quantity of summer water needed (472,851 acre/feet) was determined from the average consumptive use for pasture grass, (3.53 feet/year) and the acreage in the pasture and wildlife area (133,952 acres).

The available supply of water from the irrigated area is estimated at 125,000 acre/feet in 1990 and 252,000 acre/feet in 2020. Some storage may be required by the year 2000 in order to maximize use of the available water.

Consequently, additional water must be obtained if all the pasture and wildlife land is to be supplied summer water.

Dilution of water from portions of the irrigated area is required in order to meet the 3,000 Parts Per Million (PPM) maximum of Total Dissolved Solids (TDS) as a condition of acceptance.

In order to use the water from the irrigated area as close to the source as possible, five use areas were established. Boundaries of the use areas coincide with topographic features or political lines and are intended to make maximum use of present facilities. Existing canals will in most cases be adequate with proper maintenance and the installation of water control structures. Some additional canals will be necessary to make efficient use of available water. The area to be served water for summer irrigation must be selected before channel requirements can be determined.

Some discharge will be made from the pasture and wildlife area even under ideal management conditions. Seven possible methods of accomplishing this discharge are presented.

RECOMMENDATIONS

It is recommended that:

1. A plan of action be developed which lists items of work to be performed according to priorities.
2. Land and conveyance facilities be developed to utilize water currently available before seeking additional water supply.
3. A system of monitoring stations be established to measure water quality and flow from the irrigated area and at various points within the wildlife and pasture area.
4. A continuous program be initiated to determine the present and future salt content and soil condition at various points within the pasture and wildlife area to include:
    a. Areas which use only winter wildlife water.
    b. Areas which use winter wildlife water and summer water.
    c. Areas which use only summer water.
    d. Areas with a high ground water table where no surface water is applied.

I. IRRIGATED AREAS (Source of Water)

The source of water is primarily from seven major areas:

- Central California Irrigation District Area (CCID) - that area served directly by CCID instead of through a canal company. Figure 2-4.
- Panoche Area, Figure 5.
- Broadview Area, Figure 5.
- Firebaugh Area, Figure 4.
- Poso Area, Figure 6.
- Dos Palos Area, Figure 6.
- San Luis Area, Figure 7.

Extensive work has been done in much of the irrigated area to establish drainage mains which serve as major outlets for drainage water from both surface and subsurface sources. General drainage can be improved further by the installation of on-farm drainage systems.

A. CCID North Area, Figure 2

CCID North, consists of that area north of Highway 152 along the west side of the study area. It includes the Gustine Drainage District; the area served directly by the Central California Irrigation District (CCID); the area above the CCID service area which contributes to the drainage flow; and the city of Los Banos. The total area of CCID North is 75.8 square miles (48,530 acres). The drainage is primarily from the surface flow and open drains, except in the Gustine Drainage District, and is discharged directly into the pasture

and wildlife area at 23 points. Much of the surface flow is intercepted by the Delta-Mendota and the CCID Outside Canals. Drainage within the Gustine Drainage District is by pumped drainage wells.

The Gustine Drainage District has more than 30 pumped drainage wells that provide subsurface drainage for the area. The District has asked the Gustine-Romero Resource Conservation District for assistance to determine their overall drainage need, drainage yields, and drainage water quality and in the development of a long range plan for drainage water re-use to improve wildlife habitat and native pasture. That request is not part of this report.

B. CCID Central Area, Figure 3

This area lies along the west side of the study area and is bound by Highway 152 on the north and the Fresno County line on the south. It is made up of an area served by CCID and private systems.

The total area is approximately 62.4 square miles (39,942 acres). Much of the surface water is intercepted by the Delta-Mendota and the CCID Main and Outside Canals. Subsurface drainage has been developed in the southern part of the area by open drains and tile systems. Water discharges into the pasture and wildlife area at eleven points.

Improved drainage channels and a siphon under the CCID Outside Canal is needed to improve drainage service to the

Woo and Hamburg Ranches. Other areas have adequate drainage outlets, however, maintenance is needed in some areas.

C. CCID South Area, Figure 4

CCID South consists of the area in Fresno County between the CCID Outside and Main Canals. It is located primarily between the cities of Firebaugh and Mendota. The total area is approximately 19.9 square miles (12,736 acres).

A drainage channel paralleling the CCID Main Canal serves as a drainage outlet for the major portion of the area as well as for the Firebaugh Area. Approximately one square mile of area around the city of Firebaugh drains directly into the San Joaquin River. Approximately 5.5 square miles of area south of Firebaugh drains into the San Joaquin River through the Firebaugh Wasteway of the Delta-Mendota Canal.

The major point of discharge of the Southern Unit is through the Main Drain to Camp 13 Drain directly into the pasture and wildlife area. One minor discharge occurs under the Main Canal into the Rice Drain Watershed of the Poso Area.

Existing main channels are adequate to meet present and future drainage needs.

D. Firebaugh Area, Figure 4

The Firebaugh Area is located just northwest of the city of Mendota and west of the city of Firebaugh above the CCID

Outside Canal. It consists primarily of the Firebaugh Canal Company. The Delta-Mendota Canal goes approximately through the center of the area.

The area contains approximately 39.4 square miles (25,200 acres) and has three points of discharge.

Approximately 9.10 square miles drain into the Firebaugh Wasteway of the Delta-Mendota Canal. Approximately 16.3 square miles, discharge into the Main Drain at the central point, and approximately 14.0 square miles, discharge into the Main Drain at the northern point.

Existing main channels are adequate with regular maintenance to meet present and future drainage needs.

E. Panoche Area, Figure 5

The Panoche Area is located in the southwestern part of the study area and contains approximately 70 square miles (44,794 acres). It consists primarily of the Panoche Water District.

Subsurface drainage is well developed in much of the area, and additional tile drainage is being installed each year. Approximately 14 miles of additional drainage mains are needed to provide an outlet at least every mile.

Discharge for the entire area occurs at a siphon under the CCID Outside Canal. The drainage discharge flows directly into the pasture and wildlife area by the Agatha Canal.

The Panoche Water District has a formal agreement with the Grassland Water District which allows them to discharge 60 cubic feet per second at a quality not to exceed 3,000 PPM-TDS.

F. Broadview Area, Figure 5

The Broadview Area is located in the southern part of the study area between the Panoche Area and the Firebaugh Area. It consists entirely of the Broadview Water District. A drainage channel parallel to the Firebaugh Third Lift Canal serves as an outlet for the entire area. Although the district consists of only approximately 15.4 square miles (9,850 acres) an additional 14.2 square miles drains into the same channel. At present all the drainage flow is re-circulated into the Broadview irrigation system. This has created a serious problem in the purchase and delivery of irrigation water since at times drainage accounts for more than 50 percent of the supply.

The drainage water is usually of good quality, under 1,000 PPM-TDS, but is high in boron and poses a hazard for boron sensitive crops, and of course will create a salt problem if allowed to continue.

The area is fairly well drained by a system of drainage channels located approximately every mile which serve as outlets for farm drainage systems. Approximately 3½ miles of additional mains are needed.

G. Dos Palos Area, Figure 6

The Dos Palos Area consists of approximately 14 square miles of area (8,922 acres) located in the south central part of the study area between the Poso and San Luis areas. It consists primarily of the Dos Palos Drainage District. Flows are discharged from the area at five points.

Drainage for the area is primarily by pumped well drains. Much of the water is used for irrigation on land adjacent to the wells or discharged into irrigation canals nearby.

Some interest has been expressed concerning a study of overall drainage needs, water quality, and the amount of water produced. Those items are not a part of this report.

H. Poso Area, Figure 6

The Poso Area is located in the southeastern part of the study area adjacent to the San Joaquin River. It is one of the larger drainage areas and consists of approximately 80 square miles (50,995 acres), and consists almost entirely of the Poso Canal Company.

The area north of the Santa Fe Grade is fairly well drained by a network of natural drains and sloughs. Approximately 2½ miles of new drainage mains are needed to establish an outlet every mile. South of the Santa Fe Grade the soil is finer textured and needs additional drainage mains so that on-farm drainage can be developed. Approximately 10 miles of additional mains are needed. Drainage from this area which

is approximately 16.2 square miles (10,368 acres) discharges through the Rice Drain and the Agatha Canal into the pasture and wildlife area. Approximately 2.7 square miles (1,734 acres) north of the Santa Fe Grade and west of Holland Avenue is drained by the Shain Drain. It also discharges into the Agatha Canal.

The remainder of the Poso Canal Company drainage is discharged primarily at three points which flow directly into the San Luis Canal Company and is used to supplement their irrigation water supply.

I. San Luis Area, Figure 7

The San Luis Area, consisting entirely of the San Luis Canal Company, contains approximately 77 square miles (49,235 acres) and is located in the eastern central part of the study area adjacent to the San Joaquin River. The area is drained by a series of sloughs and natural channels. The channels have been improved under the Canal Company drainage program and are adequate to meet drainage needs for main outlets. On-farm drainage needs to be developed in the southwestern part of the area. Much of the drainage water is reused for irrigation along with that supplied from the Poso Area. Drainage water is discharged primarily at four points into Mud Slough and Salt Slough.

II. SOILS AND DRAINAGE COEFFICIENT

The soils in the study area occur primarily in three physiographic positions; (1) soils of older alluvial fans which occupy the higher elevations along the west side of the study area; (2) soils of recent alluvial fans which occupy the lower fans; and (3) soils of alluvial basins and flood plains which occupy the lower areas primarily throughout the pasture and wildlife area and along the east side of the study area.

These soils have been classified according to profile characteristics based on irrigation requirements and are placed into groups that would require similar management. The characteristics of the groups are described in the "Soil Conservation Service Irrigation Guide," and are referred to as Irrigation Site Indexes.

They may be used to estimate irrigation water requirements and frequency of irrigation for various crops.

Correlation between irrigation requirements and the peak subsurface drainage flow allows further placement of soils into drainage coefficient groups shown on Figure 8.

Peak flow in cubic feet per second, based on complete drainage can be determined by multiplying the drainage area in acres by the drainage coefficient in inches per hour.

III. SPECIAL DISTRICTS

The study area contains more than 20 irrigation districts, water districts, and canal companies plus several drainage districts and is also covered by the Panoche, Firebaugh, Poso, Grasslands, Los Banos, San Luis, Gustine-Romero, and Stevinson Resource Conservation Districts. The various districts overlap into a complex pattern as shown on Figures 9 and 10.

IV. DRAINAGE DEVELOPMENT AND NEED

It is anticipated that much of the irrigated area will need subsurface drainage within the next 50 years to control the high water table or to maintain a favorable salt balance.

It is estimated that adequate drainage will be developed for the irrigated area by the year 2020. It is further estimated that half of the irrigated area will be adequately drained by the year 1990.

The level of drainage development at the present time can be described by dividing the irrigated area into three categories:

Area Adequately Drained, subsurface drainage exists to such a degree that the ground water table can be controlled at a desired level. This can normally be accomplished only by a subsurface drainage system of tile or deep open drains.

Area Partially Drained, the water table is partially controlled and crop production or variety of crop grown is not substantially affected.

Area Poorly Drained, the ground water is uncontrolled and has risen to an elevation where either the water table or accumulated salts severely limit crop growth or the type of crop that can be grown.

These categories, shown on Figure 11, have been established based on experience and records of the area and through discussions with district personnel.

V. DRAINAGE FLOWS

A. Present Flow

Each of the nine major subareas, Figure 2 through 7, have been considered separately as to their drainage flow. The amount of water produced in many cases is based on estimates of average monthly flow.

Records were used where available. The amount of water used by owners or districts adjacent to the channels upstream of the discharge points is not reflected in the flow records.

Present flows have been listed in Tables 7 through 30 where records were available or where a reasonable estimate could be made.

Hydrographs have been developed for the various areas and represent present conditions. These curves were used as a basis for predicting future flows and represent surface and subsurface quantities.

B. Future Flow

The present trend is toward the development of subsurface drainage and the elimination of surface water flow by returning the excess water to the irrigation system on each individual farm for reuse. Based on this trend, the percent of surface water in the drainage flow will decrease in the future and the percent of subsurface water will increase.

Characteristic hydrographs were developed for each area based on present conditions of both surface and subsurface drainage. Average monthly flows were used to calculate total discharge. Peak flows were related to the average discharge rate.

Since the present and future condition is related to the soils and the application of irrigation water, which is characteristic to each area, it was assumed that the future hydrograph would be similar to the hydrograph based on present conditions.

Future peak flows were based on the drainage coefficients shown on Figure 8 and consider subsurface flow only.

The ratio of peak flow to average flow was assumed to apply to future conditions and was used to predict future discharge. The hydrograph characteristic to each area was used to relate the future discharge to the average monthly flow.

Twenty-four points as shown on Figure 1 through 7 were selected within the study area where major discharge of

drainage water occurs. These points are used for predicting future flows.

Future discharges with full development have been estimated for each of the nine major contributors within the study area listed in Table 1 as well as for each of the 24 stations, shown in Table 2. More detailed information is given in the Engineering Appendix of this report.

Table 2, lists the 24 stations where maximum future flows have been estimated and the drainage area above each station. The peak flow is based on complete drainage development in the irrigated area.

Table 3, lists the estimated average monthly flow in cubic feet per second (cfs) for the various stations based on the 50 year development.

Table 4, lists the calculated discharge for the stations in acre feet per month based on estimated average monthly flows.

TABLE 1

MENDOTA-GUSTINE STUDY

Irrigated Units, Areas & Flows

Unit	Area*		Peak Flow**
	Sq.Mi.	Acres	cfs
CCID (North)	75.83	48,531	236
CCID (Central)	62.41	39,942	150
CCID (South)	19.90	12,736	44
Panoche	69.99	44,794	166
Broadview	15.39	9,850	36
Firebaugh	39.38	25,203	91
Poso	79.68	50,995	184
Dos Palos Drainage District	13.94	8,922	31
San Luis Canal Co.	76.93	49,235	192
Total	453.45	290,208	1,130

* Includes area where drainage is intercepted by canals.

** Peak flows are based on simultaneous irrigation of the units and complete subsurface drainage development for the year 2020.

TABLE 2

MENDOTA-GUSTINE STUDY

Drainage Stations, Contributing Areas, & Estimated Peak Flows

(See Figure 1 for Location of Points.)

Station Number and Outlet	Unit	Area-Sq.Mi.*	Peak Flow**
1. Newman Spillway	CCID North	0.91	2
2. Grazas Creek	" "	----	--
3. San Luis Creek	" "	4.25	11
4. San Luis Wasteway	" "	5.70	14
5. Los Banos Creek	" "	5.03	13
6. Johnson Field Drain	" "	4.84	12
7. Airport Drain	" "	3.43	9
8. San Luis Canal	CCID Central	2.98	8
9. Ballotti Drain	" "	1.71	4
10. Woo Drain	" "	9.83	23
11. Camp 13 Drain	" " & CCID South	56.57	130
12. Panoche Drain (12A. Panoche Area - 70.0 sq.mi. - 166 cfs peak) (12B. Broadview Area - 15.4 sq.mi. - 36 cfs peak)	Panoche & Broadview Areas	85.38	202
13. Rice Drain	Poso & Dos Palos Areas	18.87	42
14. Firebaugh-Des Jardins	Firebaugh Area	13.96	31
15. Firebaugh-Santa Fe	" "	16.32	39
16. Firebaugh Wasteway	" & CCID South	14.61	34
17. San Luis Drain	San Luis Area	3.77	8
18. Salt Slough	" " "	51.62	131
19. Devon Drain	" " "	11.11	27
20. Boundary Drain	" " "	9.94	22
21. Cozzi Drain	CCID Central & Dos Palos	8.85	20
22. Wood Slough	Poso Area	13.09	33
23. San Juan Drain	" "	12.33	28
24. Poso Slough	Poso & Dos Palos Areas	38.18	87
		393.28	

* Does not include areas intercepted by canals.

** Based on drainage development for year 2020 with no dilution.

TABLE 3

MENDOTA-GUSTINE STUDY

Drainage Stations - Estimated Average Monthly Flows (no quality control)
in Cubic Feet per second (cfs) for year 2020

Station	Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
1.	- - - - - - - - - - - - - - - - Not Applicable -											
2.	- - - - - - - - - - - - - - - - - Needs Further Study -											
3.	2.8	4.1	5.4	6.5	6.9	7.1	6.8	6.6	4.0	2.4	3.1	2.6
4.	1.5	2.1	2.8	3.4	3.7	3.7	3.6	3.5	2.1	1.3	1.7	1.4
5.	3.3	4.7	6.2	7.6	8.0	8.2	7.9	7.7	4.6	2.8	3.6	3.1
6.	3.2	4.7	6.2	7.5	5.9	8.1	7.8	7.6	4.6	2.8	3.6	3.0
7.	2.3	3.3	4.4	5.3	5.6	5.6	5.5	5.4	3.3	2.0	2.5	2.1
8.	2.0	2.9	3.8	4.6	4.9	5.0	4.8	4.7	2.8	1.7	2.2	1.9
9.	1.1	1.6	2.1	2.5	2.7	2.8	2.6	2.6	1.6	1.0	1.2	1.0
10.	5.9	8.6	11.4	13.8	14.6	15.0	14.4	14.1	8.5	5.2	6.6	5.6
11.	14.9	33.1	35.7	47.4	66.1	74.1	71.6	74.9	47.6	22.4	19.1	13.6
12.	44.3	67.0	87.6	108.2	117.1	122.0	117.3	108.8	63.4	39.9	51.7	42.1
13.	3.9	7.6	12.4	20.3	30.1	33.3	34.7	34.9	32.4	10.4	7.4	3.9
14.	1.5	5.3	3.1	6.8	9.6	11.0	11.2	15.0	11.8	4.3	2.4	1.7
15.	1.8	8.3	8.2	10.7	20.3	24.3	23.3	23.4	13.9	6.0	3.3	1.3
16.	0.0	3.8	7.7	12.2	7.5	9.7	14.3	12.6	8.9	2.4	0.8	0.2
17.	0.8	1.4	2.4	3.4	4.2	5.1	5.7	6.1	5.8	3.7	2.5	1.4
18.	13.2	21.0	36.8	52.6	65.7	78.9	89.4	94.7	89.4	57.9	39.4	21.0
19.	2.7	4.4	7.7	10.9	13.7	16.4	18.6	19.7	18.6	12.0	8.2	4.4
20.	3.0	5.9	11.8	14.8	17.7	19.2	21.1	20.1	17.7	8.9	5.9	3.0
21.	2.7	5.4	10.9	13.6	16.3	17.7	19.4	18.5	16.3	8.2	5.4	2.7
22.	3.3	5.3	9.3	13.3	16.6	19.9	22.6	23.9	22.6	14.6	10.0	5.3
23.	3.2	4.0	6.4	8.8	12.0	16.0	18.4	18.4	15.2	10.4	5.6	3.2
24.	11.6	23.2	46.4	58.0	69.6	75.4	81.2	78.9	69.6	34.8	23.2	11.6

TABLE 4

MENDOTA-GUSTINE STUDY

Drainage Stations - Estimated Average Monthly Discharge in Acre Feet
(No quality control) for year 2020

Sta.	Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total A/Ft
1.	- Not Applicable -												
2.	- Needs Further Study -												
3.	173	227	332	389	427	423	420	410	239	151	186	163	3,540
4.	92	120	176	206	226	224	222	217	126	80	99	86	1,874
5.	201	264	387	454	497	493	489	478	278	176	217	189	4,123
6.	199	260	381	447	490	486	482	471	274	174	214	187	4,065
7.	141	185	270	317	348	345	342	334	194	123	152	132	2,883
8.	122	160	234	275	301	299	296	290	169	107	132	115	2,500
9.	67	88	129	151	166	165	163	160	93	59	73	63	1,377
10.	367	482	705	828	907	900	892	872	507	322	396	346	7,524
11.	916	1,852	2,209	2,836	4,083	4,432	4,434	4,643	2,847	1,389	1,139	840	31,620
12.	2,747	3,754	5,422	6,487	7,255	7,316	7,276	6,745	3,798	2,478	3,097	2,615	58,990
13.	249	426	768	1,215	1,864	1,996	2,146	2,157	2,017	651	442	246	14,177
14.	91	298	190	402	589	653	690	924	698	263	139	102	5,039
15.	113	465	508	640	1,257	1,459	1,443	1,451	835	371	195	81	8,818
16.	0	211	478	737	458	587	888	782	532	152	50	11	4,886
17.	52	75	146	202	261	303	355	376	343	230	151	84	2,578
18.	813	1,174	2,275	3,145	4,062	4,718	5,528	5,852	5,347	3,577	2,359	1,302	40,152
19.	169	244	473	654	844	980	1,149	1,216	1,111	743	490	271	8,344
20.	183	330	731	885	1,097	1,151	1,280	1,243	1,062	549	354	183	9,048
21.	169	304	673	815	1,010	1,059	1,178	1,144	977	505	326	169	8,329
22.	206	297	576	797	1,029	1,195	1,400	1,482	1,355	906	598	329	10,170
23.	198	224	397	528	744	960	1,141	1,141	912	645	336	198	7,424
24.	719	1,299	2,877	3,480	4,315	4,524	5,034	4,891	4,176	2,158	1,392	719	35,584

VI. WATER QUALITY

The Grassland Water District has established a quality standard for drainage water of 3,000 parts per million (PPM), Total Dissolved Solids (TDS) maximum, as a condition of acceptance. This maximum has been used in this report as applying to all water entering the pasture and wildlife area.

Studies conducted by the California Department of Water Resources indicate that the average drain tile quality for the area west of the Santa Fe Grade is about 4,200 PPM - TDS. See Table 5.

The study also indicates that the quality of the tile drainage water will improve with time at the rate of:

$$Y = 11.74\ X^{-0.30} \qquad (1)$$

where Y = Electrical Conductivity (E.C.) in millimhos per centimeter

and X = tile system age in years.

Based on this equation and known relationships between Total Dissolved Solids (TDS) and electrical conductivity, (E.C.) the tile drainage water quality will reach 3,000 PPM-TDS in approximately 20 years and 2,300 PPM-TDS in 50 years.

Boron and Sodium concentrations in this water is generally high. Intensive management in the use area is necessary to prevent salt build up and related detriment to plant growth.

The subsurface water quality east of the Santa Fe Grade is of much higher quality, especially adjacent to the San Joaquin River. A review of literature on analysis of water in shallow

wells (wells less than 100 feet in depth) was made for the area east of the Santa Fe Grade. The area east of the grade was further divided by Henry Miller Avenue. The average TDS for the area north of Henry Miller was 2,740 PPM, while that to the south was 846 PPM.

It is assumed that this TDS of less than 3,000 PPM represents the ground water quality east of the Santa Fe Grade since analyses are not available for drains strictly from ground water flow. Subsurface tile drains have not been installed in this area.

Table 6, shows the average TDS in Salt Slough near J-14 after leaving the San Luis Area to be near 1,000 PPM average for the six year period from 1964 - 1969.

Water originating in the Poso Area is reused in the San Luis Area.

In the event that the water quality deteriorates to over 3,000 PPM-TDS, dilution will be necessary. Presently, however, quality control will not be needed in the San Luis Canal Company or in the Poso Area, except for the Rice and Shain Drains.

The estimated 20 year flow (Year 1990) in these areas is based on the irrigation leaching requirement. The 50 year drainage flow (year 2020) will be based on full development of drainage without quality control.

TABLE 5

MENDOTA-GUSTINE STUDY

Subsurface Drainage Water Quality

Mendota-Gustine area drain tile quality PPM-TDS for the area West of the Santa Fe Grade based on TDS/EC = 0.70 from California Department of Water Resources unpublished data.

Month	Average Monthly Concentration TDS - PPM 1967	1968
January	4,150	4,350
February	4,200	3,950
March	4,000	4,260
April	4,100	4,500
May	4,680	4,430
June	4,260	4,220
July	4,090	4,260
August	3,550	3,450
September	4,250	4,050
October	4,850	4,260
November	4,800	4,540
December	4,360	4,250
Total	51,290	50,880
Average	4,274	4,240

TABLE 6

MENDOTA-GUSTINE STUDY

Water Quality Salt Slough near J-14 (Mercy Springs Road)*

Year		Monthly Average TDS - PPM
1964		1,096
1965		1,021
1966		1,096
1967		1,310
1968		883
1969		655
	Total	6,061
	Average	1,010

* Bulletin No. 130, California Department of Water Resources, Volume IV, 1964-1969. The station was formerly located at the San Luis Ranch, near Station No. 17.

VII. QUALITY CONTROL

Quality control of drainage water where necessary may be accomplished by dilution.

The amount of water needed for dilution depends on the amount and quality of the drainage flow and the quality of the water used for dilution.

Equations (2) and (3) can be combined to produce equation (4) which allows computation of the amount of known quality dilution water needed to achieve a desired quality of the entire discharge.

$$Fd + Fi = Fq \qquad (2)$$

$$FdCd + FiCi = FqCq \qquad (3)$$

$$Fi = Fd \frac{(Cd-Cq)}{(C_q-C_i)} \qquad (4)$$

The dilution factor is the parenthesis portion of equation (4). That is;

$$\text{Dilution Factor} = \frac{(Cd-Cq)}{(Cq-Ci)} \qquad (5)$$

Where:

Fd = Discharge of drainage water (cubic feet per second or acre feet).

Fi = Discharge of dilution water which is usually from an irrigation source (cubic feet per second or acre feet).

Fq = Discharge of the "quality controlled" water. (consistent units).

Cd = Concentration of drainage water (Electrical conductivity or PPM-TDS).

Ci = Concentration of dilution water (Electrical conductivity or PPM-TDS).

Cq = Concentration of "quality controlled" water (Electrical conductivity or PPM-TDS).

The dilution factor for irrigation water of 300 PPM, drainwater of 4,200 PPM, and a controlled quality of 3,000 PPM-TDS is 0.44 or the addition of dilution water equivalent to 44 percent of the drainage flow. Using dilution water of 500 PPM would result in a dilution factor of 0.48 or 48 percent of the drainage flow under the above conditions.

VIII. LEACHING REQUIREMENT

Leaching requirement is defined as the amount of water that must pass through the root zone in order to prevent soil salinity from exceeding a specified value. It is usually expressed as a depth of water or as a percent of the irrigation water applied. It can be expressed in equation form as follows:

$$LR = \frac{D_d}{D_i} = \frac{C_i}{C_d} \quad \text{or} \qquad (6)$$

$$D_d = \frac{C_i}{C_d} \; D_i \qquad (7)$$

Where:

LR = Leaching Requirement

D_d = Depth of drainage water (feet or inches)

D_i = Depth of irrigation water (feet or inches)

C_i = Concentration of irrigation water (electrical conductivity or PPM)

C_d = Concentration of drainage water (electrical conductivity or PPM)

The leaching requirement as defined above is not intended to improve the salt balance within the soil profile. It only maintains the salt balance once it is reached.

The leaching requirement based on 3,000 PPM-TDS drainage water and 300 PPM irrigation water is 10 percent and based on 500 PPM irrigation water is 17 percent.

The drainage discharge from leaching was based on the gross application of 5 acre feet per year of irrigation water and a leaching requirement of 10 percent.

There is an area in the valley that is primarily interested in wildlife habitat improvement and waterfowl hunting as recreation. These interests have organized into the Grassland Water District and have contracted delivery of winter water for waterfowl purposes from the U. S. Bureau of Reclamation.

More than 58,000 acre feet of this high quality water is applied each year between September 15 and December 1 on the pasture and wildlife area within the Grassland Water District. Additional water is obtained when the CCID Canal system is drained for maintenance. This helps to create a favorable salt balance in the area through leaching and removal of salts with the water when the ponds are drained in the spring. Rainfall which averages about 8 inches per year also contributes to leaching.

IX. FUTURE DRAINAGE DISCHARGE

Tables 7 through 30 list the monthly discharge at present (where available), for the 50 year development without quality control, the 20 year (1990) and the 50 year (2020) development with dilution water added for quality control.

The discharge for 50 year development (year 2020) "with no quality control" is based on subsurface drainage development over the entire irrigated area to fully control the ground water table.

Drainage discharge for 20 year development (year 1990) "with quality control" is based on the installation of drains over 50 percent of the irrigated area with a quality control factor applied for dilution where required or the leaching requirement as indicated.

Until the desired salt balance is reached, any water coming from the bottom of the root zone will have to be diluted to meet the water quality standard of 3,000 PPM-TDS.

The discharge for 50 year development "with quality control" is based on drain installation over the entire irrigated area with dilution water applied to meet the 3,000 PPM-TDS standard.

At some point in the future, after adequate leaching has occurred, dilution of drainage effluent will no longer be required and the drainage flow and quality can be calculated based on leaching requirement for the quality and amount of irrigation water applied.

Stations 3 through 15 and 17 through 20 are west of the Santa Fe Grade and discharge directly into the pasture and wildlife area and the water is available for reuse.

Stations 21 through 24 are east of the Santa Fe Grade, and the water is reused extensively before discharging into the pasture and wildlife area, and is not considered available in future flows. Quality control of the water originating from this area is not anticipated since all the water is below 3,000 PPM-TDS.

Quality control where needed is based on the average drainage water quality listed in Table 5 diluted to 3,000 PPM-TDS with dilution water of 300 PPM-TDS.

TABLE 7

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 3 (San Luis Creek)

Area = 4.25 sq. mi.
= 2,720 acres
L.R. = (0.5)(2,720) = 1,360 A.F./year

Month	Present Discharge A.F.	CFS	No Quality Control Year 2020 Development A.F.	CFS	With Quality Control Year 1990 Development* A.F.	CFS	Year 2020 Development A.F.	CFS
J	No Records		173	2.8	127	2.1	253	4.1
F	Available		227	4.1	159	2.9	318	5.7
M			332	5.4	236	3.9	471	7.7
A			389	6.5	288	4.7	576	9.4
M			427	6.9	335	5.4	670	10.8
J			423	7.1	309	5.2	618	10.4
J			420	6.8	303	4.9	605	9.8
A			410	6.6	244	4.0	488	7.9
S			239	4.0	171	2.9	342	5.7
O			151	2.4	124	2.0	248	3.9
N			186	3.1	151	2.5	301	5.0
D			163	2.6	121	2.0	241	3.9
Total			3,540	58.3	2,568	42.5	5,131	84.3
Average			295	4.9	214	3.5	428	7.0

* Based on installation of drains over 50% of the area.

TABLE 8

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 4 (San Luis Wasteway)

Area = 5.70 sq. mi. = 3,648 acres
L.R. = (.5)(3,648) - 1,824 A.F./year

Month	Present Discharge A.F.	Present Discharge CFS	No Quality Control: Year 2020 Development A.F.	No Quality Control: Year 2020 Development CFS	With Quality Control: Year 1990 Development* A.F.	With Quality Control: Year 1990 Development* CFS	With Quality Control: Year 2020 Development A.F.	With Quality Control: Year 2020 Development CFS
J	No Records		92	1.5	90	1.5	134	2.2
A	Available		120	2.1	113	1.9	168	2.9
M			176	2.8	168	2.7	250	4.0
A			206	3.4	204	3.4	305	5.0
M			226	3.7	238	3.9	355	5.8
J			224	3.7	219	3.6	327	5.4
J			222	3.6	214	3.5	320	5.2
A			217	3.5	173	2.8	258	4.2
S			126	2.1	121	2.0	180	3.0
O			80	1.3	88	1.4	131	2.1
N			99	1.7	107	1.9	160	2.8
D			86	1.4	85	1.4	127	2.1
Total			1,874	30.8	1,820	30.0	2,715	44.7
Average			156	2.6	152	2.5	226	3.7

* Based on leaching requirement which is 67% of potential drainage requirement.

TABLE 9

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 5 (Los Banos Creek)

Area = 5.03 sq. mi. = 3,219 acres
L.R. = (.50)(3,219) = 1,610 A.F./year

Month	Present Discharge A.F.	CFS	No Quality Control Year 2020 Development A.F.	CFS	With Quality Control Year 1990 Development* A.F.	CFS	Year 2020 Development A.F.	CFS
J	No Records		201	3.3	147	2.4	294	4.8
F	Available		264	4.7	185	3.3	370	6.6
M			387	6.2	275	4.4	550	8.8
A			454	7.6	336	5.7	672	11.3
M			497	8.0	390	6.3	780	12.6
J			493	8.2	360	6.0	720	12.0
J			489	7.9	352	5.7	704	11.4
A			478	7.7	285	4.6	569	9.2
S			278	4.6	199	3.3	398	6.6
O			176	2.8	145	2.3	289	4.6
N			217	3.6	176	2.9	352	5.8
D			189	3.1	140	1.4	280	4.6
Total			4,123	67.7	2,990	48.3	5,978	98.3
Average			344	5.6	249	4.0	498	8.2

* Based on installation of drains over 50% of the area.

TABLE 10

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 6 (Johnson Field Drain)

Area = 4.84 sq. mi. = 3,098 acres
L.R. = (.5)(3,098) = 1,549 A.F./year

Month	Present Discharge A.F.	Present Discharge CFS	No Quality Control: Year 2020 Development A.F.	No Quality Control: Year 2020 Development CFS	With Quality Control: Year 1990 Development* A.F.	With Quality Control: Year 1990 Development* CFS	With Quality Control: Year 2020 Development A.F.	With Quality Control: Year 2020 Development CFS
J	No Records		199	3.2	146	2.4	291	4.7
F	Available		260	4.7	182	3.3	364	6.6
M			381	6.2	271	4.4	541	8.8
A			447	7.5	331	5.6	662	11.1
M			490	7.9	384	6.2	769	12.4
J			486	8.1	355	5.9	710	11.8
J			482	7.8	347	5.6	694	11.2
A			471	7.6	281	4.5	561	9.0
S			274	4.6	196	3.3	392	6.6
O			174	2.8	143	2.3	285	4.6
N			214	3.6	174	2.9	347	5.8
D			187	3.0	139	2.2	277	4.4
Total			4,065	67.0	2,949	48.6	5,893	97.0
Average			339	5.6	246	4.1	491	8.1

* Based on installation of drains over 50% of the area.

TABLE 11

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 7 (Airport Drain)

Area = 3.43 sq. mi. = 2,195 acres
L.R. = (.5)(2,195) = 1,098 A.F./year

Month	Present Discharge A.F.	CFS	No Quality Control Year 2020 Development A.F.	CFS	With Quality Control Year 1990 Development* A.F.	CFS	Year 2020 Development A.F.	CFS
J	No Records		141	2.3	103	1.7	206	3.4
F	Available		185	3.3	130	2.3	259	4.6
M			270	4.4	192	3.2	383	6.3
A			317	5.3	235	3.9	469	7.8
M			348	5.6	273	4.4	546	8.8
J			345	5.6	252	4.1	504	8.2
J			342	5.5	247	4.0	493	7.9
A			334	5.4	199	3.2	397	6.4
S			194	3.3	139	2.4	277	4.7
O			123	2.0	101	1.7	202	3.3
N			152	2.5	123	2.1	246	4.1
D			132	2.1	98	1.6	195	3.1
Total			2,883	47.3	2,092	34.6	4,177	68.6
Average			240	3.9	174	2.9	348	5.7

* Based on installation of drains over 50% of the area.

TABLE 12

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 8 (San Luis Canal)

Area = 2.98 sq. mi. = 1,907 acres
L.R. = (.5)(1,907) = 954 A.F./year

Month	Present Discharge A.F.	Present Discharge CFS	No Quality Control: Year 2020 Development A.F.	No Quality Control: Year 2020 Development CFS	With Quality Control: Year 1990 Development* A.F.	With Quality Control: Year 1990 Development* CFS	With Quality Control: Year 2020 Development A.F.	With Quality Control: Year 2020 Development CFS
J	No Records		122	2.0	89	1.5	178	2.9
F	Available		160	2.9	112	2.1	224	4.1
M			234	3.8	166	2.7	332	5.4
A			275	4.6	204	3.4	407	6.8
M			301	4.9	237	3.9	473	7.7
J			299	5.0	219	3.7	437	7.3
J			296	4.8	213	3.5	426	6.9
A			290	4.7	173	2.8	345	5.6
S			169	2.8	121	2.0	242	4.0
O			107	1.7	88	1.4	176	2.8
N			132	2.2	107	1.8	214	3.6
D			115	1.9	85	1.4	170	2.8
Total			2,500	41.3	1,814	30.2	3,624	59.9
Average			208	3.4	151	2.5	302	5.0

* Based on installation of drains over 50% of the area.

TABLE 13

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 9 (Balloti Drain)

Area = 1.71 sq. mi. = 1,094 acres
L.R. = (0.5)(1,094) = 547 A.F./year

Month	Present Discharge A.F.	Present Discharge CFS	No Quality Control: Year 2020 Development A.F.	No Quality Control: Year 2020 Development CFS	With Quality Control: Year 1990 Development* A.F.	With Quality Control: Year 1990 Development* CFS	With Quality Control: Year 2020 Development A.F.	With Quality Control: Year 2020 Development CFS
J			67	1.1	49	0.8	98	1.6
F			68	1.6	62	1.1	123	2.2
M			129	2.1	92	1.5	183	3.0
A			151	2.5	112	1.9	224	3.7
M			166	2.7	131	2.1	261	4.2
J			165	2.8	121	2.1	241	4.1
J			163	2.6	118	1.9	235	3.7
A			160	2.6	95	1.6	190	3.1
S			93	1.6	67	1.2	133	2.3
O			59	1.0	49	0.8	97	1.6
N			73	1.2	59	1.0	118	1.9
D			63	1.0	47	0.8	93	1.5
Total			1,377	22.8	1,002	16.8	1,996	32.9
Average			115	1.9	84	1.4	166	2.7

* Based on installation of drains over 50% of the area.

TABLE 14

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 10 (Woo Drain)

Area = 9.83 sq. mi. = 6,291 acres
L.R. = (0.5)(6,291) = 3,146 A.F./year

Month	Present Discharge A.F.	Present Discharge CFS	No Quality Control: Year 2020 Development A.F.	No Quality Control: Year 2020 Development CFS	With Quality Control: Year 1990 Development* A.F.	With Quality Control: Year 1990 Development* CFS	With Quality Control: Year 2020 Development A.F.	With Quality Control: Year 2020 Development CFS
J			367	5.9	268	4.3	536	8.6
F			482	8.6	338	6.0	675	12.0
M			705	11.4	501	8.1	1,001	16.2
A			828	13.8	613	10.2	1,225	20.4
M			907	14.6	712	11.5	1,423	22.9
J			900	15.0	657	11.0	1,314	21.9
J			892	14.4	643	10.4	1,285	20.7
A			872	14.1	519	8.4	1,038	16.8
S			507	8.5	363	6.1	725	12.2
O			322	5.2	264	4.3	528	8.5
N			396	6.6	321	5.4	642	10.7
D			346	5.6	256	4.2	512	8.3
Total			7,524	123.7	5,455	89.9	10,904	179.2
Average			627	10.3	455	7.5	909	14.9

* Based on installation of drains over 50% of the area.

TABLE 15

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 11 (Camp 13 Drain)

Area = 56.6 sq. mi. = 36,205 acres
L.R. = (0.5)(36,205) = 18,103 A.F./year

Month	Present Discharge* A.F.	Present Discharge* CFS	No Quality Control: Year 2020 Development A.F.	No Quality Control: Year 2020 Development CFS	With Quality Control: Year 1900 Development** A.F.	With Quality Control: Year 1900 Development** CFS	With Quality Control: Year 2020 Development A.F.	With Quality Control: Year 2020 Development CFS
J	875	19.0	916	14.9	669	10.9	1,337	21.8
F	1,227	28.7	1,852	33.1	1,297	23.2	2,593	46.3
M	1,720	33.0	2,209	35.7	1,569	25.4	3,137	50.7
A	1,618	27.2	2,836	47.4	2,099	35.1	4,197	70.2
M	2,932	47.6	4,083	66.1	3,205	51.9	6,410	103.8
J	3,138	52.8	4,432	74.1	3,236	54.1	6,471	108.2
J	2,674	43.4	4,434	71.6	3,193	51.6	6,385	103.1
A	2,482	40.4	4,643	74.9	2,763	44.6	5,525	89.1
S	3,002	50.4	2,847	47.6	2,036	34.1	4,071	68.1
O	3,616	58.8	1,389	22.4	1,139	18.4	2,278	36.7
N	1,328	22.2	1,139	19.1	923	15.5	1,845	30.9
D	1,346	21.8	840	13.6	622	10.1	1,243	20.1
Total	25,958	445.3	31,620	520.5	22,751	374.9	45,492	749.0
Average	2,163	37.1	2,635	43.4	1,896	31.2	3,791	62.4

* USBR Records, 5 year average 1966-70.
** Based on installation of drains over 50% of the area.

(Includes flow from Station No. 14 and 15)

TABLE 16

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 12 (Panoche Drain Composit of 12-A & 12-B)

Area = 85.38 sq. mi. = 54,643 acres
L.R. = (0.5)(54,643) = 27,322 A.F./year

Month	Present Discharge* A.F.	CFS	No Quality Control Year 2020 Development A.F.	CFS	With Quality Control Year 1990 Development** A.F.	CFS	Year 2020 Development A.F.	CFS
J	1,445	23.3	2,747	44.3	2,054	33.1	4,010	64.7
F	1,895	33.8	3,754	67.0	2,774	49.5	5,256	93.8
M	2,775	44.8	5,422	87.6	4,021	65.0	7,699	124.4
A	3,255	54.3	6,487	108.2	5,086	84.8	9,601	160.1
M	3,570	57.6	7,255	117.1	6,117	98.8	11,390	183.8
J	3,540	59.0	7,316	122.0	5,800	96.7	10,681	178.1
J	3,510	56.6	7,276	117.3	5,700	91.9	10,477	168.9
A	3,430	55.3	6,745	108.8	4,213	68.0	8,027	129.5
S	1,995	33.3	3,798	63.4	2,783	46.5	5,431	90.7
O	1,265	20.4	2,478	39.9	2,128	34.3	4,064	65.4
N	1,560	26.0	3,097	51.7	2,651	44.3	5,017	83.8
D	1,360	21.9	2,615	42.1	1,998	32.2	3,870	62.3
Total	29,600	486.3	58,990	969.4	45,325	745.1	85,523	1,405.5
Average	2,467	40.6	5,916	80.8	3,777	62.1	7,127	117.1

* Panoche W.D. drainage only.
** Based on installation of drains over 50% of the area in the Panoche area and 90% in the Broadview area.

TABLE 17

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 12-A (Panoche)

Area = 69.99 sq. mi.
= 44,794 acres
L.R. = (0.5)(44,794, = 22,397 ' F./year

Month	Present Discharge A.F.	CFS	No Quality Control Year 2020 Development A.F.	CFS	With Quality Control Year 1990 Development* A.F.	CFS	Year 2020 Development A.F.	CFS
J	1,445	23.3	2,665	43.0	1,946	31.4	3,891	62.8
F	1,895	33.8	3,495	62.4	2,447	43.7	4,893	87.4
M	2,775	44.8	5,120	82.7	3,635	58.7	7,270	117.4
A	3,255	54.3	6,005	100.2	4,444	74.2	8,887	148.3
M	3,570	57.6	6,585	106.3	5,170	83.5	10,339	166.9
J	3,540	59.0	6,530	108.9	4,767	79.5	9,534	159.0
J	3,510	56.6	6,475	104.4	4,662	75.2	9,324	150.3
A	3,430	55.3	6,326	102.0	3,764	60.7	7,528	121.4
S	1,995	33.3	3,680	61.4	2,631	43.9	5,262	87.8
O	1,265	20.4	2,333	37.6	1,913	30.9	3,826	61.7
N	1,560	26.0	2,877	48.0	2,331	38.9	4,661	77.8
D	1,360	21.9	2,509	40.4	1,857	29.9	3,713	59.8
Total	29,600	486.3	54,600	897.3	39,567	650.5	79,128	1,300.6
Average	2,467	40.6	4,550	74.8	3,297	54.2	6,594	108.4

* Based on installation of drains over 50% of the area.

TABLE 18

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 12-B (Broadview area)

Area = 15.4 sq. mi. = 9,856 acres
L.R. = (0.5)(9,856) = 4,928 A.F./year

Month	Present Dischage*		No Quality Control** Year 2020 Development		With Quality Control** Year 1990 Development***		Year 2929 Development	
	A.F.	CFS	A.F.	CFS	A.F.	CFS	A.F.	CFS
J	137	2.2	82	1.3	108	1.7	120	1.9
F	431	7.4	259	4.6	327	5.8	363	6.4
M	504	8.1	302	4.9	386	6.3	429	7.0
A	803	13.4	482	8.0	642	10.6	713	11.8
M	1,116	18.0	670	10.8	947	15.3	1,052	17.0
J	1,310	21.8	786	13.1	1,033	17.2	1,148	19.1
J	1,336	21.6	801	12.9	1,038	16.7	1,153	18.6
A	699	11.3	419	6.8	449	7.3	499	8.1
S	196	3.3	115	2.0	152	2.6	169	2.9
O	241	3.9	145	2.3	215	3.4	239	3.8
N	367	6.1	220	3.7	320	5.4	356	6.0
D	176	2.8	106	1.7	141	2.3	157	2.5
Total	7,316	119.9	4,390	72.1	5,758	94.6	6,398	105.1
Average	610	10.0	366	6.0	480	7.9	533	8.8

* Includes runoff from 14.2 sq. mi. outside the Broadview W.D.
** Only Broadview W.D.
*** Based on installation of drains over 90% of the area

TABLE 19

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 13 (Rice Drain)

Area = 18.87 sq. mi.
= 12,077 acres
L.R. = (0.5)(12,077) = 6,039 A.F./year

Month	Present Discharge* A.F.	CFS	No Quality Control: Year 2020 Development A.F.	CFS	With Quality Control: Year 1990 Development** A.F.	CFS	Year 2020 Development A.F.	CFS
J	310	5	249	3.9	182	2.9	363	5.7
F	560	10	426	7.6	298	5.3	596	10.6
M	930	15	768	12.4	546	8.8	1,091	17.6
A	1,800	30	1,215	20.3	899	15.0	1,798	30.0
M	3,100	50	1,864	30.1	1,463	23.7	2,926	47.3
J	3,360	56	1,996	33.3	1,457	24.3	2,914	48.6
J	3,596	58	2,146	34.7	1,545	25.0	3,090	50.0
A	3,658	59	2,157	34.9	1,284	20.8	2,567	41.5
S	3,600	60	2,017	32.4	1,442	23.2	2,884	46.3
O	930	15	651	10.4	534	8.6	1,068	17.1
N	600	10	442	7.4	358	6.0	716	12.0
D	310	5	246	3.9	182	2.9	364	5.8
Total	22,754	373	14,177	231.3	10,190	166.5	20,377	332.5
Avg.	1,896	31	1,181	19.3	849	13.9	1,698	27.7

* Estimated by CCID Personnel.
** Based on installation of drains over 50% of the area.

TABLE 20

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 14 (Firebaugh - Des Jardins)

Area = 13.96 sq. mi.
= 8,934 acres
L.R. = (0.5)(8,934) = 4,467 A.F./year

Month	Present Discharge* A.F.	CFS	No Quality Control: Year 2020 Development A.F.	CFS	With Quality Control: Year 1990 Development** A.F.	CFS	Year 2020 Development A.F.	CFS
J	181	2.9	91	1.5	83	1.4	133	2.2
F	595	10.5	298	5.3	259	4.6	417	7.4
M	380	6.2	190	3.1	167	2.7	270	4.4
A	804	13.5	402	6.8	369	6.3	595	10.1
M	1,177	19.2	589	9.6	574	9.4	925	15.1
J	1,305	21.9	653	11.0	591	10.0	953	16.1
J	1,379	22.4	690	11.2	616	10.0	994	16.1
A	1,847	30.0	924	15.0	682	11.1	1,100	17.9
S	1,395	23.5	698	11.8	619	10.5	998	16.9
O	525	8.5	263	4.3	267	4.4	431	7.1
N	277	4.7	139	2.4	140	2.4	225	3.9
D	204	3.3	102	1.7	94	1.6	151	2.5
Total	10,069	166.6	5,039	83.7	4,461	74.4	7,192	119.7
Avg.	839	13.9	420	7.0	372	6.2	599	10.0

* Based on a 4 year average for 1967 - 1970.
** Based on leaching requirement which is 62% of potential drainage need.

TABLE 21

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 15 (Firebaugh - Santa Fe)

Area = 16.32 sq. mi.
= 10,445 acres
L.R. = (0.5)(10,445) = 5,223 A.F./year

Month	Present Discharge* A.F.	Present Discharge* CFS	No Quality Control: Year 2020 Development A.F.	No Quality Control: Year 2020 Development CFS	With Quality Control: Year 1990 Development** A.F.	With Quality Control: Year 1990 Development** CFS	With Quality Control: Year 2020 Development A.F.	With Quality Control: Year 2020 Development CFS
J	87	1.4	113	1.8	83	1.3	165	2.6
F	358	6.4	465	8.3	326	5.8	651	11.6
M	391	6.3	508	8.2	361	5.8	721	11.6
A	492	8.2	640	10.7	474	7.9	947	15.8
M	967	15.6	1,257	20.3	987	16.0	1,973	31.9
J	1,122	18.7	1,459	24.3	1,065	17.8	2,130	35.5
J	1,110	17.9	1,443	23.3	1,039	16.8	2,078	33.6
A	1,116	18.0	1,451	23.4	864	13.9	1,727	27.8
S	642	10.7	835	13.9	597	10.0	1,194	19.9
O	285	4.6	371	6.0	304	4.9	608	9.8
N	150	2.5	195	3.3	158	2.7	316	5.3
D	62	1.0	81	1.3	60	1.0	120	1.9
Total	6,782	111.3	8,818	144.8	6,318	103.9	12,630	207.3
Average	565	9.3	735	12.1	527	8.7	1,053	17.3

* Based on average for years 1967 - 1970.
** Based on installation of drains over 50% of the area.

TABLE 22

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 16 (Firebaugh Wasteway)

Area = 14.61 sq. mi.
= 9,350 acres
L.R. = (0.5)(9,350) = 4,675 A.F./year

Month	Present Discharge* A.F.	CFS	No Quality Control: Year 2020 Development A.F.	CFS	With Quality Control: Year 1990 Development** A.F.	CFS	Year 2020 Development A.F.	CFS
J	0	0	0	0	0	0	0	0
F	112	2.0	211	3.8	198	3.6	295	5.3
M	254	4.1	478	7.7	455	7.3	679	10.9
A	390	6.5	737	12.2	731	12.1	1,091	18.1
M	242	3.9	458	7.5	482	7.9	719	11.8
J	312	5.2	587	9.7	574	9.5	857	14.2
J	471	7.6	888	14.3	857	13.8	1,279	20.6
A	415	6.7	782	12.6	624	10.0	931	15.0
S	282	4.7	532	8.9	510	8.5	761	12.7
O	81	1.3	152	2.4	167	2.6	249	3.9
N	27	0.5	50	0.8	54	0.9	81	1.3
D	6	0.1	11	0.2	11	0.2	16	0.3
Total	2,592	40.8	4,886	80.1	4,663	76.4	6,958	114.1
Average	216	3.4	407	6.7	389	6.4	580	9.5

* DWR Records 1958-1960
** Based on the leaching requirement which is 67% of the potential drainage need.

TABLE 23

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 17 (San Luis Drain)

Area = 3.77 sq. mi.
= 2,413 acres
L.R. = (0.5)(2,413) = 1,207 A.F./year

Month	Present Discharge A.F.	CFS	No Quality Control Year 2020 Development A.F.	CFS	With Quality Control Year 1990 Development* A.F.	CFS	Year 2020 Development** A.F.	CFS
J	No Records		52	0.8	25	0.4	52	0.8
F	Available		75	1.4	36	0.7	75	1.4
M			146	2.4	69	1.1	146	2.4
A			202	3.4	95	1.6	202	3.4
M			261	4.2	123	2.0	261	4.2
J			303	5.1	142	2.4	303	5.1
J			355	5.7	167	2.8	355	5.7
A			376	6.1	177	2.9	376	6.1
S			343	5.8	161	2.8	343	5.8
O			230	3.7	108	1.8	230	3.7
N			151	2.5	71	1.2	151	2.5
D			84	1.4	39	0.7	84	1.4
Total			2,578	42.5	1,213	20.4	2,578	42.5
Average			215	3.5	101	1.7	215	3.5

* Based on leaching requirement.

** Based on full development of drainage need with no dilution required.

TABLE 24

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 18 (Salt Slough)

Area = 51.62 sq. mi.
= 33,037 acres
L.R. = (0.5)(33,037) = 16,519 A.F./year

Month	Present Discharge A.F.	Present Discharge CFS	No Quality Control: Year 2020 Development A.F.	No Quality Control: Year 2020 Development CFS	With Quality Control: Year 1990 Development* A.F.	With Quality Control: Year 1990 Development* CFS	With Quality Control: Year 2020 Development** A.F.	With Quality Control: Year 2020 Development** CFS
J	No Records		813	13.2	335	5.4	813	13.2
F	Available		1,174	21.0	483	8.6	1,174	21.0
M			2,275	36.8	937	15.1	2,275	36.8
A			3,145	52.6	1,295	21.6	3,145	52.6
M			4,062	65.7	1,672	27.0	4,062	65.7
J			4,718	78.9	1,942	32.4	4,718	78.9
J			5,528	89.4	2,274	36.7	5,528	89.4
A			5,852	94.7	2,408	38.9	5,852	94.7
S			5,347	89.4	2,201	36.7	5,347	89.4
O			3,577	57.9	1,472	23.8	3,577	57.9
N			2,359	39.4	971	16.2	2,359	39.4
D			1,302	21.0	535	8.6	1,302	21.0
Total			40,152	660.0	16,525	271.0	40,152	660.0
Average			3,346	55.0	1,377	22.6	3,346	55.0

* Based on leaching requirement.
** Based on full development of drainage with no dilution required.

TABLE 25

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 19 (Devon Drain)

Area = 11.11 sq. mi.
= 7,110 acres
L.R. = (0.5)(7,110) = 3,555 A.F./year

Month	Present Discharge A.F.	Present Discharge CFS	No quality Control Year 2020 Development A.F.	No quality Control Year 2020 Development CFS	With Quality Control Year 1990 Development* A.F.	With Quality Control Year 1990 Development* CFS	With Quality Control Year 2020 Development** A.F.	With Quality Control Year 2020 Development** CFS
J	No Records		169	2.7	72	1.2	169	2.7
F	Available		244	4.4	104	1.9	244	4.4
M			473	7.7	201	3.3	473	7.7
A			654	10.9	278	4.7	654	10.9
M			844	13.7	360	5.9	844	13.7
J			980	16.4	418	7.0	980	16.4
J			1,149	18.6	489	8.0	1,149	18.6
A			1,216	19.7	518	8.4	1,216	19.7
S			1,111	18.6	473	8.0	1,111	18.6
O			743	12.0	316	5.2	743	12.0
N			490	8.2	209	3.5	490	8.2
D			271	4.4	115	1.9	271	4.4
Total			8,344	137.3	3,553	59.0	8,344	137.3
Average			695	11.4	296	4.9	695	11.4

* Based on leaching requirement.
** Based on full development of drainage need with no dilution required.

TABLE 26

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 20 (Boundary Drain)

Area = 9.94 sq. mi.
Area = 6,362 acres
L.R. = (0.5)(6,362 = 3,181 A.F./year)

Month	Present Discharge A.F.	CFS	No Quality Control Year 2020 Development A.F.	CFS	With Quality Control Year 1990 Development* A.F.	CFS	Year 2020 Development** A.F.	CFS
J	No Records		183	3.0	92	1.5	183	3.0
F	Available		330	5.9	165	3.0	330	5.9
M			731	11.8	366	5.9	731	11.8
A			885	14.8	443	7.4	885	14.8
M			1,097	17.7	549	8.9	1,097	17.7
J			1,151	19.2	576	9.6	1,151	19.2
J			1,280	21.1	640	10.6	1,280	21.1
A			1,243	20.1	622	10.1	1,243	20.1
S			1,062	17.7	531	8.9	1,062	17.7
O			549	8.9	275	4.5	549	8.9
N			354	5.9	177	3.0	354	5.9
D			183	3.0	92	1.5	183	3.0
Total			9,048	149.1	4,528	74.9	9,048	149.1
Average			754	12.4	377	6.2	754	12.4

* Based on installation of drains over 50% of the area.
** Based on full development of drainage need with no dilution required.

TABLE 27

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 21 (Cozzi Drain)

Area = 8.85 sq. mi.
= 5,664 acres
L.R. = (0.5)(5,664) = 2,830 A.F./year

Month	Present Discharge A.F.	Present Discharge CFS	No Quality Control: Year 2020 Development A.F.	No Quality Control: Year 2020 Development CFS	With Quality Control: Year 1990 Development* A.F.	With Quality Control: Year 1990 Development* CFS	With Quality Control: Year 2020 Development** A.F.	With Quality Control: Year 2020 Development** CFS
J	No Records		169	2.7	85	1.4	169	2.7
F	Available		304	5.4	152	2.7	304	5.4
M			673	10.9	337	5.5	673	10.9
A			815	13.6	408	6.8	815	13.6
M			1,010	16.3	505	8.2	1,010	16.3
J			1,059	17.7	530	8.9	1,059	17.7
J			1,178	19.4	589	9.7	1,178	19.4
A			1,144	18.5	572	9.3	1,144	18.5
S			977	16.3	489	8.2	977	16.3
O			505	8.2	253	4.1	505	8.2
N			326	5.4	163	2.7	326	5.4
D			169	2.7	85	1.4	169	2.7
Total			8,329	137.1	4,168	68.9	8,329	137.1
Average			694	11.4	347	5.7	694	11.4

* Based on installation of drains over 50% of the area.
** Based on full development of drainage need with no dilution required.

TABLE 28

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 22 (Wood Slough)

Area = 13.09 sq. mi.
Area = 8,378 acres
L.R. = (0.5)(8,378) = 4,189 A.F./year

Month	Present Discharge* A.F.	CFS	No Quality Control Year 2020 Development A.F.	CFS	With Quality Control Year 1990 Development** A.F.	CFS	Year 2020 Development*** A.F.	CFS
J	310	5	206	3.3	85	1.4	206	3.3
F	448	8	297	5.3	123	2.2	297	5.3
M	868	14	576	9.3	237	3.8	576	9.3
A	1,200	20	797	13.3	328	5.5	797	13.3
M	1,550	25	1,029	16.6	424	6.8	1,029	16.6
J	1,800	30	1,195	19.9	492	8.2	1,195	19.9
J	2,108	34	1,400	22.6	576	9.3	1,400	22.6
A	2,232	36	1,482	23.9	610	9.8	1,482	23.9
S	2,040	34	1,355	22.6	558	9.3	1,355	22.6
O	1,364	22	906	14.6	373	6.0	906	14.6
N	900	15	598	10.0	246	4.1	598	10.0
D	496	8	329	5.3	136	2.2	329	5.3
Total	15,316	251	10,170	166.7	4,188	68.6	10,170	166.7
Average	1,276	20.9	848	13.9	349	5.7	848	13.9

* Estimated by San Luis Canal Company personnel.
** Based on leaching requirement.
*** Based on full development of drainage need with no dilution required.

TABLE 29

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION NO. 23 (San Juan Drain)

Area = 12.33 sq. mi.
Area = 7,891 acres
L.R. = (0.5)(7,891) = 3,946 A.F./year

Month	Present Discharge* A.F.	CFS	No Quality Control: Year 2020 Development A.F.	CFS	With Quality Control: Year 1990 Development** A.F.	CFS	Year 2020 Development*** A.F.	CFS
J	248	4	198	3.2	106	1.5	198	3.2
F	280	5	224	4.0	119	2.1	224	4.0
M	496	8	397	6.4	211	3.4	397	6.4
A	660	11	528	8.8	281	4.7	528	8.8
M	930	15	744	12.0	396	6.4	744	12.0
J	1,200	20	960	16.0	511	8.5	960	16.0
J	1,426	23	1,141	18.4	607	9.8	1,141	18.4
A	1,426	23	1,141	18.4	607	9.8	1,141	18.4
S	1,140	19	912	15.2	485	8.1	912	15.2
O	806	13	645	10.4	343	5.5	645	10.4
N	420	7	336	5.6	179	3.0	336	5.6
D	248	4	198	3.2	106	1.7	198	3.2
Total	9,280	152	7,424	121.6	3,951	64.5	7,424	121.6
Average	773	127	619	10.1	329	5.4	619	10.1

* Estimated by San Luis Canal Company personnel.
** Based on leaching requirement.
*** Based on full development of drainage need with no dilution required.

TABLE 30

MENDOTA-GUSTINE STUDY
Drainage Discharge

STATION No. 24 (Poso Slough)

Area = 38.18 sq. mi.
= 24,435 acres
L.R. = (0.5)(24,435) = 12,218 A.F./year

Month	Present Discharge*		No Quality Control: Year 2020 Development		With Quality Control: Year 1990 Development**		With Quality Control: Year 2020 Development***	
	A.F.	CFS	A.F.	CFS	A.F.	CFS	A.F.	CFS
J	620	10	719	11.6	247	4.0	719	11.6
F	1,120	20	1,299	23.2	446	8.0	1,299	23.2
M	2,480	40	2,877	46.4	988	16.0	2,877	46.4
A	3,000	50	3,480	58.0	1,195	20.0	3,480	58.0
M	3,720	60	4,315	69.6	1,482	24.0	4,315	69.6
J	3,900	65	4,524	75.4	1,553	26.0	4,524	75.4
J	4,340	70	5,034	81.2	1,729	28.0	5,034	81.2
A	4,216	68	4,891	78.9	1,679	27.2	4,891	78.9
S	3,600	60	4,176	69.6	1,434	24.0	4,176	69.6
O	1,860	30	2,158	34.8	741	12.0	2,158	34.8
N	1,200	20	1,392	23.2	478	8.0	1,392	23.2
D	620	11	719	11.6	247	4.0	719	11.6
Total	30,676	503	35,584	583.5	12,219	201.2	35,584	583.5
Average	2,556	42	2,965	48.6	1,018	16.8	2,965	48.6

* Estimated by San Luis Canal Company Personnel.
** Based on leaching requirement.
*** Based on full development of drainage need with no dilution required.

X. DRAINAGE SYSTEM NEEDS AND ALTERNATIVES

In order to achieve adequate drainage in the irrigated area, it is assumed that a drainage outlet should be available every mile. This has already been accomplished in the area except in a few cases. Broadview Area needs approximately 3.5 miles of additional drainage mains; Panoche Area approximately 13 miles of additional drainage mains; Poso Area approximately 2.5 miles; CCID Central in the vicinity of Woo and Hamburg Ranches approximately 3.5 miles of additional drainage mains plus a drain under the CCID Outside Canal.

Most existing drainage channels are adequate for flow requirements or will be after proper maintenance.

XI. WATER NEED

A. Area of Potential Water Use

Figure 1 delineates 133,952 acres of pasture and wildlife area outside water service districts that require summer water for optimum management. More than one-third of the area is located in the Grassland Water District.

Water is needed in varying degrees on many of the gun clubs within the Grassland Water District and on the public wildlife management areas to grow forage for livestock and waterfowl, and to provide ponds for hunting and fishing purposes.

There are approximately 170 waterfowl gun clubs in the potential use area. Public wildlife areas within the study area in addition to the gun club lands total more than 19,000 acres as follows:

San Luis National Wildlife Refuge -	7,360 acres
Volta Wildlife Area	2,884 acres
Los Banos Wildlife Area	3,208 acres
Kesterson Reservoir Area	5,900 acres
	19,352 acres

The area not receiving summer water is grazed as natural marsh or rangeland with little income being realized.

However, annual income from grazing where summer water is used can be as high as $15 per acre.

On the dry areas approximately 13 acres are required to sustain an animal on an annual basis. With summer irrigation, only about 4 acres are required per animal per year.

Livestock grazing and the growing of wildlife food plants can be compatible under proper management. Where grazing is controlled and interspersed with irrigation and flooding the carrying capacity for cattle can be increased, and waterfowl food production and cover can be improved.

Irrigation with summer drainage water creates an important marshland habitat which supports a large variety of resident wildlife and contributes materially to meeting the wintering requirements of migratory bird life. Studies by Bradberry and others indicate that in order for the grasslands to reach full potential as a wildlife area, the use of summer water is required.

B. Soils

This area consists primarily of fine textured soils which have slow permeability. They are ideally suited for waterfowl habitat and pasture.

C. Consumptive Water Use

Based on Soil Conservation Service procedures, an average of 42.41 inches (3.53 feet) per year is required as a net consumptive use for pasture grasses. This would be slightly higher for marsh pasture due to a higher evaporation loss. See Table 31.

D. Water Demand

Based on a net area of 133,952 acres, a net annual amount of 472,851 acre feet of water can be utilized in the pasture and wildlife area.

Gross requirements can be estimated by applying an overall application efficiency factor as follows:

application efficiency	acre feet
net (100%)	472,851
90%	524,865
70%	676,177
60%	789,661

TABLE 31

MENDOTA-GUSTINE STUDY

Consumptive use requirement for pasture grasses - Grassland area.

Month	Inches*
January	0.21
February	1.13
March	2.01
April	3.14
May	4.86
June	6.29
July	7.93
August	6.65
September	5.24
October	2.87
November	1.48
December	0.60
	42.14

* Computer Printout Data from Panoche Creek Station based on the average monthly requirement for 1968 and 1969.

XII. COMPARISON OF SUPPLY AND DEMAND

The drainage yield from all stations with quality control is estimated as follows:

Development	Yield, A.F.	Available to the Pasture and wildlife area
present	----------	85,000
1990 (20 years)	153,964	124,775
2020 (50 years)	320,397	251,932

Discharge from Station 16 is into the San Joaquin River and not available for reuse, and discharge from Stations 21 through 24 is used by the San Luis Canal Company and therefore not available to the pasture and wildlife area.

The demand for water exceeds the estimated supply from the irrigated area under full drainage development.

All the pasture and wildlife area cannot be irrigated with the supply available from the irrigated area, therefore, areas to be served must be selected based on some priority established by the water entities and landowners desiring the water.

If the demand for water by landowners exceeds the available supply, then other sources of water should be investigated.

Figure 12, shows the relationship of the estimated supply and demand. It is noted that the net irrigation demand exceeds the water supply based on 20 year development (year 1990) at all points indicating that no water storage or regulation will be required. However, water available based on 50 year development (year 2020) exceeds the net demand during the months of January through April. Very little water is needed during the

first quarter of the year because of the application of winter water for waterfowl.

Development of the service area and future expansion should be based on optimizing the use of available water. To maximize water use, some storage may be required by the year 2000.

Caution should be used in increasing the water supply from wells since water from wells in part of the area exceeds 3,000 PPM-TDS.

Gradual development of the pasture and wildlife area over a period of years would allow local management services to be developed and contracts made for water as it becomes available from the irrigated area or other sources. This would also be consistent with past studies by Bradberry and others which recommended that the Grassland Water District provide management services as an option to absentee owners. Such services would include the application and management of irrigation water to improve wildlife habitat, management and control of grazing leases, recreation planning, and maintenance of clubs and shooting facilities.

TABLE 32

MENDOTA-GUSTINE STUDY

Water Use Areas, Potential Water Need, and Water Available

Use Area	Area (Sq.Mi.)*	Net Potential Water Need (A.F.)	Estimated Water Available (A.F.)	
			Year 1990	Year 2020
Gustine	63.7	143,911	12,419**	23,894**
Santa Fe-San Luis Canal	73.0	164,922	55,515	105,900
Salt Slough	41.9	94,660	25,819	60,122
Dos Palos	8.9	20,107	(3,982**)	(7,970**)
Camp 13	21.8	49,251	31,022	62,016
	209.3 (133,952 acres)	472,851	124,775	251,932

* Includes Federal and State Wildlife areas.

** Plus water available from pumped drains which has not been estimated.

Note: The Dos Palos water use area can use a portion of the water discharging through Station No. 20 and 21 plus water from the deep well pumped drains.

XIII. WATER USE AREAS (Figure 13)

The problem in using the water for summer irrigation in the pasture and wildlife area is one of separation and distribution.

The distribution is simplified if the water is not allowed to accumulate into a common flow and overload the channel.

Utilization of the water as close to a source area as possible has been the prime consideration in the preliminary planning of an overall distribution system. The pasture and wildlife area was divided into five use areas and the need for a distribution system analyzed for each. Sufficient land was included in each use area to completely use the supply of water on both a short and long term basis. Land to be provided water must be selected before a detailed canal system can be designed and capacities established. This report assumes that each water use area except Gustine will require a distribution system.

A suggested system using existing canals where possible is given in Figure 13. In most cases, it appears that the existing system will be adequate with cleaning and the installation of water control structures. The system can be flexible to allow an exchange of water from one area to another if a surplus exists in any area. Table 32 summarizes the use areas, water need, and estimated supplies.

A. Gustine Water Use Area

The Gustine water use area consists of that area north of Highway 152 and west of the Santa Fe Grade. It has an area of approximately 63.7 square miles (40,794 acres) and a potential need for 143,911 acre feet of summer water per year. It contains the 2,884 acre Volta Wildlife Management area which is managed by California Department of Fish and Game.

Stations 2 through 7 contribute to the drainage flow plus numerous other points primarily from the Gustine Drainage District. The area north of San Luis Creek receives water from pumped well drains which discharge directly into the pasture and wildlife area.

The area south and east of San Luis Creek receives water primarily from open drains. Tailwater accounts for a high percentage of the present inflow. Water quality is relatively good and the water is currently used on adjacent land in both the source area and the pasture and wildlife area. Under present practices, no quality control is anticipated but will be required as subsurface drainage is further developed in the source area. Approximately 23,894 acre feet of drainage water per year will be available from subsurface agricultural drainage by the year 2020.

A preliminary distribution system has not been proposed in this report since the yields from drainage wells have not been established.

B. Santa Fe - San Luis Canal Water Use Area

The Santa Fe - San Luis Canal service area consists of the area between the Camp 13 Drain and the Agatha Canal in the southern part and the area between the Santa Fe and San Luis Canals in the north. The area contains that portion of the Los Banos Wildlife Management area west of Mud Slough which is approximately 1,120 acres of the 3,208 acre area. It consists of approximately 73.0 square miles (46,720 acres) with a potential need for 164,922 acre feet of water per year.

The area receives water from the Panoche and Broadview areas and the Poso Area's Rice Drain. By the year 1990, approximately 55,515 acre feet of water is expected annually and 105,900 acre feet by 2020.

The existing canal system will be adequate with proper cleaning and maintenance and the installation of needed water control structures with the exception of the Agatha Canal extension.

The proposed Agatha Extension can be accomplished by extending the Agatha Canal parallel to the Arroyo Canal or by using part of the Arroyo Canal channel which is larger than necessary for the service required.

The Kesterson Reservoir of the U. S. Bureau of Reclamation San Luis Drain is located in the northern part of the service area and contains 5,900 acres. The reservoir is for regulation and storage of subsurface drainage water from the agricultural area served by the California Aqueduct.

The reservoir will be managed for wildlife purposes as a series of shallow storage ponds. A channel is being considered that will carry the water from the reservoir area to the Bay and Ocean.

C. Salt Slough Water Use Area

The Salt Slough water use area consists of approximately 41.9 square miles (26,816 acres) in the northeastern part of the study area between the San Luis Canal and the San Joaquin River. It is located north of the San Luis use area and receives water from the south by way of Mud Slough and Salt Slough. Water from Stations 17 through 20 and from Mud Slough contribute to the water supply of the use area. Water from Poso Area Station 21 through 24 is used principally within the San Luis Canal Company, however, at times water passes the San Luis Sand Dam and contributes to the lower Salt Slough water supply.

The area has a potential water need for 94,660 acre feet per year. The expected annual supply in 1990 is 25,819 acre feet with 60,122 acre feet expected by 2020. Deep wells are used to supplement the water supply in this area.

Delivery systems are adequate in the use area and only continued maintenance is required.

Extensive on-farm irrigation distribution systems have already been developed in this area. Individual distribution system development is expected to expand at about the same rate as the water supply. Individual pumping plants are being

installed near Salt Slough in order to use the water as it becomes available.

The San Luis National Wildlife Refuge is located in the southern part of the service area and consists of 7,360 acres. Their distribution system is already developed and is being improved. The portion of the Los Banos Wildlife Area east of Mud Slough is also in the Salt Slough use area. It contains approximately 2,088 acres of the 3,208 acre wildlife area and has already developed a distribution system.

D. Dos Palos Water Use Area

The Dos Palos use area is located west of the town of Dos Palos. It consists of approximately 8.9 square miles (5,696 acres) and has a potential use of 20,107 acre feet of water annually.

The annual water supply from the Dos Palos Drainage District is expected to be 3,982 acre feet in 1990 and 7,970 acre feet in 2020. A supplemental source from within the use area is from pumped well drains. No estimate of the amount of water or the water quality from the pumped drains has been made. Until this is done the distribution system needed cannot be determined.

E. Camp 13 Water Use Area

The Camp 13 use area is located southeast of the city of Los Banos. It consists of approximately 21.8 square miles (13,952 acres) and has a potential water use of 49,251 acre feet annually.

Water is generated primarily from the CCID and the Firebaugh Area.

The estimated annual supply is 31,022 acre feet by 1990 and 62,016 acre feet by 2020. The present supply is approximately 26,000 acre feet annually. The water supply appears more than adequate to meet the long range irrigation needs of the area. Mud Slough will act as an outlet for excess water which can be used in the Santa Fe-San Luis or by the Salt Slough use area.

The existing distribution system is not adequate. A new canal system is proposed parallel to the CCID Main Canal to provide a gravity supply to the area of need.

Existing laterals are adequate for distribution of water from the proposed main canal except in the southern part of the service area where one new lateral is proposed.

XIV. WATER QUALITY CONTROL SYSTEM

The quality of the water can be controlled by dilution. Monitoring stations can be established at each major outlet to measure flow and monitor water quality.

Figure 13 suggests several points where monitoring stations could be installed and good quality water added to the drainage water to maintain the desired quality. The type of structure needed in each case would require special consideration so that drainage water could be monitored, dilution water added and mixed, and the flow monitored for results.

Table 33 lists the suggested stations and possible source of dilution water. More stations may be needed farther north within the pasture and wildlife area to maintain quality since the water will be reused several times, however, based on this and other studies, additional dilution stations will probably not be needed for at least 20 years. A detailed study may indicate other locations are more feasible.

XV. DRAINAGE OUTFLOW FROM THE WATER USE AREA

Some drainage outflow will occur even though a distribution system is efficiently maintained and operated.

The outflow from the water use area will be much less than that which will occur under normal irrigation conditions because there are many opportunities for reuse of the water. Even if the individual application efficiency falls below 60% the overall efficiency in the use area is expected to be between 80 and 90% due to the opportunities for reuse of the water.

TABLE 33

MENDOTA-GUSTINE STUDY

Water Quality Control Monitoring Stations

Station Number	Location	Possible Source of Dilution Water
1	Broadview W.D.	Broadview irrigation supply
2	Firebaugh Canal Co.	CCID Outside Canal
3	Firebaugh Canal Co.	CCID Outside Canal
4	Panoche W.D.	CCID Main Canal
5	Camp 13	CCID Main Canal
6	Fialho, Hamburg & Woo Ranch	CCID Main Canal
7	Rice Drain	Gable Ditch from Helm Canal
8	Poso Shain Drain	Laguna Canal

Water quality standards for the San Joaquin River will be established by the California Regional Water Quality Control Board, Central Valley Region, and the State Water Resources Control Board by July 1, 1973. All discharges into the San Joaquin River must meet the standards once they are adopted. This will apply to the discharge of winter-wildlife water from the water use area as well as the discharge of summer drainage water.

Several alternatives may be available for disposing of the water from the north end of the study area:

1. Discharge into the San Joaquin River can continue as under present conditions if the drainage water meets the water quality standards set for the San Joaquin River.
2. Discharge into the San Joaquin River with dilution to meet the water quality standards of the river.
3. The drainage water may be stored in a selected storage site near the San Joaquin River with possible discharge into the river during periods of high river flow, thus meeting the water quality standard within the river.
4. Discharge into the Kesterson Reservoir on an interim basis until the space is needed for the San Luis Drain discharge.
5. Discharge into a proposed joint facility to the San Francisco Bay.
6. The drainage flow could be stored and evaporated.
7. Combinations of the above.

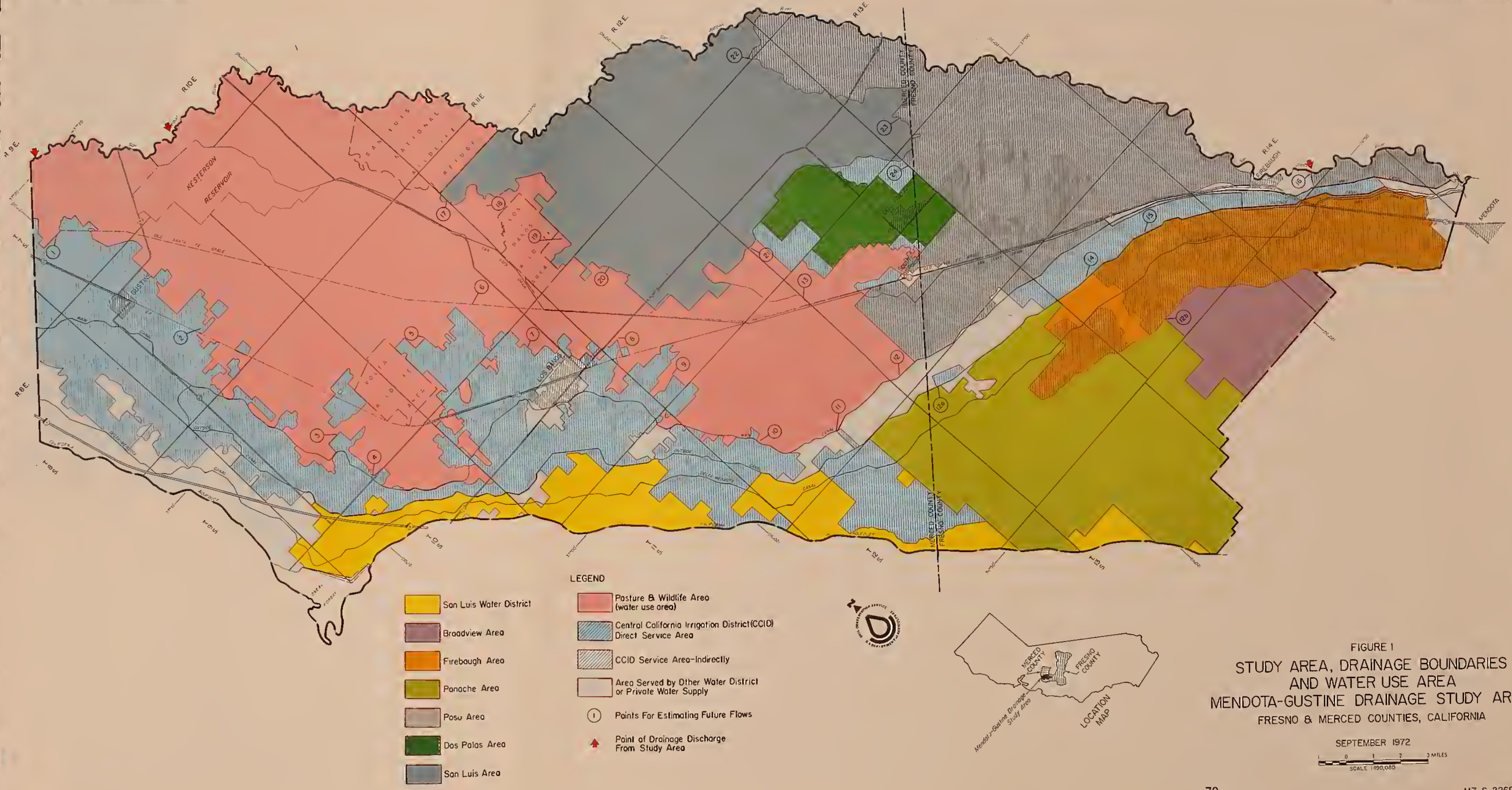


FIGURE 1

STUDY AREA, DRAINAGE BOUNDARIES AND WATER USE AREA MENDOTA-GUSTINE DRAINAGE STUDY AREA

FRESNO & MERCED COUNTIES, CALIFORNIA

SEPTEMBER 1972

SCALE 1:190,080 — 0 1 2 3 MILES

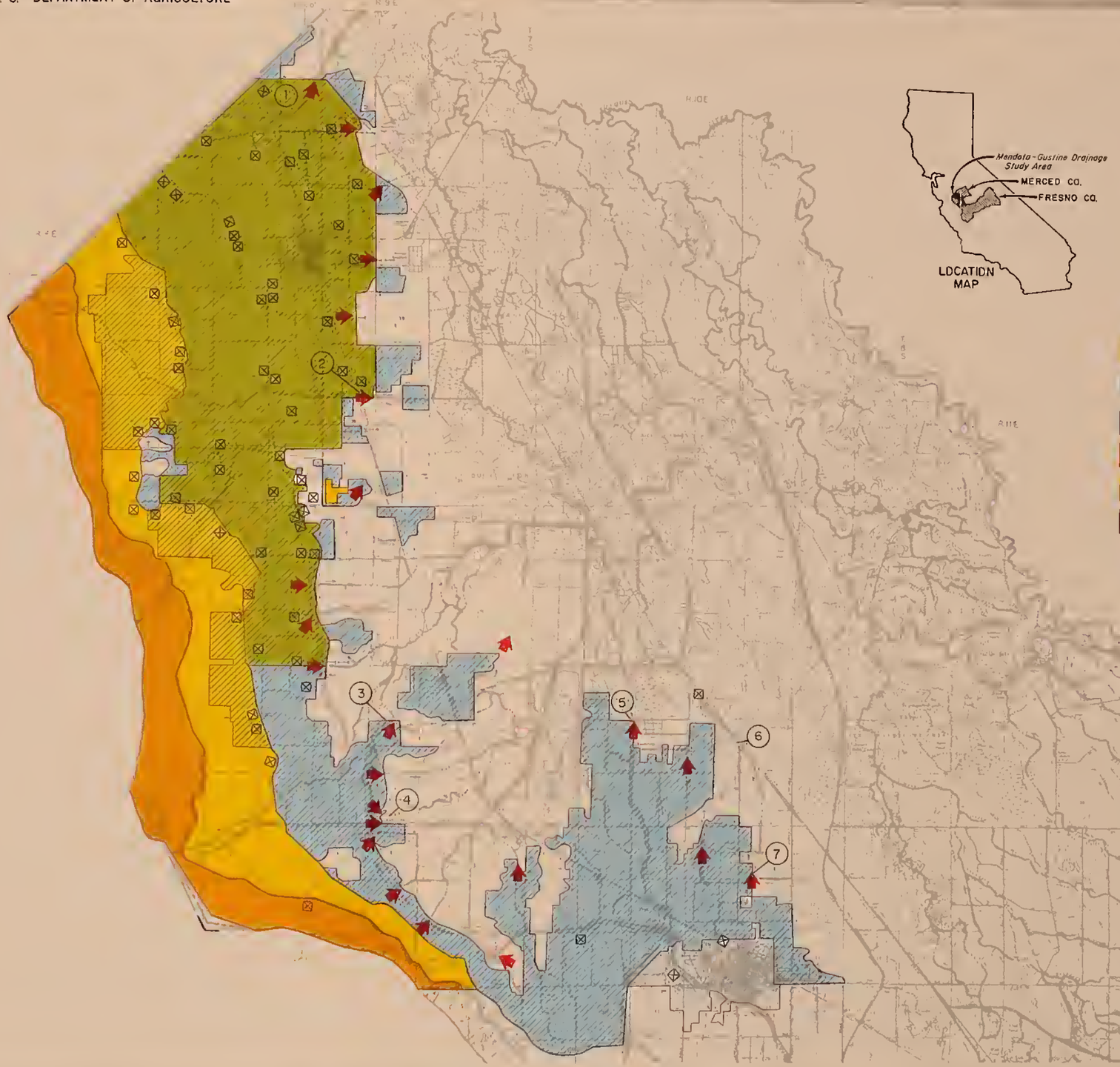


FIGURE 2

C. C. I. D NORTH DRAINAGE AREA MENDOTA-GUSTINE DRAINAGE STUDY AREA

FRESNO AND MERCED COUNTIES, CALIFORNIA

SEPTEMBER 1972

1 0 1 2 3 MILES

SCALE 1:125,000

LEGEND

- Gustine Drainage District
- C.C.I.D. Service Area
- C.C.I.D. Drainage Area
- Area Intercepted by Delta-Mendota Canal
- Area Intercepted by C.C.I.D. Outside Canal
- Other Drainage Area
- Drainage Pump
- Drainage Channel
- Canal
- Point of Drainage Discharge
- (2) Point of Estimating Future Discharge
- Pipeline

M7-E-2260 4-N

FIGURE 3

C. C. I. D. CENTRAL DRAINAGE AREA MENDOTA-GUSTINE DRAINAGE STUDY AREA

FRESNO AND MERCED COUNTIES, CALIFORNIA

SEPTEMBER 1972

1 0 1 2 3 MILES

SCALE 1:125,000

LEGEND

- Conol
- Drainage Channel
- Proposed Drainage Channel
- Drainage Pump
- Point of Drainage Discharge
- (12) Station for Estimating Future Discharge
- C. C. I. D. Service Area
- C. C. I. D. Drainage Area
- Area Intercepted by Delta-Mendota Canal
- Area Intercepted by C. C. I. D. Outside Canal
- Other Drainage Area

LOCATION MAP

Mendota-Gustine Drainage Study Area

MERCED CO.

FRESNO CO.

M7-E-22603B-N

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

FIGURE 4

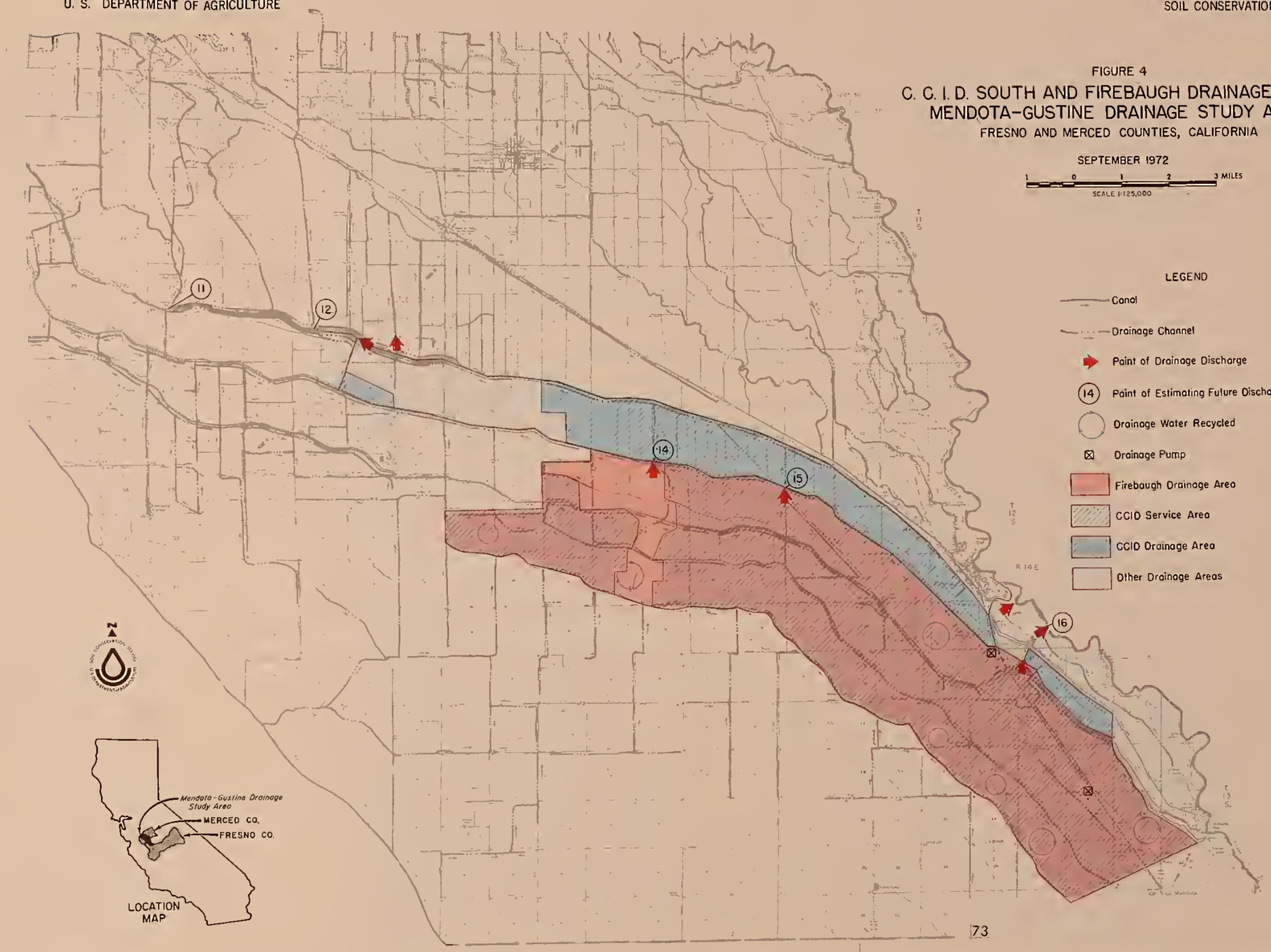
C. C. I. D. SOUTH AND FIREBAUGH DRAINAGE AREAS MENDOTA-GUSTINE DRAINAGE STUDY AREA

FRESNO AND MERCED COUNTIES, CALIFORNIA

SEPTEMBER 1972

1 0 1 2 3 MILES

SCALE 1:125,000



LEGEND

- Canal
- Drainage Channel
- Point of Drainage Discharge
- (14) Point of Estimating Future Discharge
- Drainage Water Recycled
- Drainage Pump
- Firebaugh Drainage Area
- CCID Service Area
- CCID Drainage Area
- Other Drainage Areas

LOCATION MAP

73

M7-E-22602A-N

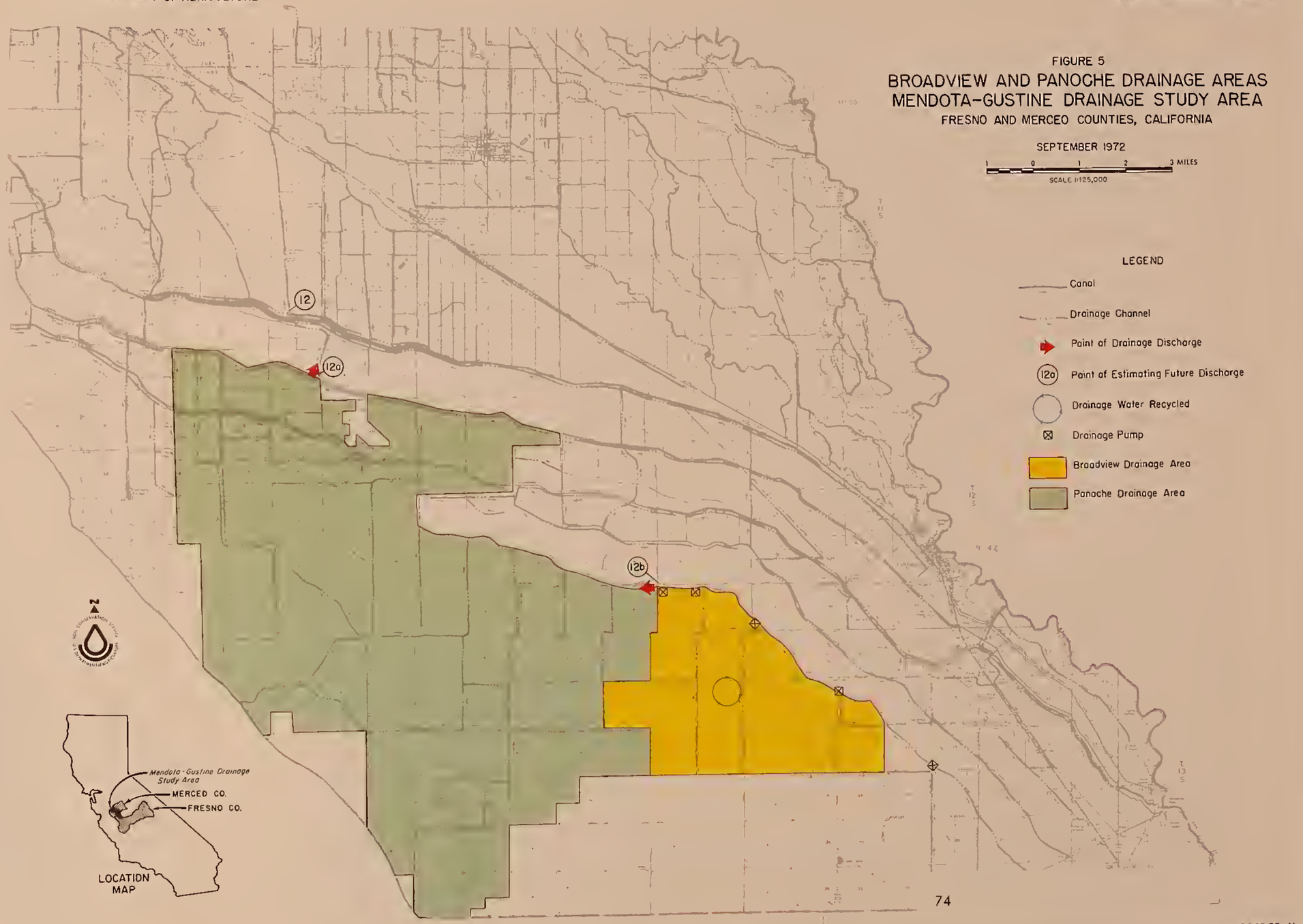


FIGURE 5

BROADVIEW AND PANOCHE DRAINAGE AREAS MENDOTA-GUSTINE DRAINAGE STUDY AREA

FRESNO AND MERCEO COUNTIES, CALIFORNIA

M7-E-226D28-N

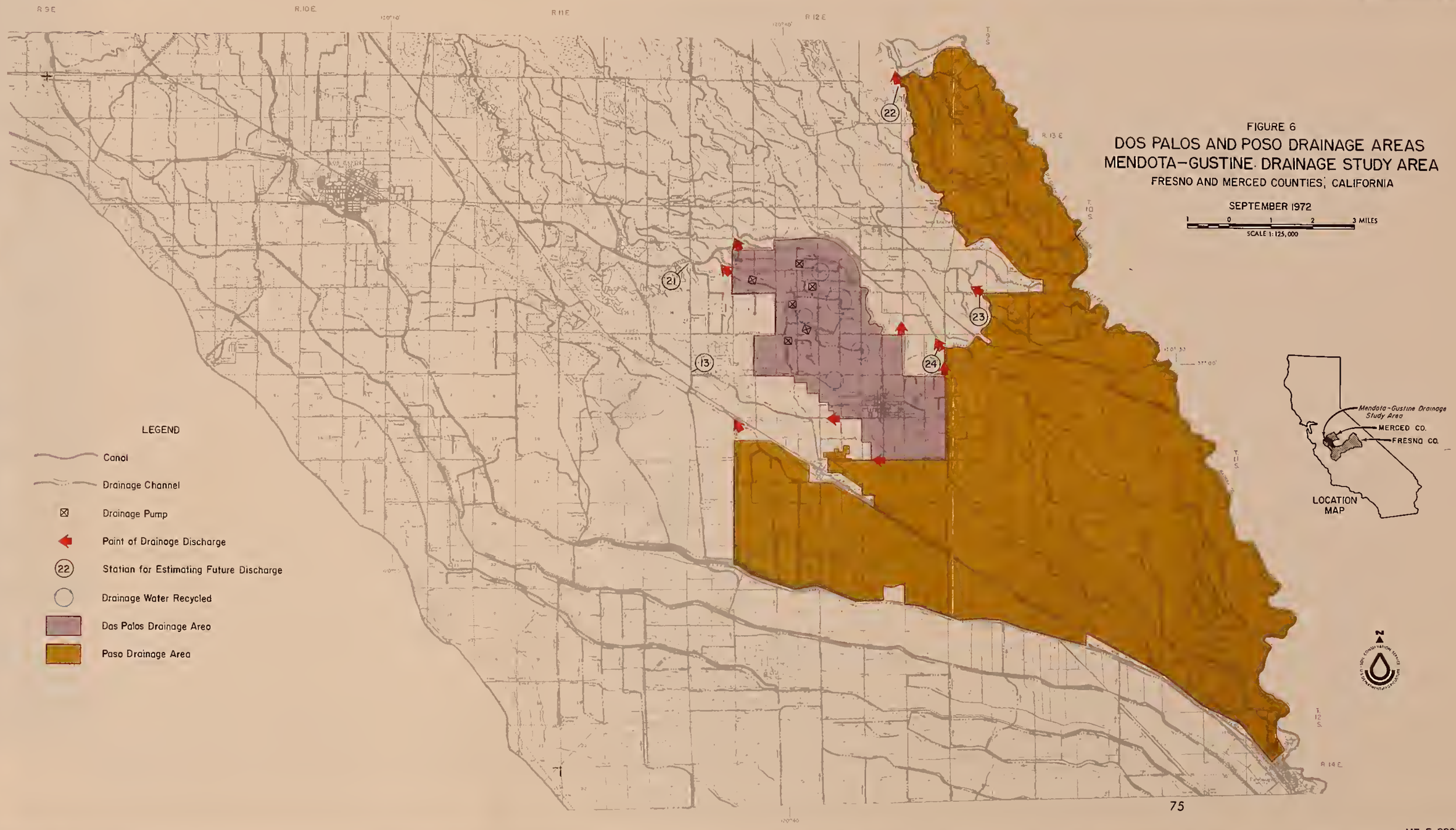


FIGURE 6

DOS PALOS AND POSO DRAINAGE AREAS MENDOTA–GUSTINE DRAINAGE STUDY AREA

FRESNO AND MERCED COUNTIES, CALIFORNIA

SEPTEMBER 1972

M7-E-22603C-N

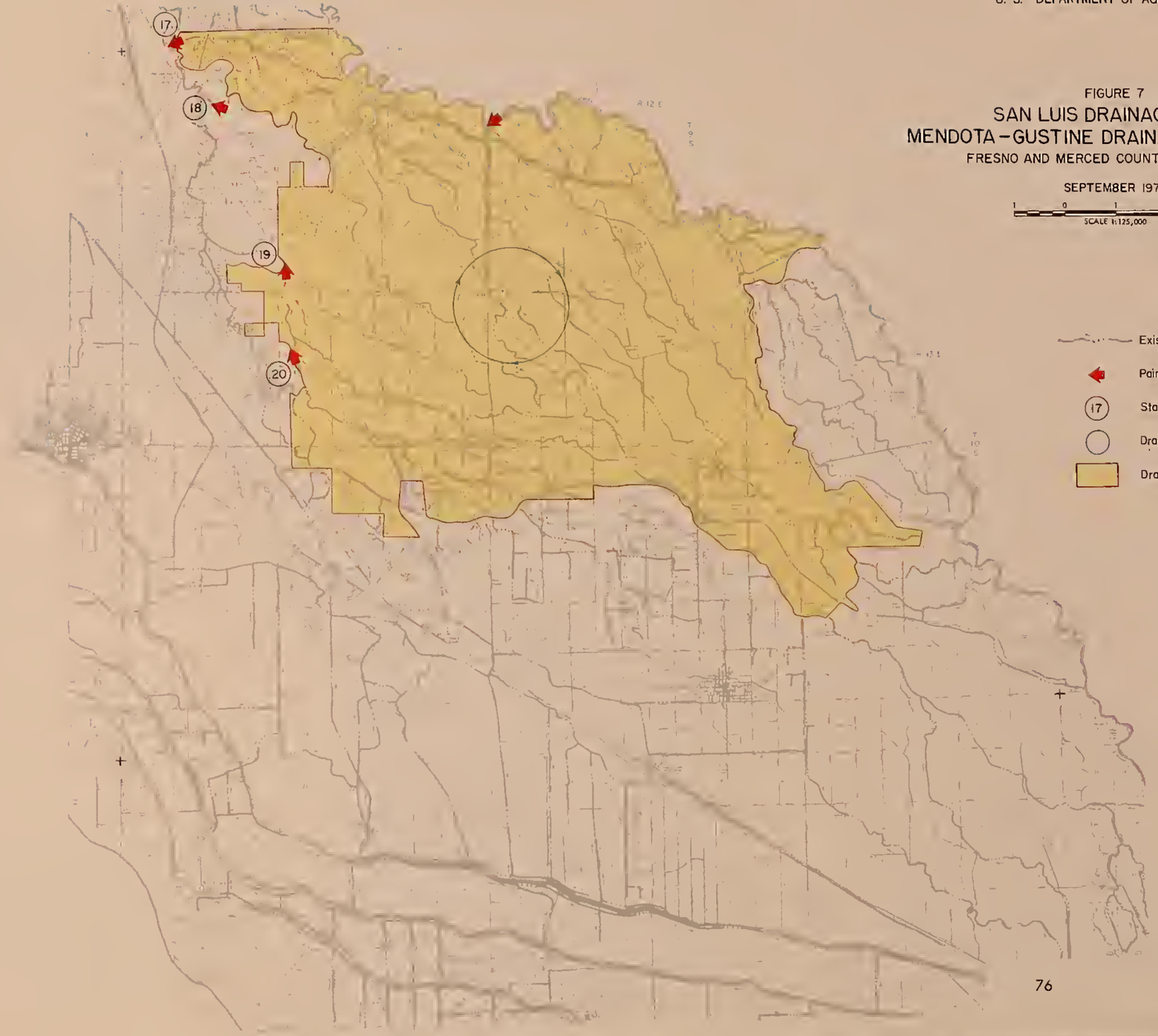


FIGURE 7

SAN LUIS DRAINAGE AREA
MENDOTA-GUSTINE DRAINAGE STUDY AREA

FRESNO AND MERCED COUNTIES, CALIFORNIA

SEPTEMBER 1972

1 0 1 2 3 MILES

SCALE 1:125,000

LEGEND

- Existing Drainage Channel
- Point of Drainage Discharge
- (17) Station for Estimating Future Discharge
- Drainage Water Recycled (entire area)
- Drainage Area

LOCATION MAP

M7-E-22603A-N

FIGURE 8

SUBSURFACE DRAINAGE COEFFICIENTS
MENDOTA-GUSTINE DRAINAGE STUDY AREA
FRESNO & MERCED COUNTIES, CALIFORNIA

SEPTEMBER 1972

SCALE 1:190,080

M7-S-22601B-N

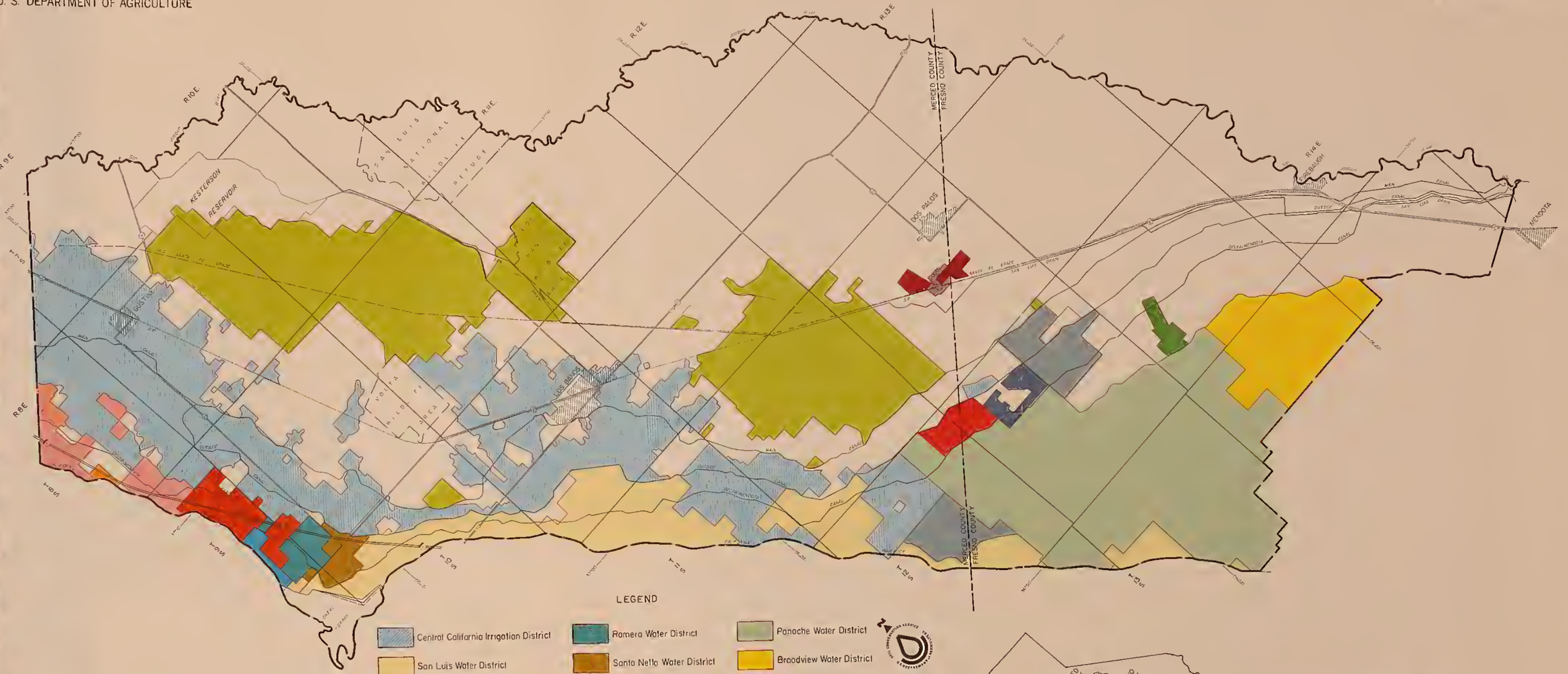


FIGURE 9

WATER AND IRRIGATION DISTRICTS
MENDOTA-GUSTINE DRAINAGE STUDY AREA
FRESNO & MERCED COUNTIES, CALIFORNIA

SEPTEMBER 1972

SCALE 1:190,080

M7-S-2260IC-N

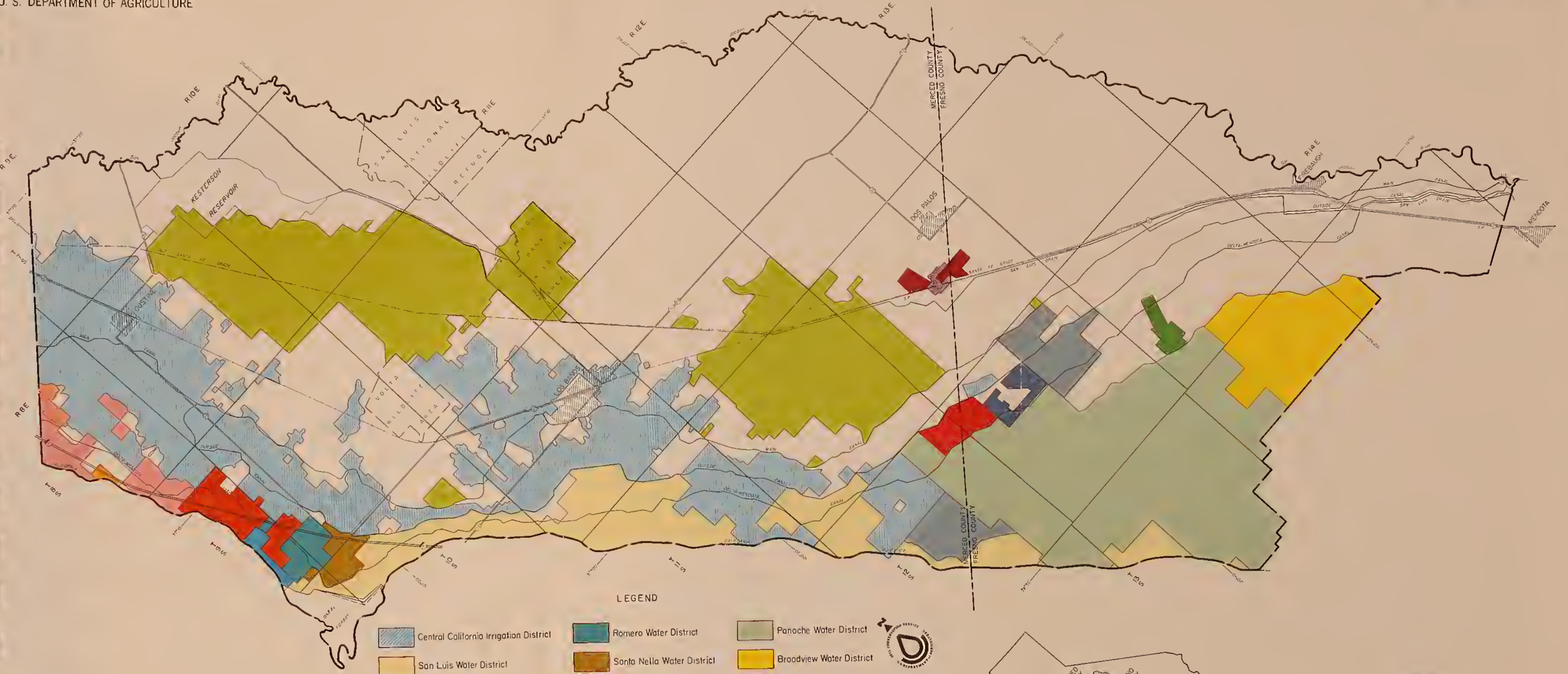


FIGURE 9

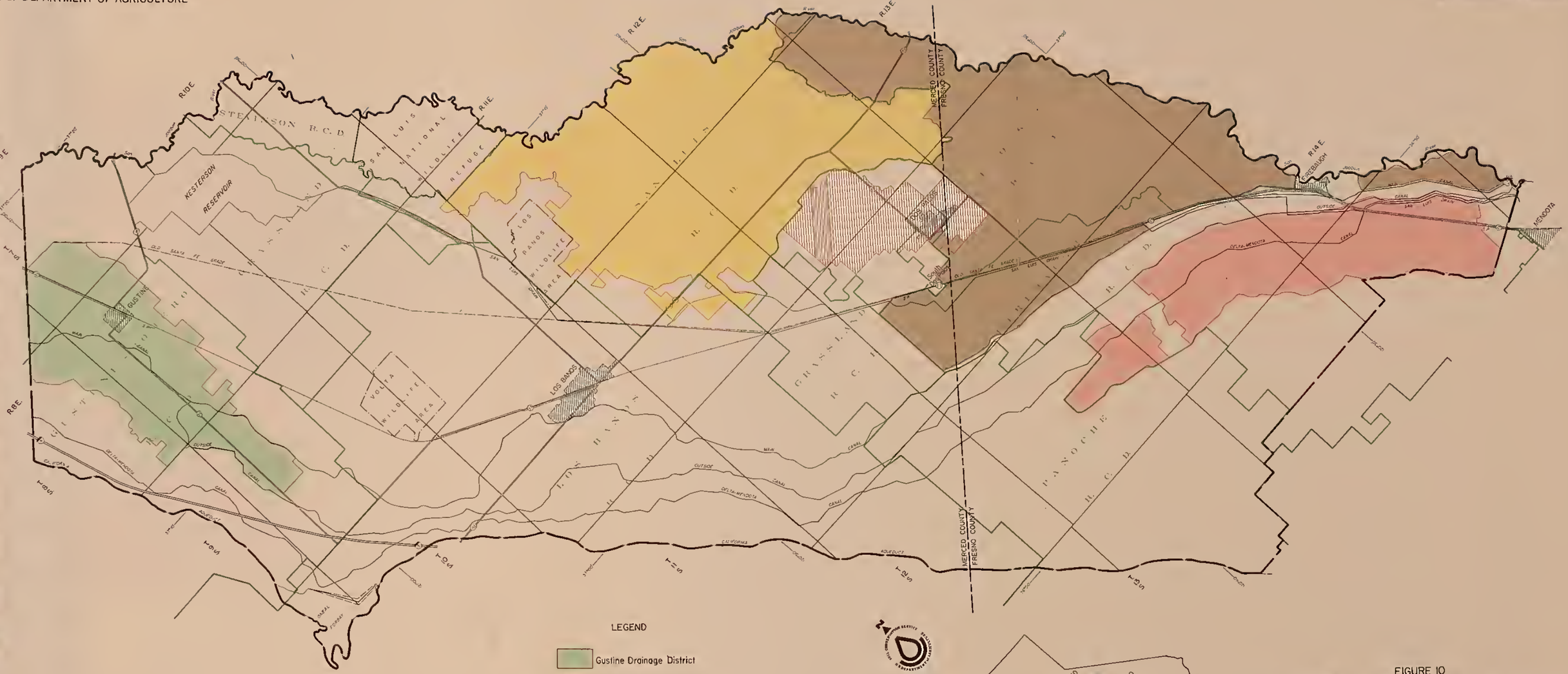
WATER AND IRRIGATION DISTRICTS MENDOTA-GUSTINE DRAINAGE STUDY AREA

FRESNO & MERCED COUNTIES, CALIFORNIA

SEPTEMBER 1972

SCALE 1:150,000

M7-S-22601C-N



LEGEND

- Gustine Drainage District
- Dos Palos Drainage District
- Firebaugh Canal Company
- Poso Canal Company
- San Luis Canal Company
- R. C. D. Boundary

FIGURE 10

RESOURCE CONSERVATION DISTRICTS, DRAINAGE DISTRICTS AND CANAL COMPANIES MENDOTA-GUSTINE DRAINAGE STUDY AREA

FRESNO & MERCED COUNTIES, CALIFORNIA

SEPTEMBER 1972

0 1 2 3 MILES

SCALE 1:190,080

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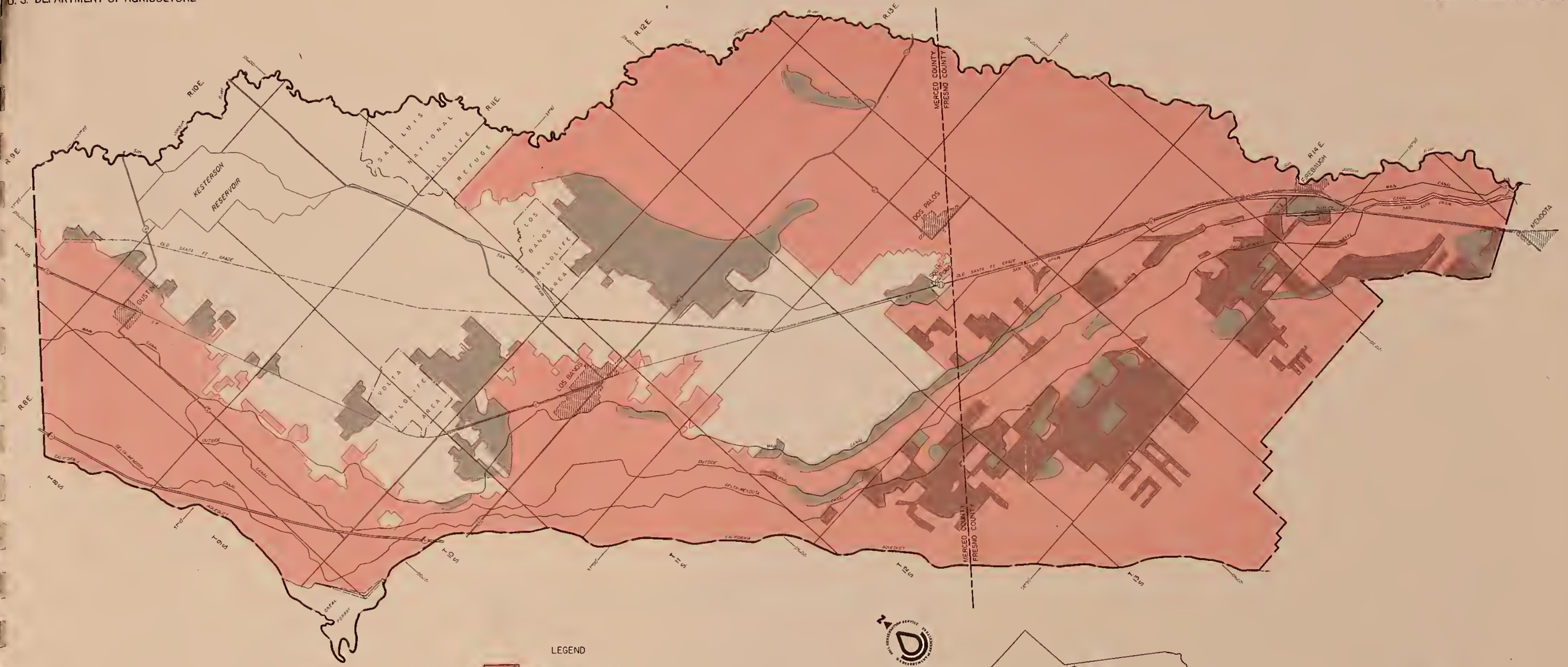

LEGEND

- Land Adequately Drained
- Land Partially Drained
- Land Poorly Drained
- Wildlife and Native Pasture Land

FIGURE II

PRESENT DRAINAGE CONDITION
MENDOTA-GUSTINE DRAINAGE STUDY AREA
FRESNO & MERCED COUNTIES, CALIFORNIA

SEPTEMBER 1972

SCALE 1:190,080 — 0 1 2 3 MILES

80

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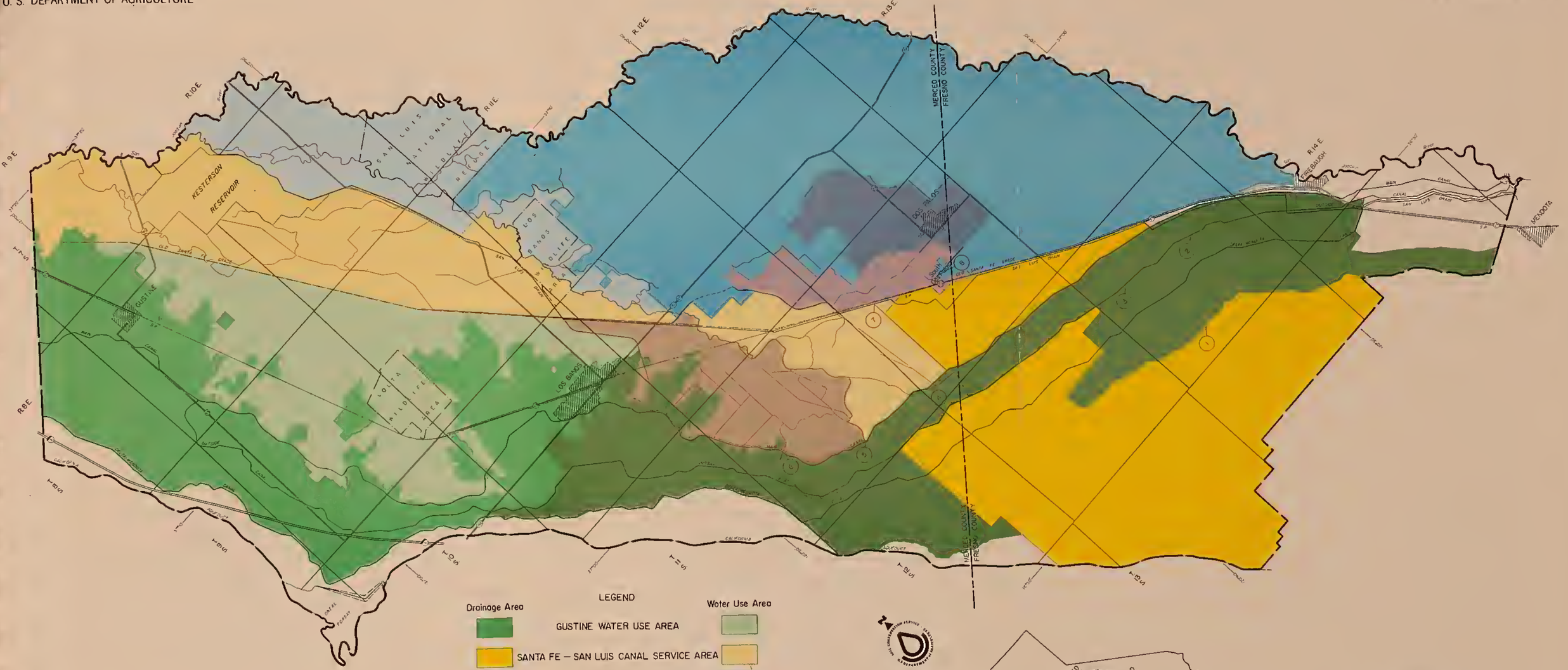
U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



LEGEND

Drainage Area		Water Use Area
	GUSTINE WATER USE AREA	
	SANTA FE – SAN LUIS CANAL SERVICE AREA	
	SALT SLOUGH SERVICE AREA	
	CAMP 13 WATER USE AREA	
	DOS PALOS WATER SERVICE AREA	

Water Service Channel (proposed)

(5) Water Quality Control Monitering Station

FIGURE 13

WATER USE AREAS

MENDOTA-GUSTINE DRAINAGE STUDY AREA

FRESNO & MERCED COUNTIES, CALIFORNIA

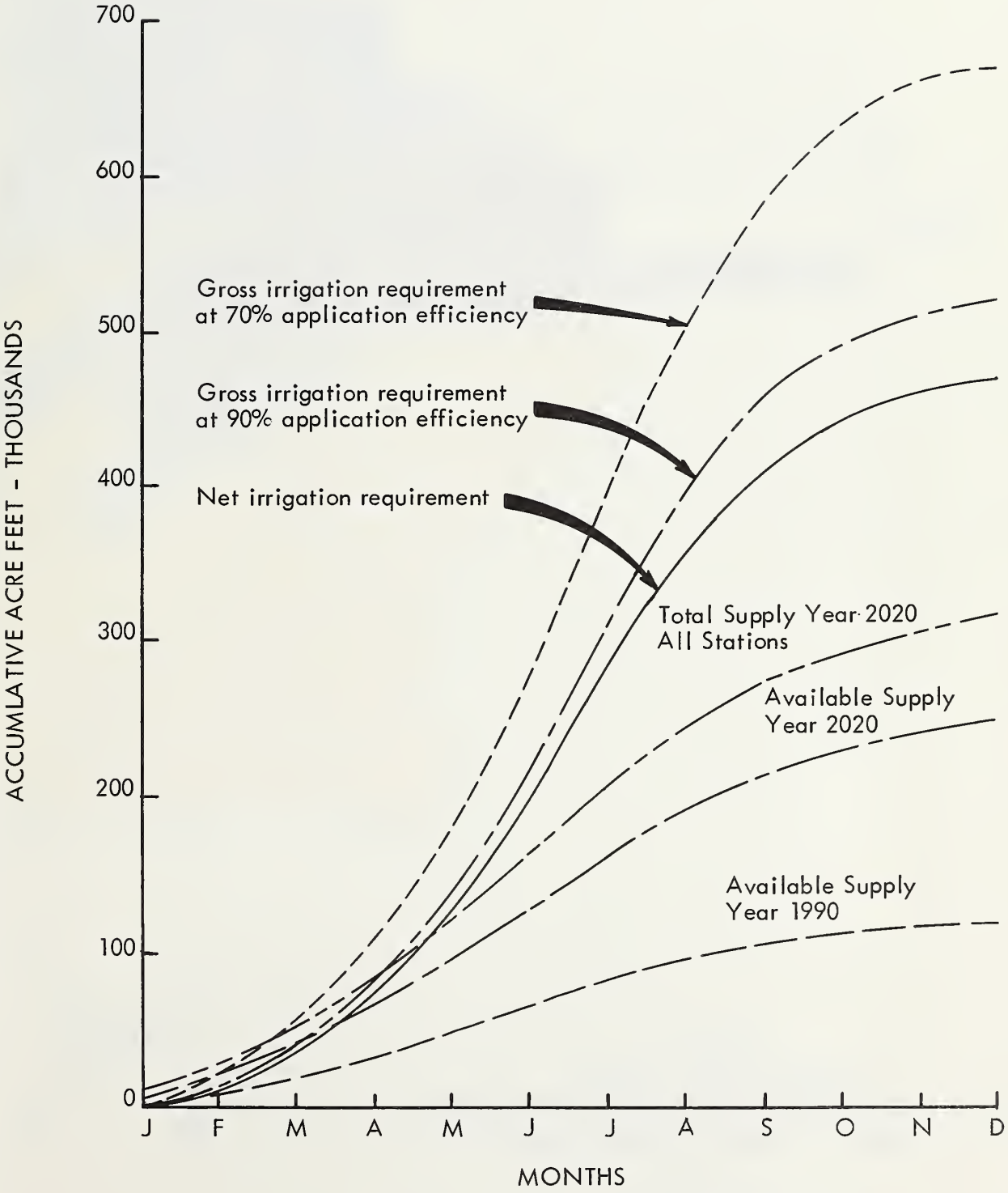
SEPTEMBER 1972

SCALE 1:190,080

82

M7-S-22601F-N

Figure 12
WATER SUPPLY AND DEMAND



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