JOB COMPLETION REPORT

As required by

FEDERAL AID IN FISHERIES RESTORATION ACT

TEXAS

Federal Aid Project No. F-5-R-11

FISHERIES INVESTIGATIONS AND SURVEYS OF THE WATERS OF REGION 1-B

Job No. B-34 An Investigation of Waters of the El Paso Area in Order to Evolve Efficient Management of the Game Fish Resource

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ABSTRACT

General surveys and observations were conducted on more than 350 miles of canals and laterals, approximately 100 miles of the Rio Grande, and 8 secondary lakes. Detailed surveys were conducted on more than 400 miles of drainage canals, 50 miles of the Rio Grande, and 6 primary lakes. Data collected included physical topography of structures, chemistry of the water, and biological data pertaining to (a) vegetation type and distribution, (b) presence, influence, and distribution of amphibians, reptiles, birds, and mammals, and (d) presence, distribution, relative abundance, condition, reproductive success, and utilization of existing fish populations.

Seventy-six rotenone collections made from 14,295 yards of drains resulted in taking 6,394 fish of 14 species. Forty-six gill net collections made in the Rio Grande resulted in the capture of 148 fish of 7 species. Seventy gill net collections from 5 lakes produced 1,422 fish of 12 species. Seining collections at lakes yielded another 3,125 specimens of 7 species. Further studies were made to determine inherent problems associated with the area, and determined man-made circumstances or limitations imposed upon the present fish producing facilities.

It was concluded that present knowledge is insufficient to provide adequate means for effectuating a substantial and long term improvement in game fish production in the Rio Grande and associated irrigation system. It is doubtful if further biological studies will provide the means of achieving a wide scale improvement in production by these facilities. The productive capacity of most of the system will continue to deteriorate. The Rio Grande and irrigation system should be employed in a secondary role in management attempted. Lakes and reservoirs offer the best potential for producing game fish in the El Paso area, and their expansion should be encouraged. Present management of lakes and reservoirs is adequate. Large scale biological investigations should be suspended until the prospects of developing additional facilities or altering existing facilities are known. When circumstances will permit, investigations of this nature should be carried out.

JOB COMPLETION REPORT

State of Texas

Project No. F-5-R-11 Name: Fisheries Investigations and Surveys of the Waters of Region 1-B

Job No. B-34 Title: An investigation of Waters of the El Paso Area in Order to Evolve an Efficient Management of the Game Fish Resource

Period Covered March 1, 1963 - February 28, 1964

Objectives:

To obtain data essential to sound fisheries management of waters of the El Paso area. To obtain (a) physical, chemical, and biological data for determining the potential fishery resource, (b) data that will establish species present, distribution, relative abundance, condition, reproductive success, and utilization, and (c) to determine the man-made circumstances and limitations imposed upon the present fish producing facilities.

Procedures:

The field work, collection and treatment of data and the original rough draft of this report was accomplished by Assistant Project Leader Glenn Omundson. During this period of study Mr. Omundson and his crew of two biology field workers were stationed at El Paso. Because of an unexpected termination of employment with the Parks and Wildlife Department, as well as other circumstances beyond his control, Mr. Omundson was unable to complete the final draft. Therefore, the field-collected data and the original rough draft was submitted to Project Leader Larry S. Campbell who revised the manuscript, completed and submitted the report in the final form.

In surveying the Rio Grande and lakes and reservoirs of the El Paso area, 100 standard gill net collections, 39 specific gill net collections, 24 standard seining collections, and 9 specific seining collections were taken. Data from these collections and basic data were recorded in accordance with the following project standards.

I. Sampling Fish Populations

A. A standard gill netting unit is made up of nylon gill netting, measuring 150 feet long by 8 feet deep. The unit is in 25-foot sections. Mesh sizes of these nets increase progressively to larger sizes in following sections, at half-inch intervals, beginning with one-inch mesh sections and terminating with a three and one-half inch section. Bags are created in these nets by means of "tie downs" that are 6 feet long and are spaced at 9-foot intervals along the horizontal length of the net.

B. A standard gill net collection is the data from fish captured in an overnight set of one standard gill netting unit.

C. A standard seining unit is a 12-foot common seine whose mesh size does not exceed 1/4 inch.

D. A standard seining collection is data from fish captured with three hauls of a standard seining unit.

E. A specific gill netting unit is any gill net, either with all its mesh the same size or with several sizes whose total components equal 150 linear feet. Data obtained from use of such nets is presented separately from that obtained from standard units.

F. A specific gill net collection is the data from fish captured in an overnight set of a specific gill netting unit.

G. A specific seining unit is any seining equipment that does not meet standard specifications.

H. A specific seining collection is data from fish captured with a specific seining unit.

I. Data from gill netting collections normally included obtaining weight, length, sex and gonadal development, stomach contents, and "K" for 50 individuals for each of the primary species.

J. Data obtained from seining collections was in accordance with the objective for carrying out the work.

II. Basic Data Recorded for Each Field Trip

A. Physical data

1. Turbidity readings to denote major deviations in turbidity.
2. Temperatures (Fahrenheit).

    a. Water temperatures including area deviations and diurnal and nocturnal variations.
    b. Air temperatures including minimum and maximum for period during which field activities were carried out.

3. Wind (mph)

    a. Estimated speed, direction and variations.

4. Hydrology

    a. Lake or stream level or volume.
    b. Flow or velocity.

5. Weather and Climatic conditions

    a. Cloud cover.
    b. Moisture.
    c. Relative stability of temperatures.
    d. Barometric pressure.
    e. Moon phase.

6. Bottom type
7. Cover
8. Vegetation
9. Other ecological conditions or influences and observations. Occurrence of springs, stream gradient, shade of trees, canyon walls, riffles or falls, aquatic vegetation or organisms.

B. Water Quality

1. Where possible data were obtained from qualified cooperating agencies. Most data were obtained from the State Health Department, the U. S. Department of Agriculture, U. S. Salinity Laboratory, U. S. Department of the Interior, International Boundary and Water Commission, and the City of El Paso Water Department.

2. Essential determination of pH, dissolved oxygen, dissolved carbon dioxide, chlorides, and alkalinity were by standard analysis outlined in FRESHWATER FISHERY BIOLOGY by Lagler.

As anticipated in planning, seining and netting proved to be ineffective for sampling fish populations of the irrigation canal system. In attempting to survey the supply canal system adequate sampling methods were not discovered. Flow, when water was present, was too great to permit effective sampling with gill nets or seines. The shallowness and velocity of the current, the deep mud of the bottom, and floating and suspended debris combined to render efforts to use nets ineffectual. It was equally impossible to sample fish populations of the supply system with chemicals. The effect of the chemical could not be adequately controlled, and fish destroyed could not be recovered in a manner to provide meanful data. A small isolated pool at the end of the Riverside Canal provided the only collection to sample fish populations for the supply canal system.

In the drainage canal system other methods were tried and chemical sampling with rotenone was selected as the best technique for carrying out objectives. The procedure most frequently used was to place two 25-foot bag seines at opposite ends of a measure length of canal (175-225 yards), and kill the entrapped fish with rotenone. As many fish were recovered as possible, tallies by species were made, and other data recorded in keeping with standards specified for netting and seining collections. In rotenone collections toxicant was applied in two ways. If flow was meager or indolent the area between the two seines was treated with a slurry of rotenone that was broadcast over nearly the entire surface of the closed off area. If velocity or flow was significant, (exceeding 2.5 - 3.0 mph), a thin slurry was mixed and introduced into the current about 10 yards above the upper net. Slow, gradual, and relatively uniform application was achieved by placing the slurry in a burlap bag for dissipation by the current in the sampling area. Trial and error determined the quantity of 6.5 per cent rotenone required to accomplish sampling of the limited area without serious damage to downstream populations. Comparative results of seining and rotenone collections taken from the same site on succeeding days are shown in Table 1.

Table 1. Comparison of Two Sampling Methods in Anthony Drainage Canal

Species	Seining Collection Taken 5-8-63 Number	Rotenone Sample Taken 5-9-63 Number
Gizzard shad	16	221
Grey redhorse suckers	0	6
Carp	0	23
Channel catfish	1	0
Black bullhead	0	9
Largemouth bass	1	0
Green sunfish	2	21
	20	280

Seventy-six rotenone collections were taken from the drainage canal system. A summation of sampling efforts for the drainage system is as follows:

Table 2. Composite for Mesilla, El Paso and Lower Valley Drainage Systems

Total number of yards of canal worked	14,295
Total surface area (sq. ft.)	348,870
(acres)	8.01
Total volume ($ft.^3$)	538,860
(acre-feet)	12.37
Number collections	76
Average Yards for Each collection	188

a. Work completed in the Mesilla Valley (Upper Valley)

Total number of yards of canal worked	1,250
Total surface area (sq. ft.)	32,400
(acres)	.744
Total volume ($ft.^3$)	54,000
(acre-feet)	1.24
Number collections	7
Average yards for each collection	178.6

b. <u>Work Completed for El Paso Valley and Hudspeth County (Lower Valley)</u>

Total number of yards of canal worked		13,045
Total surface area	(sq. ft.)	316,470
	(acres)	7.266
Total volume	($ft.^3$)	484,860
	(acre-feet)	11.13
Number collections		69
Average yards for each collection		189.0

Work completed was much greater than that specified in planning.

Results:

Background Information

Probably, El Paso has greater need for expansion of the fishery resource than does any part of the state. Over 314,000 persons reside in El Paso County, 267,687 of them in the city. This urban population makes the area the most heavily populated locality in the western half of the state. There are no large Texas reservoirs within 100 miles of the city. Previous investigations have resulted in successful management of Lake Ascarate, and have determined some of the attributes of the Rio Grande and of the canal system. A study of flood retention structures in the McNary area indicated possible development of those facilities for recreation. Other details of previous work are to be found in job completion reports B-15, Project F-5-R-8; B-14, Project F-5-R-3; 16a29, Project F-14-D-4; and 15a-11, Project F-15-D-2.

The Irrigation Canal System

Waters of the Rio Grande are impounded in reservoirs in New Mexico and released on demand to downstream locations to be diverted into a maze of irrigation canals and laterals. These structures transport water for full irrigation of 178,000 acres. Of this quantity 70,000 acres are irrigated in the Mesilla and El Paso Valleys and supplemental irrigation is provided for 18,330 acres in Hudspeth County. The study carried out under this job included investigations of approximately 90 miles of primary canals, 270 miles of secondary laterals, and nearly 457 miles of drainage canals.

Descriptions of Component Parts of the Irrigation System

<u>Primary canals</u> supply bulk water throughout the valley to farms and ranches where it is siphoned or released into laterals for final dissipation in fields. These canals average approximately 25 feet at the top and 20 feet at the bottom. Maximum carrying capacity is at 5-foot depth. The cross-section of the larger canals approximates an inverted trapezoid. Sides of canals are capped with grasses, primarily bermuda and St. Augustine, but lower portions are generally bare. Canal bottoms are covered with fine to medium sand or mud. Several larger canals as the Riverside Canal and the Franklin Canal exceed these dimensions.

Laterals are usually 3 feet to 5 feet at the top and from 1 foot to 2 feet deep. Their cross-section approximates a "U", although a few cement-lined laterals more closely resemble an inverted trapezoid. A few of the major laterals as La Union Lateral, Montoya Lateral and San Elizario Lateral greatly exceed these descriptions.

Drainage canals have three functions. (1) Excess water supplied to fields from the canal system is removed through drains, (2) seepage and ground water is returned to the supply system or to the Rio Grande, and (3) flushing action of top soils removed excessive concentrations of harmful salts and these suspended materials are transported by drains and emptied into the Rio Grande. With few exceptions, drains maintain flow the year around. Water is supplied directly to the drain system under the auspices of the Bureau of Reclamation from various dams and flood retainer structures located in New Mexico and Colorado, and subsurface flow and seepage supply drains. Due to an extended period of drouth being experienced within the Upper Rio Grande drainage area, particularly in northern New Mexico and Colorado, water storage for the Bureau's Rio Grande Project has been decreasing for more than 10 years. Should this trend continue, disasterous effects on aquatic life can be expected. Drains are from 15 to 40 feet wide at the top and from 5 to 25 feet wide at the bottom. Average depth is 8 to 10 feet. Water rarely exceeds an average depth of 2 feet. The topography and ecology of drains is kept in a constant state of flux due to alterations in water quality and a continuous program of repair and maintenance. Repeated maintenance is necessary to control rapidly growing salt cedar, accumulations of mud and silt, and erosion of banks and adjacent fields. Drain classification would range from recently renovated to mature. The renovated drains are barren and devoid of vegetation, both on the sides and bottom, and lack salt cedars. If these drains are allowed to stand unattended for some time, growths of grasses, primarily bermuda, cattails (*Typha* sp.) and filamentous algae appear in and along drains. These growths are supplemented within one year with growths of salt cedar which appear at the crown and descend the banks of drains. Within three or four years, drains have matured and are characterized by debris-filled mud bottom. When mature, drains support luxuriant growth of filamentous algae and cattails. Sides are covered with grass and salt cedar. The top of banks are crowned with salt cedar.

The Rio Grande is a functioning part of the irrigation system for 73 miles. Stream flow is jointly controlled by the U. S. Bureau of Reclamation and the Department of Interior of Mexico. Levees are maintained on both sides of the river at specific heights, widths, and distance from the channel. These have been established and maintained primarily as flood control measures, but ultimately serve to make the river into a tremendous canal. Within El Paso's city limits, gates extending across the river can divert its flow into the Franklin Canal for irrigation purposes. During the irrigation period the river below these diverting structures dries up and remains dry until water is drained back into the channel in Hudspeth County. During the remainder of the year, the river may or may not carry water, depending on municipal requirements and releases from a series of dams operated by the Bureau of Reclamation. It is the rule rather than the exception to find the riverbed dry for several consecutive months during the non-irrigation season. Normal flow descends and becomes subsurface before entering the city limits and does not emerge until it reaches Hudspeth County. Maps of various subdivisions of the irrigation system are given in Figures 3 through 12. For a complete map of the system these segments may be removed and joined together beginning with Figure 3 and continuing in the order of their appearance through Figure 12.

Figure 1. Typical canal structure that releases flow into laterals or drainage canals

Figure 2. Typical canal during period when water is being released.

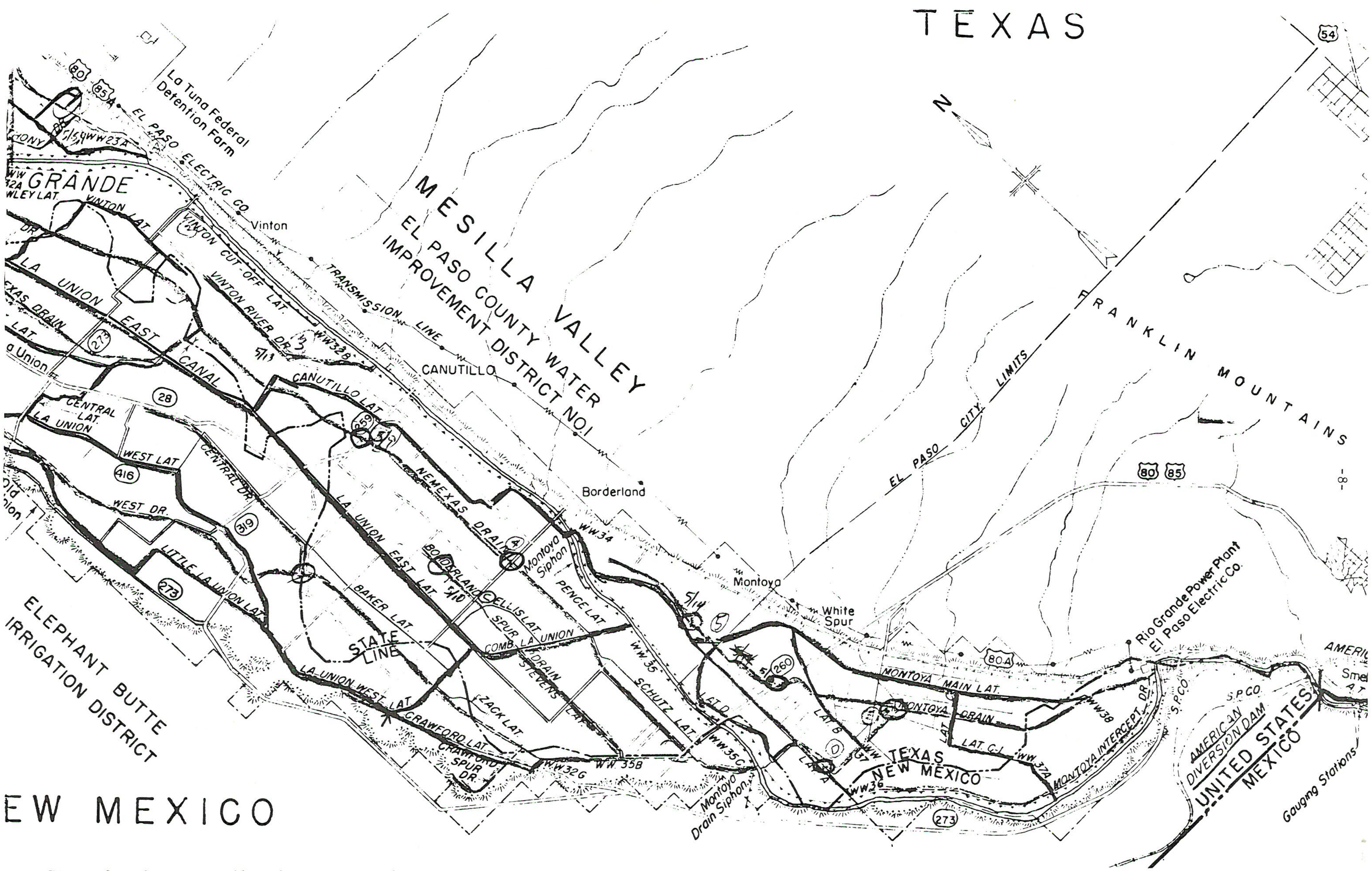

Figure 3. The Upper Valley where water quality and game fish production are favorable.

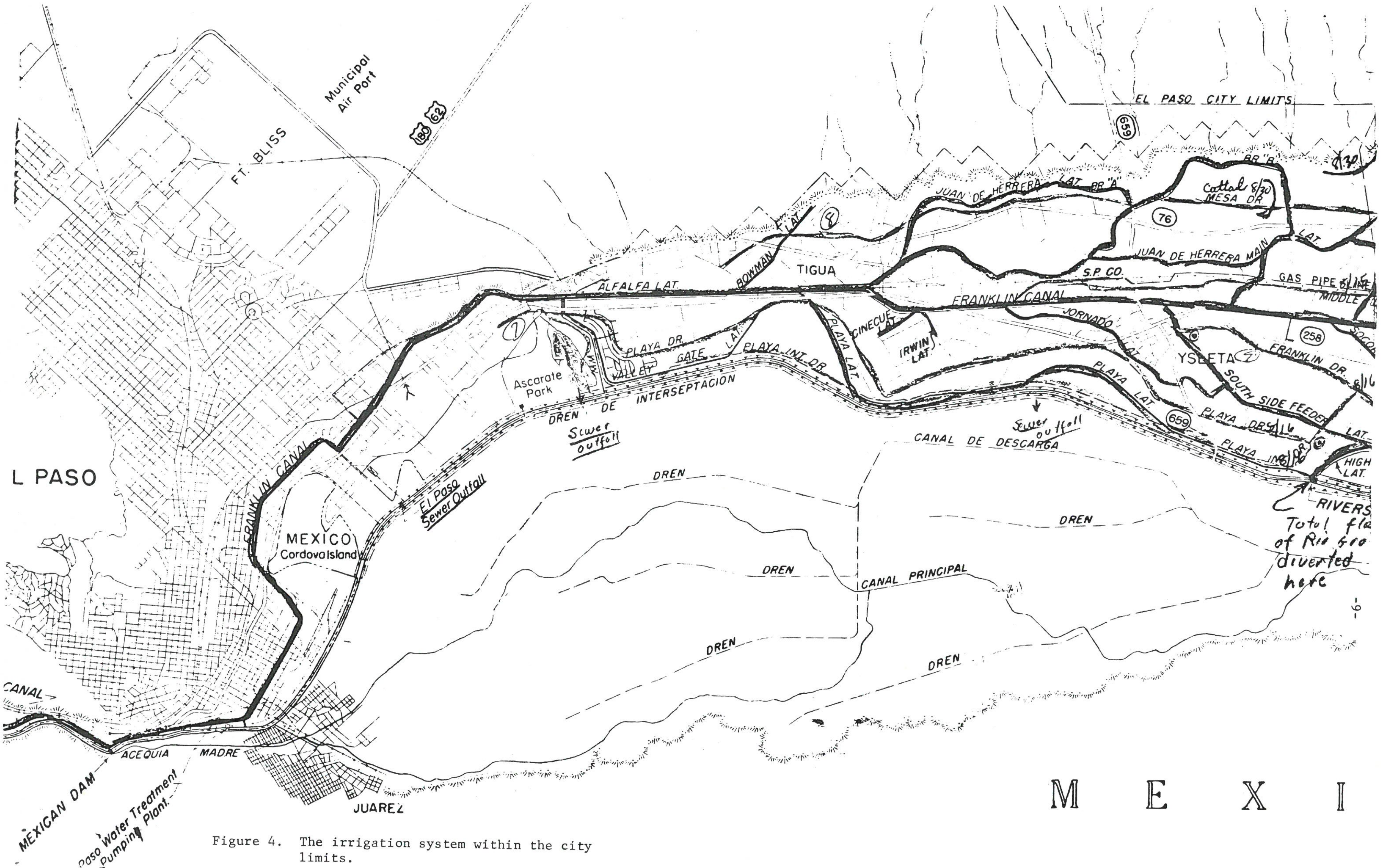

Figure 4. The irrigation system within the city limits.

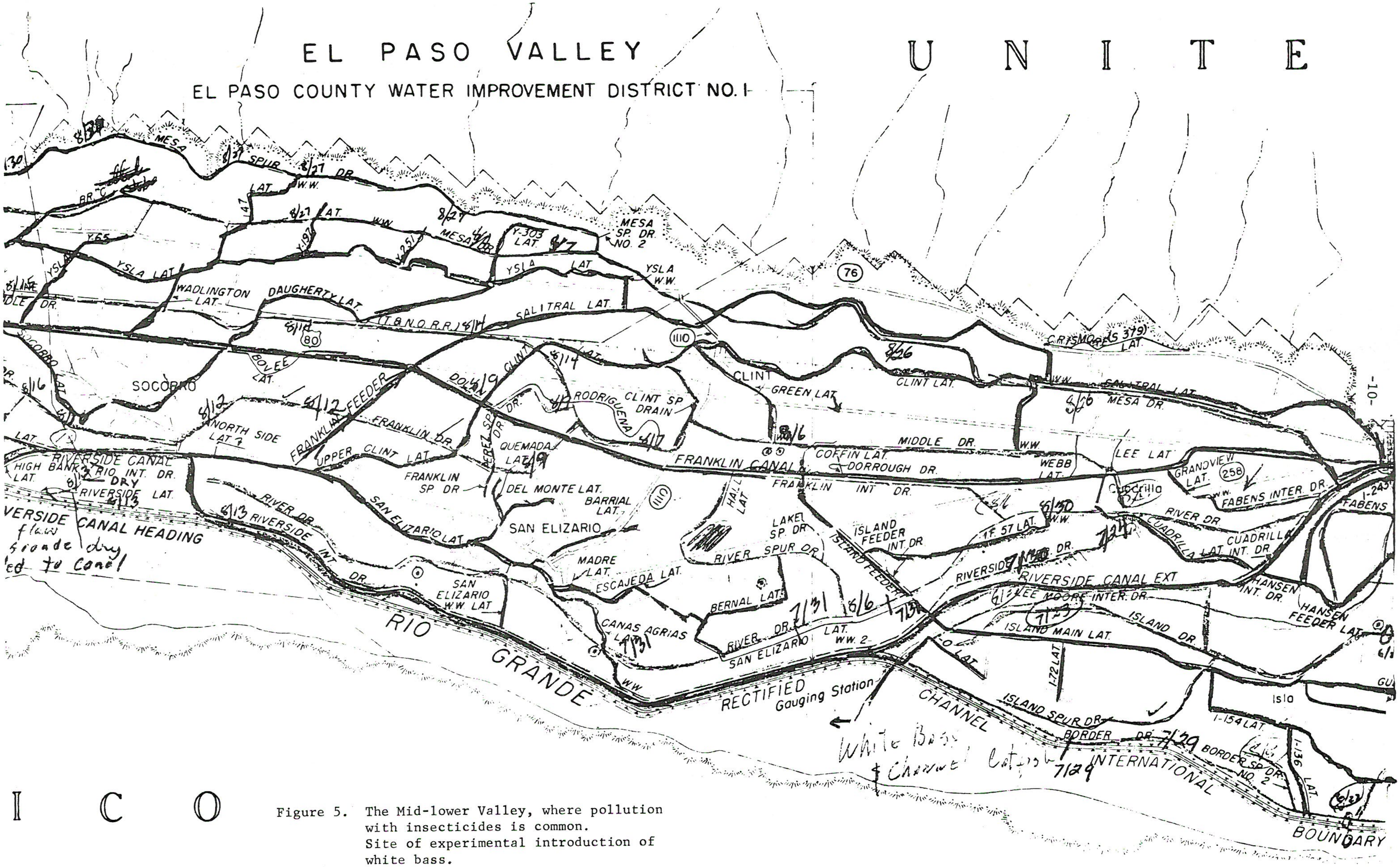

Figure 5. The Mid-lower Valley, where pollution with insecticides is common. Site of experimental introduction of white bass.

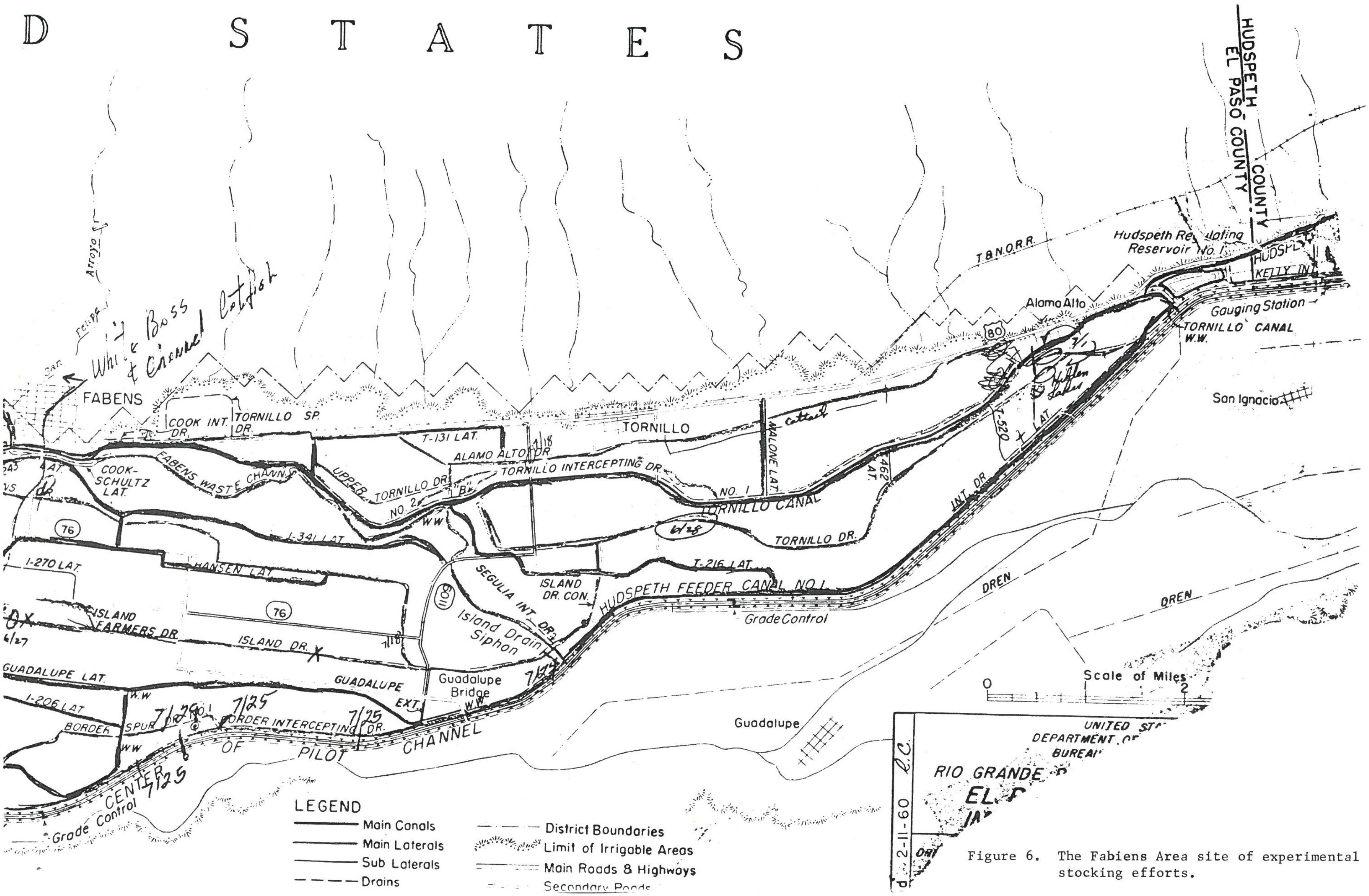

Figure 6. The Fabiens Area site of experimental stocking efforts.

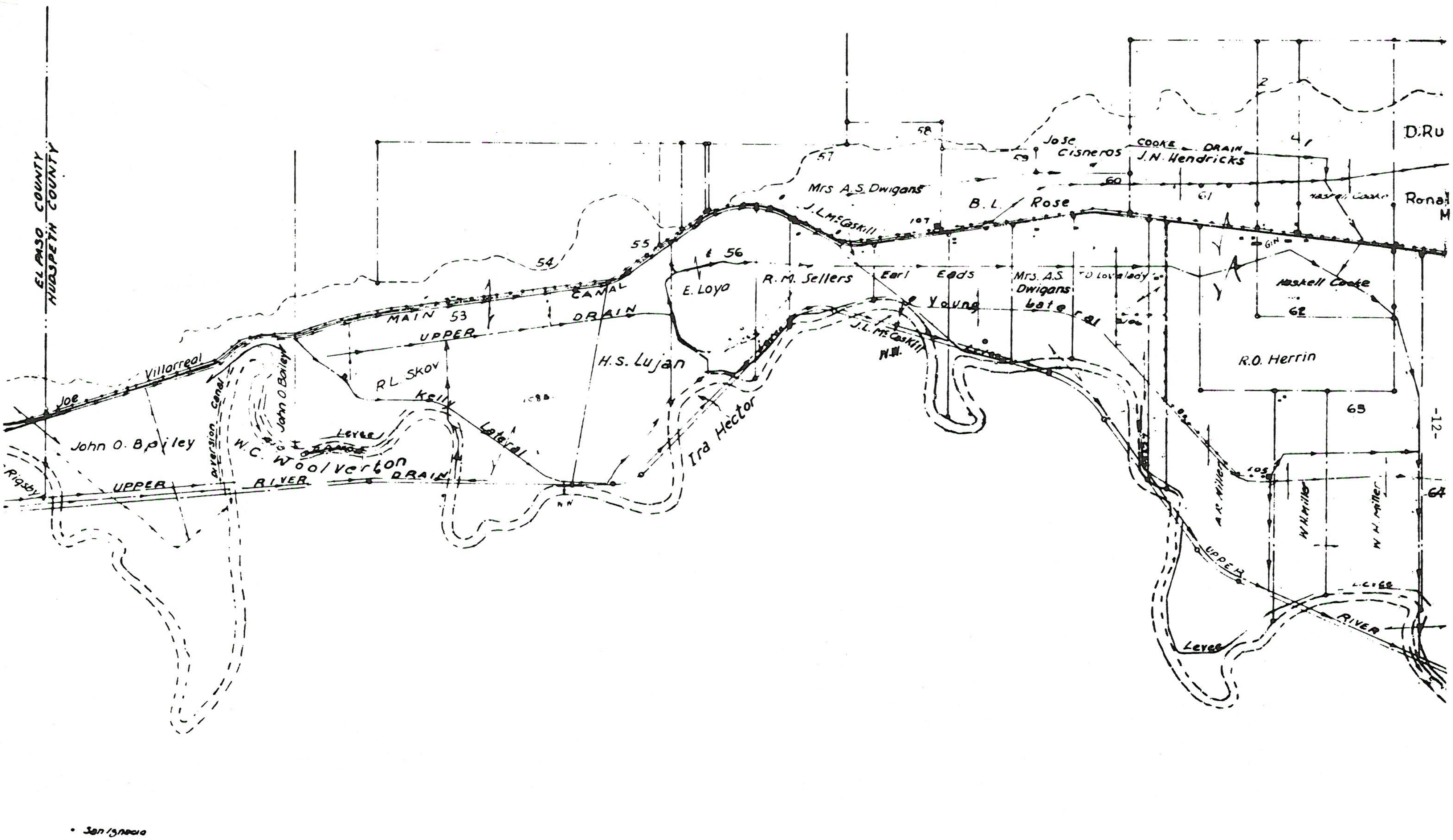

Figure 7. The Non-productive Lower Valley.

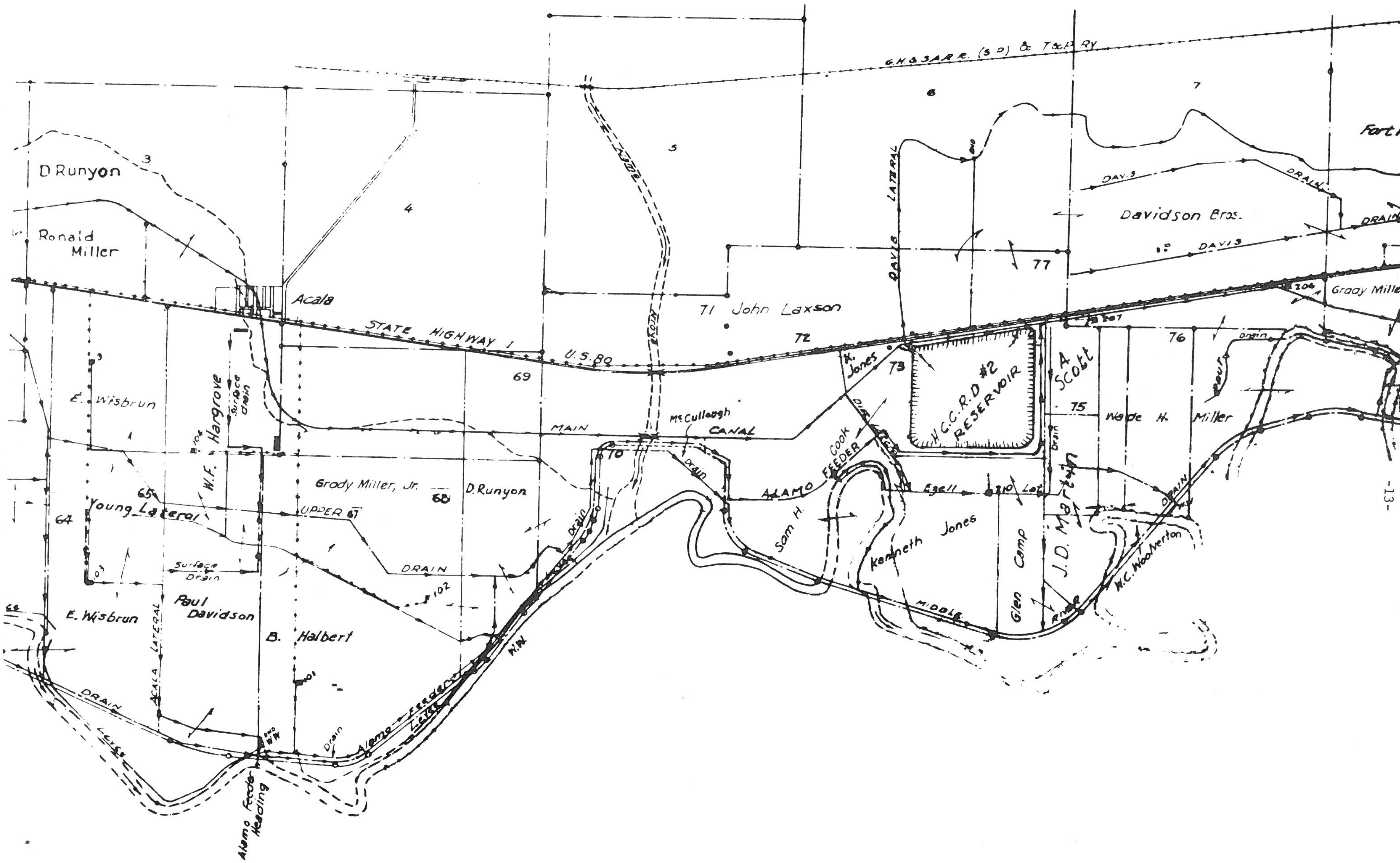

Figure 8. The Non-productive Lower Valley.

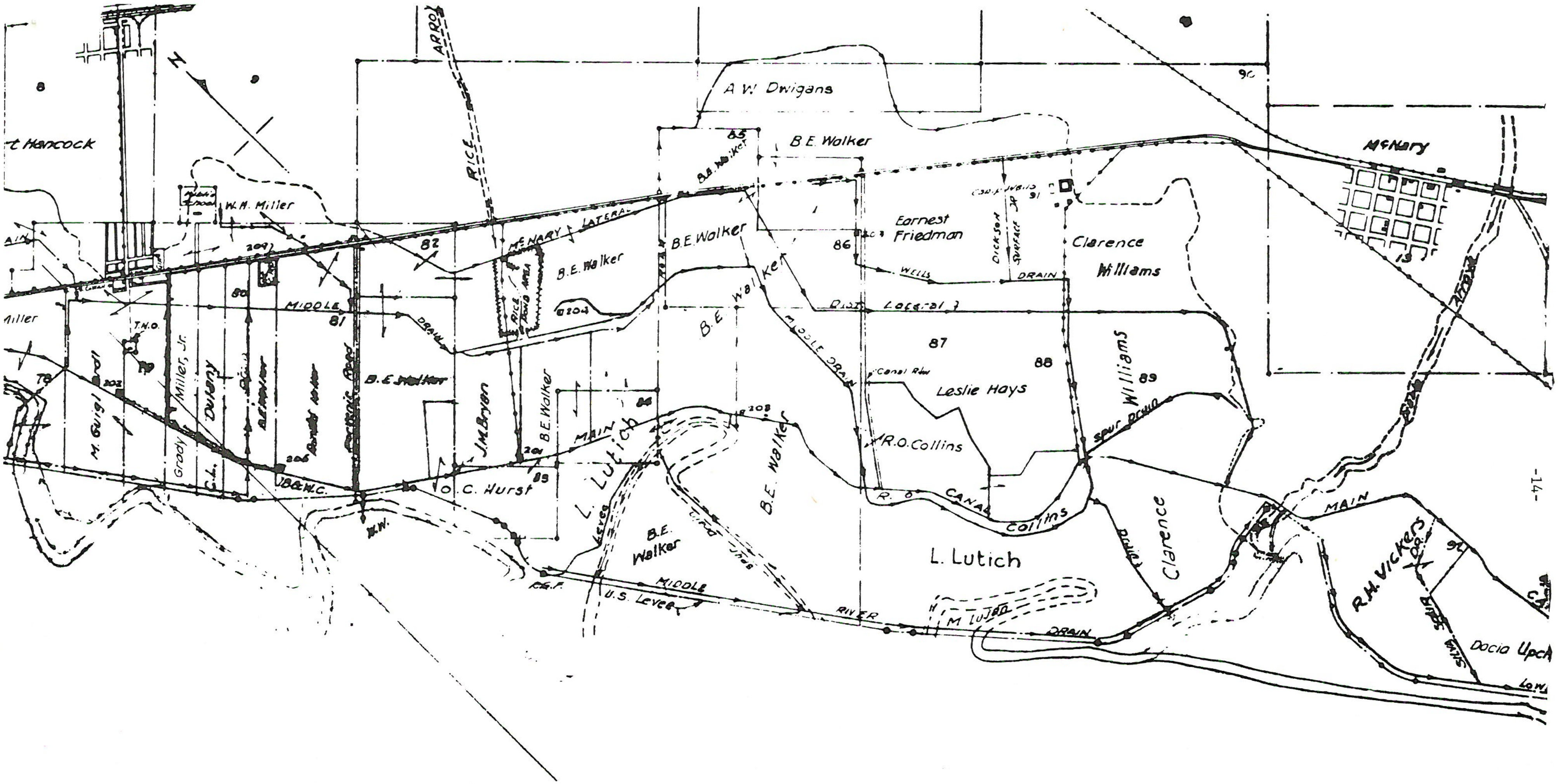

Figure 9. The Non-productive Lower Valley.

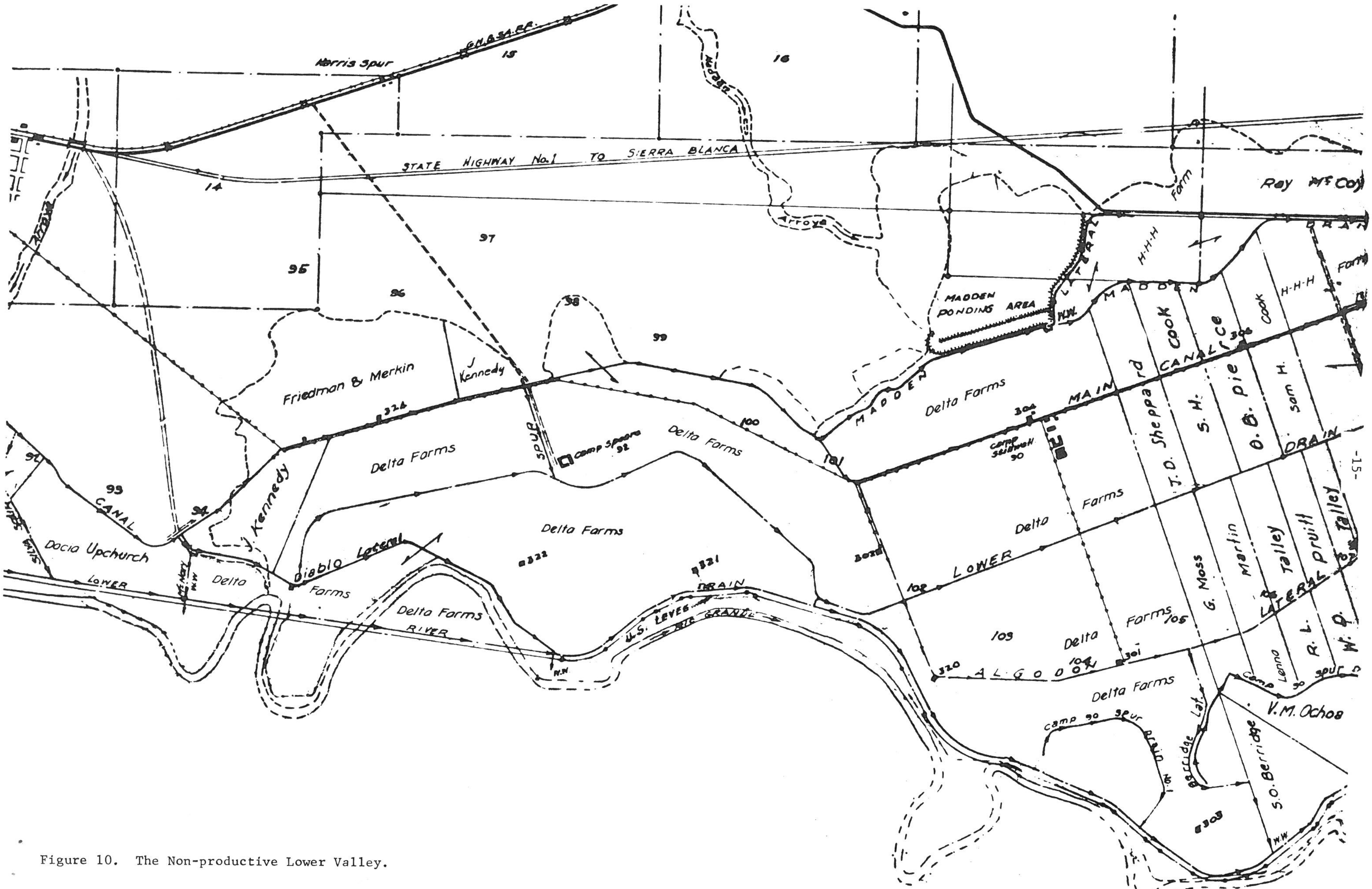

Figure 10. The Non-productive Lower Valley.

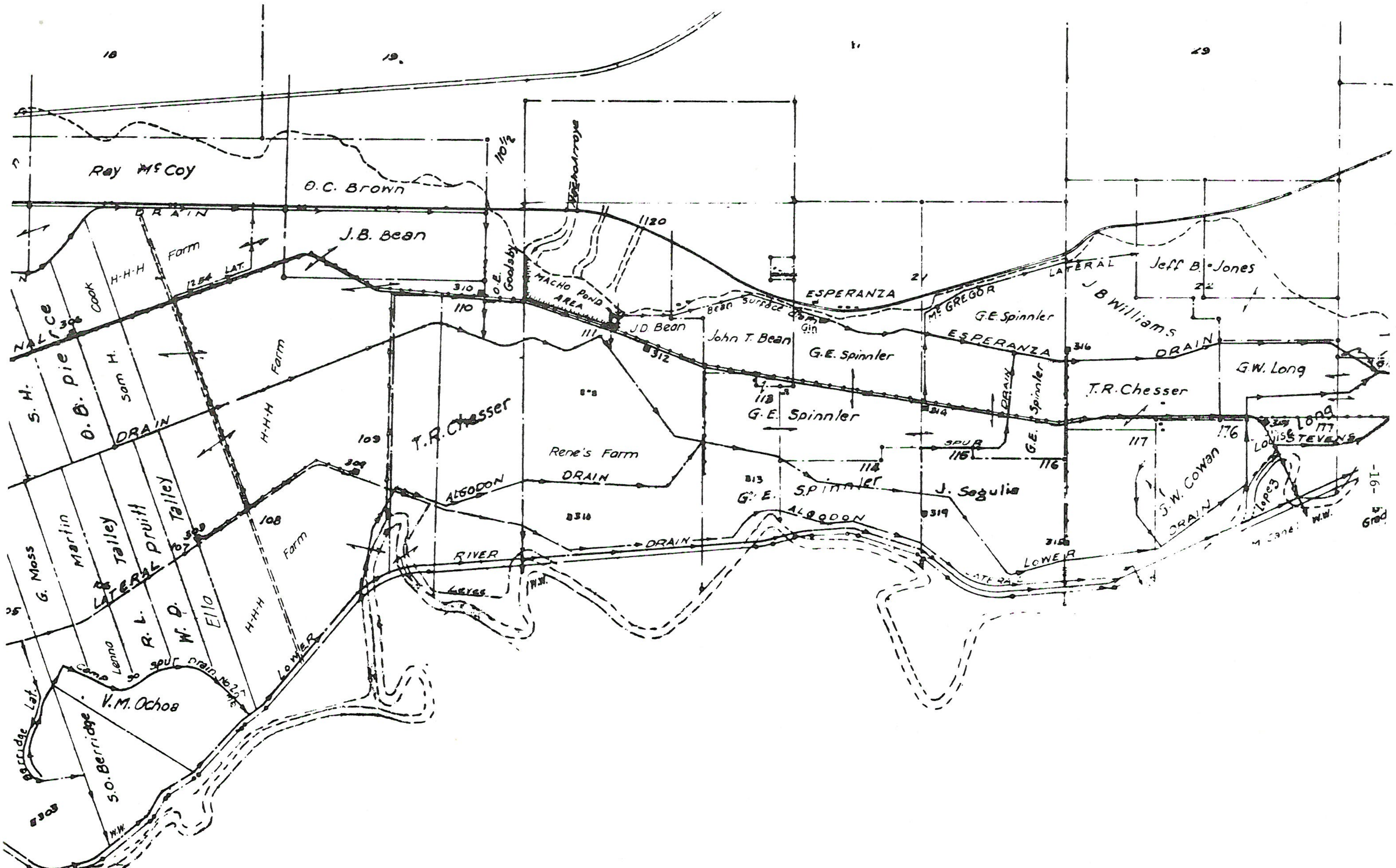

Figure 11. The Non-productive Lower Valley.

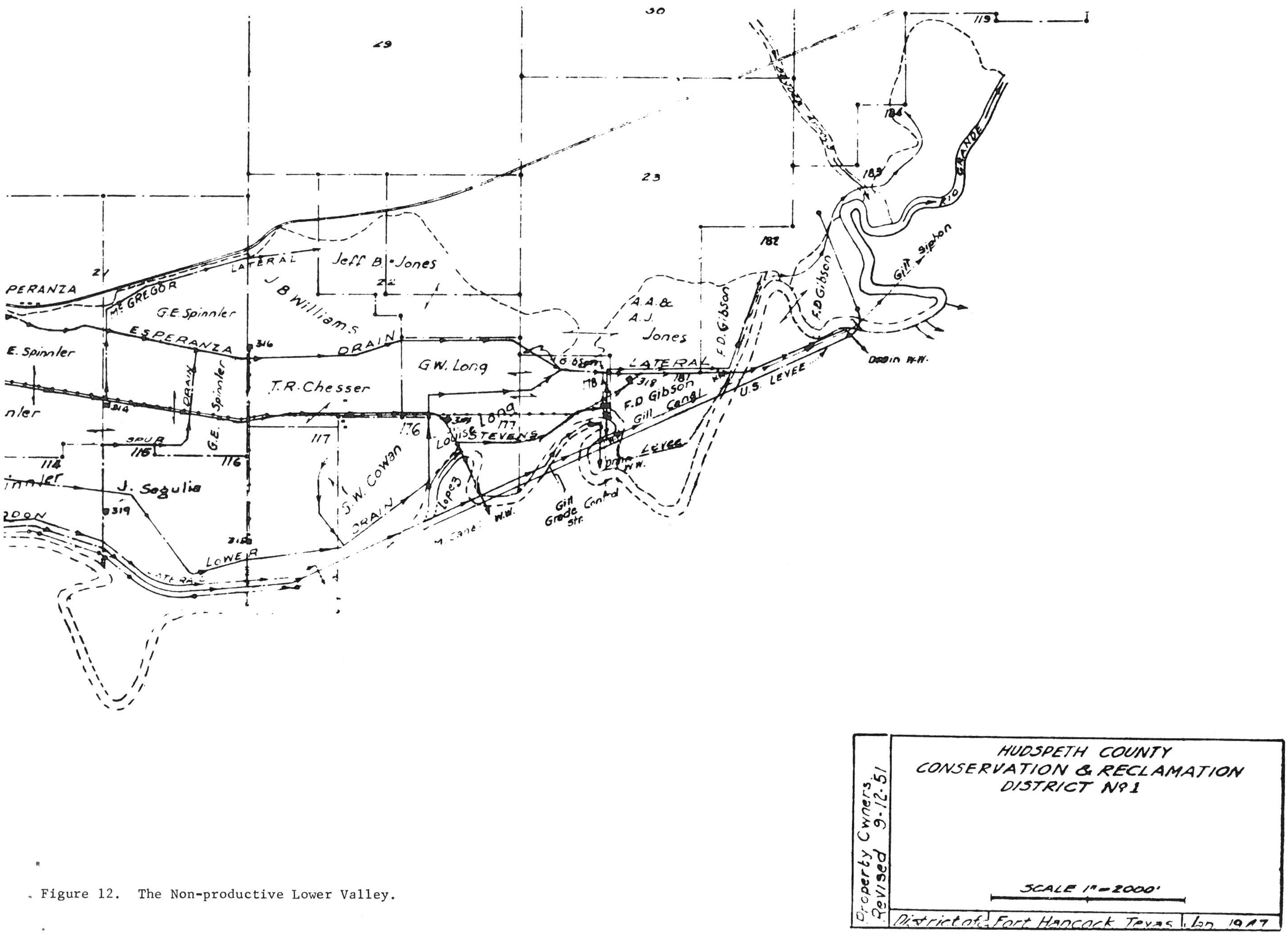

Figure 12. The Non-productive Lower Valley.

Hydrology of the Rio Grande and the Associated Irrigation System

The Rio Grande and Supply System

Flow of the Rio Grande as it enters the irrigation project area averages 994,246 acre-feet annually (Table 3). The 1962 flow of 1,043,510 acre-feet was 5 per cent above the 1934-1962 average, but was only 77 per cent of the 1,353,000 acre-feet average for the 1890-1935 period. Approximately 608,610 acre-feet of water entered Texas in 1962, and 73,705 acre-feet were discharged into the stream bed at Fort Quitman. This volume is 4 times the discharge for 1961 and 50 per cent of the 1934-1962 average of 147,835 acre-feet. Monthly flow of the Rio Grande at primary stations is presented in Table 4. The total volume and monthly quantity of water leaving the El Paso Valley Division of the Rio Grande Project at the El Paso-Hudspeth county line during 1962 is in Table 5. (This later data include water returned through the drainage canals). Flow through supply canals varies from as much as 25,000 acre-feet per month to no flow. Some canals are dry as much as 8 months out of the year, and normally all canals are dry for at least 30 days each year.

The Drainage Canal System

As previously stated, relatively permanent flow is usually maintained in most drainage canals. This flow from drains may be greater than 36,000 acre-feet in a single month and has exceeded 253,410 acre-feet in a single year. Normally, flow is greater during the irrigation period, March to September, than in other periods. Flow is seldom less than 5,000 acre-feet per month. Additional hydrological data can be obtained from the U. S. International Boundary and Water Commission, U. S. Geological Survey, State Health Department, U. S. Salinity Research Laboratory, U. S. Department of Agriculture, and the El Paso Water Department.

Physical Properties of Waters

Physical characteristics of waters of the Rio Grande and associated irrigation systems vary in accordance with occurrence of flow, quantity and velocity, and to a lesser degree with season. Normally, river water and that in supply canals and laterals is extremely turbid, usually less than 6 inches. Except for brief periods, the water in drains is less turbid and in some instances is relatively clear. Water temperatures are frequently higher in drains than in canals and dissolved oxygen and carbon dioxide content frequently reach critical limits during the hottest part of the summer. Water temperatures are usually between 75°F. and 85°F., but temperatures as high as 94°F. have been recorded.

Chemical Properties of Water

Chemically these waters are extremely variable and complex. Data on this aspect of the work were obtained from the following sources: (1) U. S. Salinity Laboratory Research Report No. 103, "Discharge and Salt Burden of the Rio Grande Above Fort Quitman and Salt-Balance Conditions of the Rio Grande Project for the Year 1963". U. S. Salinity Laboratory, Agricultural Research Service, U. S. Department of Agriculture. (2) Water Bulletin Number 32, "Chemical Analysis of Water Samples from the Rio Grande and Tributaries - 1963". International Boundary and Water Commission. (3) "Water Quality Data Sheets".

Table 3. The Rio Grande. Total annual discharge and electrical conductivity at Otowi Bridge, New Mexico, and Fort Quitman, Texas, 1934 - 1962 inclusive.

	Discharge, acre-feet		Conductivity $ECx10^6$ at 25°C.	
Year	Otwoi Bridge	Fort Quitman	Otowi Bridge	Fort Quitman
1934	380,430	102,360	408	3410
1935	1,100,740	145,380	349	2440
1936	1,071,190	149,590	340	3270
1937	1,653,710	178,290	285	3270
1938	1,329,780	282,470	298	2750
1939	786,980	152,780	348	3340
1940	584,480	124,320	372	3510
1941	2,592,700	331,190	295	2610
1942	2,144,420	1,270,400	296	1370
1943	701,960	232,390	368	2620
1944	1,303,990	275,300	270	2730
1945	1,131,550	207,710	280	3200
1946	533,990	129,450	372	3600
1947	763,730	90,780	362	3960
1948	1,228,360	77,400	289	4740
1949	1,322,650	133,600	302	4032
1950	620,430	123,530	354	4201
1951	387,080	25,690	378	4106
1952	1,408,250	11,129	297	5770
1953	530,190	20,329	366	3674
1954	435,380	14,886*	371	1975*
1955	437,150	5,888*	393	838*
1956	359,470	6,057*	367	778*
1957	1,464,040	4,843*	327	443*
1958	1,508,110	37,098*	339	831*
1959	424,510	13,226	399	2086
1960	797,700	50,193	324	3152
1961	786,650	17,220	339	6031
1962	1,043,510	73,705	318	3972
Average	994,246	147,835	338	3059

* Largely storm water that originated below Caballo Dam.

Table 4. The Rio Grande - 1962. Volume of water passing eight gaging stations.

1962	Otowi Bridge	San Marcial*	Elephant Butte	Caballo Dam
	Rio Grande at:			
	acre-feet	acre-feet	acre-feet	acre-feet
January	41,100	47,950	586	69
February	65,640	69,320	66,780	66
March	70,440	47,370	111,600	120,420
April	249,500	161,900	114,700	69,740
May	233,800	190,600	118,900	70,650
June	88,180	35,560	118,700	119,740
July	36,030	12,820	92,260	108,140
August	27,310	4,060	57,430	132,190
September	26,860	6,400	9,860	30,640
October	23,480	11,230	504	103
November	90,900	68,080	403	92
December	90,270	90,640	200	91
Total	1,043,510	745,930	691,923	651,941

1962	Leasburg Dam	El Paso (Courchesne)	County Line	Fort Quitman
	Rio Grande at:			
	acre-feet	acre-feet	acre-feet	acre-feet
January	2,830	5,009	0	1,770
February	1,100	3,694	0	488
March	101,970	46,503	0	402
April	64,380	35,856	463	943
May	59,770	34,687	0	1,259
June	104,030	52,128	0	817
July	105,220	63,855	4,531	6,513
August	116,070	62,994	651	3,405
September	39,910	41,187	21,362	28,816
October	6,680	13,307	11,143	13,438
November	2,990	8,833	5,692	8,146
December	3,660	8,100	4,757	7,708
Total	608,610	376,153	48,599	73,705

* Main (River) Channel plus Conveyance Channel.

Table 5. 1962. The volume of water leaving the Rio Grande Project at the El Paso-Hudspeth County Line as measured at the Rio Grande at Island Station, the Waste Channel at Fabens, the Tornillo Canal at Alamo Alto and the Tornillo Drain Outlet.

1962	Rio Grande at Island Station	Waste Channel at Fabens	Tornillo Canal at Alamo Alto
	acre-feet	acre-feet	acre-feet
January	3,859	2,260	0
February	617	435	5
March	470	1,160	272
April	454	3,820	938
May	239	2,990	98
June	329	3,850	178
July	6,232	6,160	2,830
August	882	5,310	1,260
September	14,714	8,130	10,480
October	1,258	6,800	1,730
November	2,242	7,890	0
December	2,687	4,330	1,730
Total	33,983	53,135	19,521

1962	Tornillo Drain Outlet	Total leaving Rio Grande Project
	acre-feet	acre-feet
January	1,810	7,929
February	1,700	2,757
March	2,680	4,582
April	3,510	8,722
May	3,200	6,527
June	3,610	7,967
July	4,670	19,892
August	4,410	11,862
September	4,140	37,464
October	3,010	12,798
November	2,240	12,372
December	2,570	11,317
Total	37,550	144,189

Water Pollution Control Division, Texas State Department of Health. (4) "Monthly Reports from Sewage Treatment Plant". Public Service Board, City of El Paso and records of El Paso Water Utilities. The purposes for which these reports were written result in data being expressed in different terms. In order to provide the means of converting data to standards more familiar to fishery personnel the following definitions are included:

(1) To convert milligram equivalents to parts per million by weight, multiply each ion by its appropriate conversion factor. These factors are: Ca, 20; Na, 23; Mg, 12.16; CO_3 plus HCO_3 (expressed as CO_3), 30; SO_4, 48; Cl, 35.5; and NO_3, 62.

(2) To convert tons per acre-foot to parts per million multiply tons per acre-foot by 735.5.

(3) Electrical conductivity is a relative indication of the concentration of dissolved solids in natural waters. A study of recent data pertaining to stations on the Rio Grande watershed indicates that the relationship may be expressed within 10 per cent by the following equations:

(a) Tons per acre-foot equal .0008878 (EC x 10^6 at 25° C) if below 7,520 micromhos.

(b) Tons per acre-foot equal .001052(EC x 10^6 at 25° C) - 1.235 when conductivity ranges between 7,520 and 22,000 micromhos.

Because a thorough understanding of the chemistry of these waters is vital to comprehension of future appraisal of existing and potential game fish production for the area, the three principal subdivisions of the system will be examined separately. A summation of basic trends will close this section.

Rincon Valley Division is the upper division of the project. It extends downstream from Caballo Dam to Leasburg Dam, a distance of about 45 miles. Quantity of water used consumptively is the difference in discharge of the Rio Grande at Caballo Dam and at Leasburg Dam. Salt balance is assumed to be the difference in the salt burden of the river at Caballo Dam and at Leasburg Dam. As shown in Table 3, water quality is excellent for this subdivision. There is a slight build-up in total dissolved solids from 438.19 p.p.m. to 498.63 p.p.m. Chlorides increase from 46.50 to 62.48 p.p.m. and sodium increases from 65.09 p.p.m. to 80.96 p.p.m. A thorough perusal of data from this region failed to note any significant departure from these averages.

Mesilla Valley Division is the second division and extends from Leasburg Dam to the American Dam at El Paso, a distance of about 63 miles. Total quantity of water used consumptively in this division is taken as the difference in discharge of the Rio Grande at Leasburg Dam and at Courchesne, just above the American Dam in El Paso. The salt balance of the division is assumed to be the difference in the salt burden of the Rio Grande at Leasburg Dam and at Courchesne. Again water quality for the subdivision is excellent for game fish production, and few significant deviations were noted in detailed examination of data as compared with the average figures that follow. The build-up of total dissolved solids nearly doubles, increasing from 498.63 p.p.m. to 823.50 p.p.m., and there is a corresponding increase in chlorides from 62.48 p.p.m. to 123.90 p.p.m. Sodium increases from 80.96 p.p.m. to 151.57 p.p.m.

El Paso Valley Division is the lowermost of the three major divisions of the Rio Grande Project. It extends, wholly on the United States side of the Rio Grande, from the American Dam to the El Paso-Hudspeth county line, a distance of 47 river miles. The quantity of river water used consumptively in this division is taken as the difference in the discharge of the Rio Grande at Courchesne, and the total quantity of water crossing the El Paso-Hudspeth county line. Salt balance of the division is assumed to be the difference in salt burden of the Rio Grande at Courchesne and the total quantity of salt crossing the El Paso-Hudspeth county line. The trend toward increasing salinity accelerates with each sampling station. Total dissolved solids increase from 823.50 p.p.m. to 2,765.13 p.p.m. Chlorides increase from 123.90 p.p.m. to 843.48 p.p.m. Sodium increases from 151.57 p.p.m. to 544.87 p.p.m. In this division average annual figures do not adequately reflect the true impact of this chemical influence on game fish production. The actual effect is much worse than indicated. This is because salt concentration is unstable and remains constant only for short periods of time. Two extreme occurrences are presented to illustrate drastic changes that apparently occur hundreds of times within a year in localities of the lower division. In only four days, between July 8 and July 11, 1962, dissolved solids recorded at Fort Quitman increased from 809.37 p.p.m. to 8,064 p.p.m. During the same year in lower portions of Tornillo Canal, chlorides increased from 497.71 p.p.m. to 3,586.21 p.p.m. in less than 10 days. In view of these abrupt and drastic changes, it is remarkable that fish life continues to exist in the extremity of the division.

General trends that are apparent from data are: (1) The chemical characteristics of dissolved constituents of water in the Rio Grande change with each diversion and drainage return. (2) In practically all instances these changes were increases in magnitude in the downstream order from Otowi Bridge, approximately 65 miles upstream from Albuquerque, to Fort Quitman a distance of nearly 315 miles. This closely follows the pattern of previous years. (3) In the downstream order from Otowi Bridge, El Paso to Fort Quitman, calcium percentage decreased from 60.6 to 34.9 to 28.2. Magnesium percentage decreased slightly. Sodium percentage varied from 24.0 to 63.2 to 61.3. Bicarbonate percentage decreased from 62.5 to 27.3 to 11.1. Sulfate percentage increased slightly. Chloride percentage increased from 4.3 to 27.7 to 55.9. These changes are similar in direction and magnitude to those shown in previous data. (4) The salt burden increased in each station in Texas. The El Paso to County Line balance was unfavorable but was favorable when corrected for the diversion into Mexico in the Acequia Madre. The balance between County Line and Fort Quitman was unfavorable as it has been for many years. (5) The long-term effect of this usage on the water quality of the lower division will be to increase salinity in both soils and water. There is apparently no way of reversing this trend.

Table 6. The Rio Grande - 1962. Volume of water and weighted mean composition of dissolved constituents passing seven gaging stations.

			Rio Grande at:			
			Otowi Bridge	San Marcial**	Elephant Butte	Caballo Dam
Discharge, acre-feet			1,043,510	745,912	691,923	651,941
Conductivity, $ECx10^6$ at 25°C.			318	558	614	662
Sodium-adsorption-ratio (SAR)*			.7	1.5	1.9	2.1
Per cent sodium (SSP)			24	35	41	43
Dissolved solids		t.a.f.	.28	.50	.53	.58
Calcium	Ca	meq./1.	1.97	3.02	2.72	2.77
Magnesium	Mg	"	.50	.71	.89	.99
Sodium	Na	"	.78	2.00	2.51	2.83
Bicarbonate	HCO_3	"	2.05	2.94	2.59	2.65
Sulfate	SO_4	"	1.08	----	2.70	2.77
Chloride	Cl	"	.14	----	.99	1.31
Nitrate	NO_3	"	.01	----	.01	.01

			Rio Grande at:			
			Leasburg Dam	El Paso (Courchesne)	County Line	Fort Quitman
Discharge, acre-feet			608,610	376,153		73,705
Conductivity, $ECx10^6$ at 25°C.			755	1,226	Sampling	3,972
Sodium-adsorption-ratio (SAR)*			2.5	3.9	Dis-	9.0
Per cent sodium (SSP)			48	53	continued	61
Dissolved solids		t.a.f.	.66	1.09		3.66
Calcium	Ca	meq./1.	2.77	4.32		11.84
Magnesium	Mg	"	1.07	1.47		4.41
Sodium	Na	"	3.52	6.59		25.69
Bicarbonate	HCO_3	"	2.27	3.44		4.71
Sulfate	SO_4	"	3.49	5.67		14.02
Chloride	Cl	"	1.76	3.49		23.76
Nitrate	NO_3	"	.02	.01		.03

* SAR is defined as $SAR = Na^+ / \sqrt{(Ca^{++} + Mg^{++})/2}$

** Main (River) Channel plus Conveyance Channel.

Table 7.-1962. Volume of water and weighted mean composition of dissolved constituents of the water leaving the Rio Grande Project at the El Paso-Hudspeth County Line as measured at the Rio Grande at Island Station, Waste Channel at Fabens, Tornillo Canal at Alamo Alto, and Tornillo Drain Outlet.

			Rio Grande at Island Station	Waste Channel at Fabens	Tornillo Canal at Alamo Alto
Discharge, acre-feet			33,983	53,135	19,521
Conductivity, $ECx10^6$ at 25°C.			1375	3209	1630
Sodium-adsorption-ratio (SAR)*			5.0	9.2	6.0
Per cent sodium (SSP)			60	66	63
Dissolved solids		t.a.f.	1.23	2.91	1.44
Calcium	Ca	meq./l.	4.02	7.47	4.47
Magnesium	Mg	"	1.50	3.68	1.47
Sodium	Na	"	8.28	21.69	10.26
Bicarbonate	HCO_3	"	2.98	3.03	2.66
Sulfate	SO_4	"	6.16	14.13	7.51
Chloride	Cl	"	4.82	16.06	6.20
Nitrate	NO_3	"	.10	.02	.04

			Tornillo Drain Outlet	Total leaving Rio Grande Proj.
Discharge, acre-feet			37,550	144,189
Conductivity, $ECx10^6$ at 25°C.			4784	2973
Sodium-adsorption-ratio (SAR)*			11	8.5
Per cent sodium (SSP)			65	65
Dissolved solids		t.a.f.	4.31	2.68
Calcium	Ca	meq./l.	12.55	7.57
Magnesium	Mg	"	4.49	3.08
Sodium	Na	"	32.15	19.71
Bicarbonate	HCO_3	"	2.64	2.87
Sulfate	SO_4	"	17.02	12.11
Chloride	Cl	"	29.87	15.67
Nitrate	NO_3	"	.01	.04

*SAR is defined as: $SAR = Na^+ / \sqrt{(Ca^{++} + Mg^{++})/2}$

Table 8. The Rio Grande - 1962. Relative composition* of the dissolved constituents in the water leaving the Rio Grande Project.

			Rio Grande at Island Station	Waste Channel at Fabens	Tornillo Canal at Alamo Alto
Calcium	Ca	%	29.1	22.7	27.6
Magnesium	Mg	"	10.9	11.2	9.1
Sodium	Na	"	60.0	66.1	63.3
Bicarbonate	HCO_3	"	21.2	9.1	16.2
Sulfate	SO_4	"	43.8	42.5	45.8
Chloride	Cl	"	34.3	48.3	37.8
Nitrate	NO_3	"	.7	.1	.2

			Tornillo Drain Outlet	Total leaving Rio Grande Proj.
Calcium	Ca	%	25.5	24.9
Magnesium	Mg	"	9.1	10.2
Sodium	Na	"	65.4	64.9
Bicarbonate	HCO_3	"	5.3	9.3
Sulfate	SO_4	"	34.4	39.5
Chloride	Cl	"	60.3	51.1
Nitrate	NO_3	"	0	.1

* Cations as per cent of sum of cations and anions as per cent of sum of anions.

Table 9. The Rio Grande - 1962. Volume of Water and tonnage of salts and constituents passing Texas Stations.

			Leasburg Dam	Leasburg Dam to El Paso Gain or Loss	El Paso
Discharge, acre-feet			608,610	-232,457	376,153
Dissolved solids		tons	401,683	+8,324	410,007
Calcium	Ca	"	45,936	-1,659	44,277
Magnesium	Mg	"	10,771	-1,625	9,146
Sodium	Na	"	67,010	+10,527	77,537
Bicarbonate	HCO_3	"	56,390	-3,575	52,815
Sulfate	SO_4	"	138,736	+571	139,307
Chloride	Cl	"	51,647	+11,650	63,297
Nitrate	NO_3	"	1,026	-709	317
Total ions		"	371,516	+15,180	386,696

			El Paso	El Paso to County Line Gain or Loss	County Line**
Discharge, acre-feet			376,153	-231,964	144,189
Dissolved solids		tons	410,007	-23,580	386,427
Calcium	Ca	"	44,277	-14,536	29,741
Magnesium	Mg	"	9,146	-1,801	7,345
Sodium	Na	"	77,537	+11,358	88,895
Bicarbonate	HCO_3	"	52,815	-35,924	16,891
Sulfate	SO_4	"	139,307	-25,255	114,052
Chloride	Cl	"	63,297	+45,644	108,941
Nitrate	NO_3	"	317	+169	486
Total ions		"	386,696	-20,345	366,351

** The volume of water and the tonnage of salts passing the El Paso-Hudspeth County Line are the sums of the values for the Rio Grande at Island Station, Waste Channel at Fabens, Tornillo Canal at Alamo Alto, and Tornillo Drain Outlet.

Biological Characteristics of the Rio Grande and Associated Waters of the Irrigation System

Vegetation

In addition to large quantities of filamentous algae and cattails, muskgrass (Chara sp.) was common but sporadic in the upper valley. These plants were abundant in many drains of the lower valley. Waterbuttercup (Ranuculus sp.) was found in two locations of Nemexas drain, and sago pondweed or another species of Potamogeton was encountered in Mesa and Mesa Spur drains. Duckweed (Lemna sp.) was found in many drains, particularly in the Riverside Intercept Drain, and sedges (Carex) were found in marshy areas.

Animal Life

Invertebrates

From various water samples, plankton net collections, and observations numerous invertebrates were recorded. Positive identification to species of many of these was impossible with existing facilities. These are identified only to class or family level. Protozoans include Amoebea, Paramoecium, Euglena, Ceratium, Volvox, and Gonyaulax. Of colenterates, only fresh water Hydra were found. Associated with vegetation were bryozoans and several species of ROTIFERA belong to orders Bdelloidea and Monogonota. Other aschelminths were of the class GASTROTRICHA and possibly from the order CHASTONOTOIDEA. Mollusca were three species of snails (GASTROPODA, order Pectinibranchia), and a fresh water mussel (Anodonta sp.) was collected. Annelids were found belonging to class HIRUDINEA. The most important invertebrates were the numerous arthropods. Of these, crayfish were the most abundant of larger forms. Of the class INSECTA, the following were encountered in abundance noted:

mayflies - Ephemera sp. and Callibaetis sp. - frequent and numerous.
dragonflies and damsel flies - Anax sp., Epicordulia sp., Aeschna sp. - frequent, other species not positively identified.
stone flies - Perlista sp., Acroneuria sp. - rare, taken in lower valley only.
waterboatman - Family CORIXIDAE - occasional.
backswimmer - Family NOTONECTIDAE - numerous.
water striders - Family VELIIDAE - rare.
water striders - Family GERRIDAE - frequent.
water striders - Family MESOVELIIDAE - rare.
giant water bug - Family BELOSTOMATIDAE - occasional.
diving beetles - Family DYTISCIDAE - numerous.
caddisflies - Halesus sp. - rare.
mosquitoes - Culex sp. - very numerous.
Dobson flies - Neuroptera - found in association with emergent aquatic vegetation

CRUSTACEA collected included:
fairy shrimp - Branchinecta sp. - frequent.
water fleas - Daphnia pulex - numerous, especially in cold weather.
copepod - Cyclops sp. -frequent.
amphipoda - Hyalella sp. - rare, only in lower valley.
crayfish and shrimp - Cambarus sp. - numerous in all areas.
water fleas - Cypris sp., Eucypris sp. - occasional.

Vertebrates

With the exception of fish, few vertebrates were collected or observed. Bullfrogs (Rana catesbeiana) and pickerel frogs (Rana pipiens) were observed, and the toad (Bufo compactilis) was collected. The only reptile directly associated with the system was the Texas soft shell turtle (Trionyx ferox emoryi). The principal mammal of importance was the muskrat (Ondatra zibethicus) and rats of the genus Rattus were abundant.

Fish Populations

References are made throughout the remainder of this report to several species of fish. The following list has been prepared to assure correct identification. Common and scientific names are as approved by the American Fisheries Society.

Common Name	Scientific Name
longnose gar	Lepisosteus osseus
gizzard shad	Dorosoma cepedianum
Mexican tetra	Astyanax mexicanus
blue sucker	Cycleptus elongatus
river carpsucker	Carpiodes carpio
gray redhorse	Moxostoma congestum
carp	Cyprinus carpio
golden shiner	Notemigonus crysoleucas
speckled chub	Hybopsis aestivalis
Rio Grande chub	Gila nigrescens
longnose dace	Rinichthys cataractae
suckermouth minnow	Phenacobius mirabilis
Rio Grande shiner	Notropis jemezanus
bluntnose shiner	N. simus
Chihuahua shiner	N. chihuahua
red shiner	N. lutrensis
roundnose minnow	Dionda episcopa
fathead minnow	Pimephales promelas
Mexican stoneroller	Campostoma ornatum
channel catfish	Ictalurus punctatus
blue catfish	Ictalurus furcatus
black bullhead	I. melas
flathead catfish	Pylodictis olivaris
plains killifish	Fundulus kansae
Pecos River pupfish	Cyprinodon sp.
mosquitofish	Gambusia affinis
tidewater silverside	Menidia beryllina
white bass	Roccus chrysops
largemouth bass	Micropterus salmoides
warmouth	Chaenobryttus gulosus
green sunfish	Lepomis cyanellus
redear sunfish	L. microlophus
bluegill	L. macrochirus
longear sunfish	L. megalotis
white crappie	Pomoxis annularis

Fish Populations of the Supply Canal System

As noted, supply canals and laterals play only a secondary role in providing a sustained fishery resource. Perhaps their most important function is that of supplying water to drains. Only one sample could be obtained from a canal, and that collection, being a rotenone sample from an isolated pool at the end of the Riverside Canal, is obviously unrepresentative of fish populations for most of the canal system. Only fingerling-sized fish were obtained. A very few channel catfish and largemouth bass fingerlings and small sunfish made up this collection. Visual checks of canals drying up following the irrigation season indicated a predominance of carp. Also observed were numerous river carpsucker and gizzard shad. A few channel catfish were present. These observations were confirmed in creels of persons fishing in canals.

Fish Populations of the Drainage Canal System

Excluding minnow populations, 76 rotenone collections provided data from 6,394 fish of 14 species. Five species of minnows including golden shiners, Rio Grande chub, red shiner, fathead minnow and mosquitofish were taken from these collections. As statistically demonstrated in tables that follow, game fish production for the entire irrigation canal system is extremely meager. Presently employed stocking efforts appear ineffective. In 1962, more than 100,000 largemouth bass fry, 30,000 channel catfish fingerling, 10,000 redear sunfish and more than 200 adult largemouth bass, channel catfish and flathead catfish were released into the system. The results of rotenone collections that extended over nearly 8½ miles of drainage canals resulted in killing only 3 channel catfish, none of which were of acceptable size. Two redear sunfish, and only 49 largemouth bass were recovered, and no flathead catfish were found. No evidence of survival of white bass released in the lower drainage system was discovered. Utilizable game fish, according to project standards, were only 1.76 per cent of the total number of game fish captured, and these fish comprised only 3.30 per cent of the total weight. Bullheads are included in utilizable game fish recovered.

<u>Game Fish Production of the Mesilla (Upper) Valley</u>

The more favorable water quality of the upper valley is reflected in a higher relative abundance of game fish. However, the apparent abundance of game fish (73.69 per cent numerically) may be misleading. None of the bluegill (41.02 per cent numerically) were sufficiently large to possess utility. On the contrary, these fish were obviously stunted. Only 42 of 869 green sunfish exceeded 100 grams in weight, although the species made up 30.08 per cent of collections.

Bluegills were found only in the Upper Montoya Drain. In 200 yards of this drain, 1,185 were collected. Most of these fish were less than 1 inch long. The most important game species for the upper valley was largemouth bass. Thirty-four of 39 fish captured were sufficiently large to possess immediate utility. These fish averaged .87 pound. Although game fish represented approximately three-fourths of the number collected, rough fish dominated weight statistics. Gizzard shad, river carpsuckers, gray redhorse suckers, carp, and golden shiners made up 79.71 per cent (485.54 pounds) of the 609.14 pounds of fish in collections.

Table 10. Utilizable Game Fish Analysis

a. Composite of Upper and Lower Valleys

Species	Number	Per Cent by Number	Total Weight	Per Cent by Weight	Average Weight
black bullhead	5	0.07	2.98	0.17	0.60
largemouth bass	43	0.68	36.55	2.12	0.85
warmouth	2	0.03	1.26	0.08	0.63
green sunfish	57	0.89	14.45	0.84	0.25
white crappie	6	0.09	1.60	0.09	0.27
Subtotal	113	1.76	56.84	3.30	
Total	6,394		1,719.37		

Minimum utilizable weights established in report F-5-R-10, Job B-32 Supplement, Inventory of Fish Species in Lake Nasworthy and its associated waters. Omundson 1/24/63.

b. Upper Valley

Species	Number	Per Cent by Number	Total Weight	Per Cent by Weight	Average Weight
black bullhead	2	0.06	1.40	0.22	0.70
largemouth bass	34	1.18	26.35	4.33	0.78
warmouth	2	0.07	1.26	0.21	0.63
green sunfish	42	1.45	10.22	1.68	0.24
white crappie	6	0.21	1.60	0.26	0.27
Subtotal	86	2.97	40.83	6.70	
Total	2,889		609.14		

c. Lower Valley

Species	Number	Per Cent by Number	Total Weight	Per Cent by Weight	Average Weight
black bullhead	3	0.08	1.58	0.14	0.53
largemouth bass	9	0.26	10.20	0.92	1.13
green sunfish	15	0.43	4.23	0.38	0.28
Subtotal	27	0.77	16.01	1.44	
Total	3,505		1,110.23		

Table 11. Per cent Composition by Numbers and Weight of Fish taken from drains.

a. Composite of Upper and Lower Valley Drain Systems

Species	Number	Per Cent by Number	Total Weight	Per Cent by Weight	Average Weight
gizzard shad	1,328	20.76	410.85	23.89	0.31
river carpsucker	202	3.16	241.16	14.03	1.19
gray redhorse	6	0.10	1.06	0.06	0.18
carp	2,265	35.42	901.06	52.40	0.40
golden shiner	8	0.13	0.07	0.01	0.01
fathead minnow	2	0.03	0.00	-	-
Subtotal	3,811	59.60	1,554.20	90.39	
channel catfish	2	0.03	0.11	0.00	0.06
black bullhead	95	1.48	12.50	0.73	0.13
largemouth bass	49	0.77	37.09	2.16	0.76
warmouth	2	0.03	1.26	0.07	0.63
green sunfish	1,242	19.43	101.51	5.91	0.08
redear sunfish	2	0.03	0.41	0.02	0.21
bluegill	1,185	18.53	10.69	0.63	0.01
white crappie	6	0.10	1.60	0.09	0.27
Subtotal	2,583	40.40	165.17	9.61	
Total	6,394	100.00	1,719.37	100.00	

b. Upper Valley

Species	Number	Per Cent by Number	Total Weight	Per Cent by Weight	Average Weight
gizzard shad	549	19.00	112.62	18.48	0.21
river carpsucker	72	2.49	93.31	15.32	1.30
gray redhorse	6	0.21	1.06	0.18	0.18
carp	127	4.39	278.52	45.72	2.19
golden shiner	6	0.21	0.03	0.00	0.01
Subtotal	760	26.31	485.54	79.70	
channel catfish	1	0.04	0.06	0.01	0.06
black bullhead	27	0.93	5.12	0.84	0.19
largemouth bass	39	1.35	26.76	4.40	0.69
warmouth	2	0.07	1.26	0.20	0.63
green sunfish	869	30.08	78.11	12.83	0.09
bluegill	1,185	41.02	10.69	1.75	0.01
white crappie	6	0.21	1.60	0.27	0.27
Subtotal	2,129	73.69	123.60	20.30	
Total	2,889	100.00	609.14	100.00	

c. Lower Valley

Species	Number	Per Cent by Number	Total Weight	Per Cent by Weight	Average Weight
gizzard shad	779	22.22	298.23	26.86	0.38
river carpsucker	130	3.71	147.85	13.31	1.14
carp	2,138	61.00	622.54	56.08	0.29
golden shiner	2	0.06	0.04	0.00	0.02
fathead minnow	2	0.05	0.00	0.00	0.00
Subtotal	3,051	87.04	1,068.66	96.25	
channel catfish	1	0.03	0.05	0.01	0.05
black bullhead	68	1.94	7.38	0.66	0.11
largemouth bass	10	0.29	10.33	0.93	1.03
green sunfish	373	10.64	23.40	2.11	0.06
redear sunfish	2	0.06	0.41	0.04	0.21
Subtotal	454	12.96	41.57	3.75	
Total	3,505	100.00	1,110.23	100.00	

Table 12. K-factor Range and Distribution for Mesilla (Upper Valley) Drainage System

carp

	K	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.6	Total No.	Avg. K
males	no.	1	1	2	2	3	6		6	4	3	2	1	1	1	33	2.74
females	no.	1			3	2	6	8	5	3	1	3	2	1		35	2.75

gray redhorse

	K	2.1	2.2	2.5	Total No.	Avg. K
males	no.	1		1	2	2.30
females	no.		2	1	3	2.30

river carpsucker

	K	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	Total No.	Avg. K
males	no.	2	1	6	4	3			1				17	2.16
females	no.	2	1	3		4	2	1		1	1		15	2.27

gizzard shad

	K	1.3	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	Total No.	Avg. K
males	no.		1	7	4	16	6	2		1	1		38	1.79
females	no.	1		5	7	2	7	3	3		1		29	1.82

largemouth bass

	K	1.7	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	Total No.	Avg. K
males	no.	1		2		4	2	4		1	3		1	1	19	2.38
females	no.		1	2	1	2	5	6	3						20	2.29

white crappie

	K	2.6	2.8	3.0	3.2	3.3	Total No.	Avg. K
males	no.	1	1	1		1	4	2.92
females	no.				1	1	2	3.25

black bullhead

	K	1.6	2.2	2.3	2.4	2.5	2.6	2.8	3.0	Total No.	Avg. K
males	no.	1	1	2	1	1	3	1		10	2.39
females	no.			3		1	1	1	1	7	2.54

channel catfish

	K	1.5	Total No.	Avg. K
males	no.	1	1	1.50
females	no.			

green sunfish

	K	2.1	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0
males	no.	1	1		1	4	2	2	1	2		1		2	4	2	3	3		4		3
females	no.				2		1		2	1	2	1	1	5	2	3	1	3	4		3	3

	K	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	Total No.	Avg. K
males	no.	1	2	1	2				2			44	4.32
females	no.		1	1				1	1		1	39	4.48

warmouth

	K	4.2	4.7	Total No.	Avg. K
males	no.				
females	no.	1	1	2	4.45

Total 318

Table 13. K-factor Range and Distribution for El Paso (Lower Valley) Drainage System

carp

	K	0.8	1.0	1.1	1.5	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4
males	no.		1		1	2	1	5	4	18	18	33	25	26	26	27	18	13	12	13	2	3
females	no.	1	1	2		1	2	4	5	14	17	18	20	39	30	29	21	17	8	11	7	5

	K	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.4	4.5	4.7	5.8	Total No.	Avg. K
males	no.	3	4	2	1					1	1	1	1	262	2.69
females	no.	4	5	1		1	1	1		1	1			267	2.71

river carpsucker

	K	1.2	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	4.2	4.4	5.8	Total No.	Avg. K
males	no.	1	2	5	13	9	19	8	15	2	3			1	1			79	2.03
females	no.		3		7	2	8	2	4	3	3	2	2	2		1	1	40	2.25

gizzard shad

	K	0.7	0.8	1.1	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.8	Total No.	Avg. K
males	no.		1	1	1	2	6	13	18	36	14	18	6	4	3	1	1	1		125	1.82
females	no.	1				3	4	13	15	30	7	12	5		2		1		1	94	1.80

golden shiners

	K	3.4	Total No.	Avg. K
males	no.	1	1	3.40

fathead minnows

	K	1.9	2.4	Total No.	Avg. K
males	no.	1	1	2	2.15

largemouth bass

	K	2.2	2.3	2.5	2.6	2.7	Total No.	Avg. K
males	no.	1	1		1	2	5	2.30
females	no.	1	2	2			5	2.16

redear sunfish

	K	3.0	3.4	Total No.	Avg. K
males	no.	1	1	2	3.20

green sunfish

	K	1.3	1.4	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6
males	no.		2				1	1	1		1		1	1		1		6	2	6	2	6
females	no.	1		1	1	1		1		1	2	4	3	2	2		3	4	6	5	2	7

	K	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.8	Total No.	Avg. K
males	no.	3	3	3	7	3	6	2	2	3	1	1	3	1	2	2	1		2		1	77	3.98
females	no.	4	5	2	5	3	4	3	5	2	3	1	3	2		2		1		2		93	3.69

Table 13 continued

channel catfish	K	.77		
males	no.	1	1	.77

black bullhead	K	1.0	1.2	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3
males	no.		3		1		2	1	1		4	3	1	2	1	1	2					
females	no.	1	3	1	4	2		1	3	2	3	3	1		1	1					1	

	K	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3		
males	no.		1					1				25	2.30
females	no.											26	1.89

Total 1,104

Species known to have successfully reproduced include gizzard shad, carp, black bullhead catfish, largemouth bass, green sunfish and bluegills. Gizzard shad, carp, and green sunfish spawned in almost every drain, but bullheads, bass and bluegills were restricted to certain localities. One spawn of bullhead fry was noted in the lower segment of Borderland Spur Drain. Others were taken from Nemexas Drain. Largemouth bass had successful spawns in the upper segment of Borderland Drain, and in Upper Montoya Drain. Many small groups of fingerlings were observed in Upper Montoya, but required means of securing adequate collection would have resulted in annihilation. Gambusia were abundant in the upper valley drainage system, but other forage species were absent except for a few golden shiners taken from Nemexas Drain.

Game Fish Production of the El Paso (Lower) Valley

Unfavorable water quality and other circumstances result in poor game fish production. Of 3,505 fish taken, only 454 (12.95 per cent) were game fish. Of these, only 27 (.77 per cent) were large enough to have any immediate utility value. By weight, game fish were only 3.74 per cent (41.57 pounds) of the total weight of 1,110.24 pounds. Utility value was decreased to 1.45 per cent. Carp dominated fish production making up over one-half of fish collected. Rough fish, carp, river carpsuckers, and gizzard shad made up 86.93 per cent (3,047 individuals) of fish collected, and comprised 96.25 per cent (1,068.62 pounds) of the total weight. Widespread spawning was detected for carp and gizzard shad south of U. S. Highway 80. Little spawning occurred north of that highway. Cotton spraying with endrin and possibly other chlorinated hydrocarbons depleted fish and other forms of life in waters north of the highway. This was particularly evident from efforts to collect fish from Mesa Drain, Mesa Spur Drain, and the upper portions of Middle Drain. Work carried out between August 26, 1963, and August 30, 1963, resulted in the capture of only a few mosquitofish and carp.

South of U. S. Highway 80, the majority of drains were well stocked with fish. In drains nearer the river, spawning success was relatively high for several species. Small populations of usable green sunfish persisted in these lower drains, particularly in Hudspeth County. One isolated population of green sunfish that had relatively high utility has continued to exist in the lower portion of Middle Drain for several years. Only one small channel catfish was found (in River Drain), indicating an almost complete absence of the species. Relatively high populations of channel catfish were reported to have existed during the 1930-1945 period. Largemouth bass were restricted to River, Middle, and Franklin Drains. These converge west of Fabens, Texas. Spawning of largemouth bass either does not occur in the lower system or else survival is unsuccessful. No bass fry have been discovered. Minnows found in the lower valley system were primarily golden shiners. Red shiners and mosquitofish were relatively abundant. Two specimens of the Rio Grande chub were collected and a few flathead minnows were present.

Production Problems of the Irrigation System and Potential Game Fish Production

Problems

1. The problems arising from poor water quality and lack of stability of constituents appear, at least at this time, to be inherent and beyond significant change. This problem will probably grow worse.

2. The lack of stability of flow and volume may be altered on a locality basis, but major changes in the practice are improbable.

3. The detrimental effects of toxic herbicides and insecticides may find resolution in forthcoming national legislation. Their long term effect cannot be determined at this time.

4. The increase in exploitation of underground aquifers for irrigation may tend to reduce salinity, but are almost certain to result in less stability of volume in drains and canals.

5. Because the system is associated with and dependent upon the Rio Grande that crosses the Texas and New Mexico line and is the international boundary between the United States and Mexico the consent and cooperation of all would be required for carrying out any major management effort.

The Potential

With unlimited cooperation much may be achieved. The annual passage of several hundred thousand acre-feet of water through this system provides the basic requirement for producing much recreation. However, the means of fulfilling this potential are not provided in present knowledge.

Problems Associated with Harvest

With few exceptions, access to drains required no more than driving to the area over county or farmer-rancher maintained roads. Permission to travel some of these roads is required by property owners, however, few such persons refused public access if contacted. In the upper valley many persons who have only one fishing license are hesitant to fish because of the uncertain designation of the stateline in some localities. Persons lacking licenses for both New Mexico and Texas are fearful of inadvertently wandering into areas that their license does not cover.

It is fortunate indeed, when existing circumstances are taken into account, that many people of the El Paso area find carp acceptable. However, the majority reject the fish and conflicts of interest inevitably arise.

Table 14. Distribution of Channel Catfish Fingerlings in Experimental Stocking

Drains

Upper Valley	No. Stocked	Lower Valley	No. Stocked
East	250	Tornillo #1	250
Nemexas at 259	250	Alamo Alto	250
West at Gato Rd.	250	Tornillo #2	500
Nemexas at Borderland	250	County Line Lake	750
Borderland Spur	250	Island	500
Montoya at 260	250	Mesa #1	250
West at Sunset	500	Middle	500
Montoya at River Bend	500	Mesa #2	500
Subtotal	2,500	River	500
		Franklin	500
		Playa	250
		Subtotal	4,750

The Rio Grande from El Paso to Big Bend

Seventeen gill nets were set in the Rio Grande River in Hudspeth County, consisting of seven "catfish" nets having uniform size of 3½-inch mesh and ten standard gill net units. Additional collections were made below this area, consisting of 29 net sets at four locations. These latter sets captured only 10 fish, while netting in Hudspeth County captured 138 fish. Failure to net fish in the lower portions of the river is attributed to current velocity, suspended debris, and mud. A great deal of vegetative matter carried by the Concho River enters the Rio Grande near Presidio.

Table 15. Nets and Net Locations of Rio Grande Survey

Location	Nets: Standard Experimental	Catfish 150'	Catfish 200'
Hudspeth County, 100 stream miles from El Paso	3	1	2
Hudspeth County, 115 stream miles below El Paso	7	2	2
Presidio	7	2	2
Lajitas	4	0	2
Castolon	3	1	2
Boquillas	5	1	0
Total	29	7	10

As shown in Table 16 rough fish dominated collections both in number and by weight. Only flathead catfish constituted over 5 per cent of total weight. River carpsucker and longnose gar were the primary rough species making up 86.49 per cent of fish caught and 78.88 per cent of the total sample weight. All game fish had immediate utility value, exceeding the minimum established weight. Twelve standard seine collections captured 18 species. These were Mexican tetra, river carpsucker, speckled chub, Rio Grande chub, longnose dace, suckermouth minnow, Rio Grande shiner, bluntnose shiner, Chihuahua shiner, red shiner, roundnose minnow, fathead minnow, Mexican stoneroller, plains killifish, Pecos River pupfish, mosquitofish, tidewater silversides, and bluegill sunfish. More complete details of seining results are in job completion report B-32, Project F-5-R-11.

Table 16. Per Cent Composition of Fish Taken from the Rio Grande

Species	Number	Per Cent by Number	Weight	Per Cent by Weight	Average Weight
longnose gar	24	16.21	58.10	27.64	2.42
blue sucker	3	2.03	11.32	5.38	3.77
river carpsucker	104	70.27	107.71	51.25	1.04
carp	8	5.40	7.03	3.34	0.88
Subtotal	139	93.91	184.16	87.61	
channel catfish	2	1.36	4.57	2.18	2.28
blue catfish	5	3.37	8.21	3.90	1.64
flathead catfish	2	1.36	13.25	6.31	6.63
Subtotal	9	6.09	26.03	12.39	
Total	148		210.19		

Lakes and Reservoirs of the El Paso Area

Lakes netted once or more during the project segment included Lake Ascarate, Diablo No. 1, Diablo No. 2, Macho Lake, and Madden Lake. The remnants of lakes at Salt Flat were visited, but only two small playa type ponds remained. These lakes were too shallow to permit gill netting. The only forms of aquatic life recovered were mosquito larvae an occasional water spider, and algae. Previous investigations had shown a form of grass shrimp (possibly Paleomontes sp.) to be present, but none were recovered. Water temperatures in one of the shallow ponds was 35° C. at all depths while in a deeper pond temperatures ranged from 30°C. at the bottom to 35°C. at the surface.

Lake Ascarate is a 43-acre lake (247 acre-feet) maintained by El Paso City-County Recreation Board. Management of this lake precedes project history. The lake was treated to reduce rough fish in 1950, retreated in 1956 for the same purpose, and was treated for vegetation control and production renovation again in 1960. All of these efforts have been initially successful, and the work in 1963 is still producing good results. A total of 32 gill nets, 24 standard units, and 8 "catfish" nets were set in the lake during the year. The analysis of data obtained is shown in Tables 17, 18 and 19.

Table 17. Percentage Composition by Number and Weight of Fish from Ascarate Lake

Species	Number	Per Cent by Number	Weight	Per Cent by Weight	Average Weight
river carpsucker	1	0.28	1.56	0.42	1.56
gray redhorse	1	0.29	1.19	0.32	1.19
carp	18	5.17	106.64	28.88	5.92
golden shiner	5	1.44	0.86	0.23	0.17
Subtotal	25	7.18	110.25	29.85	
channel catfish	40	11.49	57.46	15.57	1.44
black bullhead	121	34.77	87.95	23.81	0.73
largemouth bass	61	17.53	71.81	19.45	1.18
green sunfish	74	21.27	30.95	8.38	0.42
redear	9	2.58	4.62	1.26	0.51
bluegill	16	4.60	4.54	1.23	0.28
white crappie	2	0.58	1.66	0.45	0.83
Subtotal	323	92.82	258.99	70.15	
Total	348	100.00	369.24	100.00	

Game fish predominated in number, weight, and number of species represented. This is considered proof of management benefits 3 years after work was completed. Carp were the only rough fish found to contribute over 2 per cent by number or over .5 per cent by weight. As previously stated carp have utility in this area. Of 18 taken, only 1 carp weighed less than 3 pounds, and all averaged nearly 6 pounds. Largemouth bass averaged 1.19 pounds and represented 19.34 per cent of the catch. Prior to management in 1960 all game species combined made up less than 5 per cent of the total number and weight of fish produced.

Table 18. Utilizable Game Fish taken from Ascarate Lake

Species	Number	Per Cent by Number	Weight	Per Cent by Weight	Average Weight
channel catfish	36	10.34	56.22	15.22	1.56
black bullhead	86	24.71	77.41	20.97	0.90
largemouth bass	60	17.24	71.60	19.39	1.19
green sunfish	9	2.59	2.69	0.73	0.30
redear	8	2.30	3.64	0.98	0.46
bluegill	13	3.73	4.26	1.15	0.33
white crappie	2	0.58	1.66	0.45	0.83
Subtotal	214	61.49	217.48	58.89	
Total	348		369.24		

Bullhead and channel catfish also contributed high percentages of utilizable specimens. Eighty-six of 121 bullheads averaged .90 pounds and represented 20.96 per cent of utilizable fish. Thirty-six of 40 channel catfish averaged 1.56 pounds and were 15.22 per cent of total utilizable weight. As shown below, 7 species of forage minnows were collected from 12 seining collections.

Table 19. Results from 12 Seining Collections of Lake Ascarate

Species	Number
golden shiner	13
red shiner	1
mosquitofish	22
largemouth bass	4
green sunfish	2,932
redear	1
bluegill	88
Total	3,061

Figure 13. Fish from Lake Ascarate exhibited excellent growth and condition.

Table 20. K-factor Range and Distribution for Principal Species from Lake Ascarate

																								Total No.	Av.K
river carpsucker	K	2.9																							
	no.	1																						1	2.90
carp	K	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	4.4													
	no.	1	1	1	2	3	3	1	1	1	3	1												17	2.49
golden shiner	K	1.8	1.9	2.0	2.1	2.2	2.3																		
	no.	1	2	1			1																	5	1.98
red shiner	K	1.8																							
	no.	1																						1	1.80
channel catfish	K	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	3.6									
	no.	5	1	2	4	4	1	7	6	1	1	2	2	1	1	1								38	1.84
black bullhead	K	0.7	0.8	0.9	1.3	1.4	1.5	1.6	1.8	2.0	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4		
	no.	1		1	1			1	2	1	2	5	3	4	9	9	7	4	10	9	8	4	8		
	K	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.4	4.6	5.0	5.6												
	no.	4	3	2	5	2	1	1	1	1	1	1	1											112	4.00
largemouth bass	K	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3										
	no.	1	1	1	4	7	9	7	4	5	6	2	1		1									49	2.60
green sunfish	K	1.6	1.9	2.0	2.7	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.8	3.9	4.0	4.1	4.2	4.3	4.7					
	no.	1	1	1	1	3	1	3	1	5	1	5	1	2	1	2	2	1	1	1				34	3.36
redear	K	4.5	4.8	4.9																					
	no.	1	1	1																				3	4.73
bluegill	K	3.2	3.7	4.0	4.4	4.5	4.7	4.8	5.0	5.2	5.3	5.6													
	no.	1	1	1	1		2	1	3	4	1	1												16	4.76
white crappie	K	3.6	3.7																						
	no.	1	1																					2	3.65
																							Total	278	

Diablo No. 1 is located on Diablo draw, 7 miles north of McNary, Texas. The dam is an S. C. S. flood control structure designed primarily to trap and temporarily retain flood waters during periods of flooding. Through cooperation of the Soil Conservation Service, Hudspeth County Bureau of Reclamation, local ranchers, and the Texas Parks and Wildlife Department, Diablo No. 1, Diablo No. 2, Macho, and Madden Lakes have been turned into potential public fishing and recreational areas. Vegetation around Diablo No. 1, a 45-acre lake, consists of greasewood and salt cedars. These structures were completed in 1960-61 and were stocked with fish in 1961-62. Three field trips were made to the lake. Twenty-eight gill net collections were taken (24 standard units and 4 "catfish" units). Six seining collections captured only four largemouth bass fingerlings and four bluegills. Seining was ineffective because of aquatic and terrestrial vegetation, rocks, stumps and other obstructions.

Table 21. Percentage Composition by Number and Weight of Fish taken from Diablo No. 1

Species	Number	Per Cent by Number	Weight	Per Cent by Weight	Average Weight
golden shiner	487	51.53	76.89	33.25	0.16
Subtotal	487	51.53	76.89	33.25	0.16
channel catfish	33	3.49	57.08	24.68	1.73
largemouth bass	15	1.59	6.81	2.95	0.45
green sunfish	50	5.29	6.09	2.63	0.12
redear	87	9.21	22.66	9.80	0.26
bluegill	268	28.36	60.45	26.14	0.23
white crappie	5	0.53	1.26	0.55	0.25
Subtotal	458	48.47	154.35	66.75	
Total	945	100.00	231.24	100.00	

Over half of the fish captured were golden shiners (51.53 per cent) and these fish made up 33.25 per cent of the 231.24 pounds captured in gill nets. These fish had originally been introduced to provide forage for game species, but under prevailing conditions had grown to sizes too great to permit their control by predators. Utility of channel catfish and redear sunfish was high. All catfish (33 of 33 captured) and nearly all redear sunfish (69 of 87 captured) were above minimal weight values (.44 pound for catfish and .22 pound for sunfish). Total utility of game species represented 59.47 per cent of the total weight of all species captured.

Table 22. Usable Game Fish taken from Diablo No. 1.

Species	Number	Per Cent by Number	Weight	Per Cent by Weight	Average Weight
channel catfish	33	3.49	57.08	24.68	1.73
largemouth bass	7	0.74	6.11	2.64	0.87
green sunfish	1	0.10	0.38	0.17	0.38
redear	69	7.31	20.58	8.90	0.30
bluegill	206	21.79	52.42	22.66	0.25
white crappie	2	0.22	0.95	0.42	0.48
Subtotal	318	33.65	137.52	59.47	
Total	945		231.24		

Diablo No. 2 is an S. C. S. structure on Diablo Draw 3 miles north of McNary. This 30-acre (135 acre-foot) lake is relatively barren of fish life as it has been dry. The lake was restocked in 1962, and most fish have not yet reached nettable sizes. Three seining collections captured 60 fish of four species. Included were 6 golden shiners, 1 mosquitofish, 1 green sunfish, and 52 bluegill sunfish. The results of three standard collections with gill nets from a single field trip are in Table 23.

Table 23. Percentage Composition by Number and Weight of fish taken from Diablo No. 2

Species	Number	Per Cent by Number	Weight	Per Cent by Weight	Average Weight
largemouth bass	42	40.77	13.81	63.37	0.31
green sunfish	10	9.71	1.61	7.39	0.16
redear	4	3.88	3.02	13.86	0.76
bluegill	47	45.64	3.35	15.38	0.07
Total	103	100.00	21.79	100.00	

Sampling indicated that maximum utility of game species populations is at least a year away. However, over one-half of the largemouth bass were sufficiently large to meet project standards for utility. A few sunfish met these standards.

Table 24. Utilizable Game Fish taken from Diablo No. 2

Species	Number	Per Cent by Number	Weight	Per Cent by Weight	Average Weight
largemouth bass	25	24.27	10.60	48.64	0.42
green sunfish	1	0.97	0.38	1.75	0.38
redear	4	3.88	3.02	13.85	0.76
Subtotal	30	29.12	14.00	64.24	
Total	103		21.79		

Macho Lake is a third S. C. S. lake in the McNary area. Four standard netting units set during a single field trip captured only 20 fish from this new lake. Seining efforts proved ineffectual. As shown in Table 27 the lake promised good production in the future.

Table 27. Percentage Composition by Number and Weight of fish taken from Macho Lake

Species	Number	Per Cent by Number	Weight	Per Cent by Weight	Average Weight
channel catfish	11	55.00	13.70	81.88	1.25
largemouth bass	5	25.00	2.65	15.84	0.53
bluegill	4	20.00	0.38	2.28	0.10
Total	20	100.00	16.73	100.00	

Table 25. K-factor Range and Distribution for Principal Species from Diablo Lake No. 1

																								Total No.	Avg. K
golden shiner	K	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0												
	no.	4	8	11	11	17	9	8	10	12		2	1											93	2.34
channel catfish	K	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.9													
	no.	1	1		4	3	6	6	2	5		1												29	1.95
black bullhead	K	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8												
	no.	1		1			1				1		1											5	3.24
largemouth bass	K	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0														
	no.	1	4		1	1				1	1													9	2.41
green sunfish	K	2.6	2.7	2.8	2.9	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	5.0						
	no.	1	2		3	4	1	1	2	3	2	4	3	2	2	1	1	1	1					34	3.60
redear sunfish	K	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.7							
	no.	1	1	4	5	3	4	6	1	12	7	5	2	9	5	2	2	1						70	3.83
bluegill	K	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9		
	no.	1	1	1	1	4	6	5	4	5	5	15	7	25	16	16	10	17	9	8	11	5			
	K	5.0	5.1	5.2	5.3	5.4	5.5	5.6	6.4																
	no.	5	4	2		4	3	2	1															193	4.20
white crappie	K	2.5	2.6	3.1																					
	no.	2	2	1																				5	2.66
																	Total							438	

Table 26. K-factor Range and Distribution for Principal Species from Diablo Lake No. 2

												Total No.	Avg. K
largemouth bass	K	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8		
	no.	1		1	5	3		1	4	1	1	17	2.37
green sunfish	K	2.8	3.0	3.1	3.3								
	no.	1	1	1	2							5	3.10
redear	K	4.3											
	no.	1										1	4.30
bluegill	K	2.1	2.6	2.7	2.8	3.0	3.2	3.8					
	no.	1	1	1	2	5	3	1				14	2.96
											Total	37	

Madden Lake, an S. C. S. structure, is located on Madden Ravine 7 miles northeast of McNary. At present the lake covers 20 acres and impounds 75 acre-feet of water. Three standard collections were obtained during a single field trip. Only six fish were taken. The five largemouth bass were in excellent condition and high utility; the bluegill was too small to possess utility.

Table 28. Percentage Composition by Number and Weight of fish taken from Madden Lake

Species	Number	Per Cent by Number	Weight	Per Cent by Weight	Average Weight
largemouth bass	5	83.33	3.92	99.74	0.78
bluegill	1	16.67	0.01	0.26	0.01
Total	6	100.00	3.93	100.00	

Other Lakes of the El Paso area that are under construction or which already possess fish populations, but were not included in this survey include:

(1) Baca Lake a 3.5-acre lake (10.5 acre-feet) recently completed in the upper valley on Rancho Las Quatro Milpas farm. When filled, the proposed lake will cover about 20 acres and impound about 75 acre-feet. The lake will be open to the public on a membership basis. To date, stocking has consisted of 750 channel catfish. Heavier stocking will take place when the lake is completed.

(2) Camp River is another S. C. S. structure near McNary, and will impound more water than any other structure in that area during flooding. However, there is some question as to the capacity of this structure to retain water, and it has not impounded sizable quantities to date.

(3) Alamo No. 1, Alamo No. 2 and Alamo No. 3, are a series of S. C. S. flood retention structures located 15 miles to 25 miles northwest of McNary in Alamo ravine and wash. Water has never been permanently impounded.

(4) Hideway Lakes are on the Bowden-Owen farm near Tornillo. These lakes have provided excellent fishing in the past. Chemical treatment of these waters to renovate game fish production was recently carried out. It is too early to determine results.

(5) Horizon City Lake is under construction by Horizon City Lake and Land Corporation. Ultimately, this lake will cover 110 acres and contain 550 acre-feet of water. The lake received its initial stocking with channel catfish in October 1963. At that time the lake covered 25 acres and held 90 acres of water.

(6) Thomas Manor Lake is a small residential lake open only to community residents of Thomas Manor. Reports indicate the fish population has been depleted due to drouth.

Conclusions:

The Rio Grande and Associated Irrigation System

(1) Present knowledge is insufficient to provide adequate means for effectuating a substantial and long-term improvement in game fish production in these facilities. (a) Little is known of the supply canal system, (b) present management efforts do not utilize this facility, (c) the current practice of stocking these waters with warm water species from hatcheries is ineffective.

(2) It is doubtful if further biological study will provide the means of developing a systematic fisheries program that will effect the major portions of the river and the supply-drainage canal system. (a) Man-made control of stream flow is exercised by several irrigation systems, agencies of the federal and state governments, and the state and national governments of Mexico. (b) Almost any large scale fisheries management effort presently visualized would require major changes in current water control and irrigation practices and such changes could, and probably would, result in economic loss by those controlling water distribution. It is doubtful, and understandably so, if the required cooperation could be achieved.

(3) The productive capacity of most of the system will continue to deteriorate. (a) There are no known means of reversing the tendency for salt content to increase in soils of the lower valley and in the drainage canal system. (b) The increase in use of herbicides and insecticides can be expected to further reduce productivity and may result in irreparable damage to facilities. (c) Further lowering of ground water levels through further exploitation of subsurface aquifers for irrigation can be expected, and this can only result in less stability of drains.

(4) Only an extensive experimental management program can be expected to provide the means of effecting local production benefits. Such benefits would probably be of short duration. The instability of physical and chemical properties of waters and periodic disruption of management for routine maintenance of canals would limit procedures.

(5) In view of the above conclusions, the Rio Grande and associated irrigation system should be employed in a secondary role in any management attempted.

Lakes and Reservoirs of the El Paso Area

(1) These structures offer the best potential for producing game fish in the El Paso area, and their expansion should be encouraged.

(2) Present management of these waters is satisfactory.

(3) The major problem incurred in maintaining production in these facilities is the irregularity of run-off, or the instability of the water supply.

Recommendations:

Large scale biological investigations should be suspended until the prospects of developing additional facilities or altering existing facilities are known. When these requirements are provided additional investigations should be made.

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